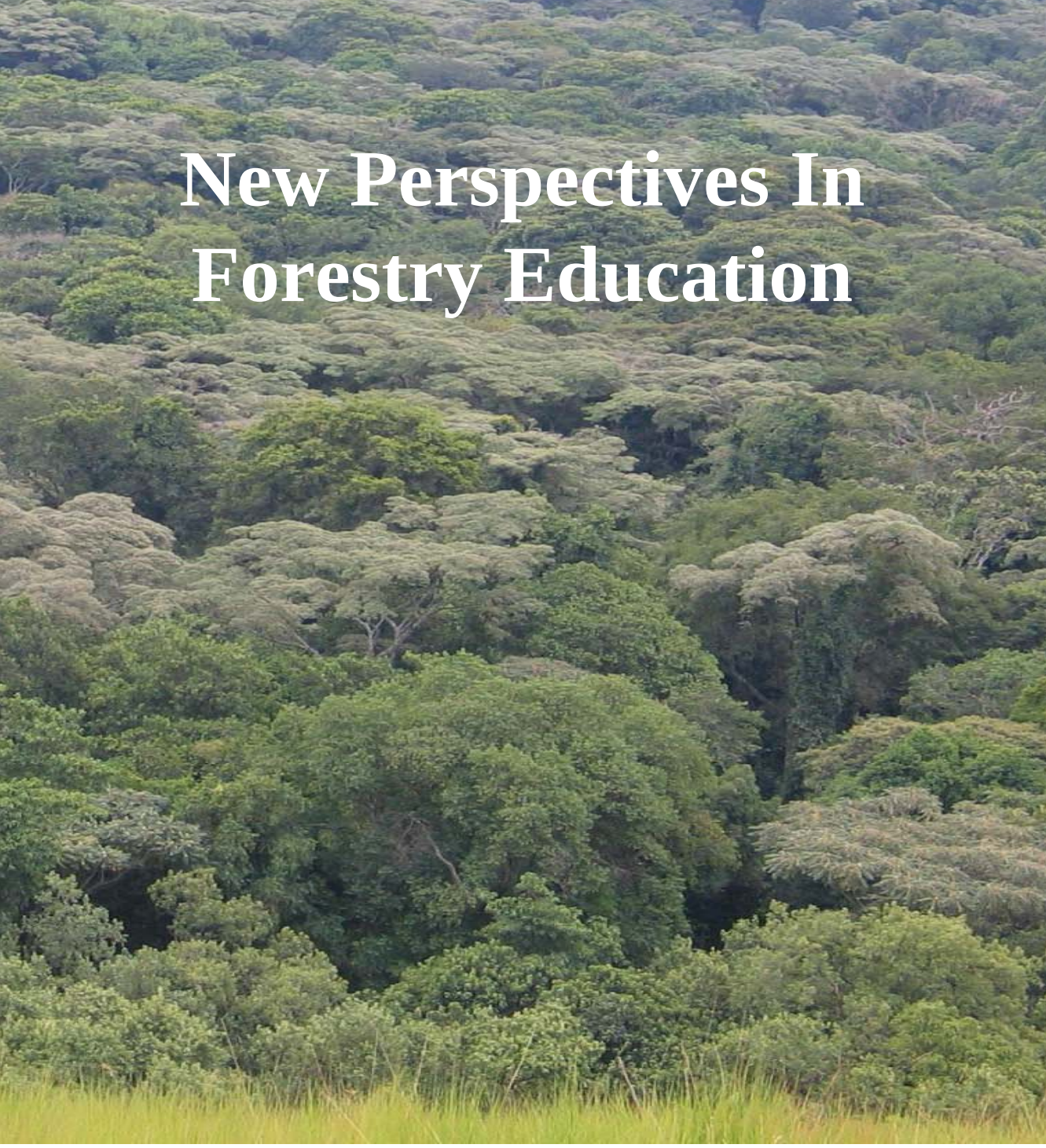
New Perspectives In Forestry Education



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Cover picture

The photo on the cover is of Kakamega Forest in western Kenya. Kakamega is the only surviving rainforest in Kenya. It is situated 51 km from Lake Victoria and encompasses an area of 240 sq. km. Kakamega Forest is the eastern-most fragment of the Guineo-Congolian rainforest, which once stretched from Kenya across Uganda, East and Central Africa to the West African coast. It provides a unique sanctuary for a remarkable diversity of endemic plants, birds and insects not found anywhere else in Kenya. The forest is an important habitat for migratory wildlife and is home to the rare Colobus monkey. The broad-based nature of tree foliage in Kakamega Forest, together with the dense canopy of indigenous trees provide appropriate conditions for improved carbon sequestration. Kakamega Forest is also an important watershed for some of the rivers that flow into Lake Victoria. This perception notwithstanding, there is growing evidence of unprecedented degradation of the water catchment, resulting from deforestation. The current trend of degradation of the forest will lead to a gloomy future for the populace if the status quo is maintained. To avoid further degradation of forest resources in Kenya and elsewhere, it is imperative to transform forestry education to respond to the increasing societal needs.
(Photo credit: ANAFE).

NEW PERSPECTIVES IN FORESTRY EDUCATION

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A note on ANAFE

Launched in April 1993, ANAFE is one of the largest working African networks of educational institutions. Presently (2008), ANAFE membership comprises 128 universities and colleges in 34 African countries. ANAFE is hosted at the headquarters of the World Agroforestry Centre (ICRAF) in Nairobi, Kenya. The initial objective of ANAFE was to incorporate Agroforestry and multi-disciplinary approaches into agricultural education. Over the years, the ANAFE mandate has been expanded to include agriculture and natural resources education. Colleges and universities outside Africa may also apply for associate membership in ANAFE.

ANAFE's current mission is **"To improve Agricultural education for Impact on Development"**. The mission is achieved through a wide range of activities including policy advocacy, institutional reforms to link education to development, review of curricula, development of learning resources, facilitating knowledge sharing, promoting women and youth in agriculture, HIV/AIDS mitigation, sound environmental practices, mitigation and adaptation to climate change, quality education assurance and risk management in agriculture.

ANAFE works through four regional chapters known as RAFTs (Regional Agricultural Forums for Training - one each in Eastern and Central Africa (ECA), Southern Africa (SA), the Sahelian countries (Sahel), and the Africa Humid Tropics (AHT)). ANAFE has national chapters NAFTs (National Agricultural Fora for Training) in 21 countries.

On the international scene, ANAFE plays a major role in defining perspectives in agriculture and forestry education. In 2007, ANAFE convened the first global workshop on forestry education and the outcomes have been shared and appreciated worldwide. In 2008, ANAFE will host a workshop in 'mainstreaming climate change into agricultural education.'

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A note on IPFE

The International partnership for forestry Education (IPFE) was formally launched at FAO headquarters in Rome on 27th April 2006. It is a global platform for analysis, collaboration, coordination, information, and improvement of forestry education. IPFE links forestry education to social, economic, and environmental imperatives.

The objectives of the partnership are:

- To raise the profile of Forestry Education;
- To improve quality and relevance of forestry education globally; and
- To enhance global communication among forestry educators, students and learning institutions to improve global collaboration

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Foreword

Forest management is becoming increasingly complex due to the need to balance highly varied interests by an increasingly wide range of stakeholders. A widening range of recognized products and services from trees and forests is also challenging the ecological, social, and economic criteria that are often applied in making choices of management options. The boundaries of forestry are being extended to include the management of trees in landscapes outside forests. This brings in a wide range of interests, people and institutions. There is a gap between what is being learnt in forestry schools and the new societal expectations.

Designing forestry education that is responsive to the social, economic, and environmental challenges is an emerging complex issue. New forestry education programmes are emerging but without sufficient global guidance on the coherence, content, quality or relevance. Concerted efforts are needed particularly at global and regional levels to design, coordinate and link relevant institutions and stakeholders to help transform forestry education. Hence the purpose of this book which documents various ways of improving forestry education. The book covers five main areas namely:

- Forestry education challenges and coping mechanisms currently in use;
- Challenges in curricula, teaching and learning experiences, tools and methods, and the way forward;
- Global factors influencing the forestry profession and tree/forest management practices;
- Synthesis and way forward; and
- Views from various organisations.

Readers of this book will recognize how the authors addressed issues in forestry education and articulated strategies for resolving them. Part IV of this book, summarizes how forestry education can solve the current challenges in forestry practice. It also, highlights how forestry education links with global challenges, especially environmental conservation, climate change, biodiversity and desertification. In addition, a strategy for integration of current and projected future societal needs into forestry education is proposed. Finally, recommendations for implementing the proposed strategy are given.

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Acronyms

AFF:	African Forest Forum
AFORNET:	African Forest Research Network
ANAFE:	African Network for Agriculture, Agroforestry and Natural Resources Education
APFC:	Asia-Pacific Forestry Commission
ASK	Agricultural Society of Kenya
ATO:	African Timber organisation
BCS	Basic Cycle Schools (The Gambia)
C&I:	Criteria and Indicators
CBU:	Cross Border University
CDM:	Clean Development Mechanism
CIFOR:	Center for International Forestry Research
CITES:	Convention on International Trade for Endangered Species
COL:	Commonwealth of Learning
CPF:	Collaborative Partnership on Forests
CRD	Upper River Division (The Gambia)
DOF	Department of Forestry (The Gambia)
ECOWAS:	Economic Community of West Africa's States
EE	Environmental Education (The Gambia)
EHEA:	European Higher Education Area
EIMI:	Economic Information and Marketing Intelligence
EU:	European Union
FAO:	Food and Agriculture Organization of the United Nations
FARA:	Forum for Agricultural Research in Africa
FE:	Forestry Education
FI:	Forest Industry
FORNESSA:	Forestry Research Network for Sub Saharan Africa
FSC:	Forest Stewardship Council
FSC:	Forest Steward Council
GDP:	Gross Domestic Product
GIFN	Global Industry Forestry Network
GIS:	Geographic Information System
ICRAF:	World Agroforestry Centre
IPFE:	International Partnership for Forestry Education
ISO:	International Systems Organisations
ITTA:	International Tropical Timber Association
ITTO:	International Timber Trade Organization
IUCN:	World Conservation Union
IUFRO- (SPDC):	International Union of Forestry Research Organizations (Special Programme for Developing Countries)
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KEFRI	Kenya Forestry Research Institute

LBS	Lower Basic Schools (The Gambia)
LMS	Learning Management System
MDGs:	Millennium Development Goals
MENR:	Ministry of Environment and Natural Resources
NAADS	National Agricultural Advisory Services (Uganda)
NARO	National Agricultural Research Organisation
NEPAD:	New Partnership for Africa's Development
NGOS:	Non-Governmental Organizations
NORAD	Norwegian Agency for Development
NRM:	Natural Resources Management
NTFPs:	Non-Timber Forest Products
PCV	Peace Corp Volunteer (The Gambia)
PFM:	Participatory Forest Management
QAS:	Quality Assurance System
R & D:	Research and Development
RECOFTC:	Regional Community Forestry Training Centre
RED	Regional Education Directorate (The Gambia)
REDD:	Reducing Carbon dioxide Emissions from Deforestation and Forest Degradation
RFM:	Reforestation and Forest Management
RIFFEAC:	(Réseau des institutions de Formation Forestière et Environnementale d'Afrique Centrale
RIL:	Reduced Impact Logging
SFM:	Sustainable Forest Management
Sida	Swedish International Development Agency
SNV:	Netherlands Development Organisation
SSA:	Sub-Saharan Africa
SUTROFOR	Sustainable Tropical Forestry
TFT:	Tropical Forest Trust
UBS	Upper Basic Schools (The Gambia)
UNCTAD:	United Nations Convention on Trade and Development
UNFCCC:	United Nations Framework Convention on Climate Change
UNFF:	United Nations Forum on Forests
URD	Upper River Schools (The Gambia)
USAID	United States Agency for International Development
USDA:	United States Department of Agriculture
UWA	Uganda Wildlife Authority
WWF:	World Wide Fund for Nature

PART I

FORESTRY EDUCATION CHALLENGES AND COPING MECHANISMS IN USE

1 Global Forestry Education Guidance and Monitoring: How Imperative is it?

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ABSTRACT

The forester's job has transformed from managing forests to applying a wide range of skills to respond to the needs of forestry stakeholders and contextualize their demand for products and services from trees and forests that are different landscapes and owned/managed by a wide range of people and institutions. This requires very different knowledge and skills from the kind currently imparted by schools of forestry. Today's forester is constantly challenged to remain professionally relevant in a very dynamic environment, and there are no simple reference resources. Worldwide, there is a decline of enrolment in forestry education, particularly since the 1990's. The reasons are various, but can be summed up as failure to adequately respond to rapidly changing social, economic and political environments. The erstwhile Advisory Committee on Forestry Education (ACFE) provided good guidance on forestry education since its formation in 1956 until it ceased to exist in 1996, at a time it was badly needed. A historical analysis of its work is presented here with a view to coalescing ideas on how to re-orient forestry education to meet the emerging demands on the profession. Despite the materialization of new education programmes covering areas of environment, biodiversity and integrated natural resources management, forestry remains critical to sustained productivity and conservation, hence the need to refocus forestry training to make it more responsive to ever changing societal demands worldwide. It is argued that there is a need to re-establish a

global forestry education advisory mechanism to provide guidance to forestry schools in evolving ever-relevant training to fill this lacuna.

1.1 INTRODUCTION

Forests are a conspicuous and crucial component in the livelihoods of all societies – rich or poor, developed or developing, endowed with forests or not. The growing prominence of conserving biodiversity, arresting desertification, conserving soils, sequestering carbon, improving water quality and quantity and providing bio-energy raises the premium on forest resources. The balance between wise use and conservation is often argued from very different perspectives. The number of stakeholders in forestry has been increasing rapidly, crossing territorial as well as social, economic and political boundaries. The forester's job has drifted from managing trees and forests for timber, to managing trees and forests to achieve multifarious stakeholders' interests and biological systems that are threatened and/or influenced by among others:

- Local communities who derive livelihoods directly from them;
- Industrialists who make profits from them;
- Governments who want to utilize them to leverage development;
- Farmers who view them as agricultural land reserves and sources of new germplasm;
- Die-hard conservationists who believe forests should never be cut for whatever purposes; and
- Climate change mitigation and adaptation groups that want more carbon sequestered.

The forester occupies the fulcrum position, holding onto a lever that is under pressure to swing in all directions at the same time. Griffin (1990) aptly described the situation: "The history of the forestry profession since the 1950s and more so in the last 20 years can be characterized as one of a struggle to remain relevant in a world experiencing a social and environment crisis".

The situation becomes more complex when we attempt to define forestry. Current thinking is that forestry should include trees and forests, wherever they occur. The rapid growth of Agroforestry science and practice is certainly a major factor pushing in this direction. This introduces the issues of land and tree tenure, and value systems that change widely with social, cultural and economic conditions. The traditional forester has been

groomed to manage large chunks of forests, applying ecological and economic principles to sustain productivity and profitability while conserving the environment. His area of comfort therefore has been the public and private sectors. The philosophical and practical changes described therefore create a new paradigm in forest management. With the inclusion of trees outside forests, the challenges facing foresters now require application of knowledge and skills that were never imparted in the old school.

It is against the above settings that we sought to investigate the trends in forestry education advisory from 1956 to 2006. We strongly believe that the forestry profession has been under very high pressure to evolve into a broader perspective, which should have triggered changes in forestry education. It is therefore instructive to reflect on changes in global institutions and instruments, societal perspectives (including the emergence of new and more stakeholders) in tandem with the responsiveness of foresters and forestry education in particular. In this treatise, emphasis is placed on the content of and response to forestry education advisory, particularly that arising from the FAO's Advisory Committee on Forestry Education (ACFE). As will be seen in the next section the choice of ACFE was on the strength of its global coverage on forestry education issues, as compared to any other frameworks related to forestry education in the period covered in this analysis. This work is based on ACFE reports, consultations with schools of forestry, a large number of publications on forestry education and FAO annual reports. We believe that the historical perspective will help to inform our future vision. The key questions we ask are:

- What should be the role of forestry in society today and tomorrow?
- How do we prepare the necessary human and institutional capacity to meet the emerging needs?
- What structures can guide forestry institutions in evolving forestry curricula that meet national, regional and global demands for forestry?

1.2 GLOBAL ADVISORY ON FORESTRY EDUCATION: 1956 - 2006

In 1956, A FAO panel on forestry education was formed as a follow up on recommendations at the Fourth World Forestry Congress in 1954. Among other things the panel's terms of reference were indicated as to:

- Advise FAO on all phases of education in forestry and conduct studies as it may be called upon;
- Promote liaison among forestry schools of the world and between the schools and FAO;
- Prepare agenda for discussion on forestry education at international forestry meetings and prepare reports on deliberations of such meetings;
- Facilitate faculty and student exchange programmes among colleges and universities and to provide information on study opportunities at various schools; and
- Advice FAO on personnel for staffing technical missions.

Its mandate included university level education leading to a bachelor's degree, ranger schools offering diplomas and certificates, vocational training of forest workers, and informing forest owners and the public about forestry.

The first meeting of the panel was held in 1956 at the 12th World Forestry Congress, with a membership of 14 individual nominees (FAO, 1956). The members were drawn from Europe and North America, India, and South Africa, and it held two further meetings thereafter. At the 12th session of the FAO ministerial conference, it was noted that the convening of occasional meetings of the panel were no longer adequate, and it was recommended that it should be converted to the FAO Advisory Committee on Forestry Education (ACFE), which was effected in 1964. Its terms of reference were to advise the FAO Director General on the evolution and implementation of the programmes of FAO in the field of forestry education and on ways in which those programmes should be developed. Membership of the committee was also expanded from the original 14 to 21 to represent different regions of the world. The initial member countries were Argentina, Australia, Brazil, Canada, Chile, Finland, France, Germany, India, Iran, Japan, Liberia, Mexico, Nigeria, Poland, Spain, Sudan, Thailand, UK, USA and Venezuela (FAO, 1964). The FAO Director General was mandated by this resolution to hold periodic committee meetings, and further meetings were held as shown in Table 1.1.

At its third and fourth sessions, the committee recognized the need for global consultation to further understanding and cooperation in forestry education. The first consultation was held in 1972 (FAO, 1972), and at least four more global and many regional consultations were held during

the life of the committee. These consultations had representation from educators, practitioners, and other stakeholders across the world, and recommended actions to improve forestry training. While the global meetings discussed issues on forestry education worldwide, the regional meetings focused on more localized problems and ways to remedy them.

Table 1.1: Meetings of FAO Advisory Committee on Forestry Education

Session	Year	City and Country	Participants		
			Members	FAO	Observers
1st	1964	Merida, Venezuela	10	10	12
2nd	1966	Madrid, Spain	N/A	N/A	N/A
3rd	1967	Munich, Germany	13	2	1
4th	1969	Ibadan, Nigeria	14	18	3
5th	1972	Stockholm, Sweden	World Consultation		
6th	1974	Hyvinkaa, Finland	N/A	N/A	N/A
7th	1976	Rome, Italy	13	3	20
8th	1978	Jakarta, Indonesia	10	2	17
9th	1980	Rome, Italy	12	1	24
10th	1981	Kyoto, Japan	13	8	4
11th	1983	Nairobi, Kenya	19	3	30
12th	1985	Mexico City, Mexico	15	8	17
13th	1986	Ljubljana, Yugoslavia	11	6	14
14th	1989	Antalya, Turkey	14	5	12
15th	1991	Paris, France	11	4	9
16th	1993	Bangkok, Thailand	27	N/A	N/A
17th	1996	Santiago, Chile	N/A	N/A	N/A

N/A = not available from proceedings and reports

A key recommendation of the committee's 1965 meeting was the creation of a forestry education branch at the FAO to coordinate forestry education activities worldwide, which was later effected. The committee recognized the need for it to have wider impact, and recommended that its members improve communication and exchange of information with training institutions in their countries to influence curricula development. In 1971, the ACFE recommended its expansion and strengthening, and asked for periodic consultation and assessment of educational problems. This recommendation was repeated in 1976, but with a further recommendation to widen the range of expertise within the committee in light of the expanding scope of forestry training. This suggests that the committee felt itself deficient in breadth of subject coverage. The membership comprised largely government officials and deans or heads of schools of forestry. Over the years, membership to ACFE was expanded to include countries, which were gaining independence. By

1993, the ACFE membership had increased to take into account emerging global political realities as shown in Table 1.2.

It is clear that global demand for advisory from the committee was raising and therefore, its attempts to be more inclusive. At its 17th Session in 1996, the committee recommended its own restructuring, but ACFE was abolished in 1997, and the FAO forestry education post was scrapped in 2006.

Table 1.2: ACFE Membership by Regions in 1993

Region	Developmental Status of Country			Total
	Developing	Transition	Developed	
Africa	5			5
Asia	4		3	7
Europe		1	9	10
Latin America	5			5
North America			2	2
Total	14	1	14	29

1.4 A REVIEW OF TRENDS IN AGENDA AND RECOMMENDATIONS OF ACFE

1.4.1 The agenda of ACFE

ACFE was mandated by FAO to advise on forestry education and human resource development at all levels, but with special emphasis on university-level degree training. It was also supposed to disseminate its findings widely to achieve impact. The committee's meetings were usually held in parallel with other forestry meetings, e.g. IUFRO and World Forestry Congresses. At each meeting, the agenda comprised a report by FAO on the status of forestry education activities, followed by presentations of voluntary papers, discussions and resolutions. Invited papers were mostly on subjects identified as requiring exposition by the committee on which situation reports were presented. Uninvited papers covered any subject of interest to the authors. Initially, very few uninvited papers were presented, but the numbers increased to exceed invited papers in latter sessions.

A review of the ACFE deliberations shows that issues discussed included items requiring FAO intervention to improve forestry education. Others

were manpower assessment, curricula content, quality of forestry education, postgraduate training, forest extension, public education, continuing education, world and regional consultations on forestry education, and its representation and effectiveness, amongst other things. In Tables 1.3, we review the frequency of appearance of different themes in the committee agenda, and the number of papers presented on these themes over different periods.

The table reveals some interesting patterns. Training for forest industries was the most commonly discussed item in the agenda of the ACFE, which clearly demonstrate the importance the committee attached to the role of forests in industrial development. Even in countries that were under colonial rule, the forest policies prioritized production of industrial round wood as well as harvesting of the same, much as most of the industrial capacity was located outside these countries. Extension and social/community forestry featured as the second most frequent item in ACFE agenda. This high frequency reflected the growing importance of extension in forestry, especially with the widening of ACFE membership to developing countries. Vocational and in-service training was also frequently tabled as an agenda item of the committee, underscoring the importance attached to the need to upgrade skills of practicing foresters in light of the emerging issues in the sector.

In order to meet personnel requirements for government services of countries then achieving independence, manpower assessment was frequently discussed in the early life of ACFE, from the 1950s to mid 1970s. Use of computers in forest management appeared for discussion from late 70s and became more prominent in the 80s and 90s. Policy issues were more prominent after the 80s, probably as a response to economic reforms that started being implemented in many developing countries during this period as well as a reaction to making forest practice match international agreements like those emanating from Rio '92.

Administration of forestry education had by far the most number of papers presented at ACFE meetings (Table 1.4). This may reflect the changing demands on forestry, which dictated continuing evolution of forestry education programmes. On the other hand, these were meetings of administrators of forestry and forestry education (Table 1.6). It is quite possible that this was an area in which many of them were working and therefore given more prominence. Other areas were training for forest industries, forestry curricula, extension education, manpower assessment, environmental education and continuing education in that order of

frequency. Papers on administration of forestry education were presented at virtually all ACFE meetings, which points to the challenges facing forestry practice and the need for forestry training to respond to it. Training for industries was prominent up to 1990 and not so much thereafter. This could be due to the growing recognition of environmental roles of forestry after Rio 92.

Table 1.3: Agenda Topics by Frequency at ACFE Meetings at Various Periods

Subject item	Number of times subject appears in ACFE agenda over ten year periods					
	1956-65	1966-75	1976-85	1986-95	1996 +	TOTAL
Number of meetings held	1	5	6	4	1	17
Watershed Management			1			1
Training for Industries	2	4	4	4	1	**15**
Forestry & Employment	2	1	1			4
Wildlife & parks management		1	2	1		4
Extension, social/ community forestry		1	4	3		**8**
Forest products Marketing		1				1
Extension-Research-Education links			1	1		2
Vocational/In-service Training		2	2	4	1	**9**
Forestry curricula	1		1	1		3
Environment in Forestry Education			1	2		3
Forest Policy				2	1	3
Post graduate education		1	1		1	3
Manpower Assessment	4	2	1			**7**
Communication between ACFE and Institutions.	1		1			2
Information and communication technologies (ICT)				2	1	3
Organization of Forestry Education	2	3	2	2		**9**

Papers on extension and social forestry were presented from 1975 and increasingly thereafter. This also coincided with the increased representation and participation by developing countries in the ACFE. Forestry curricula papers were regular throughout the life of the committee, but in much greater numbers after 1986. However, review of

curricula was mentioned in almost all papers presented on any one of the themes, so this statistic is somehow misleading.

Recommendations of ACFE largely followed the patterns in its agenda. At inception, the ACFE focused on offering technical advice to FAO on its forestry education support to developing countries, in order to produce manpower for government forest services, with industrial forestry as the focus.

Regional university education programmes were recommended as the most cost effective approach to meeting the manpower needs, but this was largely overtaken by nationalistic demands for training so that most countries initiated their own programmes. The most spectacular example was the initiation of an East African regional forestry education programme at Makerere University (with support from Norway) in 1970. By 1973, Tanzania initiated its own programme, while Kenya started its own in 1976, though this was mainly caused by political instability in Uganda in the 1970s. In the subsequent years, Zambia, Mozambique and Malawi also launched new professional forestry education programmes. At technical level, the training remained national. Assessment of manpower needs of countries was an early focus of the committee up to 1985, but featured minimally thereafter.

Table 1.4: Number of Papers Presented at ACFE Meetings by Subject Areas

Subject Item	Number of Papers in subject area presented at ACFE meetings by ten-year periods					
	56-65	66-75	76-85	86-95	96+	TOTAL
Number of meetings	1	5	6	4	1	17
Watershed Management			1			1
Training for Industries		5	14	7	1	27
Continuing Education		1	4	4	1	10
Forestry & Employment	1	1		2		4
Wildlife & parks management			2	1		3
Extension, social/ community forestry			15	5		20
Forest products Marketing			1			1
Extension-Research-Education links	1	1	4			6
Forestry Curriculum	1	4		6	12	23
Environment in Forestry Education			3	7		10
Forest Policy				1	1	2
Post graduate education		3	7	1		11
Manpower Assessment	3	4	8	2		17
Communication between ACFE and Institutions.	1	1		1		3
ICT in Forestry				3	1	4
Organization of Forestry Education	6	5	12	20	1	44

1.4.2 Debates on curricula and quality of delivery

Much of the discussion at ACFE meetings was centred on improvement of curricula. Ideas were generated on exactly what areas were becoming more important and why. H.C. Miller, the then ACFE chair, described forestry curricula as a "perennial subject for discussion reflecting the rate at which the forestry profession is changing, and the number of graduates who make their careers outside forestry" (Miller 1996).

Over the years, the committee recommended expanding forestry curricula by including the following courses: industrial forestry, engineering and wood utilization (1950's); agriculture, physical sciences, engineering, extension, range, watershed management, wildlife management and land use (1960's); environmental education, wildlife and parks management, extension, communication skills, and public relations (1970's); watershed management, agroforestry, dryland forestry, forest policy and law, agriculture, rural sociology, and politics (1980's), and; multiple land use, sustainable development, information technology, GIS (1990's). In Table 1.4, detailed data are provided. See also Annex 1.

After 1990, unemployment of forestry graduates became more of an issue because job opportunities in public forest services were already dwindling in many countries. Therefore, more attention was drawn towards expanding the curricula to incorporate more management, economics and social sciences to widen employment opportunities for the graduates. Severe concerns were raised over the ever-increasing number of courses recommended for inclusion in forestry curricula. The inelastic 3 - 4 year duration of most degree programmes was considered 'too short' to accommodate the additional courses. It was also pointed out that including too many new courses would degrade the professional integrity of forestry programmes, which could then end up as "down market degrees" of other specializations.

Three approaches around this problem were proposed. The first was to generalize the training into a natural resource degree, with forestry as a major (Gilbert, 1993; Roche, 1992). The second proposal was to establish a 'core' of professional competence, around which a range of disciplines relevant for forest resource management would be built, to enable the graduates to work effectively with other disciplines (Temu, 1993; Griffin 1990). The last was to develop new programmes, e.g. agroforestry, environmental forestry, wood science, etc, to fill niches created by emerging demands on the profession (Roche, 1992). The approach

selected by institutions depended on their countries socio-economic and forestry circumstances, and therefore needs for personnel. Following the termination of ACFE in 1996, there has not been a systematic follow up on what models were adopted and why.

Quality of forestry training became a concern in the latter stages of the committee's life, and teacher training, improvement of learning facilities, provision of learning materials, and continuing curricula review were recommended as offering the best opportunities for overcoming these. Forestry faculties were advised to regularly consult stakeholders on quality standards and curriculum evaluation.

Postgraduate education to develop capacity for training and research in the developing world did not feature greatly in committee deliberations. It was recommended at various times that postgraduate training be conducted in close links with research institutions, to make better use of the highly trained manpower available. Shortcomings in forest research were also recognized, and training in research skills, and education-research-extension linkages were recommended to improve this.

Continuing education and life-long learning were regularly discussed by the committee. It was recognized that continuing education was critical for practicing foresters, to ensure their relevance. However, funding for this was recognized as greatly hampering its realization. Another recurrent recommendation was the need for public education on forestry issues to influence public perceptions on forestry, and to bring better understanding between forestry organizations and its 'publics' (FAO, 1972). However, this concern was either never adequately addressed, or was a continuing one hence its recurrence in the committee agenda.

1.4.3 Follow up on ACFE's recommendations

The committee's recommendations can be divided into three groups. Those requiring FAO action, those requiring ACFE action, and those made generally to countries and schools of forestry. The ACFE regularly reviewed the implementation of those recommendations requiring actions by FAO and the committee itself. At these reviews, the committee examined each recommendation made, and the status of its implementation. Up to the 1970's when the FAO had forestry education support programmes, the committee usually reviewed the status of implementation of its recommendations from the preceding meeting through a presentation and discussion of reports from the FAO Forest

Education branch. These programmes dried up after the seventies, and the committee did not evaluate the implementation and impacts of its recommendations thereafter.

Follow up of recommendations of the committee to FAO was done mainly through visits by FAO missions to the supported institutions to assess the impacts of the support, and to encourage fulfilment of its recommendations. Indicators of success of these missions include the many forestry schools established in various parts of the world following ACFE's recommendations, curricula review, and FAO funding of various programmes recommended by the committee. At each meeting, there was the provision of progress reports to the panel by the secretariat. Follow up reports provided the secretariat with an indication on how to plan and formulate agenda for meetings, and activities to be undertaken by the secretariat.

The third category of recommendations comprises those to forestry training institutions on curriculum changes, organization of education programmes, etc. The follow up and impacts of these recommendations are more difficult to evaluate. In 1982, the committee recommended that the impacts of its recommendations on forestry education be evaluated, but this recommendation appears not to have been followed up. In the last years of the committee, it recommended that its composition be restructured and its membership widened and increased to include representation from developing countries, clearly demonstrating that the committee was eager to increase dissemination of its recommendations. However, some indicators show that the ACFE recommendations were adopted by several aid agencies, notably Sida, NORAD, UNDP and FINNIDA and national governments as more projects supporting education in areas recommended by the committee were developed and implemented, especially in the seventies and eighties. This was particularly visible in a few developing countries in Africa, Asia and Latin America.

1.5 ACFE's RESPONSE TO GLOBAL CONCERNS ON FORESTS

A review of the agenda and papers presented at ACFE (Tables 1.3 and 1.4), showed that in the 1980s, topics in focus were on environmental issues. This shows a progression in focus on world concerns on forests leading up to a climax in environmental issues after Rio Summit in 1992. The recommendations in the 90s were to link industry with educational institutions and to develop appropriate technologies for forest industries,

silviculture, ecology and ecosystem dynamics, biodiversity conservation, and processing non-wood forest products. Table 1.5 shows some key global protocols and agreements relating to forests agreed at Rio 92 and thereafter, the year they were adopted, and the year they came into force.

The correlation between concerns on forestry and the debates at ACFE meetings is not very conclusive. Apart from the spike in papers on environment and forestry linkages in the late 1980's and early 1990s leading up to and after the UNCED in Rio in 1992, there are no other clear linkages between the ACFE agenda and recommendations, to the developments in world agenda as evidenced by the Rio 92 (Agenda 21) and related agreements such as the Kyoto protocol, UNFCCC, etc.

Table 1.5: International Agreements, When They Were Adopted and Came Into Force

Agreement/ convention	Adoption	Entry into Force
UN Convention on Biological Diversity (UNCBD)	05/06/1992	29/12/1993
UN Framework Convention on Climate Change (UNFCCC)	09/05/1992	21/03/1994
Kyoto Protocol on Clean Development Mechanism (CDM)	1994	In force on voluntary basis
UN Convention on Combating Desertification (UNCCD)	17/06/1994	26/12/1996

It is therefore very unfortunate that the committee was terminated in the nineties. This created an organizational vacuum among forestry education institutions as they disparately struggled to understand and incorporate emerging global issues such as climate change, biodiversity, environment, poverty eradication, and millennium development goals into forestry education.

1.6 REPRESENTATION AT ACFE MEETINGS

Many countries in Africa and a few in Asia were still under colonial rule when the committee was formed in 1956. Moreover, forestry schools offering professional training at the time were mainly found in Europe and North America. In many cases, therefore, European countries represented African and Asian colonies in ACFE deliberations up to the mid 1960s. With many countries becoming independent by this time, the committee recognized that it had very limited representation and recommended its expansion. Further, it was observed that there was need

to widen expertise within the committee, and it was proposed that profiles of required representatives be prepared by FAO.

1.6.1 Representation of African countries at the FAO advisory panel on forestry education meetings

A key question about the trends in forestry education as deliberated by ACFE is that of the level and type of representation to the committee, and the effect that representation had on the evolution of forestry curricula, particularly in Africa. We start by examining representation by African countries in the committee over the years until its demise. As stated earlier, representation in ACFE was only by invitation, while non-members attended and contributed as observers or resource persons. Over the life of the committee, Africa was represented most commonly by Kenya (6 times), followed by Nigeria (4 times), Cameroon (3), Ghana (2), Liberia (2), and one each by Gabon, South Africa, Ivory Coast, and Sudan (See Table 1.6). Africa was represented by five countries that have tropical rain forests. The emphasis in forestry in these countries was logging the natural forests for export of logs. With the exception of Nigeria and Ghana, there was scanty wood processing capacity in the other countries. Even in these two countries, there was considerable export of logs in the colonial period and some years after political independence. South Africa and Kenya developed an industrial wood processing industry, hence the prominence of training for industries in Table 1.3.

Only North America, Europe and India were represented at the first meeting of ACFE. It was recommended at that meeting that Liberia and the Republic of South Africa be invited to send representation as the only countries then offering professional forestry education in Africa. South Africa was unable to participate due to the distaste of apartheid, despite having one of the earliest forestry schools on the continent. Thus, Liberia was the only African representative at the 1961 meeting, while Nigeria and Ghana attended from 1969 to 1981, at a time when forestry education programmes had just been established in these countries. Some countries such as Liberia and Sierra Leone may have been prevented from attending by a breakdown in education systems due to civil strife, which explains the sporadic attendance at the meetings between 1961-1972, and not at all thereafter. A very clear pattern emerges from the attendance records in Table 1.6. Africa and Asia were largely represented in these meetings by their forest services. In most of this period, these regions were developing their forestry education institutions, and most probably, the appropriate

representatives had to come from the forest services that were in all probability overseeing these developments. South and Central America were least represented in these meetings. Europe and North America were represented largely by educators. The many Northern educators in forestry were obviously talking with the few Southern public forest administrators. Evidently, the ensuing forestry education direction reflected mostly the views of the Northern educators. The conspicuous absence of civil society, business (industry) and other related professions, especially agriculture, biodiversity and environment further limited the scope of discussions. A university professor from the North always chaired the committee. The critical question this brings is whether the nascent African, Latin American and Asian educators could be effective in influencing the agenda or the outcomes.

Table 1.6: Type and Level of Representation to ACFE by Region from 1960 to 1996

Region	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996
Africa								
Educators	-	1	-	1	2	-	-	1
For. Service	-	3	-	2	5	1	2	-
Research	-	-	-	1	1	-	-	-
Asia								
Educators	1	1	1	3	1	3	2	-
For. Service	-	2	1	4	3	-	1	-
Research	2	-	-	1	1	-	-	-
Others	-	-	-	-	1	-	-	-
Europe								
Educators	8	5	4	10	10	5	10	5
For. Service	-	2	-	-	-	4	2	-
Research	-	1	-	-	-	3	-	-
Others	-	-	1	-	1	1	2	-
N. America								
Educators	2	4	2	5	2	2	3	5
For. Service	1	-	-	-	-	-	-	-
S. America								
Educators	-	1	-	1	-	-	-	-
For. Service	3	-	-	-	-	-	-	-
Others	-	1	-	-	-	1	1	-
C. America								
Educators	-	-	-	1	1	1	-	2
Others	1	-	-	1	-	-	-	-
Australia								
Educators	-	-	1	2	3	2	2	1

'Others' included some donors or industry

1.7 CURRENT TRENDS IN FORESTRY EDUCATION AND ENROLMENT

Today, forestry education is in a crisis. Over the last ten years, graduates from forestry education and training programmes have declined by over 30% worldwide, and many forestry technician schools either have closed down or have vastly reduced enrolment. Enrolments in forestry technician training in Europe and Africa have declined substantially since 1993 as shown in Figure 1.1. This is happening despite the trend of rapid expansion in university level education, where enrolments in universities have tripled over the last twenty years. At the undergraduate level, graduations from forestry institutions in Africa and Europe have been declining slightly since 1993, while that in Southeast Asia has roughly doubled. There was a drastic drop in graduating technicians in both Africa and Asia after 1995, while that in the UK and Germany was stable.

The declines were attributed to scaling down of these programmes due to reduced funding and by structural adjustment programmes. The sharp rise in graduates in Asia after 1999 was due to a significant increase in the number of graduates from Indonesia and Vietnam, while those in other countries were stable or increased more modestly. These increases were driven by traditional job opportunities in government forest services, industry, and the NGO sector. Non-traditional jobs, while low, were also noted to be increasing in importance (Miller, 2004; Rudebjer and Siregar 2004). The decline in graduation in Africa has been attributed to dwindling employment opportunities for graduates despite the increased role of foresters in environmental management, devolution of forest management to communities, privatization of forest resources. It is also a result of students opting for training leading to better paying job opportunities in information and communication technology, manufacturing in fast growing economies, and increased productivity of forest industries (Nair, 2004).

An increasing number of forestry-related courses such as natural resources management and environment planning and management attract a considerable number of students who find employment in the mushrooming NGO sectors related to forestry. This indicates a switch from governments being the main employer of university forestry graduates to the NGO world, the private forestry sector and the informal forestry sub-sector. Emphasis in forestry training should therefore increasingly target these new markets for forestry graduates, by

strategically harmonizing training programmes among related institutions, and relevant departments and faculties within institutions.

The decline in Europe is mainly a result of reduced funding opportunities for forestry education and the emergence of alternative programmes in environment and biodiversity. A lower proportion of students are opting to enter the forestry profession. Further, applicants to forestry programmes, especially in Europe, are increasingly those with lower passes at school level (Miller, 2004). Whatever the cause, forestry education programmes in Africa and Europe, and less so in Asia, are facing the challenge of attracting more and quality students and resources. Reduced government funding for forestry education in many countries has led to universities and colleges reducing the scope of their training (usually cutting down on field exercises) to cut costs, with sacrificing quality and relevance.

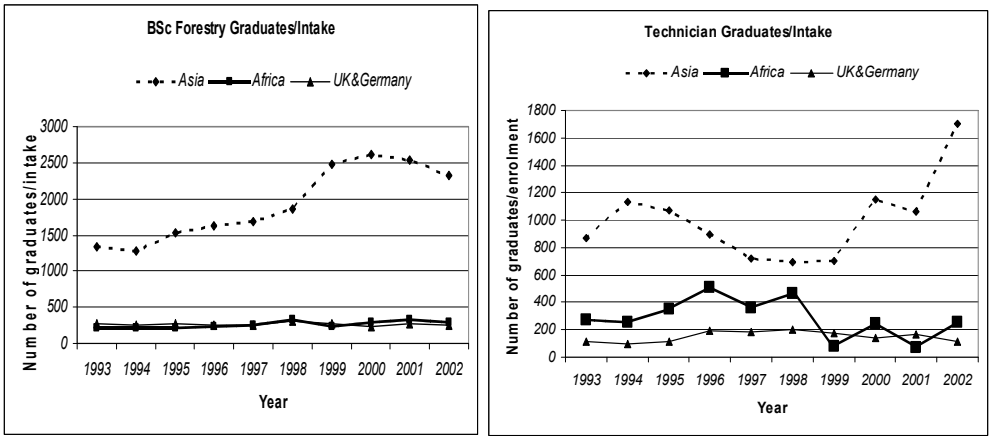

Figure 1.1: Trends in Graduation/Enrolment in Forestry Education in Selected Countries in Africa, Asia and Europe (Temu *et al*., 2005; Miller, 2004 and Siregar, 2004)

Griffin (1990) argued that we provide forestry "*education for capability*". To this, Miller (1990) aptly asks "*capability for what, and at which level*?", and to which we add "*how*"? These questions are critical to keeping the profession relevant to society, and the FAO Advisory Committee on Forestry Education (ACFE) was established to provide continuing global guidance on these important issues.

1.8 DISCUSSION

In terms of realizing its objectives, ACFE was instrumental in establishing, improving and influencing the direction of forestry education and support for it worldwide. Based on its recommendations, the FAO education department was established at FAO in Rome in the early sixties. The department undertook many projects in support of forestry education and training in developing countries. Forestry training in Bangladesh, Nigeria, Uganda, the Sudan, Ghana, Cote d'Ivoire, and many other countries around the developing world would probably not have been established so successfully without FAO support and the guidance of ACFE. Many fellowships were offered to students from developing countries to undertake graduate and post graduate training in forestry schools in Europe and North America, which had a multiplier effect on capacity development in their countries, as many beneficiaries of the fellowships ended up as trainers in institutions within their countries.

The work of ACFE was an inspiration for many parts of the world, but most especially Eastern and southern Africa. In 1971, an advisory Committee for Forestry Education in Eastern and Southern Africa was formed. It brought together educators, public forest managers and industry to discuss the human resource needs and determine the content and quality of existing education programmes. It also planned additional programmes and refresher training. Unfortunately, the committee fizzled out in the late eighties.

A perennial recommendation of ACFE was for preparation and provision of textbooks and manuals. Because of this recommendation, the FAO produced many textbooks and manuals on many aspects of forestry practice, based on ACFE advice. In some controversial cases such as the planting of Eucalypts, FAO publications were the standard reference. Textbooks and manuals ranging from teaching methodologies to extension, sawmilling, ergonomics, nursery practices, etc were published and distributed to institutions and extension workers worldwide. In many developing countries, FAO textbooks and manuals were and still are the most readily available reference material on forestry bookshelves.

With regard to drawing agenda and background information to IUFRO and World Forestry Congresses, the committee produced technical papers such as background papers on technology and forestry education, training and extension to UNCED preparatory meeting in 1992; education and training for forests research for CIFOR's strategic planning, and; updated

directories of forestry training institutions, etc. Further, the committee organized at least four world consultations on forestry education, which afforded forestry professionals, educators, and practitioners great opportunities to deliberate on trends and needs for education and training, and published the proceedings of these.

Because of concerns about manpower needs for forestry services at ACFE's formation, and through FAO efforts, skilled manpower requirements were met in most developing countries by the 1980s. After this period, the concern then became that of expanding the curricula to include other courses so that forest graduates could find employment in other areas. From late 1980s, it was realized that manpower requirement was no longer a pressing issue and to maintain the competence of the previously trained foresters and to equip the staff with specialized knowledge for example new developments such as IT, ACFE recognized the importance of continuing education. Therefore, this became ACFE's major concern in 1990s before it was terminated. Similarly, ACFE recognized the importance of vocational training so that workers could be equipped with basic work methods. Therefore the ACFE recommended that continuing and vocational education be undertaken by universities, state agencies, forest industries and employers. While not included in ACFE representation, professional societies can play an important role in continuing education, as is the case with other professions such as medicine, engineering and law.

Another perennial issue during the life ACFE was curricula content for first degrees and technical training such as diploma and certificate courses. Apart from dealing with curriculum content, many recommendations were made on added need for the courses to impart proper attitudes and ethics. It should be noted, however, that societies around the world depend on forests, and will continue to do so for the many important goods and services it offers. The objectives of forest management and the goods and services emphasized in different parts of the world will vary according to the developmental phases of the society.

Therefore, management objectives tend to differ not only from one country to the other but also within any society over time. Arising from this, there is an inescapable conclusion that society will continue to require personnel trained in managing forest resources to meet whatever the needs of society may be. However, with globalization, forestry development in developing countries is paradoxically under heavy conservation as well as harvesting pressure! These pressures make the

question of curricular content in forestry education and training in the developing world rather complex and difficult to resolve. This underscores the importance of an advisory body, which can provide continuing dialogue on forestry education issues worldwide. A new instrument with a balanced global vision and representation is needed.

1.9 CONCLUSIONS AND RECOMMENDATIONS

The now defunct ACFE and the Forestry Education Department at the FAO made very valuable contributions to forestry education around the world. This paper highlights the roles played in the past by the FAO and ACFE in supporting forestry education globally, their effectiveness, and of the likely gaps arising from their demise.

Society will continue to depend on forests for a variety of important goods and services including soil and water conservation, carbon sequestration, climate amelioration, recreation and tourism, wood and non-wood products. Forest management objectives are set by society, and these change as societies themselves change. Therefore, the forestry profession will continue to be required to shift paradigms from time to time. We know now that forestry education has not been able to transform at pace with global changes, resulting in failures and triggering perceptions that foresters are not what society needs. Flexible curricula with a diversity of specializations are urgently needed to address this issue. There is still a need to develop databases and strengthen regional and national institutions through the worldwide and regional networks and ICT systems to inform and guide forestry training.

There are now international forestry and forestry related research organizations such the World Agroforestry Centre (ICRAF) and the International Center for Forestry Research (CIFOR), which are active globally in forestry research and education activities. The International Union of Forestry Research Organization (IUFRO) and regional education networks such as ANAFE, AFORNET, CATIE, COMIFAC, ETFN, RIFFEAC and SEANAFE are other important players in forestry education matters.

A global mechanism to guide the process, mentor institutions and facilitate peer reviews to achieve common standards is urgently needed. The above institutions have organizational structures and contacts and are very well placed to house global, regional and sub-regional mandates to promote and support a global advisory body. The critical issue is whether

such a global advisory mechanism is necessary in today's world to provide a new global vision on forestry education. If the answer is affirmative, how can we raise the effectiveness of such an instrument? To answer these questions there is a need to discuss and resolve the following:

- What are the desired specific outcomes and impact?
- What kind of agenda would it be mandated to carry out?
- What representation would such an instrument have?
- What mechanisms will the instrument need to influence education and training programmes around the world? and;
- How would it be funded?

These questions have been bothering many universities offering forestry and related education and other stakeholders. The ACFE appreciated this since the 1980s. It is a function uniquely suitable for a global advisory body. After long informal debates, the International Partnership for Forestry Education (IPFE) was launched in April 2005, at a meeting hosted by FAO in Rome. The partnership has a secretariat at the University of Joensuu in Finland, thanks to a Finnish government grant. It is our belief that the answers to these questions will enable the IPFE to take this debate to another level.

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Annex 1: Focus of ACFE Forestry Education Advisory by Decades

Topic	Main content of ACFE advisory by decades
Forestry Curricula	1950s Admission criteria 1960s Extension, forest terminology, work studies, industry organization, wildlife management, watershed and range management 1980s Continuing education in extension; continuing education for forest workers; assess needs for continuing education; continuing education to be part of extension; FAO to increase activities in ergonomics 1990s -Consult stakeholders to increase frequency of curricula review and base it on needs; GIS and computer modelling in watershed management in dry lands; personnel management, work science and ergonomics
Human resources and employment	1950s Employment possibilities versus trained personnel-surveys; manpower requirements versus training needs; 1960s Manpower requirement versus training; manpower assessment techniques 1970s Methodology for manpower assessments; increase more women in forestry education; career outlook of forestry education; role of forestry in employment 1980s Manpower needs for wildlife management; manpower planning and training to based o research; balance employment to training needs; fully-fund planned forestry manpower assessments and planning 1990s Retention of manpower; lessen brain-drain; mobilize manpower
Training for forest industries	1960s Wood technology; logging and sawmilling 1970s Industrial training; occupational safety and health; assess manpower requirements for industry; tools, machinery and ergonomics; harvesting, processing and sawmilling; and industrial processing 1980s Draw code of practice and standards; link institutions to industry; FAO and Finland to help in training for industries 1990s Develop appropriate methods for forest industries; link industries to educational institutions

Topic	Main content of ACFE advisory by decades
Forest extension	1970s Communication skills; agriculture and attitudes; forestry and society-public relations; awareness on role of forests; compile extension manuals; extension for small scale sawmills; community forestry development; socioeconomics and resource allocation; FAO to publish books; business management; manual on training methodology 1980s Social forestry; afforestation of wastelands; link research, education and extension; FAO to introduce extension manuals; include extension in all training programmes; 1990s Teach alternative livelihoods; extension methods; methodologies for extension in watershed management
Vocational/in-service training	1970s Strengthening continuing education 1980s Watershed, parks and range management; Forest policy to be more developed in curricula; introduce ergonomics at all levels; train lecturers on pedagogy; business management; expand education to fit other job opportunities; Sociology, anthropology, extension
Information and communication technology	1970s Production of textbooks; manuals on training methodology
Administration of forestry education	1960s Textbook needs assessments; standardizing Forest terminology; establishment of university-level education; University-to-university linkages; 1970s Organize world consultations; new methods of teaching; comparative study of forestry education; integrated work study; pre-university exposure in forestry 1980s Establish exam boards; develop regional centres of excellence, coordinate research and education; regional centres for industrial training 1990s Teacher training; link education and research to obtain data in dry land watershed management
Postgraduate education	1960s Postgraduate education, intensification of research 1970s University-to-university linkages in community education 1980s ACFE to focus on postgraduate training; training in forest product marketing; increase harvesting, socioeconomics, wood sciences and technology content in curricula and specializations; pedagogical training to lecturers; correct bias in favour of professional training and encourage technical training
Others	1960s Organize world consultations; organize ACFE in 6 regional committees 1980s Rehabilitate wasteland through afforestation; research on energy biomass; research on conservation and management of tropical forests; develop network of information centres

2 ITTO's Holistic Approach to Forestry and Environmental Education

Aoki, C.
International Tropical Timber Organization

ABSTRACT

ITTO is a unique international organization formulating and putting forest policies into practice within its member countries. It provides a forum to discuss global forest policies and has implemented more than 850 projects and activities in the last 20 years in order to achieve its primary goal: to promote sustainable forest management. These activities include a wide variety of workshops, training activities, and fellowships at the national, regional and global levels. Training events are focused on three technical domains, namely reforestation and forest management, forest industry, and economic information and Market Intelligence. They cover critical issues, such as sustainable forest management, reforestation, biodiversity conservation, community forestry, illegal logging, efficient timber processing, forest statistics and timber market strategies. Recently, ITTO's work has been expanded to cover global warming and climate change, including promotion of CDM in afforestation/reforestation and bio energy. This holistic approach to forestry has had a great impact on the environmental awareness of citizens, students, and government authorities, as well as on environmental problems. It also calls for, and has generated, strong partnerships among international organizations, forestry research institutes, NGOs, and universities. In this paper, we will provide an overview of ITTO's work and make recommendations on ITTO's future contribution to forestry and environmental education.

2.1 INTRODUCTION

Forests embrace all living forms on the planet, including human beings. They provide clean air and water, food, shelter and rich nutrition for the soil, river and ocean. They also contribute to climate and environmental stability. Considering the current critical issues of climate change and loss of biodiversity, forest conservation and afforestation is a key to the future existence of humans and other creatures.

However, forests, especially tropical forests, are diminishing at a rapid pace mainly due to human activities. Current activities in forests are based on the human desire for rapid and continuous economic growth and have damaged forests and natural environment, both of which are fundamental for life. To reverse the deterioration of forests and minimize human impact on the environment, humans may need to reconsider their current way of life based on mass production and consumption and change their views and approaches to forest conservation and the natural environment. Otherwise, the current civilization might follow the similar destiny as some ancient civilizations that disappeared when deforestation progressed.

Critical to this reversal is improved forestry education. Forestry education is becoming more interdisciplinary and takes into account ecological, social, economic, environmental and cultural aspects. In order to meet the new demands required by the interdisciplinary approach, forestry educators need to enhance and expand their knowledge and skills to capture a holistic view of the complex issues associated with forestry and the environment. They should also have good communication and teaching skills to teach the significance of forestry from multiple angles, and motivate forestry students to work on forest conservation and afforestation with pride and confidence and help them find alternative income generating resources to timber.

The International Tropical Timber Organization's (ITTO) work could provide insights and guidance to the future direction of forestry education based on its 20 years of experience in promoting sustainable forest management (SFM). SFM is a holistic approach to forest management, conservation and sustainable development and helps tackle pressing issues such as poverty alleviation, biodiversity conservation and climate change. This paper will review ITTO's key work on SFM, its holistic approach to capacity building, and its contribution to forestry education, especially in Africa. It will also propose ITTO's future contribution to

forestry and environmental education in order to meet the urgent demands for social, economical and environmental aspects and climate change.

2.2 ITTO AND SUSTAINABLE FOREST MANAGEMENT

The International Tropical Timber Organization (ITTO) is an intergovernmental organization working to promote the conservation and sustainable management, use and trade of tropical forest resources. Its 60 members represent approximately 80% of the world's tropical forests and 90% of the global tropical timber trade. The primary objective of ITTO is to promote SFM in its member countries to create a balance between conservation and sustainable use of timber and timber products from tropical forests in ITTO producer member countries.

In order to facilitate implementation of SFM, ITTO provides a forum to discuss global forest policies among its 33 timber producer member countries, 27 timber consumer member countries, a trade group and a civil society advisory group consisting of non-governmental organizations (NGOs). They exchange views on the status of sustainable management of tropical forests and provide information on the tropical timber industry, trade and markets. These discussions enhance transparency in both forest management and the timber trade, which is indispensable for SFM.

ITTO was established as a commodity organization under the auspices of United Nations Convention on Trade and Development (UNCTAD) in 1987, although its scope of work is more comprehensive than other UN-affiliated commodity organizations. This is why the concept of SFM was introduced in ITTO, so that conservation and utilization of tropical forest resources could be considered in tandem. In fact, more than 70% of ITTO's work involves reforestation and forest management, conservation of forests and their resources, and the conservation of biodiversity and watersheds. The organization's work on value-added and efficient processing of timber, promotion of Non-Timber Forest Products (NTFPs) and community forestry helps reduce poverty and increase quality of life in producer member countries. ITTO's activities on timber certification, forest law enforcement and illegal logging ensure trade of timber from sustainably managed forests. Its work on SFM and reforestation and afforestation also contributes to the mitigation and prevention of climate change, and is extended to assist its member countries to implement afforestation and reforestation projects under the Clean Development Mechanism (CDM) of the Kyoto Protocol.

The unique and important feature of ITTO is its capacity to put its policy work into practice, by implementing field projects in its member countries and organizing training workshops and conferences at national, regional and international levels. The field projects test the effectiveness of the policy and guidelines set up by ITTO and assist with capacity building required for SFM. Furthermore, the field projects often provide successful models for effectively implementing various aspects of SFM. Through the wide and solid ITTO network among its member countries and associated international and regional organizations, the successful project models have catalysed the process of SFM implementation efficiently and widely. Thus, ITTO has a leading role in promoting and facilitating SFM in the tropics.

2.2.1 ITTO's work on sustainable forest management

ITTO has defined sustainable forest management as "the process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without under reduction in its inherent values and future productivity and without undue undesirable effects on the physical and social environment (ITTO 1992,)." In 1991, ITTO set up the 'Year 2000 Objective', under which ITTO member countries made a commitment to achieving sustainable management of tropical forests and trade of tropical timber by the year 2000. In order to facilitate the progress, ITTO has published various guidelines and manuals on SFM as shown in Table 2.1. ITTO also has funded many projects to promote SFM and enhance capacity building in implementing SFM.

Although significant progress in reforming forest policy and legislation to adapt SFM had been made by year 2000, progress with implementing actual strategies in the forest was very slow, partly due to a lack of financial resources for institutional as well as forest management capacity building. In order to further assist the member countries to move more swiftly toward achieving SFM, the Year 2000 Objective was reformulated as Objective 2000, which is "to enhance the capacity of members to implement a strategy for achieving exports of tropical timber and timber products from sustainably managed sources". Since then ITTO has sent diagnostic missions to timber producer countries to identify the factors that severely constrain progress towards achieving Objective 2000 and SFM and has helped formulate action plans to overcome the constraints in each country (ITTO 2007a).

Table 2.1: A List of Major ITTO Guidelines on Sustainable Forest Management

Guidelines	Year
ITTO Guidelines for the Sustainable Management of Natural Tropical Forests	1992
Criteria for the Measurement of Sustainable Tropical Forest Management	1992
ITTO Guidelines for the Establishment and Sustainable Management of Planted Tropical Forests	1993
ITTO Guidelines on the Conservation of Biological Diversity in Tropical Production Forest	1993
ITTO Guidelines on Fire Management in Tropical Forest	1997
Criteria and Indicators for Sustainable Forest Management of Natural Tropical Forests	1998
Manual for the Application of Criteria and Indicators for Sustainable Management of Natural tropical Forests	1999
ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests	2002
ATO/ITTO Principles, Criteria and Indicators for the Sustainable Management of African Natural Tropical Forests	2003
Revised ITTO Criteria and Indicators for the Sustainable Management of Tropical Forests including Reporting Format	2005

These efforts resulted in a noticeable increase of the area of sustainably managed tropical production forest in ITTO member countries, from almost 1 million hectares in 1988 to over 25 million hectares in 2005, and to more than 36 million hectares, if tropical protection forests are included. There was also large expansion in the area of forest covered by management plans, to more than 100 million hectares, and a significant increase in forest certification from virtually none in 1988 to over 10 million hectares of tropical forests (ITTO, 2006 a, b).

Despite of these significant improvements, it was found that only less than 5% of total permanent forest estate is sustainably managed (ITTO 2006 a, b). Some of the factors hindering achievement of SFM are identified as financial incentives, changing markets and lack of human capacity. In order to strengthen SFM, it is necessary to enhance timber qualities from sustainably managed natural forests, provide local skills in value-adding industries, and some funds for forest owners in the tropics who commit to keeping and sustainably managing their forests to provide services such as biodiversity and carbon storage (ITTO 2007a).

Thus, SFM does not focus only on forest management and operation but instead involves activities beyond the forest, including the development of technology for the efficient and value added processing of timber, the

promotion of NTFPs and an open and transparent market for tropical timber and NTFPs (ITTO, 2007a). In order to undertake this holistic approach efficiently, ITTO's projects and activities are focused on three technical domains, namely Reforestation and Forest Management (RFM), Forest Industry (FI) and Economic Information and Market Intelligence (EIMI). Hence, training events are also carried out in accordance with the three domains, particularly in the framework of the criteria and indicators (C&I) of SFM.

2.3 CAPACITY BUILDING IN SFM

2.3.1 ITTO criteria and indicators of SFM

ITTO created the first internationally agreed set of criteria for SFM in 1992 (ITTO, 1992) and established a set of 7 key criteria and indicators (C&I) for the sustainable management of tropical forests in 1998 (ITTO, 1998), with a further revision in 2005 (ITTO, 2005), in order to assist member countries in "assessing, monitoring and reporting changes and trends in forest conditions and management systems at the national and forest management unit levels". ITTO uses the C&I as a central tool to assess progress towards SFM and the ITTO Objective 2000 as they identify the essential elements of SFM.

2.3.2 ITTO workshops on criteria and indicators of SFM

Although ITTO has made efforts to promote SFM in its member countries, it has been shown that less than 5% of the natural tropical forests are sustainably managed (ITTO, 2006a, b). In order to urge the member countries to facilitate implementation of the SFM, ITTO has been organising workshops to train government officials, forest managers, forest concessionaires, educators, NGOs and community people in using the C&I and C&I based on ITTO reporting formats since 2002. The primary objective of the workshops is to test and use C&I as a tool to monitor and report on progress toward SFM at national level as well as the forest management unit level. As of December 2006, 1,030 people had been trained in 22 countries, with 42% from Africa, 35% from Latin America and 23% from Asia/Pacific.

The workshops consist of wide variety of participants. Fifty-one percent of the participants are from government and forest administration, 23% from private sector and forest management units, 16% from NGOs and communities, and 13 % from research and educational institutes and

others. In general, the participants from research and educational institutions are fewer than those from government and private sectors.
This tendency is even greater in Africa than in Asia/Pacific and Latin America (See Figure 1.1). This suggests that more training on C & I of SFM may be necessary for educators and researchers particularly in African educational and academic institutions, to enhance their knowledge and skills in C&I of SFM to educate and train forestry students to meet the demands of both forestry sector and private sector in competent workforce in SFM.

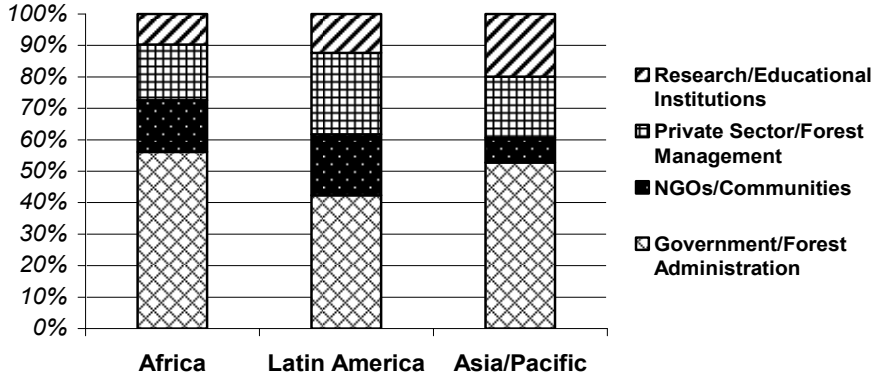

Figure 2.1: Categories of Participants in ITTO Workshops by Region

In addition to the above workshops, ITTO also organized three regional workshops to exchange experience on the implementation of SFM through ITTO supported projects and the application of C&I in Africa, Asia/Pacific and Latin America in 2007. This type of workshop is useful to provide successful models to other countries for implementing SFM and building human resources and institutional capacity. More instructors and researchers from forestry educational institutes are encouraged to attend this type of workshop to learn the updated status of SFM.

2.3.3 Training projects in the framework of SFM

ITTO uses the C&I of SFM as a central tool to develop and implement field projects, which include training on the successful implementation of SFM. For instance, an Indonesian project on SFM and human resource development was undertaken as a field test of the C&I and trained more than 500 forestry staff in various subjects related to SFM and eventually led to 90 people receiving PhD, or Masters Degree at national and

overseas universities (ITTO, 1990). The project also created a research and training station in West and Central Kalimantan where research and training on C & I, such as biodiversity, participatory park management, forest fire management, soil erosion control, forest inventory, were conducted in collaboration with several universities in Indonesia.

Another successful example is a Brazilian project on development of human resources in SFM and Reduced Impact Logging (RIL), which provided practical training and workshops in SFM and RIL to more than 2,500 forestry professionals including community people in the Brazilian Amazon (ITTO, 2003a). The project contributed to increased awareness of the importance and benefits of forest management and RIL for many stakeholders across Amazon, and especially benefited forest-based communities as the training allowed them to be more competitive in the timber market and less dependent on large timber companies.

Until December 2006, there were a total of 852 projects, pre-projects and activities completed or under implementation, of which 468 are projects, 195 pre-projects and 189 activities. A summary of all ITTO projects approved by 2006 can be found in the ITTO Annual Report 2006 (ITTO, 2007b). About 80 % of all ITTO projects contain some kind of training components, as it is necessary to train project related personnel to successfully implement the ITTO projects. Furthermore, about 30% of the projects are directly related to human resources development and strengthening institutional capacity building or have large training components. These training events are focused on the three technical domains as mentioned earlier. The examples of trainings undertaken in each domain are shown in Table 2.2.

There is a clear shift in the trends in forestry training for the last 20 years. In earlier years, ITTO projects provided training that is more technical for foresters working in the forestry sector and private sector involved in forest management. Recently ITTO's projects offer more training involving community groups. This is because the importance of social, environmental and cultural aspects in SFM has been emphasized lately, and community forestry has been recognized as an important mechanism for "addressing social equity while pursuing the sustainability of the forest resources (ITTO, 2007a)." Community forestry could protect the traditional culture and wisdom to live in harmony with the nature that the villagers and indigenous people have inherited for hundreds of years and promote community life.

Table 2.2: Training in the Three Technical Divisions of ITTO.

Technical Domain	Category of Training	Subject of Training
Reforestation and Forest Management (RFM)	Forest Conservation and Sustainability	Biodiversity conservation
		Community forestry
		Ecotourism
		Forest fire management
		Forest inventory
		Forest landscape restoration
		Forest law enforcement
		Forest management plan
		Forest rehabilitation
		GPS and remote sensing
		Mangroves forests and ecosystem conservation
		Reduced impact logging (RIL)
		Reforestation and afforestation
		Restoration and rehabilitation of degraded forests
		Restoration of forest landscape
		Soil and water protection
		Silviculture of natural forests
		Timber tracking system
		Transboundary conservation
		Watershed management
Forest Industry (FI)	Assisting Development	Alleviating poverty
		A/F Clean Development Mechanism
		Efficient timber processing
		Non-timber forest products
		Value-added processing
		Wood-based bio energy
Economic Information and Marketing Intelligence (EIMI)	Markets, Marketing and Trade	Ecosystem services
		Forest auditing
		Forest certification
		Forest Policy
		Illegal logging control
		Marketing access
		Marketing strategies
		Statistics on timber and forest
		Trade on endangered species

2.3.4 Shift in training for participatory and community forestry

Overall, at least 23% of 663 projects and pre-projects involve direct community participation in training. The proportions of the projects with the community involvement in three geographic regions are 27% in Africa, 35 % in Asia/Pacific and 38% in Latin America. Figure 2.2 shows an increase of projects involving community training in three geographic regions in recent years.

Overall, 85% percent of the projects with community involvement take place in the domain of RFM, 12% in FI and 3% in EIMI. However, in the Asia/Pacific region the percentage of community involvement in the

domain of FI, such as NTFPs and value-added timber processing, is higher than that in Africa and Latin America, with 26% in Asia/Pacific and only about 5% in the African and Latin American region

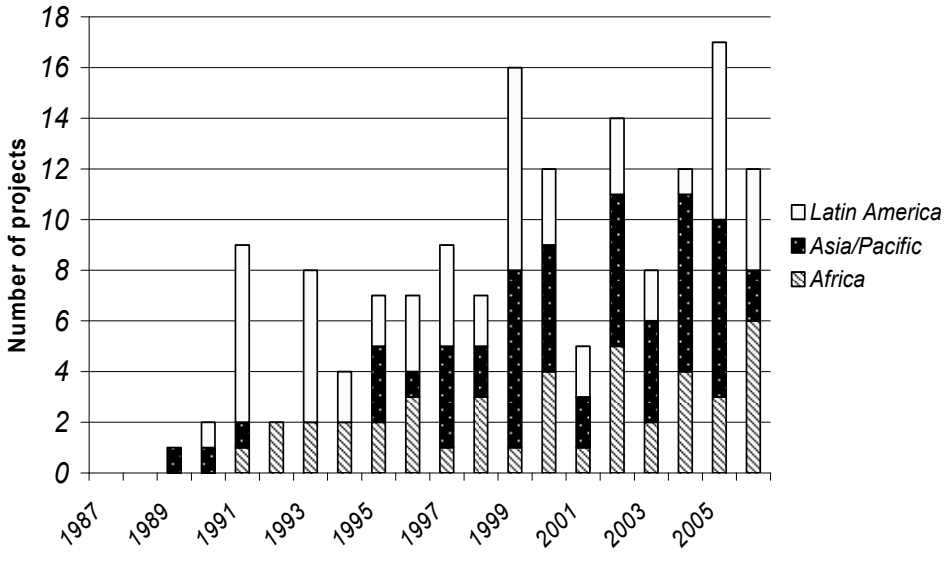

Figure 2.2: Number of ITTO Training Projects Involving Community in Different Parts of the World

ITTO promotes community and participatory forestry also through organizing workshops and conferences. For example, in July 2007, ITTO organized an international conference on "Community Forest Management and Enterprises: Global Issues and Opportunities" in Acre and Brazil, to raise global awareness of the contributions of community forest management and enterprises to conservation and sustainable development.

2.4 PARTNERSHIPS, WORKSHOPS AND CONFERENCES

2.4.1 Partnerships

As the SFM is a holistic approach to the conservation of forest resources and sustainable development, it involves a variety of stakeholders. ITTO has expanded its work beyond projects and organized many training workshops, seminars and conferences in collaboration with local and national governments, many international organizations such as Food and Agricultural Organisation (FAO), United Nations Forum on Forests (UNFF), Convention on International Trade for Endangered Species

(CITES), World Convention Union (IUCN), regional organizations such as African Trade Organisation (ATO) and ATIBT, international and local NGOs, research and educational institutes and local communities. A good example of partnership in training is an international short course on forest policy conducted in Bangkok, Thailand in April 2007, which ITTO sponsored in collaboration with FAO, United States Department of Agriculture (USDA), Forest Service and other partners. The advantage of this kind of course is that a number of experienced international foresters, forest policy makers and professional educators are brought together to teach a course that makes forestry a challenging area for effective policy making.

2.4.2 Conferences in poverty alleviation

The ITTO's new agreement, the International Tropical Timber Agreement (ITTA) 2006, put emphasis on poverty alleviation in ITTO's roles. ITTO's various projects to promote value-added and efficient processing of tropical timber, NTFPs and community and participatory forestry increase the income level of local people, help reduce poverty and increase quality of life in the producer member countries. In order to facilitate this process, ITTO has participated in organizing an international conference on managing forests for poverty reduction in Vietnam in 2006 in collaboration with many partners, such as FAO, Netherlands Development Organization (SNV), Department of Forestry in Viet Nam, Tropical Forest Trust (TFT), Regional Community Forestry Training Centre (RECOFTC), Asia-Pacific Forestry Commission (APFC) and World Wide Fund for Nature (WWF). The meeting concluded by setting up a taskforce to "promote community-based and labour-intensive forest management for poverty reduction", calling for a partnership among many stakeholders to ensure that "forests are managed for the benefits of the poor" and on policy makers to "improve access and rights of the poor to forest resources and to simplify forest laws and regulations." Another international conference on SFM and poverty alleviation, emphasizing on roles of traditional forest-related knowledge, is scheduled in December 2007 in Kunming, China.

An international conference to promote the development of tropical NTFPs and services was also held in September 2007, in Beijing, China. NTFPs are important alternative income sources to timbers, which could secure the life of the forest dwellers and community while protecting the forests. ITTO has rich experience in promoting NTFPs in many member countries that could be shared with conference participants. These

conferences serve as good platforms to discuss poverty alleviation in the SFM framework.

2.4.3 Workshops related to climate change

ITTO naturally has recognized the important roles of tropical forests in climate change. ITTO has been participating in many international meetings related to climate change and role of forestry and has been also actively organizing workshops and conferences on related issues, such as afforestation and reforestation under Clean Development Mechanism (A/R CDM), bio energy, increased efficiency in the wood industry, SFM and forest restoration. For instance, ITTO has organized an international workshop on CDM to promote the participation of African tropical timber producing countries in CDM projects in 2006 (ITTO, 2005b), and convened regional workshops on A/R CDM in Asia/Pacific in 2006 and Latin America in 2007. ITTO also published a "Guidebook for the formulation of afforestation and reforestation projects under the Clean Development Mechanism" (ITTO, 2006c) to assist its member countries to formulate the A/R CDM projects. An international conference on wood-based bio energy was held in collaboration with FAO and the German Federal Ministry of Economics and Technology in Hannover, Germany in May 2007.

ITTO's projects also involve the specific issues of reducing CO_2 emissions from deforestation and forest degradation (REDD). REDD is considered as an integrated part of SFM of the protection and production forests. ITTO published Guidelines for the Reforestation, Management and Rehabilitation of Degraded and Secondary Tropical Forests (ITTO, 2003b). In order to promote the usage of the guideline and train people from governments, communities, NGOs, private sector and research and training institutions in forest landscape restoration, 6 regional and 10 national workshops have been conducted in ITTO member countries in the tropics. Since 2006, ITTO has put more emphasis on clarifying the role of ITTO in climate change negotiations and in the implementation of REDD system under the United Nations Framework Convention on Climate Change (UNFCCC) (Robledo and Masera, 2007). ITTO suggests that the concept of permanent forest estate and SFM should be included as key elements to maintain carbon pools within forest and landscape management.

2.5 ITTO FELLOWSHIP PROGRAMME

In addition to the projects and workshops, ITTO offers fellowships through the ITTO Fellowship Programme to promote capacity building and capacity enhancement of young and middle-level professionals who are engaged in the sustainable management of tropical forests, the efficient utilization and processing of tropical timber, and the provision of economic information on the international trade in tropical timber. Fellowships support a wide range of activities, including participation in international conferences, short training courses and study tours, preparation of manuals and monographs and pursuit of post-graduate study.

The programme provided fellowships to 911 people from 44 member countries working for government, research institutes, universities, NGOs and private sector by 2006. More than 95% of all fellowships have been awarded to nationals of the ITTO member countries in Africa, Asia/Pacific and Latin America, with almost even distribution. The total amount of fellowships is more than US$ 5.2 million. A survey of fellows conducted in 2006 showed that the Fellowship Programme has made a significant contribution to professional development and promotion of SFM in tropical countries (Aoki, 2006). Many fellows have been promoted in their workplace and taking leadership roles in forestry and related fields in their home countries after completing fellowship trainings. ITTO has made efforts to promote gender equality, with 46% of ITTO fellowships awarded to women in 2006.

Since 2000, 45% of the fellowship activities are related to Masters and PhD programmes in forestry and forest sciences, such as management and conservation of forest and forest resources, conservation of biodiversity, community forestry, participatory management of forest and forest resources, forest industry and forest products, in prestigious universities in both developed and developing countries. More than 25% of the fellowships have been awarded for undertaking short training courses in the subjects, such as Geographic Information System (GIS) and remote sensing, diversified management of natural tropical forests, tree breeding and improvement, biodiversity assessment and monitoring, forest products marketing, forest and natural resources management (NRM), tropical dendrology, forest governance and forest policy, and environmental leaderships, in esteemed universities and training institutions. It is advisable that students and educators of research and

educational institutes utilize this mechanism of funding to enhance their knowledge and skills in SFM.

2.6 ITTO's CONTRIBUTION TO AFRICAN FORESTRY EDUCATION

ITTO has provided financial assistance to more than 130 projects in Africa. While around 80% of the projects have some kind of training components, about 25% projects are directly related to capacity building and training in SFM. At present, there are projects specifically formulated to improve African forestry education in order to meet the new demands of government and the private sector and changes in forest policy and forest management under the SFM framework at the national and regional levels.

At the national level, ITTO assisted Ecole des Eaux et Forêts (MINEF) in Cameroon to implement a project to develop technical skills and training structures at the Mbalmayo School of Forestry in Cameroon in order to meet the new demands arising from fundamental changes in forest management that took place in 1990s in Cameroon (ITTO, 2001). The changes, such as the decentralization of forest management, the concession of almost all permanent production forests to the private sector, the building of support infrastructures and the priority given to rural and community participation in forest resources management, require new approaches for training and management of human resources responsible for forest management. Reforming training programmes requires the reform of existing teaching tools, the establishment of new tools, and a revised training curriculum. Therefore, a Forestry Training Master Plan has been developed to train and retrain school instructors and is currently being validated. Some school teachers have been trained overseas in wood technology, trade and marketing while the infrastructure of the existing facilities, such as the library, the arboretum and the wood workshop, was updated, and new facilities, such as a herbarium and a research unit on silviculture, wood technology and forest genetics, were created. This example could provide a success model in enhancing the quality of forestry education in Africa as well as other regions.

At the regional level, ITTO has been actively involved in promotion of SFM in Congo Basin countries, where the implementation of SFM is slower than in Asian/Pacific and Latin American countries (ITTO, 2006a). In fact, only 11.5% of the total production forests within the permanent forest estate in the Congo Basin countries were managed by

concessionaires with a forest management plan. Furthermore, forest management had been certified in only 2.4% of these forests (ITTO, 2007c). Therefore, there has been an increasing demand of SFM training in this region and a strong need to upgrade training programmes, infrastructure and instructors' skills and knowledge in order to cover the SFM training needs for forest concessions in forestry training institutions of the Congo Basin countries.

To meet the demands, ITTO funded a project in 2003 to examine and evaluate the training needs and develop new forest management training programmes in eight forestry schools in the Network of the Central African Forestry and Environmental Training Institutions (RIFFEAC) in collaboration with IUCN Regional Office for Central Africa in Cameroon (ITTO, 2003c). The project identified the following key urgent needs for improvements for the training programmes: (i) a gap between SFM training needs and the training gained by instructors in the forestry training institutions, (ii) a discrepancy between the knowledge and skills acquired by the graduates of the institutions and the job demanded by the industry and forestry sector, (iii) a narrow scope of SFM taught in the institutions, (iv) a need for more emphasis on social and environmental aspects, participatory and community forestry and biodiversity, (v) a need for more regular adaptation and integration to changes in national forest policy , (vi) a need to integrate the training programmes with the LMD credit system (main stream college graduation system), (vii) a need to strengthen partnerships between the training institutions and private sectors, and among the training institutions, and most importantly, (viii) a need of financial resources to meet changing demands. (ITTO, 2007c).

In order to meet the urgent needs identified above, a training programme with 15 modules on forest management for Central Africa, the methods and pedagogic tools to be used by the instructors, and the methods for the follow-up and evaluation of the training programmes have been developed. To further validate the new training needs and facilitate implementation of the new training programmes, a sub-regional workshop was held in Yaoundé, Cameroon in 2006 in collaboration with Central African Forests Commission. Based on the outputs of the project and the workshop, a follow-up project was proposed and approved in 2007 to actually implement the training programmes on forest management and forest concession management with an emphasis on socio-economic needs and ecological balance in the training institutes in Congo Basin countries (ITTO, 2007c).

This project will assist RIFFEAC training institution members to revise training programme contents, train instructors and provide logistic and infrastructure to ensure the effective implementation of the training programme required for SFM at country level. It will also assist them to harmonize and coordinate the training programme at regional level. The partnership between the training institutions, industries and other stakeholders and the student internship in the industry will be key elements of successful capacity building of RIFFEAC members (ITTO, 2007c).

2.7 ITTO's FUTURE CONTRIBUTION TO FORESTRY EDUCATION

ITTO is now entering into a new era as the International Tropical Timber Association) (ITTA), enters into force in 2008 or 2009. The ITTO's role in new agreement is expanded to assist member countries to pursue sustainable development and alleviate poverty, to assist forest-dependent indigenous and local communities to achieve SFM, to promote trade in NTFPs and valuation and trade of tropical services (ITTO, 2007a). The new agreement also creates a sub-account for thematic programmes to which donors could contribute directly to thematic areas rather than individual projects. The examples of thematic areas are forest law enforcement and governance, poverty alleviation, certification, information-sharing, indigenous and local communities, market intelligence and transparency, further timber processing, marketing and distribution and tropical timber and so on. Improvement of forestry education could be considered as a thematic programme for funding if ITTO identifies it as an urgent matter of concern.

Although there seems to be a concern about a decline in forestry education, it is evident from ITTO's work that under the SFM scheme, forestry education should be expanding its role in wider disciplines and is becoming a more holistic and interdisciplinary field of study taking into account socio-economic, environmental and cultural aspects. Forestry now plays more important roles in the human society and wildlife than in the past, as it can provide solutions to poverty alleviation, climate change, renewable energy, conservation of biodiversity and wildlife, clean water supply, which leads to healthy and wealthy human society and wildlife. As a whole, forestry under SFM scheme could provide a tool to maintain harmony between human life and nature and remove current environmental problems from which the planet is suffering.

ITTO's 20 years experience in SFM both in policy and field projects could provide important implications to improvement of forestry education. As we have seen, in order to successfully spread SFM, it is necessary to have a strong and cooperative network among stakeholders, financial resources, highly competent and knowledgeable personnel and technicians, infrastructure and the right mentality to utilize these resources with good will. Based on ITTO's experience with training in SFM, the following issues are suggested for consideration for improvement in forestry education.

Firstly, it is advised that the instructors and researchers in academic and research institutions should upgrade and expand their knowledge and skills to understand the holistic approach of SFM. One way of doing this is to participate in ITTO's wide variety of workshops and conferences specialized in the current issues and challenges of SFM and climate change. The instructors and researchers are also encouraged to apply for ITTO fellowships to attend international short training courses, undertake study tours to the ITTO's projects sites to learn the key elements of success and failure in implementing SFM related projects, and share their key findings in international conferences and symposiums. They could also expand their field of interests by further studying in advanced degree programmes in SFM related fields.

Secondly, the infrastructures and school curricula of the academic institutions should be enhanced to accommodate the SFM framework. This requires financial resources as well as human resources. The research and educational institutions could submit project proposals to ITTO through their governments in order to obtain funding to enhance forestry education. Improvement in forestry education could be considered as a thematic programme for funding if ITTO identifies it as a priority theme.

Thirdly, it is recommended that more emphasis on community and participatory forestry should be put in the forestry curricula as community involvement is indispensable for SFM and contributes to poverty alleviation. While ITTO works to help local communities meet the global standards of SFM, it also highlights the importance of conservation of local culture and indigenous knowledge and wisdom concerning forest usage, for instance, medicinal plants and NTFPs, through harmonizing life with nature. This suggests that forestry is now responsible not only for forests but also for social, economic, cultural and health aspects of human being.

Fourthly, skills in communication, negotiation and conflict resolution should be included in the forestry training. As the current work on forestry and environment involve many stakeholders, good communication and negotiation skills in all levels of stakeholders is essential to make successful achievements in forest management and community development plans. It is also recommended to provide courses on motivational and humanistic psychology and stress management in a curriculum in order to help students maintain their motivation and good will to conserve forests and cope with potential stress in working in a highly stressful situation created by the current complex issues in forestry and environment.

Fifthly, partnerships between universities, research institutions, local community, private sector, government, NGOs, and international organizations should be strengthened. As ITTO offers many training workshops and conferences to enhance the partnership in all levels, more forestry educators should join the ITTO network. Furthermore, internships and training opportunities of forestry students in industry, governments, NGOs and international organization should be increased so that the students could understand the real issues and concern about forestry and environment and could be more motivated to work on improvement of the current state of forests. Perhaps, a mechanism of student internships in the ITTO field projects could be established.

Sixthly, students should be given opportunities to learn the importance of local tree species and conservation of biodiversity to maintain unique and special values of the local forests in order to counter against the globalization and the conversion of forests to agricultural and cattle fields.

Seventhly, forestry educators and students should be given opportunities to learn from the ITTO's case study of SFM in different countries and identify the key elements of success and failure that are globally common and locally specific.

Eighthly, a curriculum should include issues on climate change and roles of forestry. ITTO could also provide training and funding for work on these issues. Thus, forestry education has become an interdisciplinary field of study that requires a holistic view and understanding of the complex issues of the current world.

2.8 FORESTRY AND ENVIRONMENTAL EDUCATION FOR CHILDREN AND TREE PLANTING ACTIVITIES

ITTO has been aware of the importance of forestry and environmental education for children in addition to forestry education in universities and higher academic institutions. In 1995, ITTO implemented a youth forestry project in Ghana in order to raise awareness of the need to protect the environment and to contribute to the national afforestation programme (ITTO, 1994). Youth groups were directly involved in the planning and establishment of their own woodlots and shared their thoughts on forestry issues. The project successfully resulted in providing skills in establishing and managing tree nurseries to selected members of the youth groups and produced education materials on environmental protection and nursery management. It was found that continuation of the production of seedlings to meet the demands of the communities and youth groups is important for further continuing tree plantation development.

Learning from this experience, ITTO is planning an international programme on forestry and environmental education for children and tree planting activities now that the issue of environmental protection has become even more critical. Children of some model schools in several ITTO member countries will receive the same education on forestry and environmental issues as well as become involved in establishing tree nurseries, planting trees and monitoring tree growth and biodiversity, and reporting their activities and exchanging ideas about environmental protection through the internet and study tours between the countries. We believe that this programme will provide better understanding of the multiple roles of forests for environment as well as for human activities among the children and will guide the children to becoming future leaders on forestry and environmental issues. In order to accommodate these children in higher education, we even strongly need to expand our knowledge of forestry to wider disciplines. The forestry education is no longer only about the forests; instead, it requires an interdisciplinary approach and view of the world under the SFM framework and climate change which brings harmony between humans and nature.

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3 Restructuring Africa's Forestry Education

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ABSTRACT

In Africa, unlike in the west, local people are more dependent on forests for their livelihoods. In addition to timber, forests supply food, fuelwood, medicine, building poles and dry season grazing. In spite of this, forestry education over the last 70 years has focused mainly on timber production and water conservation and neglected other forest uses and products e.g., non-timber products, biodiversity, eco-tourism, etc. The central governments have reinforced this bias by putting a premium on timber production and water catchment value while undervaluing the other forest uses. Increasingly, however, changes in public perception of forests and forestry are defining new approaches to the conservation and use of trees and forests. Recognition of forests as major carbon sinks is raising the number of stakeholders and influencing the goals, science and practice of managing trees and forests. Reconciling all interests is hard for the forester and even harder for the forestry education curriculum developer. In this paper, we reflect on the history and status of forestry education in Africa and propose some ideas for the future.

3.1 INTRODUCTION

In order to re-focus forestry education in the continent three steps are needed. The first step is to understand the history and growth of forestry

[1] Currently renamed as African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE).

education in the continent. This will enable us understand the successes and failures and their underlying reasons. The second step is to understand how forestry relates to other associated disciplines and how forestry teaching can better integrate ecological, social/cultural and economic values and interests in order to improve forest management sustainability. This could help increase private sector and local community involvement in the forestry sector and also increase its capacity to adapt to changing conditions (e.g., shrinking public sector job market) and paradigms e.g., biodiversity, community forestry, agroforestry, trade in carbon (global warming), eco-tourism, etc. Lastly, we will review the global dynamics that have put new demands on forests leading to new perspectives in forestry management and increasing the number of stakeholders in the sector. These dynamics challenge the relevance and effectiveness of current forestry education programmes. The paper concludes by suggesting some necessary forestry education reforms.

3.2 HISTORICAL PERSPECTIVE

3.2.1 Establishment of formal forestry education

Formal forestry education in Africa can be traced back to setting up of national forestry departments in the colonial era. The independence wave that swept through the continent in early 1960s coincided with the need to find nationals to replace expatriate staff leaving the public service, forestry included. Available local forestry professionals were very few and all were trained outside the continent. The Food and Agricultural Organization (FAO) of the United Nations (UN) spearheaded expert and consultative meetings on the need to produce professional foresters (FAO, 1962). The inception of forestry education in Sub-Saharan Africa was largely patterned and shaped after models that were already in place in Europe and North America. For example, the forestry curricula proposed by Sisam (1964) took a rather narrow perspective, i.e., it borrowed heavily from forestry schools established in North America. These put much emphasis on biophysical aspects of timber production as the main end product of forest management and underemphasised economic, social/cultural and ecological/environmental issues that also affect forestry. The conceptual framework was a vibrant public forestry sector raising and managing forests to feed into public and private wood and fibre industries; and also conserving forestry for multiple benefits (Wyatt-Smith, 1970) but the latter was taken as a spill over benefit rather than a mainstream purpose of managing forests. However, soil and water

conservation were taken seriously. With this frame of mind, forestry education was structured to produce vocational workers, technicians and professionals. The training period recommended ranged from 2-3 three years (certificate and diploma level) and 3-4 years for Bachelors degree level training.

Vocational and technical forestry training (offering certificate and diploma qualifications, respectively) has a much longer history than degree level professional education. An overview of historical development for these institutions as well as their regional spread is worth our attention. Most of these were established as early as 1930s through 1950s (e.g., Nyabyeya Forestry College in Uganda 1931, Olmotonyi Forestry Training School, Arusha, Tanzania in 1936, Ivory Coast Forestry School 1938 and Technical Forestry School in Cameroon 1949, etc). Recognizing the heavy costs of establishing professional forest training institutions in each individual country, a regional approach was adopted (Williamson, 1964). Thus, the College of Forestry in Monrovia, Liberia 1955; Department of Forestry at Ibadan University in Nigeria, 1963; and Makerere University, Uganda, 1970 were established to cater for several countries within their proximity. Forestry schools in Congo-Kinshasa and Cameroon were planned to meet training needs for French-Speaking Africa. Southern Africa was well served from South Africa's Stellenbosch University. However, from the 1970s through to 1990s the countries abandoned this approach and started their own forestry programmes thus expanding forestry education considerably. For example, Moi University in Kenya was started to offer degree programmes in forestry and wildlife management.

One of the difficulties in evaluating the development and success of forestry education in Africa is the lack of published information on the expansion process. Earlier philosophical discourses in the 1960s to 1970s (Shirley, 1964, Williamson, 1964) and analyses of manpower requirements were not followed up with studies on how various programmes and institutions actually evolved. The period between 1980 and 2006 is conspicuous for its silence on forestry education.

3.2.2 Forestry education content

Fundamentally, curriculum content in most forestry schools has developed from the viewpoint of forestry as a biological science and the end products of forestry as mainly wood products. Sisam (1964) proposed that undergraduate forestry curricula be comprised of two main parts: two

years of basic science courses (Physics, Chemistry, Botany, Zoology, Geology and Soils, Mathematics, etc.) and two years of "core" forestry courses: silviculture, forest ecology, surveying, forest engineering, tree morphology and physiology, forest mensuration, inventory and statistical methods, economics, pathology and entomology, forest management, wood technology and utilization, forest policy and administration, forest fire control, etc. These courses are found in forestry training curricula to varying degrees depending on the background and subject bias of faculty. Richardson (1969) criticized classical forestry training offered in North American and many other parts of the world schools for having a biological bias and being weak in industrial economics and business management. That in spite of the programmes being timber production oriented, curricula were not well suited or adequate for wood industry. Wood science is often offered as an option within forestry programmes. In rare cases wood science and technology is given as a stand alone programme. A first degree in forestry on the average takes 3-4 years. According to Roche (1975), as a basic minimum, expertise in all aspects of silviculture and management of large industrial plantations, in management of remnants natural forest ecosystems, in wood utilization, forest economics and forest engineering should be required to an increasing degree in Africa and hence reflected in training curricula.

Concerning the development of forestry curriculum in Africa, three key issues must be underscored. First, the curricula and basic forestry text books used in Africa had the character of temperate forestry and required vastly experienced faculty (with considerable field experience) to make appropriate application of the principles to the local situation. The strong temperate forestry bias has placed considerable emphasis on production forestry, with plantation forestry at the fore front. Criticism levelled against forestry training in the past decade could be attributed to this rather narrow perspective; namely, the prime goal of timber production and extraction. The need for basic text books in silviculture, forest mensuration, management, and other disciplines written specifically for use under tropical conditions has long been recognized by FAO and others but the need remains largely unfulfilled. Based on a recent survey report by Temu (2002), it is evident that forestry education institutions are responding to paradigm shifts by reviewing their curricula. Aspects such as forest extension, participatory forest management, non-timber forest products and values, biodiversity and environmental conservation are now finding their way into mainstream forestry training curricula. These are positive steps but a few pertinent questions remain for instance to what extent are the observed curricula changes informed by a clear vision at

national and regional levels and not merely responses to donor-driven processes? How do forestry education institutions and academia get involved in broad based institutional reforms? Exactly where are the changes leading forestry as a whole? In 2003, the African Network for Agroforestry Education (ANAFE) organized a symposium on quality and relevance of agricultural and natural resources (read forestry) education in Africa. The highly intensive interactions and debates that ensued led to a very concrete declaration, strategy and action plan to improve quality and relevance of education programmes (Temu *et al.,* 2003). The linking of all land use disciplines in a common forum and networking as done by ANAFE helps to underscore the need to form and nurture strong relationships in educational programmes, and also the need to integrate social-economic considerations into curriculum development. Thus, the teaching of agroforestry is helping to bring experts of land use programmes closer together.

The second issue regards the scope and breadth of teaching and learning in relation to institutional setup. Forestry programmes are variously found as departments in a faculty of agriculture, or natural resources and environment and rarely as stand alone faculties. Where the forestry programme is linked to related disciplines (agriculture or natural resource management), the curriculum content tends to reflect elements of the other disciplines. On the other hand, a stand alone forestry faculty tends to have a "higher loading'' of forestry courses. There is also a difference between a forestry programme mounted by a department as opposed to a fully-fledged forestry faculty with various departments. There is of course more flexibility - a wider variety of courses and options to students in a faculty than in a department. Nevertheless, this advantage must be weighed against cost of running a full faculty as opposed to a department. It seems to make more sense to have a faculty if there is an intention to offer several degree programmes and it might be more efficient to house the programme in a department for one degree course. Both these situations predominate within various forestry institutions in Africa. There also seems to be a relationship between the institutional set up and funding support available. Where a university has received reasonable and consistent funding support, development of a faculty has resulted.

The third issue relates to the demand for forestry expertise. There seems to be a disconnection between training institutions and employment sector. A large proportion of job opportunities for foresters were initially in the public sector. This is derived from the forest service practice where gazetted forests are distinct and separated from other land uses, especially

farms. The consequence of this is the perception that foresters are trained for public forest service and their mandate ends there. Furthermore, the public sector-driven training fails to address the broad spectrum of land use issues and interrelationships with rural livelihoods. However, public sector employment has been declining rapidly since the 1980's. Forestry curricula must be reformed to respond to a shrinking public and "expanding" non-public sector job market. Current thinking envisions tertiary education in an enlarged agricultural and natural resource management context, with a systems approach that taps into sectoral synergies and facilitates robust response to improvement of livelihoods and conservation of natural resources and environment. Further, emphasis on a graduate with entrepreneurial and business skills is increasingly becoming popular.

The fourth issue relates to the changing global perspectives. International interest in agroforestry in the 1980s heralded a raging debate (e.g. Huxley, 1987; Asare, 1990; York Jr. 1990; MacDicken and Lantican, 1990; and Zulberti, 1993) on strategies for forestry and agricultural education. At the centre of the storm were questions on how and who would offer agroforestry education, which was seen as better focused on understanding complete land use systems. There was a strong feeling that neither agriculture nor forestry as disciplines responded adequately to land production systems of small scale farmers and that there was a need to re-orient forestry training in this direction. The mantle of agroforestry education was spearheaded by the International Centre for Research in Agroforestry (now World Agroforestry Centre) through the Swedish funded ANAFE. Perhaps the greatest single contribution of ANAFE to advancing agroforestry in Sub-Saharan Africa (SSA) is the role it has played in facilitating the incorporation of agroforestry into training curricula in all land use disciplines. For the period 1993-2002, ANAFE supported 67 education and training institutions in Africa to adopt multi-disciplinary approaches to Natural Resource Management (NRM) in their curricula. It is noteworthy that the introduction of the tree into farming systems has transformed our perspectives of agriculture and forestry.

In this sub-section, we have focused the discussion on university programmes leading to a first degree in forestry. However, the content of education programmes at the vocational levels (so called certificate and diploma training) are very similar, the main difference being in the duration (usually no more than two years for vocational levels) and the greater emphasis on field practice (nursery operations, planting,

silvicultural operations, logging and forest engineering, wood-processing industries) in the case of vocational training.

3.2.3 Trends in forestry education

A survey reported by Temu (2002), revealed the following key trends regarding forestry education in SSA. A sharp decline in training of forest technicians especially in mid 1990s. In many countries, this was linked to Structural Adjustment Programmes (SAPs). The response of many governments was either to close down these institutes or drastically reduce enrolment. Mrema (1995) had aptly argued that overall, the agricultural sector (including forestry) in SSA in coming decades 'will be most impacted by macro-economic factors and training programmes tailor-made to produce personnel for public sector employment must be reformed in a fundamental manner to meet new realities'. It is suggested that a broader NRM and a rural development orientation combined with more entrepreneurial approaches can make graduates more attractive and less dependent on the public sector.

Student enrolment in forestry is generally low compared to disciplines such as agriculture. Based on data from 20 forestry training institutions surveyed covering as many countries, graduation numbers do not seem to justify the heavy investment already made in terms of staff and infrastructure. Some schools secure temporary donor support and are able to occasionally enrol more students but the pattern is not predictable. The unpredictable fluctuation in student enrolment and graduation hampers any meaningful planning and implementation of forestry programmes. The current trend for certificate holders to register for diploma and diploma holders for BSc without corresponding admissions into certificate level training is of concern and an important policy issue to consider. The trend is eroding the vocational and technical cadre in forestry, thus creating a vacuum in practical supervision of forestry work. The result is declining capacity for and quality of forest management. There was a modest increase in the number of students obtaining BSc qualifications in forestry during the 1980-1990s, but this was accompanied by a shrinking forestry job market. Many of the graduates remain jobless or are engaged in jobs often completely unrelated to their training.

3.2.4 Funding forestry education

Investment in education has varied considerably from country to country and over different time periods. Reidar (2003) sketches the different phases of forestry assistance in the past four decades focusing on industrial forestry (predominant in the late 1960s and 70s), social forestry (1980s), environmental forestry (1980s-90s) and the more recent focus on NRM. In most cases, funding has been from public and donor resources.

Considerable bilateral donor financing was experienced especially during programme (institutional setup) inception. A good example was the Food and Agriculture Organisation (FAO) and United Nations Development Programme (UNDP) support to establish the Department of Forestry at the University of Ibadan, Nigeria; NORAD (Norwegian Agency for Development Cooperation) funding support to Makerere University, Uganda and Sokoine University of Agriculture in Tanzania. Such funding usually involved establishing physical infrastructure (class-rooms, laboratories, computers labs, field stations, vehicles etc) and paying salaries to expatriate faculty for a defined time frame during which national staff capacity was developed. International organizations that have supported university education (not necessarily only in the field of forestry) include: NORAD, Swedish International Development Cooperation Agency (Sida), Sida's Department for Research Cooperation (SAREC), Netherlands Organization for Cooperation in Higher Education (NUFFIC), Danish International Development Agency (DANIDA), Canadian funded, International Development Research Centre (IDRC), German Agency for Technical Cooperation (GTZ), plus various Foundations and international forestry research organizations.

Another source of resources is collaborative research projects with other universities, individual projects to international organizations (e.g. African Forestry Research Network (AFORNET), Rockefeller Foundation, Ford Foundation, IDRC, GEF small grants projects, International Foundation for Science (IFS) etc). This kind of funding is usually very limited and used for research and for extremely limited equipment support to educational institution in the form of laboratory equipment, computers, copiers etc. The volume of such funds depends strongly on leadership, creativity of individual lecturers in the institution, as well as institutional policy and practice in managing grants. Such funds have played an important role in advancing forest science, in maintaining professional interest and contacts among educators and in supporting

postgraduate programmes. Thus, they contribute to faculty retention and stability.

A rather poorly utilized funding source is forest and related industries. The linkage between universities and industry are generally weak especially in the area of NRM. As a consequence, industrial funding support to forestry training is limited. Most universities have received some funding in terms of prizes for students but these are largely tokens. Recently, Total International Oil Company through its Kenyan subsidiary (Total Kenya) has started an initiative to support afforestation in the country with the Department of Forestry at Moi University giving technical leadership to the project. This is a potential that has not been exploited in the past, but it is too early to determine the direction this partnership will take. More substantive support for forestry and wood science education have been made by Mondi and SAPPI forest companies in South Africa for the forestry schools at Stellenbosch and Kwa Zulu Natal universities. The support includes infrastructure, research equipment, scholarships and paying for field attachments and field trips for student to gain practical experience.

Recent scaling down of donor contributions have resulted in substantial decreases in funding as governments fail to fill in the funding gaps. Generally, national support to forestry educational programmes has been demonstrably inadequate as is the case indeed with overall funding of other university programmes. Willet (1998), cited in Temu et al. (2003) reported that between 1987 and 1997, the World Bank provided US $4, 819 million of which 51.50 % went to agricultural research, 46.25% to extension and the remainder 2.25% to tertiary education. This demonstrated the low appreciation of the contribution of tertiary agricultural education to the production chain of the economy and hence the low priority accorded to it.

3.2.5 Postgraduate education

Postgraduate training in forestry is still at a fairly low level in terms of student enrolment although in some universities e.g., in the Department of Forestry at Ibadan University, postgraduate training appears to be more stable than undergraduate training. Given the heavy investment of overseas graduate training that took place in the 1980s through 90s, some of the forestry schools have fairly well established capacities in terms of manpower to mount effective postgraduate programmes yet this capacity is largely underutilized. For example, Faculties/departments of Forestry at

Sokoine University, Ibadan University and at Moi University have highly qualified staff and yet only Ibadan seems to have a good population of graduate students. The main reason for this could be lack of funding for postgraduate programmes or preference by forestry professionals to get their graduate training overseas. In almost all cases, institutional capacity is limited or severely constrained by lack of infrastructure and /or teaching staff.

The shrinking capacity for postgraduate training is pushing interested students to foreign universities. However, studying overseas is expensive and very few find the necessary resources. Besides, few of them return to serve their countries. This has affected negatively on overall scientific and especially on research capacity. A regional approach to postgraduate education is recommended. Griffin (1982) questioned the logic of graduate training of personnel from developing countries in developed countries where young scientists are exposed to and led to perceive research in terms of sophisticated equipment and experimental conditions that are way beyond what is available to them when they return home. Thus, although there is need for rigorous exposure to research tools and methodologies, care must be taken to ensure relevance of such training.

3.2.6 Forestry education in comparison with other professional fields

Forestry has traditionally been regarded as a sub-sector within the agriculture sector and it is for this reason that departments of forestry at universities are often housed within faculties of agriculture. Although forestry scholars in the sixties and seventies saw this as strategic and a more efficient way of using scarce resources in developing countries, they cautioned that it was necessary for forestry not to lose its identity. Contrary to the romanticized view of forestry by these early thinkers (forestry put at per with such other profession as law and medicine (Shirley, 1964)), in practice, professional training in forestry or agriculture has never come close to these professions either in terms of student admission or employment after graduation.

One can almost generalize that student admission into agriculture and forestry courses is not nearly as competitive as it is, say for medicine or engineering. In some cases, university admission criteria are deliberately lowered to lure students into these courses (agriculture, forestry and NRM related). There may be differences from country to country and among different universities but the general trend is the same. For example in a survey of public universities in Mozambique, in 2000, 230 students

sought admission in Agronomy and Forestry against 100 available positions (ratio of 2:3), 228 for computer science against 37 available positions (ratio of 6:2), in medicine 277 against 90 (3:1), in economics and management, 486 against 75 (6:5), and in law 1062 against 100 places (10:6). In Kenya, public universities in the recent past have introduced privately sponsored courses (the so-called parallel degree programmes – becoming a common trend in many other African countries) in various fields (mainly attractive courses such as medicine, law, commerce and business management etc). As a result, it is becoming increasingly difficult to get students admitted in courses of second or third choice if they can afford to get their first choices under privately sponsored programmes. Basic science courses and those related to earth sciences (agriculture, forestry, wildlife management, botany, zoology, and geology) are not as attractive because of their limited job market. A Makerere University report (Musisi and Muwanga, 2001) showed that the Faculty of Forestry had the lowest number of students at 157 in 1999. This was in fact lower than those registered for continuing education (211), and considerably less than the 539 for agriculture, 665 for medicine and 971 in the faculty of law although reasonably comparable to 211 doing veterinary medicine. The low enrolments in agriculture, forestry and other NRM degree courses is not just a reflection of public perception and shrinking job market but also a case of limited international as well as national support to tertiary education in these fields and non-empowering policies.

3.2.7 Dynamics influencing global perspectives on forestry

The urgency and frequency with which schools of forestry are seeking to review their educational programmes is in recognition of the inadequacy of the traditional forestry education and training. The broadening forestry professional area suggests the demand for *additiona*l expertise in inter alia:

- Policy, social and economic issues, including participatory methodologies interactive learning, communication skills, social values and ethics;
- Broad-based handling of the larger field of natural resources management, including capacity for analysis, synthesis and decision making on complex natural resource situations and sustainable forest management;
- Management of both tree and forest resources beyond designated ‘forest‘ areas;

- Agrarian and natural resource production systems;
- Entrepreneurship and business management;
- Agroforestry, farm forestry, community forestry;
- Gender issues, access to and natural resource benefit sharing, resource and land tenure regimes; and
- Processes and impacts of globalization, climate change, biotechnology.

These aspects while not entirely new are major modifications to the forestry profession and have not been emphasized in traditional forestry training curricula. Although considerable progress has been made in the past two decades to incorporate some of the above issues in forestry training curricula, it is evident from analysis of forestry institutions that they have inadequate capacity to do so. This must be addressed in three ways. Faculty in most cases lack adequate exposure to these emerging issues despite the heavy international discourse and publications from international research organizations and development agencies. The lack of adequate exposure is caused by many forestry institutions operating in isolation with no internet-networks, a situation that can easily be ameliorated through collaborative ventures and formation of regional networks. The second aspect concerns curricular reforms. Three key factors delimit progress in this area the first one being the rigidity of university senates to programme changes, often requiring push and persuasion to get new programmes approved. The second reason is the high cost of reviewing curriculum and the policy vacuum linking education to other national needs. Urgent policy and institutional reforms are needed in these areas, as advocated by Temu *et al*. (2003). Thirdly is the weak delivery capacity – almost all institutions surveyed responded that they lacked or had inadequate facilities (lecture halls, labs, field stations, teaching equipment). The wide range of changes envisaged leads us to suggest what could be the structure of future forestry programmes as in Figure 3.1

3.2.8 Regional and sub-regional collaboration

The Rabat expert consultative meeting (FAO, 2001) identified regional networking and inter-institutional exchange of knowledge and experience as one concrete way of supporting and strengthening forestry education. One such initiative is RIFFEAC (Réseau des institutions de Formation Forestière et Environnementale d'Afrique Centrale or Forestry Schools in Central Africa) network. The network was created by eight forestry schools and research institutions in October 2001 with a view to

improving the quality of forestry training to respond to the needs of sustainable management of forest ecosystems in the Congo Basin. Among other objectives, the network seeks to promote exchanges between the members, particularly in teaching and research. The facilitation role of IUCN helps RIFFEAC to build strong collaboration among its members and develop synergies with other regional initiatives.

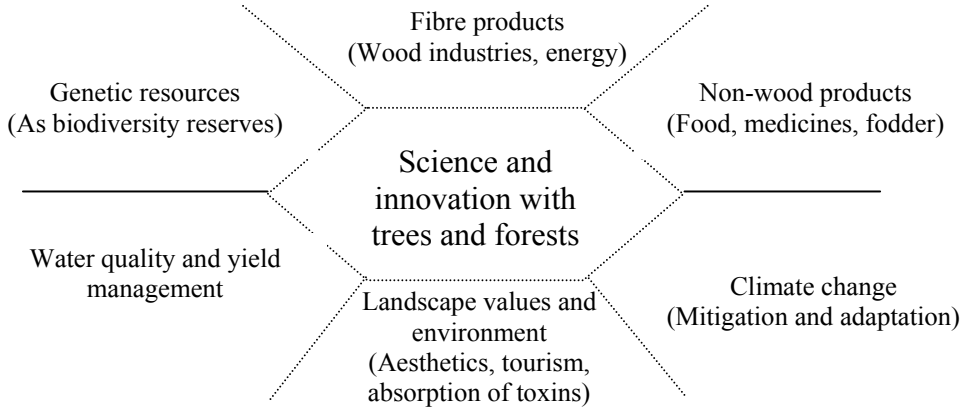

Figure 3.1 A model for Future Forestry Education

The emerging geo-political and economic blocks provide a basis for possible collaboration of training and research institutions within the regional blocks. For instance, within the framework of the Economic Commission for West African States (ECOWAS), forestry schools in West Africa could take advantage of the economic and political cooperation to forge similar linkages as RIFFEAC. The three East African States (Kenya, Tanzania and Uganda), are once again reviving the spirit of the collapsed East African Community and this opens up avenues for collaborative ventures in sustainable forest management including networking in forestry training and research. In 2002, FAO and ANAFE facilitated a sub-regional workshop for forestry deans and heads from Kenya, Tanzania and Uganda to explore possible collaborative ventures. The Inter-University Council for East Africa is currently developing and implementing mechanisms for student exchange among East African Universities with at least forty students from each country receiving university education in the sister countries. Already, there are joint research projects being coordinated in the region by this body. How much forestry schools will be part of the equation will depend on how proactive

forestry academics are within the universities. More than ever before, there is urgent need for forestry education to be profiled at the regional level and for a more active scholastic engagement and redirection of programmes to make them relevant in a rapidly changing job market. It is critical that the forestry academia plays an active role and help to focus the debate on the direction of forestry education vis-à-vis related disciplines in natural resource management. Collaboration should seek to ensure that respective institutional capacities are fully utilized to enhance complementarity and diversity (NOT duplication) and quality of programme delivery nationally and within regions.

3.2.9 Continuing education

No amount of curriculum review will adequately cater for emerging issues and myriad of forest /land resource clientele. FAO (2003) advocated that curricula at all levels must be updated to include such topics as role of trees outside forests, collaborative management, gender equity, access and benefit sharing, the potential impact of certification schemes on forest practices and participatory learning. Although it would be nice to have a curriculum that addresses all these and other aspects of forestry (and including "traditional core forestry" courses), in reality such a programme will be impossible to implement as it is likely to be amorphous and lead to no definable competency. Inadequacies of forestry education and emerging issues have been addressed through short courses addressing specific aspects. For example, ICRAF runs training courses in agroforestry. The International Training Centre (ITC) mounts courses in social forestry, participatory forest management and NRM in which forest managers, extension workers and those teaching in forestry schools have benefited.

The Oxford Forestry Institute has also given this type of courses in the past. Several universities in Africa offer short courses in agroforestry, social forestry, community forestry and some aspects of mainstream forestry subjects. In 1995-96, a GEF funded biodiversity project made it possible for university academic staff from Kenya, Uganda and Tanzania to attend intensive field courses on biodiversity resources assessment techniques including use of participatory methods. Short courses on ethno-botany have been supported by World Wide Fund for Nature (WWF), UNESCO, KEW Royal Botanical Gardens, and CIFOR. These institutions also support the regular publication of "People and Plants" handbook. Training workshops related to formulation and project management have also become a common phenomenon especially among

Non-Governmental Organisations (NGOs) and for many donor-funded projects. Egerton University (Kenya) is well known for short courses on Participatory Rural Appraisal (PRA), a participatory approach used in all sectors of rural development including in the field of natural resources. All these are critical aspects of continuing education and it can be correctly argued that much of the professional awareness created in emerging issues of tree and forest resource management has been achieved through issue-specific and targeted short courses obtained from a variety of institutions. However, in most cases, the efforts are anecdotal and highly dependent on external support. There is a need to establish fitting regional and/or sub-regional mechanisms to capture the needs and to design and manage such programmes. Existing networks such as ANAFE, African Forestry Research Network (AFORNET) and RIFFEAC could be instrumental. The emerging African Forest Forum (AFF) could also provide an excellent platform for this.

3.2.10 Necessary forestry education reforms

The XII World Forestry Congress held in Quebec Canada made the following observation: "… the forestry profession does not reflect the diversity of stakeholders involved in forests. Education needs to adapt to new elements in forestry practice, including social sciences and communication skills. However, funding for forestry education is declining in many parts of the world, and training institutions often operate in isolation. Continuing education and professional accreditation are being implemented in many developed countries to maintain public confidence in the forestry profession" (Congress Report, 2003). From the foregoing and based on empirical evidence, the following pertinent issues can be raised regarding education in forestry and NRM:

- The public perception is critical for successful implementation of natural resource initiatives especially where historically these resources were managed on a restricted narrow domain of officialdom. We need a new understanding of the role of a 'forester' or whatever we will call the new professional, who in addition to expertise in forestry will also be conversant in local community participation techniques and proficient in other relevant disciplines;
- Curriculum reviews notwithstanding, current university degree programmes must change to embrace new paradigms, which reflect emerging societal perspectives, policies and international instruments. More fundamental reforms are necessary, including

possibilities to run several degree programmes or options in areas such as Community Forestry, Industrial Forestry, Environmental forestry, Landscape forestry, Fibre products and Technologies, Bio-prospecting etc;

- The traditional board-and-chalk method of teaching and learning delivery is inadequate in a world that is increasingly dependent on information technology communication tools. Better access to ICTs is necessary; and
- National and international support must be increased and channelled to institutions of learning to assist with the transformation.

There are three key points to be underscored regarding needed reforms in forestry education and related NRM fields. Firstly, considerable synergy is building in terms of reforms of higher education in Africa. Partly because of declining national funding to colleges and universities and also because of external initiatives (e.g., the multi-donor Partnership for Higher education in Africa Initiative), institutions are embracing phenomenal reforms hitherto thought impossible in order to remain relevant. Forestry faculties and Departments should take advantage of these reforms. Secondly, because the field of NRM is broad and it can be used loosely to mean different things, there is need for academia to focus and sharpen the idea of integration of land use related disciplines to allow relevance and coherence in proposed programme delivery. Thirdly, evolution of these ideas cannot be left to institutions alone. Strong international participation and collaboration are necessary to provide depth of perspectives and build synergy. It is also critical that this kind of change is brought about through national policy systems to ensure ownership and a wider consensus.

3.3 CONCLUSION

As global societies, recognize the multi-functional nature of forests; their expectations from forestry professionals are changing, creating a gap between what is learnt in forestry schools and the new expectations. Increasingly, the role of society in determining how forestry will be managed to meet the rising social, economic and climatic and environmental challenges is rising. Current education programmes appear to be a patchwork of reviews and additions to old curricula. There is a need to link forestry to other land use and environment disciplines in order to curve out the content of forestry education. New programmes are emerging but without sufficient global guidance on the content and

quality. Concerted efforts are needed particularly at global and regional levels to coordinate and link programmes as well as provide advice at the national level. This implies major transformations of forestry education, so new resources are needed to finance improved forestry education programmes. Inter-institutional collaboration through networking of institutions and other stakeholders will augment efforts by individual countries or institutions.

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4 Challenges to Forestry Education: A Perspective from Nigeria

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ABSTRACT

In this paper, Forestry education trend and priority settings in Nigeria were examined with the hope of addressing enrolment concerns, admission criteria, curricula efficiency, staff endowment/capabilities and programme sustainability. The current trend showed marked attenuation in forestry graduands vis-à-vis undergraduate enrolment; decline in societal norms and priorities which should normally attach appreciable value to the forestry profession and the falling standard of professional ethics among forestry graduates who now prefer and seek after white collar jobs. Parents and candidates for university admission are not well informed of the potential of forestry as a profession, thus their attitude and perception are that forestry is mainly a rural concept with limited horizon. To improve forestry education and societal acceptance, fundamental rectifier steps are recommended; revise existing school curricula, improve research and training, bridge apparent gap between practical and theoretical contents. Civil perspective of forestry as vital component of contemporary educational need to be improved. Foresters must acquire contemporary technologies for accessing information on forest sustainability and make the profession more attractive. It is believed that when forestry graduates can, on the field, put knowledge acquired into valuable forms, the profession would have succeeded in producing enviable job creators rather than job seekers.

4.1 INTRODUCTION

Those who are part of the forestry profession in Nigeria for the past 25 years have witnessed changing times, which influence the profession. Forestry education in Nigeria is integrated and it, embraces various natural resource disciplines including forestry, environmental management, wood science and technology, fishery and aquaculture, wildlife management, rural sociology, ecotourism, landscaping, forestry extension, and communication. The institutions offering these disciplines in Nigeria (Table 4.1) often encourage significant overlap of programmes (Table 4.2) at faculty or college levels to broaden their scope and relevance. The institutions have ethical responsibility to evaluate the forestry profession in light of contemporary attitude of parents to their wards proposing to pursue a course in any of the listed subject areas.

Table 4.1: Stakeholder Institutions Administering Forestry Education in Nigeria

S/N	Universities	Pb/Prv	S/N	Universities contd.	Pb/Prv	S/N	Technical Colleges/Vocational centres
1.	University of Benin, Benin City	Pb	11.	University of Uyo, Akwa-Ibom	Pb	1	Federal College of Forestry, Ibadan.
2.	Delta State University, Abraka	Pb	12.	University of Port Harcourt	Pb	2	Federal College of Forestry, Jos
3.	Federal University of Technology, Akure	Pb	13.	Federal University of Technology, Yola	Pb	3	Federal College of Wildlife Management, New Bussa.
4.	University of Ibadan, Ibadan	Pb	14.	Bowen University, Iwo	Prv	4	Federal College of Forestry Mechanization, Afaka, Kaduna.
5.	Imo State University, Owerri	Pb	15.	Bells University, Otta	Prv	5	Forestry Manpower Development Centre, Oluwa (vocational)
6.	Kogi State University, Ayangba	Pb	16.	Igbinedion University, Benin	Prv	6	Forestry Vocational Centre, Kano (vocational)
7.	Federal University of Agriculture, Makurdi	Pb	17.	Joseph Ayodele Babalola University, Arakeji	Prv	7	Forest Utilization Centre, Benin City (vocational)
8.	Olabisi Onabanjo University, Ago-Iwoye	Pb	18.	University of Maiduguri	Pb		
9.	University of Agriculture, Umudike, Umuahia	Pb	19.	University of Nigeria, Nsukka	Pb		
10.	University of Agriculture, Abeokuta	Pb	20.	Usman Danfodio University, Sokoto	Pb		

Pb – Public Institutions (Federal or State Government owned); Prv – Private Institution

Key issues that confront forestry education in Nigeria include people's perception (i.e. a measure of customer appreciation) and need for paradigm shift besides value addition, entrepreneurial and commercial character, and improved extension services. These issues must be addressed to meet the challenges to forestry education as a threatened component of development. Interests of applicants rather than institutional or national plans must also be catered for. The mind frame of the civil society on what should be a socially acceptable discipline must be addressed. For example, one is apt to question the rationale behind diminishing public confidence in forestry education. Can forestry evolve from being a risky and unattractive profession when the graduates cannot be gainfully employed? As more of such questions than answers were raised, increased dissatisfaction was expressed; both within and outside the university community about the role the universities are playing (Sherrard, 2002). They are accused of not responding adequately to market forces and the employers are dissatisfied with the type of graduates being produced. The graduates now prefer white-collar jobs and could not adapt well to the need of the producers, rural communities, forest industries and businesses neither are they skilful enough to meet tomorrow's challenges (Maguire, 2000). Certainly, it is not in the professional interest to remain silent when issues affecting forestry are not fairly handled.

4.1.2 Civil perception of forestry and related dynamics

As Nigeria's foreign exchange earnings dwindled in the 80s, with concomitant negative balance of payment, structural adjustment programmes of the government lured people to look for cheap ways of earning cash. For example, the banking sector along with the oil industry, in the 80s and 90s, became significant employers of labour, ready to pay higher salaries than obtainable in the forestry sub sector. Subscription to Information Technology (IT) also influenced career choice, as IT professionals became more valued across public and private enterprises.

Table 4.2: Range of Forestry Education Programmes and Nomenclature in Nigerian Tertiary Institutions

S/N	Programme nomenclature	Institution / location
1	Forest Resources Management	University of Ibadan, University of Benin
2	Forestry and Wood Technology / Wood and Paper Technology	FUTA, Akure, Bowen University, UNIBEN, DELTSU Abraka, Yola, Ago-Iwoye, Fed. Col. Forestry Ibadan. (Tech).
3	Forestry and Wildlife Management	FUTA, UNAAB, UMUDIKE
4	Forestry and Environmental Management	UNAAB, Uyo, BELL
5	Forestry, Wildlife and Range Management	U.I., Imo State U. Owerri
6	Pasture and Range Management	U.I., Kogi State, Ayigba
7	Fisheries and Wildlife Management	U.I., FUTA, Benin, Uyo
8	Aquaculture and Fisheries Management	Sokoto, U.I., UNAAB, Umudike
9	Environmental Management and Toxicology	UNAAB, Makurdi
10	Forest Engineering	University of Ibadan
11	Forestry and Environmental Technology	U.I., Bowen University, Iwo
12	Environmental and Resource Engineering	Bowen University, Iwo
13	Horticulture and Landscape Technology	Fed. Col. Forestry Ibadan. (Tech).
14	Tourism/Ecotourism (ND)	Fed. Col. Wildlife Mgt. New Bussa (Tech).
15	Wildlife Management/Animal Production Technology (HND)	Fed. Col. Wildlife Mgt. New Bussa (Tech).

In a study of the perception of some secondary school pupils towards forestry as a profession, Adu *et al.* (2003) reported that 49.5% of the respondents had intent in becoming foresters: 60.5% saw forestry as a prestigious profession while 94% saw forestry as a tedious job. In other words, the aspiration of secondary school leavers to pursue forestry as a profession is limited by their attitude and perception about forestry activities. Public perception of the forestry education could however be made objective through increased awareness and understanding of its relevance to development. In some quarters, forestry education is regarded as a mere academic endeavour with its merits evaluated independently of its relation to the society. This does not erase the value of the forestry profession, which is threatened for not radiating recognizable emissions (Figures 4.1 and 4.2). The implication is that

stakeholders must rise up to and accept the professional responsibility of encouraging greater participation and infusion of members. Concerted efforts should be made to provide professional information that has a purified effect on the way people perceive and do forestry related business. This is a responsibility-demand on forestry professionals to influence the society positively.

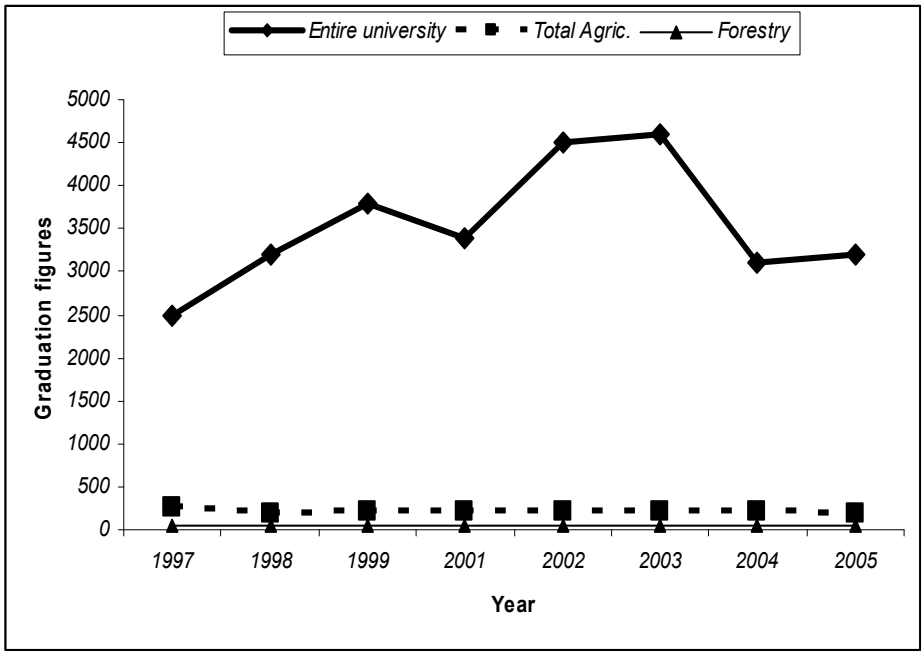
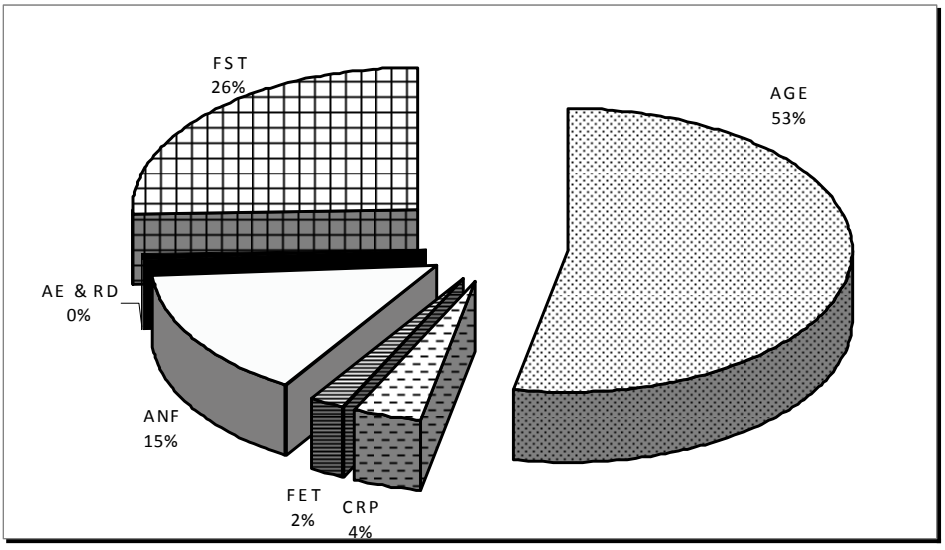


Figure 4.1: Relative Low Response to Forestry at the University of Ibadan Considered being the Off-Shoot of Forestry Education in Nigeria.

Students, parents, guardians, individuals and agencies invest in education on the understanding that it brings enlightenment and helps the individuals to develop profitable skills needed for development. On this note, the Nigerian national policy on education had aimed to inculcate national consciousness and the right type of values and attitudes for the survival of the individual and the Nigerian society as a whole; to train the mind to understand its environment and the world around; and to encourage the acquisition of appropriate skills, abilities and competencies needed to live in and contribute to development (Okeke, 1981; 2001). The forestry profession has enormous potential for satisfying the aforementioned needs and the craze for non-forestry jobs is unjustified in light of Nigerian problems and priorities.



AGE – Agric. Econs.; AE&RD – Agric. Extension & Rural Dev.; ANF – Animal Sci. & Fisheries;
CRP – Crop Production; FET – Forestry & Environmental Tech.; FST – Food Sci. & Tech.

Figure 4.2: Very Low Response to Forestry Enrolment at Bowen University – A Private-Owned University Offering Forestry Education in Nigeria

Studentship in forest resources management should be made a process of discovery and excitement, a time to develop an attribute of working towards laudable goals and of achieving success in the chosen field. To make these possible, this paper sets out to assess the status, trend and priority settings in forestry programmes and research endeavours in order to offer sustainable solutions to student enrolment problems, curriculum efficiency, programme implementation and sustainability.

4.2 FORESTRY EDUCATION ENROLMENT TREND IN NIGERIA

Student enrolment in forestry is a critical public policy affecting the profession. Recent data (Akande and Larinde, 2004) suggests that Nigerian universities experienced stunted growth in forestry student enrolment and graduation figures towards the end of the last millennium. The identified obstacles to student enrolment include:

- The lower priority given to the profession by State governments who should be alert to understand the interconnectivity between forestry and environmental issues;

- The forestry curriculum itself emphasizing less of practical and societal needs;
- Increased number of forestry schools not commensurate with employment opportunities in the government sector, which is on the decline;
- Minimal private involvement in forestry activities and forestry establishment;
- Lack of scholarships for forestry students;
- More attractive remuneration for white-collar jobs that can promote withdrawal syndrome, in the current generation, from activities that can soil their hands; and
- No published list of job opportunities in forestry for the civil society to consider.

These challenges are enormous and call for an awareness programme to educate on the potential benefits of the forestry profession and in a wider context of job and trade opportunities and other functional goals calling for forestry applications. It is burdensome that parents who send their children to school are now less concerned about what their awards will earn than about the certificate and money they will earn after graduation. Manpower training for economic empowerment should, not necessarily be the overriding aim of forestry education. Indeed, the efficacy of the forestry profession must be preserved. A situation where many forestry jobs lie fallow, in waiting to be done, while people with requisite education, relevant skills, technical knowledge and proper orientation cannot be found is regrettable. There is therefore a need for timely intervention of experts in this matter of uttermost importance to the nation. Primarily, the admission pool to forestry should be revisited to encourage greater enrolment, and also curriculum review exercises to ensure sustainability of programmes.

Akande and Larinde (2004) depicted a dim future for forestry education in Nigeria unless some reform agenda are put in place. Their survey showed that the schools demonstrating significant aggressiveness in student recruitment efforts (see Figure 4.3) have employed defined strategies of broadening their programme base while establishing specialized schools to administer the programmes. This brought in greater dynamism and credibility as students can identify better with programmes adopting environment, rural development, toxicology, ecotourism, horticulture, landscaping etc as market attractants rather than when institutions stick to orthodox forestry nomenclature and paradigms.

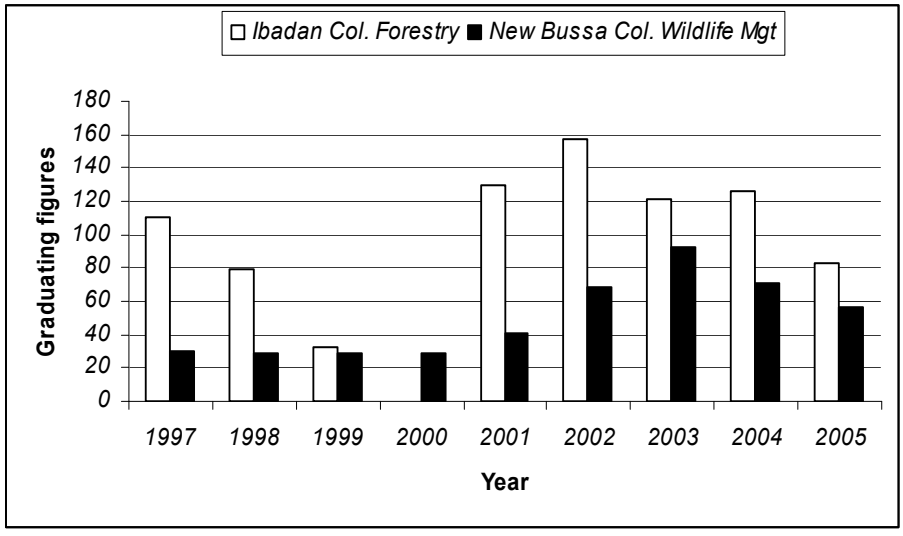


Figure 4.3: Graduation Figures in Two Nigerian Forest Technical Colleges over Years

Expectedly, the private universities considering forestry as a course are generally more concerned with the issue of numbers, which ultimately tells on the accruable school fees, budgetary allocations to base departments and programme sustainability.

Joint industry/university recruiting exercise for forestry graduates should be encouraged while securing more and better funded scholarships for forestry students. It is necessary to become very active in student recruiting exercise. Whether one agrees philosophically with the idea of student recruitment or not, the truth is that other fields are recruiting and aggressively too. Hiring of specific personnel vested with the responsibility of student recruitment is pertinent.

4. 2.1 Evaluating shortfalls and social reaction

The key to educational success lies in the attitude of the civil society, the workforce and the academia. The situation with forestry education demands an open platform for discussion between the various stakeholders so that the rationale for social objections can be evaluated and their legitimacy appraised. The particular nature, subjects and circumstances of the forestry education problems require public dialogue to open up the parameters for neglect or objections that fall outside scientific rationality. To effect this goal, action plans are needed on

critical issues affecting the system. For example, the problem of forestry education in Nigeria could be traced to:

- Insufficient publicity of the inherent potentials and benefits of forestry to the society at large; and
- Traditional alignment of forestry education units with competing land-based agriculture programmes with shorter gestation of investment outlay. Clienteles naturally want to associate with low gestation investments particularly when the benefits of longer gestation investments are not well explained.

4.3 FORESTRY EDUCATION ACTION PLANS

4.3.1 Curriculum efficiency

In the nineteen sixties and seventies government programmes such as ‘’green revolution’’ helped to increase students’ awareness of their environment, but of concern is how well the new generation is prepared to take over forestry related businesses. Inadequacies exist in the forestry curriculum and duration to graduation. The undergraduate programme in forestry normally takes a period of 5 years in Nigeria, and this combines a series of lecture courses with practical fieldwork. This is however a disincentive to applicants and it may be necessary to advice the Nigerian Universities Commission (NUC) to allow the programmes to be condensed, particularly in the private universities, to a 4-year module without compromising contents (credit hour requirement) and by using three summer school (one academic session equivalent) period to complete the work meant for the fifth year. It is valuable to surgically remove the current state where applicants shy away from the 5-year arrangement which portent no preferential bargain after graduation. Granting the request shall be a very positive development in creating a common platform for science oriented and management disciplines. The private forestry institutions must work with the NUC to fashion a 4-year programme for the purpose of encouraging timely programme attainment of goals, enduring equity, and encourage student attraction from other fields. Recommendations are therefore needed on programme objectives, contents, methods and materials for forestry education in Nigeria.

Emerging curricula in forestry education must challenge the youths to select careers in forest resource management whereby trainees would know how to use the resource properly. Educational materials and projects must be well prepared to help the next generation appreciate the

mechanics of forest resource management. If enough graduates were produced, the profession would be self perpetuating; the graduates would be visible and would be a continuing advertisement to clientele on the viability of the forest profession. The reverse is the case now as the enrolment figure dwindles (Figures 4.1, 4.2 & 4.3) and there is danger of becoming invisible and disenchanted. This is a legitimate cause for concern, thus, professionals must take a hard look at existing academic curricula. Some repackage may be necessary to serve the industry and other private sector and this will in the near future attract greater number of clients. There is also need to develop strong market oriented and entrepreneurial curricula that provide job attraction and ensure greater exposure to forestry.

The current political dispensation in Nigeria favours the establishment of private universities (JAMB, 2001/2002) to compliment the existing tertiary institutions. In the private universities, faculty interests are also changing the direction and thoughts about forestry education in line with their resourcefulness. The primary concerns include public image enhancement, student involvement and recovery strategies.

4.3.2 Manpower endowment/capabilities

Attainment of forestry education goal in Nigeria is predicated on the availability and proper utilization of the high level manpower with requisite technical and professional skills (Agbogidi and Ofuoku, 2005; Ureigho *et al.* 2005). The character and extent of Nigeria's development actually mirror the attitudes and values of the people as well as the stock of forestry education knowledge and skills acquired or accumulated for national development purposes.

In retrospect, forestry education has provided the necessary tools, skills and knowledge that helped the nation to survive and develop to the present stage. It is good to look back at the past and project to greater heights in a new form and dimension. In a rapidly changing world, universities must respond to the stakeholders and civil society. It must be dedicated to the production of professionals with knowledge; skills, attitudes and values that will help them integrate production with social and environmental concerns. In essence, the universities must improve on problem-solving approaches to experiential and participatory learning; develop in the student's social and environmental consciousness, also entrepreneurial mentality and skills suitable for creating outstanding opportunities in the market place.

Nigerians cannot afford to neglect the forest education sector. Influential citizens should foster increased cooperation among the universities, as the consequence of neglect would be loss of support, contained relevance and funding opportunities. If education increases the stock of knowledge and ensures its diffusion (Aghenta, 2001) then, forestry education promises the society with the needed human capital for further achievement. Once a student is enrolled in a professional forestry curriculum, a faculty adviser must be attached and he/she becomes the key to success in promoting and maintaining students' interest. It is essential to develop forestry education ethics that would lead to the evolution of mature community based partnership in forest resources management. New commitment to forestry education is anchored on a vision of and need to produce students that will be trained for self sufficiency in knowledge and self-reliance in the practice of their career. There is an established correlation between the nation's economy and market, which determine the effective direction to which collective goods are channelled. Where students constitute the collective goods, improved patronage could be achieved through private institutional participation in forestry education because of competing hypothesis.

Forestry education in Nigeria has so far failed to raise the level of productivity, initiative, creativity and inventiveness of Nigerians. Until very recently, industry and academic alike largely overlooked the need for business and market oriented forestry graduates. Yet, it is employees in the sales, distribution and customer relations side of the industry that most frequently interact with customers to discuss proper application of materials and problems in use.

4.3.3 Programme sustainability

The future of any profession depends on how the stakeholders deal with the difficult and relevant policy issues with promptness and resolve. To ignore this fact is to sacrifice rights, status and even relevance in the course of time and the ultimate penalty is early obsolescence. Forestry education has a big selling to do in convincing the industry executives and the civil society of the value of contemporary training in forestry related professions. While the goal is to develop job creators, there is potential to increase job opportunities of forestry graduates in industry than in any other areas of employment.

The general concern for development with sustainability has been a feature of third world countries in the near past. The emphasis on

sustainable development is not only on production without lowering the environmental quality and the productive capacity of the ecosystems, but also on maintaining and improving the well-being of people as well as enhancing their capacity to utilize available resources effectively and efficiently to meet the needs of the present and future generations.

Nigeria's future prosperity depends on producing children who are well prepared to take their place in tomorrow's society. To achieve this goal, more funds need be committed to supporting courses like forestry that build vocational and entrepreneurial skills; build technical schools and equip such adequately; improve training and exposure to information and communication technology while providing special distance learning in forestry on mass media.

4.3.4 Impact of forestry research

There may be needs to look inward for opportunities to fund forestry education and capacity building. Needless to say, the merging of forestry technical training schools and forestry research institute in Nigeria under the same umbrella organization has enhanced capacity building in forestry. The quality of graduates of the training institutions is improved by the participation of research staff in the training programme, thereby encouraging technology transfer of research findings (Owonubi and Dada, 2002). Ecological funds in Nigeria should be harnessed to enhance capacity building in forestry, being the centre-piece of environmental restoration.

4.3.5 Extension forestry

Less direct but probably more effective in arousing enthusiasm, not only among students but also among some jaded professionals, would be extension news describing existing and rewarding experiences on forestry endeavour. This could be research breakthroughs, a new improved product, an economy in production, an innovation in processing and quality control or a new twist in forest products marketing. The underlying thought is to bring attention to the attractiveness of career through forestry education and thereby stimulating a heightened "es-spirit de corps" within the profession.

Forestry extension programmes must be given high priority. Modern communication technologies should be employed to extend forestry education courses to secondary schools. Special introductory course packages may particularly be important as these may serve to attract

potential students. Other strategies that can enhance forestry education in Nigeria include:

- Offering of forestry related courses as 'General Studies' for non-forestry students. This will help to spread essential information that will later serve to attract greater number of students to forest resources management courses;
- Publication of recruitment posters, information packages, personal contacts, introduction and promotion of 'career days' when secondary schools and polytechnics are visited to enlighten about the forestry education profession; and
- Extension overtures through newspapers, websites, public broadcasting and television programmes. Also distribution of programmes pamphlets, brochures and video tapes to secondary school counsellors and at all forestry education fora.

More strategies could be engaged but it is up to the professionals to give these a great deal of thought and then act to build the desired numbers.

4.4 ROLE OF GOVERNMENTS AND NGOs

It is a knowledgeable public that can strengthen the promotion of good natural resource science that is basic, applied and commercial. All of the forestry education programmes have functional identities and overlapping jurisdictions needed for sustainable welfare. But investments in education is a measure of its functionality; the motivation of the students to learn; the curriculum package; the human resource availability to teach the subjects; the time for learning and the requisite tools for teaching (World Bank, 1995).

It has always been a Civil Service policy in Nigeria to train and retrain its manpower to improve efficiency (FAO, 1974). Courses are organised through Ministries, Parastatals or by NGO for capacity building in forestry. Workshops, seminars, and conferences are also arranged for forestry officials. For over 40 years in Nigeria, education and capacity building has always been a priority project of the government. As at 1963, the University of Ibadan was the only institution offering forestry at the degree level. Today, there are various institutions (Table 4.1) offering forestry and related courses at the B. Sc degree or Higher National Diploma (HND) levels. In Nigeria, these institutions are generally funded by government, which also put in place regulatory organisations to set standards for meeting national needs.

The regulatory bodies in Nigeria include the National Universities Commission (NUC) and the National Board for Technical Education (NBTE). There is also the government owned Industrial Training Fund (ITF) that takes care of the Industrial work experience Scheme (SIWES) that is useful for building science and technical expertise. All these arrangements show that the Nigeria Federal and State governments pay priority attention to capacity building. The intervention of NGOs as agencies for development at the grassroots level has also helped to bridge existing gap in the training and capacity building of the grassroots. The constraints to capacity building in forestry, however, include fund limitation, lack of incentives, curriculum deficiency and weak linkages among stakeholder in forestry training and development.

4.5 THE WAY FORWARD

Involvement in public policy making and dialogue in matters of concern is a professional responsibility that cannot be ignored. If stakeholder involvement implies citizens' rights to take part in influential decisions and a moral duty on the side of experts to inform those interested in what they are doing and address possible concerns (Bennett *et al.,* 2003) then, appropriate forestry education for national development should be discussed in terms of policies, programmes, enrolment, skill acquisition and manpower development. Like all endeavours that succeed, the forestry profession in Nigeria consists of a number of talented, devoted and enthusiastic people that can nurture and accentuate the professional fortune. To encourage future careers in forest resources management, the educational structure must be made to boost critical infusion of members. In order to do this:

- Qualified secondary school and Ordinary National Diploma (OND) graduates should be introduced to related professional programmes in the universities;
- Student members of professional bodies should be absorbed into organized professional units upon successful graduation from the universities;
- Teaching modules in forestry, adapted to secondary schools level, should be developed and introduced;
- Quality videotapes and compact discs describing career opportunities in forestry should be produced and widely distributed; and

- The forestry extension arm should be encouraged to embark on the above projects in joint venture with government and universities.

The fact that marketing oriented courses are mounted in forestry represents opportunities for the future. These professionals are also relied upon by the industry to bring a total marketing focus rather than mere sales focus to them.

4.5.1 Value reorientation

Despite considerable natural wealth, Nigerian remains poor and social development is limited to meet the Millennium Development Goals (MDGs). Reorientation of values is one of the specific goals of the Nigerian National Economy Empowerment and Development Strategy (NEEDS, 2004) but the economic and development agenda must be complimented by reforms for which people must agree to work hard and honestly to achieve. For example, people could be empowered through sustainable forestry educational and environmental schemes. Forestry offers opportunities for employment and wealth creation. We must take advantage of opportunities in forestry by creating a system of incentives that reward hard work and punish corruption by investing in forestry education and by providing special programmes for the most vulnerable members of society.

4.5.2 Strengthening the skill base

The following needs to be done to strengthen the skill base:

- The courses taught at the tertiary institutions must reflect the priority demand of the economy while innovative approaches to forestry education need be developed to ensure that lecturers have access to continuing professional development;
- Wages, as a form of incentive, should be linked to performance on duty while hard work, discipline and selfless service should be rewarded bountifully;
- There should be continuous capacity building, enlightenment and sensitization retreats in forestry, with lectures delivered by technical support teams, institutions and professional associations; and
- Establishment of group foresters club, career talks, exhibitions, educative field trips and excursions should be explored in broadening awareness and interest in forestry while the use of

mass media for communication may serve to elucidate detailed information on forestry issues.

4.6 CONCLUSIONS

The main conclusions are:

- Forestry education is crucial to national development. Quality management in this realm is the collective responsibility of all stakeholders who must jointly guide their fortunes. It is time to come up with a forestry plan act. That is, a philosophy of encouragement from the academic community for increased visibility, credibility and recognition of forestry specialists at the work place;
- From the scientific and commercial standpoint, forestry education holds many promises in creating functional identities. Forestry education demands a pseudo-independent arrangement from Agriculture to give it a key and recognisable niche. Establishment of solo Faculties or Colleges of Forestry and allied disciplines would help achieve the required identity;
- In Nigeria, it is necessary to evolve a strategic framework for managing forestry education capital. Forestry education is endangered by lack of critical number of trainees needed for sustainable growth and this require improvements capable of generating high performance and relevance;
- The future of forestry education is increasingly tied to the integration of essential knowledge of information to display the superiority of the discipline in providing an enviable professional stature. Some coping mechanisms are recommended against market vulnerability and disempowerment;
- Adjustment of existing programme nomenclature to reflect the full content of the discipline is desirable. In an attempt to achieve a winner figure, it is always necessary to understand what is at stake and what should constitute a social compromise. A situation where other disciplines from the social and management sciences 'take over' green technology advancement from forestry is unacceptable and challenging;
- Quality education is a precondition for development. A challenge to secure the involvement of the civil society in forestry education is necessary through citizen conference, value workshop and dialogue and the responsiveness of educational policy in Nigeria, to this issue, would be measured by how forestry education is able to address people's aspirations and personal interests. and

- What does these mean, in the long run, for the wise use of forest resources? It means that at least several hundred thousands of youths may select projects and businesses related to forest resources and would be able to manage such professionally and sustainably. Higher education in forestry should prepare students for breakthroughs and useful living within the society. It must also provide support for sector-wide programmes and development.

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5 Transforming Forestry Education: Challenges and Opportunities – A South African Perspective

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ABSTRACT

Societal development in the 21st century, coupled with globalisation and internationalisation has had far-reaching consequences on the development of the forestry sector internationally. It has also impacted on the role of forests in our modern society and the qualifications and core competencies required of a newly graduated forester. The information age of the 21st century has also affected education in general and higher education in particular. Learning has become an ongoing process, flexible learning is demanded and easy access to education required. As a result today's forest education institutions have to equip their graduates not only with an in-depth understanding of forests and natural resources, but also of the complex environment of social and economic demands on land and natural resources and of human attempts to manage these natural assets. However, forestry education institutions internationally are currently overextended and have seemingly missed the chance to react to far reaching changes and to update their curricula and learning outcomes to meet the qualifications and expertise demanded by new job markets. Consequently, a decline in forestry student numbers has been observed internationally. This combined with a severe shortfall of funding compared to what was previously obtained from governments and traditional forest industries, has caused a rapid reduction of faculty and radically reduced forest science programmes and the modules offered. This paper discusses the challenges faced and opportunities to be gained in transforming forestry education at Stellenbosch University in order to

meet current requirements of an internationally competitive forestry and land-use science/management degree.

5.1 INTRODUCTION

Societal development in the 21st century, coupled with globalisation and internationalisation has had far-reaching consequences on the development of the forestry sector internationally. It has also impacted on the role of forests in our modern society and hence the qualifications and core competencies required of a newly graduated forester. According to Kanowski (2001), some of these critical changes include the conceptualization of forests and forestry as complex soft systems, changing roles of the public and private sectors and of civil society as well as the changing social, economic and environmental values of different forest types.

The information age of the 21st century has also affected education in general and higher education in particular. Due to the rapid developments in the field of information and communication technologies, globalisation of our society and due to cross-linking of information systems, knowledge is growing exponentially. At the same time, knowledge is out-dated faster. The half-life of school knowledge is estimated at 20 years, university knowledge 10 years and professional expertise at less than 5 years. We are drowning in information but starved for knowledge.

Learning has become an ongoing process, flexible learning is demanded and easy access to education required. Driven by changes in education, new teaching and learning approaches have been developed. “Student centred learning”, “learning by doing”, “collaborative learning”, or “the teacher as a guide on the side and not a sage on the stage”, are but few of the buzzwords associated with the new trends in teaching and learning (Beyth-Marom *et al.,* 2003). Therefore, life-long learning and on-the-job training are key-competencies of university graduates and are not only peculiar to forestry students.

As a result today’s forest education institutions have to equip their graduates not only with an in-depth understanding of forests and natural resources, but also of the complex environment of social and economic demands on land and natural resources and of human attempts to manage these natural assets. Tertiary education institutions have to adapt and update their curricula and rethink the skills and competence they need to impart to their students. Universities have to apply “new” and up-to date

learning and teaching approaches, encourage problem based learning, support lifelong learning along with the facilitation of learning. They therefore need to offer the necessary flexibility to quickly adapt curricula, achieve freedom from scheduling and spatial constrains and react rapidly to requirements of the job market. "Forest education is evolving in response to changing national and local perceptions and attitude towards forests. In this regard, unlike many other professions, public opinion is shaping forest management of the future, including the type of graduate foresters that is needed to respond to emerging issues and new trends" (El-Lakany, 2001). However, forestry educational institutions internationally are currently overextended and have seemingly missed the chance to react to far reaching changes and to update their curricula and learning outcomes to meet the qualifications and expertise demanded by the new job market (Temu, 2004; Kiyiapi, 2004; Mthembu, 2004; Dyer and Wingfield, 2004).

Consequently, a decline in forestry student numbers has been observed internationally. This combined with a severe shortfall of funding compared to what was previously obtained from governments and traditional forest industries, has caused a rapid reduction of Faculty and radically reduced forest science programmes and the modules offered. This implies education institutions having to achieve more with less while maintaining the integrity of the programme against international standards. Currently forestry curricula, with an already far reaching diversification internationally, are changing drastically to reflect the new needs of the profession.

This paper discusses the challenges faced and opportunities to be gained in transforming forestry education at Stellenbosch University in order to meet current requirements of an internationally competitive forestry and land-use science/management degree. The authors are sharing experience gained at the Department of Forest and Wood Science, Stellenbosch University over the past two years while involved in an extensive process of curriculum review of undergraduate (BSc Forestry and Natural Resource Management) and postgraduate (MSc Forestry and MFor Development Forestry) programmes.

5.2 CHALLENGES AND RECENT DEVELOPMENTS IN SOUTH AFRICAN FORESTRY

South Africa (SA) has a total land area of 122.3 million ha, of which 68.8% is used for grazing, 13.7% is arable land, and 9.6% set a side for

conservation and the remaining 7% for urban areas and other miscellaneous uses. Approximately 1.1% (1.35 million ha) of the total land area is under plantation forestry, while natural forests and woodlands cover an estimated 29 million ha. Woodlands are the most extensive vegetation type in southern Africa, and dominate South Africa. Almost all timber bound for commercial applications in South Africa, is generated from plantations. About 80% of these plantation forests are either Forest Stewardship Council (FSC) and/or International Systems Organisations (ISO) certified. The predominant species are hardwoods (*Eucalyptus spp*. 39%), softwoods (52% *Pinus spp.*) and 8% Wattle – (*Acacia mearnsii*). Both hard and softwoods are used in pulping and the saw timber industry (FSA, 2002; FSA, 2003; DWAF, 2004).

Commercial plantation forestry and the wood processing industry plays a significant role in South Africa and contributed an estimated R12.2 billion to the country's Gross Domestic Product (GDP) in 2003 (FSA, 2003). The sector has created an estimated 200 000 to 260 000 job opportunities mainly in the rural areas where unemployment is high at 35% to 47%. The true significance of the industry becomes clear if one takes into account a factor of five for the indirect support the industry creates for each wage earner thus securing a living for between 1.0 and 1.3 million people.

Major developments in South African forestry over the past 10 years as well as economical, social and political challenges had a direct and indirect impact on higher forestry education and forestry graduates' job market.

The last ten years have been characterised by a decline in overall total plantation area from 1.5 m ha to 1.3 m ha and severely reduced afforestation. The reduction in plantation area is mainly due to the exclusion of extensive areas to conservation pressure. These pressures relate largely to the conservation of water and as such the delineation of riparian zones, wetlands and catchment areas. Current afforestation rates are below 2 000 ha per annum as apposed to a peak of 45 000 ha in 1990.

Recent years have seen significant change of ownership and the privatization of state owned plantation holdings. Apart from these changes, companies such as Mondi, Sappi and Hans Merensky Holdings (HM) have taken the opportunity to consolidate their activities. Sappi and Mondi are global companies with extensive northern hemisphere interests (Ham, 2004; Mayers *et al.,* 2001).

The early 1990's saw companies such as Sappi and Mondi making policy decisions to drive outsourcing within their enterprises to the extent of almost complete reliance on contractors to execute all their forestry activities. Various reasons for this outsourcing drive have been mooted, most of them are however debatable. In essence, escaping the threat of organised labour and resultant industrial action during the late 80s and early 90s has been put forward as the real reason for outsourcing. The main outsourcing drive resulted in a flood of contractors taking over most of the forestry operations. Unfortunately, this also meant that most of these contractors were either poorly trained or not qualified to undertake the rigours of forestry based operations. This situation has not improved over time as one might have expected and there is still a serious lack of training and skills amongst contactors working in the field (Morkel, 2000; Längin, 2007; Längin *et al.,* 2006).

Inadvertently, in the process of outsourcing, the forest industry, and even worse, the whole forestry sector, has been affected in various ways. There has been an estimated 50% drop in productivity in the last ten years. Outsourcing has significantly reduced the general professional forestry expertise capacity in forest companies. To add to this problem, foresters have been rationalised to such an extent (one forester for every 20 000 ha) that the overall infrastructure is suffering; this is especially evident from the radical increase in fire damage in the summer rainfall regions in recent years. Plantations are also being allocated cost centre status and being viewed purely as a resource base (Chamberlain *et al.,* 2005).

Because of the factors mentioned above there are no new entrants into the field of contracting. Unfortunately, this does not necessarily equate to more activities that are professional for the remaining contractors. The rationalisation of technical skills by companies and general outsourcing has resulted in reduced employment of trained and professional foresters. This in turn has created a situation in which companies can no longer find a ready supply of graduates. Another effect of outsourcing is a fragmented system of higher education in the country. In the same vain, the basic research capacity of the country has also been severely limited in the process (Längin and Ackerman, 2006).

Further challenges to the South African forest industry, which will impact, in the mid to long-term, on forestry education and training in the country include:

- Land claims – around 80% of private forest plantation holdings are currently under land-claims (Chamberlain *et al.,* 2005);
- Sirex and *Fusarium circinatum* (pitch canker fungus) are posing severe threats to forest plantations;
- Black Economic Empowerment charter – the transformation process places pressure on private forest grower companies to uplift former disadvantaged people and invest heavily in training and skills development programmes. The 2007 Forestry Charter will have significant impact on training and development in South Africa with employee's contribution of 4% of their payroll to training and development. Organisations are required to have 5% of their workforce registered on learnerships at any one time (FSA, 2005);
- The economic consequences of the HIV/Aids epidemic are currently difficult to assess, but will undoubtedly be significant (see Tables 5.1 and 5.2); and
- As an indirect effect of outsourcing, financial support from government and the forest industry for higher forestry education, research and development has been constantly reduced over recent years (Längin and Ackerman, 2006).

Table 5.1: HIV/AIDS Epidemic in South Africa (WHO, 2004; Mzolo, 2006)

18.5 – 24.9% of population HIV positive
Since 2000, 1.7 million deaths related to HIV/AIDS
New infections/year 500,000
In-direct costs of HIV/AIDS on labour costs 8.4% (2003)
In-direct costs of HIV/AIDS on labour costs 26% (2012)
Number of orphans (HIV/AIDS related) in 2010: 2,000,000
Life expectation South African woman in 2010: 37 years
Life expectation South African man in 2010: 38 years

Table 5.2: HIV-Positive Forest Workers by Region and Skills Level (Steenkamp, 2004)

	HIV positive in %		
	Men	Women	Total
Mpumalanga	23.3	39.2	27.7
Highveld	38.5	58.7	46.5
Zululand	29.3	77.8	46.2
Midlands	29.3	33.3	31.5
NE Cape	31.7	43.6	34.7
Mean	30.4	50.5	37.3
Management	20	0	20
Skilled	33.3	71.4	35.5
Semi-skilled	36	38.8	36.8
Unskilled	26.4	18.1	20.9

5.3 SOUTH AFRICAN PERSPECTIVES ON HIGHER FORESTRY EDUCATION, RESEARCH AND DEVELOPMENT

Higher education in forestry in South Africa has its origin with the South African College, established in 1905 at Tokai in Cape Town. Stellenbosch University started offering a professional BSc Forestry degree from 1932 in parallel with the Saasveld School of Forestry who also opened their doors at the same time. It offers a technical oriented diploma in forestry. Since 2005, Saasveld has merged with the Nelson Mandela Metropolitan University (NMMU). On a college level, Fort Cox College for Agriculture and Forestry started its programme in 1970 as part of the now defunct Swartkop Forestry School established 1946.

While enrolments in forestry education declined over the years at Stellenbosch University, other institutions were starting up forestry undergraduate and postgraduate programmes (Table 5.3). For instance, the University of Kwazulu Natal (UKZN), offered BSc Agriculture with a Forestry major in 2000, and the University of Venda is offering Agriculture and Forestry combination from 1999. Both Venda University and UKZN have had difficulty in maintaining these initiatives, as their continuously low student numbers indicate.

Not only are low student numbers a concern but also teaching and research staff involved in the education programmes. As suggested by the

Society of American Foresters' Task Force on Forestry Education, a minimum of eight full-time equivalent academic staff are necessary to constitute a Faculty of Forestry deserving a professional accreditation. According to this definition not one (Table 5.4) of the higher education institutions offering forestry degrees or majors in forestry in South Africa have the permanent staff capacity required. From a strategic point of view, it must be questioned if this fragmentation of effort is healthy for the forestry sector or cost effective in providing for professional forestry education.

Table 5.3: Institutions Offering Tertiary Forestry Training and Education in South Africa (Längin *et al.,* 2006)

Institution	Programmes	Web Page
Stellenbosch University	Professional degrees. BSc., MSc. and PhD in Forest and/or Wood Product Science (since 1932)	http://www.sun.ac.za/forestry
Nelson Mandela Metropolitan University	Technical training. National diploma in Forestry or Wood Technology, B Tech., M Tech degrees (since 1932)	http://www.nmmu.ac.za
University of KwaZulu Natal	BSc Agriculture with a major in Forestry (since 2000)	http://www.forestry.unp.ac.za
University of Fort Hare	Diploma, Community Forestry	http://www.ufh.ac.za
Fort Cox College of Agriculture and Forestry	Diploma, Community Forestry (since 1970)	
University of Venda	B.Sc. in Forest Science (since 1999)	http://www.univen.ac.za/agiculture/agriculture.php
University of Pretoria (FABI) Tree Protection Co-operative Programme (TPCP)	Education of undergraduate and graduate levels in the field of forest protection from pests and pathogens.	http://www.up.ac.za/academic/fabi/tpcp

Table 5.4: Academic Capacity of Forestry Programmes in South Africa. Critical Mass?

	Full time staff*	Temporary staff
Fort Cox	5	-
NMMU	5	-
Stellenbosch	5	1
UKZN	2	-
Venda	2	-

*Numbers exclude wood science staff, being part of the Forestry and Wood science Departments at Stellenbosch University and NMMU.

Higher forestry education has gone through a challenging period in South Africa, not only due to the changes and developments in the forestry industry, as outlined above, but also due to socio-political developments in the country over the last 25 years.

In the 1980's forestry, education was dominated by government being the main landowner of forest plantations. They sponsored higher forestry education significantly through bursary schemes and mentorship programmes. A career path in forestry was at that stage well defined and assured, graduates moved directly from university to a two-year internship and from there to full employment in the government.

This has changed completely since 1994. Privatisation of government plantations, the realigning of the Department of Water Affairs and Forestry, and resultant significant decline in government bursary and financial support for forestry research and development, higher forestry education institutions are fighting for survival. On top of this, forestry as an industry and a career has an image problem among the citizens of the country. The forestry sector is seen as a water consumer that continues to plant alien/invasive trees that have a negative impact on the environment. Uncertainty has been created in the minds of stakeholders by the privatisation process of government forests, the outsourcing of forestry operations, restructuring of commercial grower companies and current land claims. Not all this makes forestry a career path young school leavers choose to follow. There are, however more and more students enrolling at universities from disadvantaged backgrounds, providing higher education institutions with additional problems. Students from disadvantaged backgrounds often do not have sufficient finances to enrol at the costly South African Universities, making financial support from government and industry in the form of bursaries and loans more and more important. This however does not come without further challenges. In general, most school leavers have a poor grasp of mathematics and science and hence are unprepared for tertiary education. The burden is thus placed on universities to offer bridging courses in mathematics, the sciences and supporting live skills modules.

Although industry has not employed many graduates in recent years, a change in attitude and perspective has been observed recently. Commercial grower companies have started to realise that forestry is core to the sustainability of their business and that professional in-house capacity is required to manage and control business in the new era.

Kanowski (2001), discussed the "purpose of education", with its four pillars, as the discovery (original research and advancement of knowledge), the integration (connecting ideas and synthesis across discipline boundaries), the application (assembling knowledge through an interaction between intellectual and real world problems) and the teaching (transforming knowledge through bridging the gap between the scholar's understanding and the student's learning), and that education and research go hand in hand. Forestry research and development is of utmost importance for tertiary institutions. Table 5.5 compares South African Research and Development (R & D) budget to international competitors in financial support per cubic meter harvested. It gives an indication on the current negative situation in research support in the South Africa.

Table 5.5: South African Forest Sector Research and Development (R & D) Budget in Comparison to Selected International Competitors

	Annual Harvest (million m^3)	R & D Budget (R million)	R & D / m^3
United Kingdom	10	276	27.6
Finland	83	1370	16.5
Australia	16	1110	69.4
South Africa	18	163	9.0

Approximately R 163 million is annually invested in forest research and development in South Africa by private industry, government and through national and international research grants, while 80% of all research is funded by the commercial forest industry. In general, R & D investment in industrial round wood and processing is low by international standards (investment < 1 % of turnover) currently and estimated at 0.65% of industry's turnover. Of major concern is the low investment in basic research in the country (Figure 5.1). Government and higher education institutions only conduct around 10% of the forest sector's research in the country as a major portion of research is done at in-house research facilities and at commercial forest industry research institutes. There is low investment in basic research and focus of the industry driven research into industrial round wood processing and production aspects (Figure 5.2). Social issues, policy and legislation aspects as well as non-timber forest products research in the country are severely neglected in terms of financial research and development support.

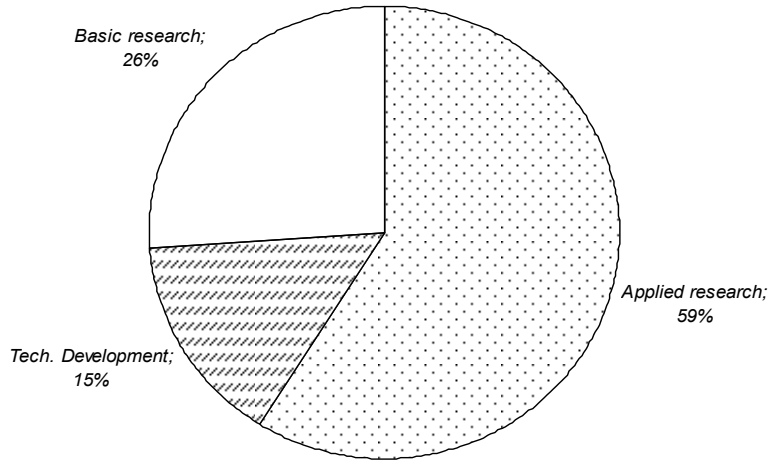

Figure 5.1: Type of Forest Sector Research Performed in 2005 (DWAF, 2005)

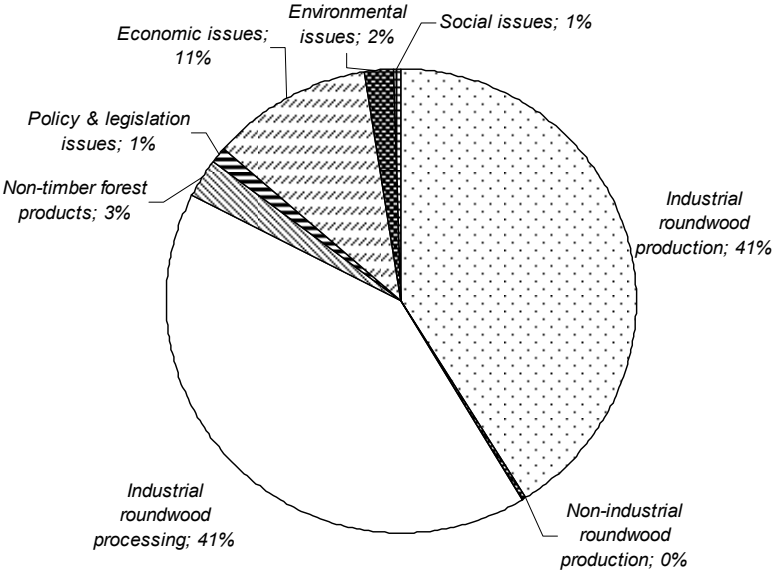

Figure 5.2: Forest Sector Research Performed Per Research Focus Area in 2005 (DWAF, 2005)

5.4 TRANSFORMING FORESTRY EDUCATION - A STELLENBOSCH UNIVERSITY PERSPECTIVE

As a result of low student numbers (Figure 5.3 and Table 5.6) at BSc. level, the changing requirements on forestry graduates by national and international commercial forestry companies, government and other employees; the Department of Forest and Wood Science at Stellenbosch University, undertook a review of its BSc Forestry and Natural Resource Management programme which also included its MFor. Development Forestry programme in 2006/2007.

The curriculum review was based on national and international developments in forestry and the forest sciences and focusing on the Department's BSc programme in Forestry and Natural Resource Management and the Master's programme in Development Forestry (MFor). The programmes were designed to meet the requirements of foresters in the new millennium by combining professional, social and personal competencies, attributes and attitudes. Both programmes allow a more holistic approach; i.e., focusing not only on industrial forestry, but also on natural forests and ecosystems, woodlands and land-use management at a regional level. The role of forestry managers and practitioners is currently being defined as one of managing forests within the broader regional landscape by addressing the social, environmental and ethical perspectives that are typically prevalent in the systems.

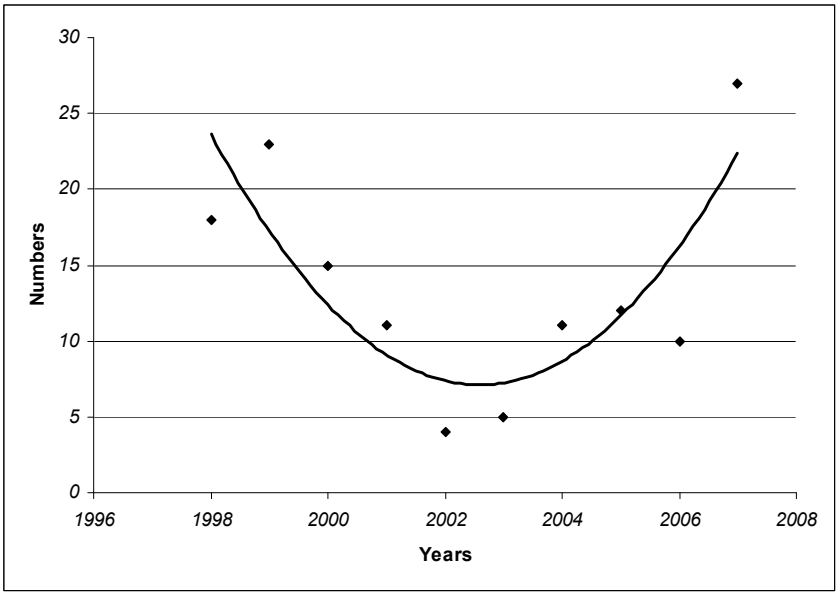

Figure 5.3: First Year Student Intake – Department of Forest and Wood Science, Stellenbosch University 1996-2007

Table 5.6: Postgraduate Student Enrolment 2003 to 2005 Stellenbosch University (US) and Nelson Mandela Metropolitan University (NMMU)

	2003		2004		2005	
	NMMU	US	NMMU	US	NMMU	US
White	6	29	8	22	8	22
Black	1	30	1	24	1	27
Total	7	59	9	66	9	49

The following integrated review process was embarked on to ensure successful implementation of the revised BSc programme:

- Step 1: Critical internal review of the current BSc programme by Faculty, undergraduate and postgraduate students;
- Step 2: Workshop with various national and international sector stakeholders to sketch an "optimal" BSc Forestry and Natural Resource Management programme and to outline required skills and competencies of future forest science graduates;

- Step 3: Develop a reviewed curriculum based on internationally accepted academic pillars of a professional BSc forestry degree (Figure 5.4);
- Step 4: Stakeholder endorsement - The proposed curriculum presented to a meeting of the Department's Advisory Board, representative of the leading stakeholders from the South African Department of Water Affairs and Forestry, the industrial forestry sector, NGOs active in forestry, the forest education and research sectors and forestry specialists, both local and international; and
- Step 5: Implementation of the revised BSc curriculum in 2008. (This includes a review process through Stellenbosch University's academic committee as well as a registration of new modules and course outlines with the South African Qualification Authorities).

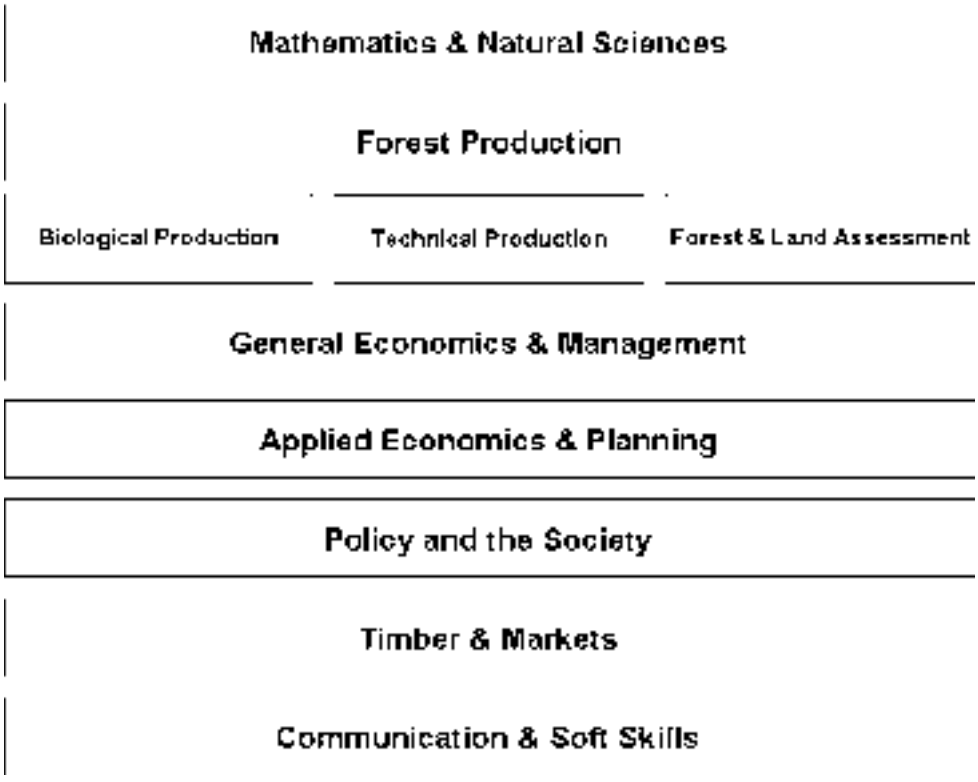

Figure 5.4: Academic Pillars of a Professional BSc Forestry Degree

By work shopping the old curriculum with industry and sector stakeholders as well as through input from students, various problem areas were identified including:

- Offering three directions (Forest Science, Forest Management, and Conservation Forestry) within a single programme is not feasible for the inherently low student numbers and limited staff capacity in the department;
- Key Forest Science modules, which have been offered in previous curricula at Stellenbosch University, were identified as core competencies required from a forest graduate; Forest growth and yield science, Forest finance, economics and marketing, Forest and environmental policy and law, Forest botany, Forest informatics.
- A lack of focus on the wider forestry landscape; i.e. African natural forests and woodlands and land use management was identified; and
- There was little integration between spatial analysis techniques, forest inventories and enumerations to comply with both national and international trends.

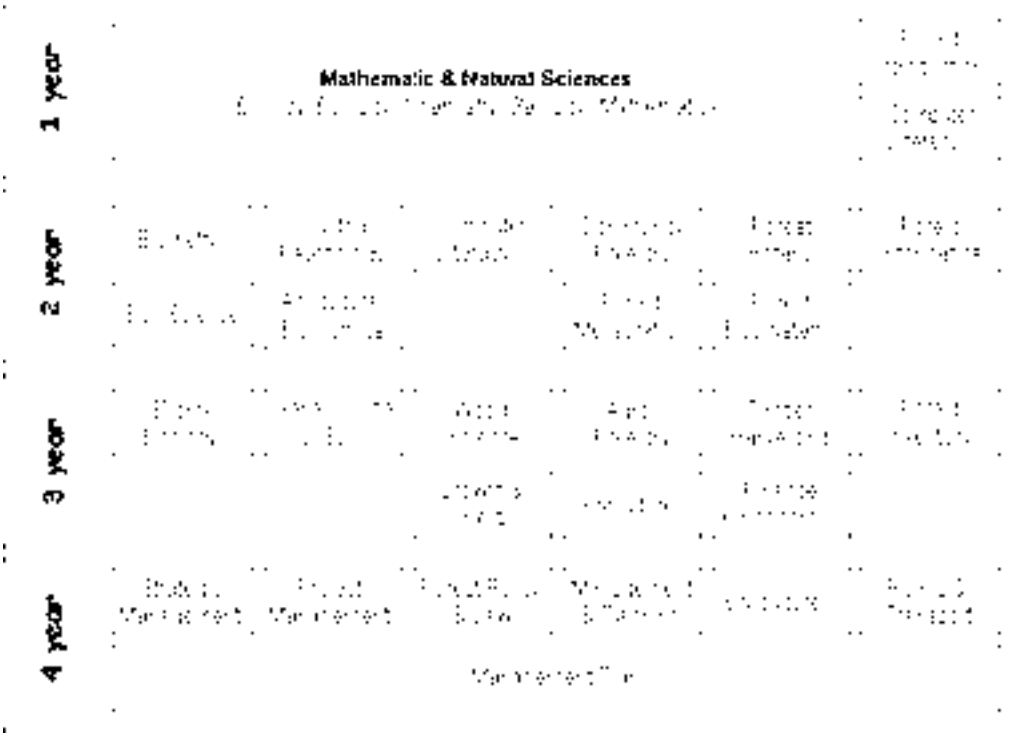

Figure 5.5: Simplified Overview of the New BSc. Forestry and Natural Resource Management Four-Year Programme at the Department of Forestry and Wood Science

As in the past, in the first year of study students focus on the basic sciences, which include biology, ecology, chemistry, geology and mathematics. This is now complemented by an intensive introduction to forestry and vitally important computer literacy course. Together with biometry, soils, industrial psychology and economics, the BSc. students will follow five core forestry courses in the second year of their study. These include an introduction to natural forest ecosystems, (specifically catering for natural forests and woodland), forest botany and a new course, forest informatics. In the third year, two new courses have been introduced. These are forest finance, economics and marketing (introducing students to the national and global forest financial and economics environment) as well as forest growth and yield science. The final year will include, beside a revised forest management plan, the capstone of the BSc. curriculum, a new course in forest and environmental policy and law.

The new BSc. programme includes a variety of practical periods exposing students to the broader forest sector in a number of ways. In addition to the three hours practical training per week that is included in each forestry course, the students will have further practical experience:

- Introduction to applied forestry in the first year of study;
- Chainsaw course in the second year;
- Soils and growth characteristics practical in the third year;
- Field school and industry tour in the third/fourth year; and
- Capstone management plan in the final year.

The updated BSc. Forestry and Natural Resource Management curriculum aims to:

- Offer a world class BSc Forestry and Natural Resource Management degree programme, benchmarked to international higher education standards in forestry;
- Prepare graduates for a job market which requires both traditional and "new" forestry skills and understanding;
- Cater for the needs of the commercial plantation forestry industry as well as management of natural African forests and woodlands;
- Meet the requirements and expectations of today's graduates in terms of both professional and soft skills;
- Provide a programme that keeps pace with international developments by making use of international expertise in teaching and research supervision;

- Keep pace with international development in terms of using the latest teaching and learning techniques and didactical approaches, including problem-based learning, in preparation for lifelong learning, and e-learning;
- Offer a current relevant curriculum which has the necessary flexibility to cater for the integration of cutting edge research and developments in the industry and sector;
- Provide practical exposure; and
- Provide students with an attractive and interesting degree programme.

In order to meet the demand for directed postgraduate training, and to make provision for new developments in sustainable energy production, land-use management, plantation forestry and participatory forest management, the Department of Forest and Wood Science has also reviewed its Master's programme in Development Forestry (MFor) during 2006/2007.

The MFor programme is highly flexible and caters for forestry development, renewable resource and land resource management issues. Access to this programme is given by a three-year BFor, a BSc (forestry) degree, or other qualification that is relevant. The MFor for the first time allows students with a BTech and several years of directed and professional work experience access to a university education and research environment.

The MFor programme entails 120 credits of course work and research thesis of 120 credits spread over two years. The thesis should address applied research. This combination of course work and research thesis is ideal for those professionals who cannot study full-time over a two-year period.

Within the MFor programme, there are three major directions:

- Bio-energy Systems: This is offered by the Department in co-operation with the Renewable and Sustainable Energy Studies programme of the Faculty of Engineering. It focuses on quantitative aspects of natural resources, biomass production and bio-energy systems. (Further information is available online at: http://www.sun.ac.za/crses);

- Commercial plantation forestry**:** Forest management, including growth and prediction of yield, harvesting and logistics, ecology, silviculture and economics of plantation forestry;
- Participatory Forest management: Sustainable land use management including socio-economic and policy aspects as well as ecology and silvicultural management of natural and plantation forests;

5.5 THE WAY FORWARD

Over the past 12 months, positive developments have been observed in South Africa. Forestry sector role players, including commercial timber growers, small growers, Non-Governmental organisations (NGOs) as well as the government Department of Water Affairs and Forestry (DWAF) seem to have realised, that the current developments in forestry education and training will have a negative effect on the sustainability of the forestry sector in South Africa and on the international competitiveness of the forest industry in the country.

While compiling this paper, DWAF announced a National Forestry Skills Development Forum in August 2007 in Durban. This two-day workshop aimed at bringing all national role players together, discussing current problems and future challenges in forestry education and training. Questions discussed included:

- How relevant is higher forestry education in South Africa – is it addressing the needs of the industry and sector stakeholders?
- Forestry centres of excellence versus healthy competition amongst education institutions.
- Curriculum design versus sector job requirements?

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6 South African Forestry, Integrating the First and Second Economies: a Curriculum Template for African Forestry

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ABSTRACT

The current global economy is characterised by a growing disparity in wealth between the rich and the poor nations. In order to redress this inequality, the Millennium Development Goals (MDGs) have been established and their progress benchmarked with annual reports. In South Africa the challenge of resolving the inequitable distribution of resources is addressed through a policy founded upon a symbiotic relationship of support between the industrial, *First Economy* and the marginalised, *Second Economy*. This is a process promoted as an African solution to resolving the weak economic performance of a continent, which is heavily dependent on mineral extraction, agriculture and forestry. A prime vehicle for validating this initiative is the South African Forest Industry, one that is highly commercialised and profitable, yet situated amongst impoverished, marginalised rural communities. The enabling tool to realise a more equitable distribution of forest resources is the *Forest Sector Transformation Charter* (2007), which is referred to as the Charter.

To demonstrate how a successful transition in South African forestry can be achieved through the Charter, the current positions and future needs of the state (which also represents the communities), the commercial industry, as well as recent tertiary forestry curricula are outlined. Further support for this transition is provided by a review of an on-going forestry programme of technology transfer, which strengthens the conceptual debate. Finally, with inputs from inter-African dialogue, the *Forest Sector Transformation Charter* is promoted as the basis for new South African Forestry curricula templates, which can be adopted elsewhere in Africa.

6.1 INTRODUCTION

Since the Brundtland report on *Our Common Future - World Commission on Environment and Development (WCED 1987),* the principle of sustainable development has gained general acceptance (Wiersum, 1999). Expanding upon this principle, the Rio Declaration on the Environment and Development Principles (1992) emphasised the importance of sustained development through the integration of economic, environmental and social components, (Department of Environmental Affairs and Tourism, 1997). Thus, *sustainable* is considered successful in terms of overall development where the entire nation's constituency benefit, rather than fiscal growth where the distribution of a nation's wealth is not equitably distributed amongst its members (Cellier, 1993). Despite these attempts at the equitable distribution of resources, the poverty gap between the rich and poor nations continued throughout the latter years of the 20th century (Young, 1997) and spurred on an important response from the United Nation in the Year 2000, with the unveiling of the MDGs. This new initiative (the MDGs), sought to provide a time-frame, with specific targets to address the global challenges of grinding poverty, hunger, diseases, gender discrimination, education, the environment and global partnership. The Secretary-General for the United Nations at the time was optimistic that the MDGs were and will remain initiatives which differ from previous ones because of their measurable nature, the stress on North-South co-operation, high-level political support and because they are achievable (Annan, 2005).

In part, the Secretary-General's positive commitments were well grounded and certain Asian and South American countries have shown some improvement. However, in sub-Saharan Africa (SSA), the state of poverty and diseases, especially HIV/AIDS continues to deteriorate so that most of these countries are currently requesting emergency aid for SSA (Ocampo, 2006). The reason for this disparity between nations in the

Global Economy has long been widely attributed to the adoption of large-scale industrial projects (de Beer and Swanepoel, 2000). Unfortunately, there has been relatively little industrialisation in Africa and therefore economic growth has been "sluggish" as the majority of the population rely upon mineral extraction, agriculture and forestry as a source of income. This challenge, the bridging of the gap between the rich and poor led to what President Thabo Mbeki of South Africa termed *the First and the Second Economies* during a Cabinet Lekgotla in July 2003 (ANC Today, 2003).

6.2 FIRST AND SECOND ECONOMIES

The First Economy is modern, producing the bulk of a country's wealth and integrated within the global economy. The Second Economy (or Marginalised Economy) is characterised by underdevelopment, contributes little to the GDP (Gross Domestic Product), contains a big percentage of the population, incorporates the poorest of the rural and urban poor, is structurally disconnected from both the First and global economy, and is incapable of self-generated growth and development (ANC Today, 2003). The concept of the "two economies" is to respond to the challenge of the Second Economy based on the financial solidarity of "Structural Funds" from the First Economy, therefore placing the Second Economy in a position to alleviate the inequalities in the nation's wealth and ensure sustainable economic growth for all constituents.

Underpinning all the aims of sustainable development in Africa is the contention that in order for the continent to reach its goals, it should seek answers from current African success within the global context. Secondly, that having identified successes that these models are adapted to their individual resource bases in developing First Economies and thereby meeting the challenges of the New Millennium.

6.2.1 South African forest industry: an example of the first economy

The forest industry of South Africa is an excellent example of how the policy of structural funding can be implemented. What distinguishes South Africa from other similar initiatives in Sub-Saharan Africa (SSA) is that it has a successful commercial industry, which supplies round wood, fibre, poles and charcoal to both established and emerging markets around the world. In 2006, forestry contributed in excess of US$ 2.2 billion to the economy, about 1% of the Gross Domestic Product (GDP), generated US$ 1.0 billion in foreign exchange and provided employment for an

estimated 170 000 people (Department of Water Affairs and Forestry, 2007a). However, this development is not without its shortfalls as only a few people enjoy it. Indeed, the bringing together of the First and Second Economies has been the thrust of South African Government since 1994.

6.3 SOUTH AFRICAN FORESTRY: CURRICULA CHANGES FROM AN EMPHASIS ON THE "HARD SCIENCES" TO A BROADER DISPENSATION

The remainder of this paper looks to answer three questions. Firstly, how did commercial viability of the industry come about? Secondly, how is government policy being applied to ensure a transfer of assets to the Second Economy and finally, how should tertiary institutes support the Nation in terms of curricula response?

6.3.1 Early South African forestry, the establishment of a first economy

Act 28 of 1889 can benchmark traditional, formal forestry in South Africa: The Cape Forests Act, which was subsequently superseded by further acts covering this period up to 1984. Forest tertiary education in the early half of the 20th Century was established at three colleges, which gained autonomy as the Saasveld School of Forestry (1932) focusing on forest technology, The Forestry Programme, University of Stellenbosch (1932) focusing on forest science and the Swartkop, now Fort Cox Forestry (1946) which was initially reserved for African people. Only much later were other tertiary forestry programmes offered, notably the BSc Agric (Forestry) at the University of KwaZulu-Natal 1999 and a joint Forestry /Agriculture BSc (Honours) at the University of Venda, in 1999.

During the early period, the forestry curricula provided in tertiary institutes in South Africa focused solely upon a limited "first economy" market place, one reliant upon the "hard sciences", the natural sciences of mathematics, physics and chemistry, as well as biology, soil science, law and business management, which were taught in parallel with the forest sciences of silviculture, forest management, forest economics, and forest engineering. Wood-technology formed an important though separate course during this phase of study. In addition, some time was allocated to forest ecology, while at the diploma level more focus was given to practical subjects such as chain saw and transport maintenance, compartment estimation, road construction, conservation practices, environmental and labour law. It was at this time, in the early to mid 20th

Century, that in South Africa, as elsewhere in the world, foresters perceived themselves to be in control of forests, rather than managing them according to society's needs (Luckert, 2006). However, towards the end of the 1990s the numbers of forestry students began to decline in enrolments shown in Figure 6.1. It was apparent that forestry was losing its appeal as a career in South Africa and this is found elsewhere in Europe and The United States at the turn of the century (Luckert, 2006).

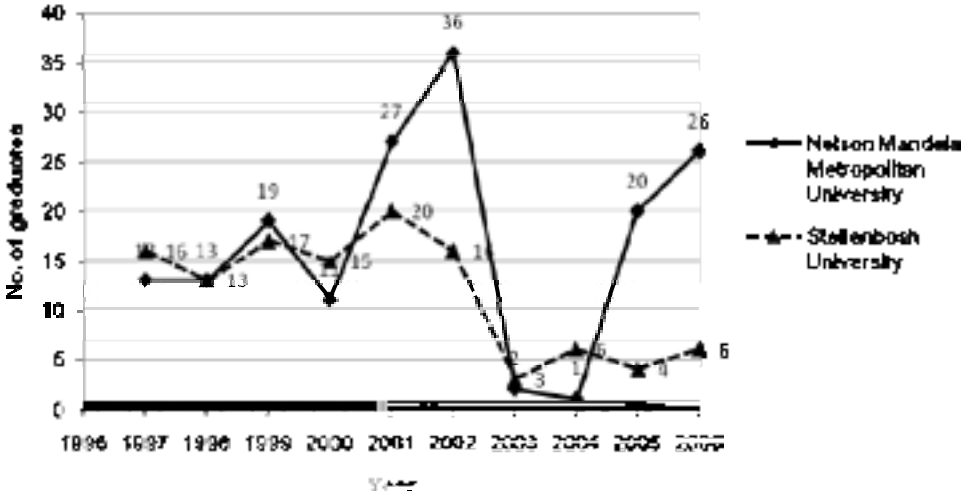

Figure 6.1: Recent Variations in Forestry Enrolment Patterns in South Africa

Figure 6.1 relates to the trends in graduation at the two oldest tertiary institutes engaged in producing forestry graduates. The Nelson Mandela Metropole University (NNMU), which reflects the demand for forest technicians and the University of Stellenbosch (US), which provides forest scientists. The general decline in graduation reflects the general disquiet amongst potential forest applicants that was being expressed in the latter years of the 20th century. In contrast, the upward movement from 2003 is a response to new curricula being offered and in the case of forest technology the availability of funding for Previously Disadvantaged Individuals (PDIs) to promote small emerging growers and business to replace the former "in-house" structures provided by the large corporate forestry concerns.

The fluctuation in demands for forestry education shown in Figure 6.1 is an excellent example determining mechanism behind successful curricula. Curricula are, or should be an institutional response to the demands of

society. It is one of the few occurrences where practice can pre-empt theory, (Lawton, 1983). How institutions arrange their resources to meet these demands is reflected through syllabi, which are programmes of research and formalised courses of learning. Each component of the syllabi is further sub-divided into modules, and credits, which are calculated upon nominal hours of contact and study. The crucial perceptual base to an effective use of tertiary education then is to acknowledge that the curricula is "a voice of the people", a response to society, to the needs of the market- place. Further, that such demands are dynamic, they will change. Whereas it is true to agree that an academic "must publish or perish", it is equally true to acknowledge that education institutes must constantly evolve or decline into obscurity. What is also true is that academic and therefore tertiary institutions with the increase in knowledge overload through the medium of Information Technology (IT) has brought about a state where the elite of these organisations are "no longer the custodians of knowledge, rather facilitators to its access," (Muir-Lerescher, 2004).

6.4 FOREST SECTOR TRANSFORMATION CHARTER, KEYSTONE FOR A NEW FORESTRY CURRICULA

It is because of South Africa's forest infrastructure and the government's current policies to address the needs of all the forestry stakeholders, that South Africa can provide such an important template for the development of Tertiary Forestry Curriculum development in African Forestry. The most recent demonstration of this process, one of bringing together the First and Second Economies is in the first draft of the *Forest Sector Transformation Charter* launched by the Minister of Water Affairs and Forestry, Gauteng, on 25th June 2007. The Minister summarised the process of development for forestry in South Africa as a "Multi-billion dollar industry that cuts across several industries, yet the people on whose back this industry was built still remain in poverty. Our aim through this charter is to ensure that we continue to grow the forest sector and that it remains a globally competitive industry" (Department of Water Affairs and Forestry, 2007b).

In order to realise these objectives, the Charter will cover all the major aspects of commercial forestry, growers, contractors, fibre producers, saw millers, pole treatment, and charcoal producers. Non-timber forest products are omitted. Unlike former initiatives, there is a strong bid in the Charter to include as many PDIs as possible. This will result in a transfer of equity ownership and the sale of business assets to achieve 25%

ownership by African people or 10% held by African women. The Charter will capture the key national priorities for the Sector reflected in the Accelerated and Shared Growth Initiative for South Africa (AsgiSA) and the Joint Initiative on Priority Skills Acquisition (JIPSA) and will importantly be aligned to the broader vision of the forest industry value change through working with the Department of Trade (South Africa).

Figure 6.2: The "HUB" Model for New Forest Policy and Curricula Development

To ensure the development of forestry curricula for the benefit of all the stakeholders who are affected by a new South African Forest Policy, a workable association must be established between every party. It is insufficient for the traditional institutions of government, commerce and education to consult with communities; they must bring people into the total process. Instead of referral consultation, communities must be the "focus" of the new policy. This process should be likened to a wheel in which all the parties interact at the same level.

The HUB concept is one where all the traditional decision makers still have their normal access to each other but the communities are included in the total process of planning and implementation. Thus as the new

Forest Policy is developed the communities are able to influence and comprehend the position of the forest industry and equally the other parties are better placed to understand and work with communities.

This is an interactive mechanism, one in which trust and respect can be built, thus ensuring true Participatory Forest Management. Towards this end, the position of the Department of Water Affairs and Forestry (DWAF), commercial forestry, as well as an outline of the new tertiary forestry curricula on offer at five educational institutes is present below:

6.5 ROLE PLAYERS TO THE DEVELOPMENT OF THE NEW FORESTRY CURRICULA IN SOUTH AFRICA

6.5.1 The vision of the state (the Department of Water Affairs and Forestry)

The new vision of the Department of Water Affairs and Forestry (DWAF), expresses the current thinking about the relationship between forests and people and the multiple implications for capacity development and training. Until 2004, the Department had not prioritised the institutionalisation of the capacity development and training function within Forestry in the National Office and the regions. This was because DWAF has been reliant upon two donor support programmes, which have also been tasked with the production of learning materials and other resources. However, it was realised that the development of staff capacity for forestry sector stakeholders to deliver training was unsustainable under such conditions.

Since 2005, DWAF has strived to bring together its own suitable packages to realise the competencies, skills knowledge, values attitudes and approaches required by its officials. An important part of this capacity development is the development of new, more appropriate qualifications, which will enable the current policies being put in place. These new qualifications will need to broaden the base of professional training for service providers as stipulated by DWAF policy statements. The current strategy to realise this capacity is structured into three spheres, which will then provide the opportunity for DWAF to meet its obligations in terms of the skills development. This forestry capacity building strategy identifies the specific elements that can incorporate the Forestry Broad-Based Black Economic Empowerment (B-BBEE) Charter, Accelerated and Shared Growth Initiative for South Africa (ASGI-SA) and Joint Initiative for Promoting Skills Acquisition (JIPSA) to ensure alignment and

compliance with legislative mandates and sector needs. To this end, three spheres are conceived:

Sphere 1

The primary focus of the capacity development strategy is DWAF employees within different National Office Directorates fulfilling forestry functions and the regions. The strategy must enable employees at different levels and in different roles to effectively fulfil their present and future functions. Key elements include the introduction of effective induction processes for new staff, the development of Individual Development Plans (IDPS); a schedule of mandatory courses indexed to particular job functions and improved performance management.

Sphere 2

DWAF is progressively withdrawing from the direct management of forests. The strategy assumes that where other management agencies are appointed, third party forest managers will need a period of training and support which DWAF will either facilitate or provide. These will include managers of indigenous forests, lessees of state plantations and community entities to whom a woodlot has been devolved.

This training and support, certain aspects of which will be mandatory, will familiarize them with the legislative and policy framework; the criteria, indicators and standards that govern forest management and will introduce participatory approaches, sustainable use and enterprise development strategies, which create livelihoods opportunities for the poor.
This sphere also focuses on the services and support that DWAF must provide to the range of actors involved in the implementation of the National Veldt and Forest Fire Act (NVFFA), No. 101 of 1998, from Fire Protection Officers (FPOs) to local government and the members of Fire Protection Associations (FPAs).

Sphere 3

The third sphere contains a range of different actors that DWAF needs to support with information and advice in terms of its mandate and through the National Forests Act, No. 84 of 1998, section 32(2), which states that the Minister may provide:

Information, training, advice and management and extension services for community forestry; and
Material or financial assistance, if no such grants are available from any other source.

Thus, it is envisaged that Forestry (DWAF) will need to provide such support to communities that have indigenous forests, woodlands or woodlots on their land. Support may be needed for particular resource users such as woodcarvers or harvesters of medicinal plants to promote sustainable use and the development of viable enterprises. Support will also be needed to assist the full spectrum of emergent forestry enterprises established as part of DWAF's overall contribution to the reduction of poverty. DWAF may choose to provide this support directly, or in partnership with NGOs and other agencies.

Sphere 3 also includes tertiary institutions. Forestry will continue to develop relationships with tertiary institutions offering fire and forestry qualifications and will aim to ensure that forest policy and new approaches to forestry are adequately reflected in curricula. In response to this and the shift of ownership, which will result in a major structural change to the forest industry over the next 10 years, industry is setting about addressing a dual challenge, the need to ensure mutually beneficial partnerships and the re-training of current management to integrate successfully with the new owners. Currently this will see major shifts in forest tenure through the transfer of assets to achieve 25% ownership by black people in existing forest enterprises of which 10% must be black women.

One immediate response to this process, which has been underway for the past 18 months has been the establishment of industry based models which are put up for debate. Initially, in the early part of the decade this resulted in former State owned land (approximately 332 000 ha) mostly belonging to the South African Forest Company Limited (SAFCOL) being devolved to private ownership and consortia. These new owners comprised mainly of former commercial private timber companies in partnership with Black empowerment associations, the state through the Industrial Development Corporation, Community and small grower trusts, the National Empowerment Fund, and representatives from local development trusts. These "packages" were based upon extended lease agreements, where the consortia were in a position of usufruct, they could grow timber in the former State forest areas but did not have right of its ownership. A major shortfall of this system is that a substantial portion is

retained by parties outside the immediate forest area, so that the benefits at local level have been limited and often paternalistic.

In contrast, under an alternative model of distribution set out by the Forest Sector Charter, land and resources will be allocated to local community members. In response to this new challenge, existing corporate forest owners are developing strategies, which will meet both the financial and social needs of the new owners while ensuring a regular supply of fibre to the pulp mills.

6.5.2 The vision of a commercial partner for new forest curricula

The advent of a democratic South Africa and consequent move towards equitable work and business opportunities linked to land reform has created a new dynamism within the forestry industry. Previous corporate management and business skills are running out of "knowledge systems" and it is acknowledged that there is a need to embrace a more disaggregated plantation ownership model and secondly the green-fields forestry expansion present in community owned areas. Further, legislation in the form of the Forestry Charter is set to change the way in which forestry operations across the value chain deal with business, environment and community issues.

Currently, the corporate owned plantations and processing capacities have focused on a management style, which has been dependant upon First Economies seeking solely rigorous, scientific methodologies in order to provide rational, reliable and ultimately indefatigable approaches to resolving the problems of development, poverty and inequality. This approach to management though successful on corporate owned plantations has often failed with community centred out-grower programmes where the top-down approach could not understand that there were other pressing needs facing communities and emerging stakeholders. These are issues such as lack of fire protection training and equipment, road infrastructure, lack of institutional growth and poor communication that have caused promoting companies to miss the loans and timber that they assisted people to plant. Consequently, these programmes have stopped or are not expanding as rapidly as before.

To illustrate a way of dealing with the future issues facing the industry the Mondi Group has established an agency, Mondi Zimele. This initiative is now starting to facilitate the integration of the First and Second Economies in forestry across the value chain. The Zimele model has been

established through the recognition of government policy and the need for black economic empowerment as a key development area, with reference to the Forestry Charter and in line with transformation of the industry. The problem to be addressed are the likelihood of land restitution on some 40% (100,000 hectares) of the Mondi forest plantations. These areas will need to be supported in order to ensure a sustainable business for the new owners, as well as to maintain the economic status of the processing industry. The ultimate impact on the industry is estimated to account for 40 % of commercial forestry. Thus, plantation management will need to be re-structured. The multiple land use aspect of the land reform properties will be a new issue requiring different skills, which will also have to address the need for establishment of trust as the basis for sustainable relationship with the new owners.

In addition to establishing relationships with growers, the forestry contracting industry needs to engage new, black owned and managed enterprises. Currently, high barriers to entry exist and these have been recognised and overcome. Finance and support are the two major elements that need to rectify the situation, and Mondi Zimele has built these elements into its model.

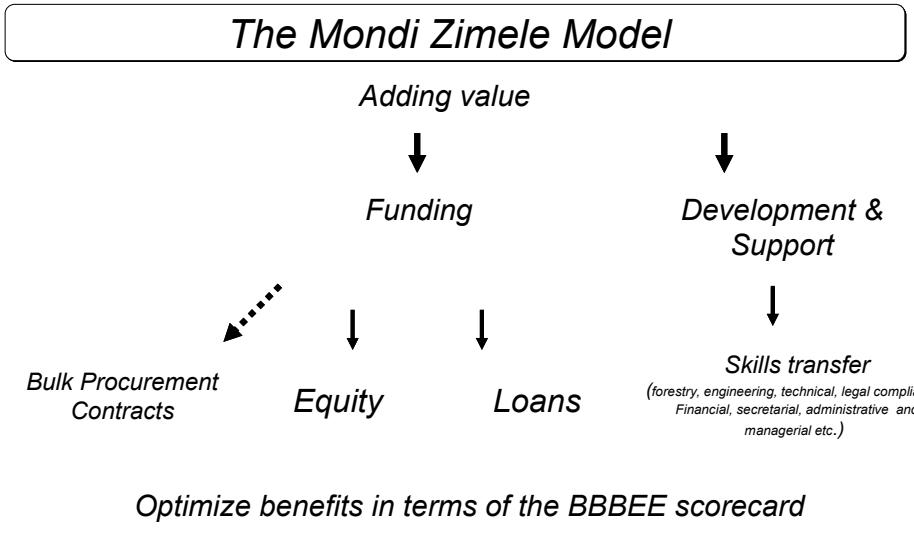

Figure 6.3: The Mondi Zimele Model for Integrating of Corporate Forestry into the 2nd Economy

Thus, linked to financial loan funding, Zimele has created two subsidiary companies to deal with the business and technical support elements. These companies operate as independent businesses and are staffed with individuals who are experienced in different forestry, developmental and small business fields. The ability to identify needs and to deal with aspirations of new entrants into the forestry industry is critical. Models that then tap into these needs and aspirations must be developed for sustainable forestry practice to endure. This will enable Mondi to grow into the new era going forward.

The people that are to manage, develop policy and support the growth of the forestry industry in the medium to long term require a different mind set and the ability to harness knowledge through an alternative set of basic skills. Curricula in learning institutions require strategic development in recognising the complementary skills required. These can be broadly classified in terms of institutional development, participatory community skills, as well as the technical forestry capability, which will need to be developed in order to equip future forestry enterprise facilitators. In addition to the professional level skills development there is an even larger requirement for training programmes for the entrepreneurs and the broader community involved in various forestry businesses.

6.5.3 Current status of forestry curricula in South African tertiary institutions

Curricula are the institutional response to the demands of society and current forestry developments as the First and Second Economies are brought closer together in South Africa have broadened the debate. Apart from traditional technical skills, new graduates from tertiary forestry institutions are required to realise greater supervisory/management skills, a better understanding of environmental issues, as well as an improved awareness of certification, national policies and legislation.

A recent survey of curricula at major forestry tertiary institutes in South African reveals that a new curriculum has been developed at every level. At the University of Stellenbosch, the cradle of forest science in South Africa, a new syllabus now includes agroforestry, community forestry, industrial psychology, policy and law. The programme retains a strong scientific forest science core upon which it has expanded the syllabi to include the more pertinent elements of the “soft sciences”.

Similarly, the Nelson Mandela Metropolitan University, formerly Saasveld College that traditionally focused on forest technology, has a forest programme, which is now part of the School of Natural Resources Management. This initiative of bringing together, agriculture and nature conservation, with strong international links and is now meeting the ever increasing demand for skilled forest contractors, as well as those interested in nature conservation and wood science.

Where forestry programmes are still in their relative infancy, curricula is also embracing development through change. At the University of KwaZulu-Natal, the Forestry Programme is placing an increased emphasis on links between crop and horticultural sciences, the development of the regional small emerging forest growers, as well as food security issues.

Finally but by no means least, the latest to contribute to forestry training in South Africa is the University Venda, where the forestry initiative is part of the School of Agriculture, Rural Development and Forestry and has a programme which emphasises small-scale mixed community farming and forestry.

6.6 TECHNOLOGY TRANSFER - MERGING THE FIRST AND SECOND ECONOMIES

An example of merging the First and Second Economies is the contract out grower schemes, which have been established between the corporate forestry companies and the local communities in the province of KwaZulu-Natal and its neighbours on the eastern seaboard of South Africa. Under these schemes, genetically improved planting material is provided to local communities in a programme of financial and technical support, which provides an income for the grower, and a reliable supply of fibre for the pulp mills.

Subsequently, this practice as been exported as tree-biotechnology programmes (TBPs) which utilizes *Eucalyptus* clones forestry. These initiatives are needs-driven technology transfers and educational exchanges from South Africa to East Africa that provides genetically improved material, technology and on-going education to growers, foresters, nurserymen and small-scale farmers in Kenya, Uganda and Tanzania.

The reason for these TBPs is to curtail and reverse the decline of the natural forests and woodlands in East Africa, it is crucial that an alternative energy resource be found. Wood in various forms is required by over 93% of the population for cooking, heating and building purposes. With no alternative, governments are powerless to act in order to reverse the current trend of over exploitation of the natural forests and woodlands, which are so vital to basic needs of an increasing population, growing urbanization and an expanding requirement for agricultural land. The diminishing availability of fuelwood can only lead to catastrophic social consequences for the poor, the national economies and the environment. In the longer term, this will cause the destruction of habitats and the depletion of plant and genetic resources.

In 1995, Mondi Forests (now Mondi Business Papers) were approached by the International Society for the Acquisition of Agri-Biotech Applications (ISAAA) with a view to sharing clones technology with Kenya, specifically with a view to contributing to resource-poor farmers, and to assisting to offset the fuelwood crisis in that country. As a result, the Kenya Tree Biotechnology Project, funded by the Gatsby Charitable Foundation (GCF) of United Kingdom, and backstopped by Mondi Forests of South Africa started in 1997 in Kenya.

The project achieved remarkable success in partnership building and technology transfer, with personnel from Mondi Forests providing strategic and backstopping support for some seven years. The project has been replicated in Uganda and in Tanzania, again with funding support from the GCF, most recently through the Kilimo Trust. Assistance in education, technology transfer and development of breeding strategies is now done by individuals and by members of the forestry tree breeding team at the Council for Scientific and Industrial Research (CSIR) in South Africa. ISAAA, as the initial facilitating institute for the projects, has been instrumental in providing the continued facilitation for the technology transfer and education within the projects. The linkages with the Tree Biotechnology Projects in each country are productive and continuously evolving, as are those with the Kenya Forestry Research Institute (KEFRI), The Uganda Forestry Research Institute (FORRI) and the Tanzania Forestry Research Institute (TAFORI).

Clones programmes of plantation species have developed because of the need to afforest diverse and sometimes marginal sites with appropriate planting stock, including hybrid species, as well as because of the demand for quality wood fibre. The benefits of clonal forestry are numerous, the

most obvious of which are the ability to propagate hybrids, the increase in growth and yield with appropriate clone-site matching, disease- and drought-tolerance, and the improvement in wood quality when integrated with specific end uses (Bayley and Blakeway, 2002). In a five- to seven-year rotation of clonal Eucalyptus, increased yield, disease resistance, and specific fibre quality improvements are key objectives (Denison, 1998; Wright, 2003). Appropriate clone-site matching is critical to optimising gains from clonal selections, and rigorous clonal testing programmes are critical to the success of clonal forestry practice.

In many established traditional *Eucalyptus* clonal programmes, a breeding programme precedes a clonal programme, eventually culminating in the deployment of clones through vegetative propagation (cuttings). In the East Africa Tree Biotechnology Projects, the access to Mondi clones, as well as access to the expertise required to establish appropriate breeding and clonal testing programmes and clonal nurseries has allowed for the clonal testing, the breeding programmes and deployment strategies to be embarked upon simultaneously and to be fast-tracked in East Africa.

The sustained success of clonal forestry is dependent on long-term clearly defined breeding strategies that ensure that the resource of a broad genetic base is maintained. The essence of clonal forestry is the large-scale use of a finite number of selected clones from a robust breeding programme. In ensuring that the supply of genetically improved material (eucalypt clones) to small-scale farmers in East Africa is sustainable, the two key components to *Eucalyptus* clonal forestry need always to be considered i.e. 1) the production and selection of clones from the breeding programme, and 2) the ability to cost-effectively commercially deploy these clones to plantation areas. Both of these will determine the success of the application of a clonal strategy in any region, country, forestry company or situation.

Continued education is achieved through visits by South Africa forestry researchers and managers to the East African countries, by visits of personnel from these countries to South African operations and research institutes for extended periods to receive “hands-on training, by student training in South African Universities, and by individual mentoring programmes. Through this process three key elements have emerged: i) a philosophy of environmental awareness which is positively affecting the national psyche, ii) a strong political will of the governments to find alternative sources of fuel and building materials and iii) a genuine fear of an encroaching desertification of the countryside.

6.7 CONCLUSION

Curricula need to respond to the new demands of society. These demands will be determined by economic conditions and the policy of the state as it attempts to balance the expectations of the nation's constituency with the realities of the local resource base and global economics. South Africa is embracing a wider constituency as it moves away from one solely focusing upon the demands of the First Economy towards an integrated strategy, which utilises elements of the First Economy to the advantage of the Second Economy. It is this process of merging the First Economies and the Second Economies and the resulting new forestry curricula in tertiary institutes that can provide and gainfully assist other countries in Africa with their predominantly Second Economies learn how to utilise the Global First Economies to empower their existing forest industries.

The new curricula which are practiced or envisaged in the near future in South African tertiary forestry institutes will formulate syllabi which produce learners who have not just been exposed to the hard sciences but have had to undertake a broader platform of knowledge. This new approach is one, which goes as deep as to challenge the traditional understanding of a forest as a more comprehensive definition (Lund 2002) is often more relevant when addressing the needs of developing forestry in a Second Economy. Towards such goals, current curricula in South Africa now embrace modules focusing upon small domestic woodlots, indigenous forest management, urban agroforestry, as well as at the community level, fruit tree and small scale domestic and semi-commercial orchard utilisation. In addition, forestry courses address issues as diverse as income generation for small-scale and emerging growers, contract-farming, entrepreneurship and the co-operative establishment to sustainable forest management in terms of The South African *"Principles, Standards, Criteria and Indicators"* and their adherence to the Forestry Stewardship Council guidelines. Finally, modules on the crosscutting issues are required to expose learners to technology transfer, training and skills acquisition, land tenure, global warming environmental management, gender, and HIV/AIDS.

Finally, the need for dynamic, changing curricula is never ending. Tertiary institutes with forestry curricula in South Africa recognize that they cannot be omnipotent and that the experience of other countries within the Continent is vital for meaningful delivery. In this regard, the work of the African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE) and its regional and national structures

have been especially important in the transferee of African experiences and curricula to South Africa. Particularly useful have been the promotion of agroforestry curricula (Rudebjer *et al.,* 2005), conferences, staff and student exchanges, as well as the inter-change of ideas such as the emphasizing of experiential learning and entrepreneurial skills development as part of contemporary agricultural and forestry education.(Muir-Leresche, 2004).

In conclusion, if curricula are to have real meaning and real impact, the best evidence as to their value is their use in the market place.

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7 Strengthening Wondo Genet College of Forestry in Natural Resource and Biodiversity Education and Research for Capacity Building in Eastern Africa

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ABSTRACT

Wondo Genet College of Forestry and Natural Resources, at the University of Hawassa in Ethiopia has forged a partnership with the College of Forestry at Oregon State University since September 2003 with funding from USAID. The overriding purpose of this partnership is to strengthen and enhance the capacity of Wondo Genet to implement the natural resources undergraduate and graduate curricula developed through the partnership. In addition, short-term trainings were provided for faculty members at Wondo Genet in pedagogy, computer technology, and scientific writing to improve their teaching and research skills. The implementation of four new undergraduate and seven new graduate programmes in natural resources sciences will substantially enhance the educational and research capacity of Wondo Genet College. The implementation of these new programmes will help prepare the next generation of leaders to direct Ethiopia's and other Eastern African countries' use of their natural resources in the most efficient and effective ways. In addition, a centre of excellence in Natural Resources Research and Development will be build to address biodiversity and natural resources management issues and is intended to serve as a regional centre for Eastern Africa and other parts of the continent. One focus of the centre

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will be applied and development-oriented research to address the challenges of food security and environmental degradation that threaten many Eastern African countries

7.1 INTRODUCTION

7.1.1 Natural resources in Ethiopia

The future of Ethiopia and its people is closely tied to its natural resources. Ethiopia has diverse physiographic features and climatic regions, and is endowed with extensive natural resources. It is home to over 6,500 species of plants (12% of which are endemic), 240 species of mammals, and 845 species of birds (EFAP, 1994). The vegetation (forest and woody vegetation resources) covers large tracts of land, although the high forests have been significantly reduced in size and quality. The country also has vast water resources, with high potential for irrigation, hydroelectric generation, fishing, and other uses.
Currently the natural vegetation, biodiversity, and wildlife of Ethiopia are severely threatened because of unsustainable natural resources management (NRM) practices. As a result of deforestation, Ethiopia currently has less than 3% of its natural forest cover. Its large rivers are repositories of silt from increasing erosion of soil resources. Considerable areas of rural lands are degraded, resulting in low agricultural productivity. The capacity of the economy to absorb the landless and the rural unemployed is inadequate. With insufficient income and food shortages, poor people from both the rural and urban areas depend upon the remaining natural resources. Land and soil degradation, caused by depletion of natural high forests and woodlands, presently stands out as the most severe environmental problem in Ethiopia.

Ethiopia's rapid loss of its natural resource base is jeopardizing the well-being of its people. Dwindling resources in the face of an ever-growing population could kindle conflict over scarce resources and political instability. Some development efforts of the past lacked basic considerations of critical elements such as land tenure, education, and rural infrastructure, or were based on ideologically driven, rather than science-based, resource use and management plans. The need for natural resources education in Ethiopia is very critical as the country currently faces severe deforestation and environmental degradation. Solving these problems and ensuring that future generations can enjoy the benefits of the earth's natural resources will require better and more careful

management, along with NRM professionals who can train today's farmers and managers and educate the next generation.

Education in NRM can make a significant contribution toward altering the ecological trajectory of Ethiopia and can play an important role in food security, poverty alleviation, and development of a sustainable future. Among other things, increased understanding of the underpinnings of the science and practice of NRM can improve the sustainability of current land use practices (such as reducing erosion), promote new sustainable sources of income (such as ecotourism), and create new national human capital by training future policy makers in sustainable NRM.

Wondo Genet College of Forestry and Natural Resources (WGCF and NR) at the University of Hawassa is responding to this challenge by establishing undergraduate and graduate programmes in NRM with four major specialty areas. Temu et al. (2006) discussed the competition, collaboration, and interdisciplinary nature of forestry education in Africa. The expanded understanding of forestry to include agroforestry, soils, water, fish, wildlife, timber, biodiversity, and all forms of flora and fauna suggests that we look beyond trees or timber management and broaden our thinking to include whole ecosystem management and conservation. The College has realized the positive side of integrating all of these aspects into a holistic natural resources education programme.

Equally important is the need to undertake development-oriented research that will address real-life social, environmental, and economic issues and also improve the quality of education in Eastern Africa. The Forestry Research Centre (FRC) at the Ethiopian Institute of Agricultural Research (EIAR) and WGCF and NR has national mandates to conduct research on the biology and social issues of natural resources. Strengthening WGCF, NR, and FRC in natural resources education and research will help them play an important role in conserving and developing forestry and natural resources and in addressing food security issues in the country. WGCF and NR has already started a Development-Oriented Interdisciplinary Thematic Action Research (DOITAR), supported by the Swedish International Development Agency (Sida). Although this effort is encouraging, it requires the involvement of many international institutions and professionals to achieve the intended goals. As a partner to these Ethiopian forestry institutions, Oregon State University (OSU) can provide assistance in developing their academic and scientific capacity and infrastructure to address challenges to Ethiopia's natural resources and food security.

This paper presents the achievements and work in progress of the institutional partnership between University of Hawassa, Ethiopian Institute of Agricultural Research and Oregon State University, which began in September 2003 with funding from the United States Agency for International Development (USAID).

7.1.2 Enabling policy environment

Ethiopia has adopted policies and strategies pertinent to poverty reduction, food security, and environmental protection. Especially significant is The Environmental Policy (1997), a comprehensive set of principles that encompass environmental issues, such as soil husbandry, sustainable agriculture, biodiversity, forests and woodlands, water, and mineral resources. Moreover, cross-sectoral environmental concerns, such as population, community participation, tenure and access to natural resources, and gender issues are also addressed.

The Rural Development Policy and Strategies (Federal Democratic Government of Ethiopia, 2001) and the Food Security Strategy (2002) aim at building an economy that ensures food security and alleviates poverty. The strategies are founded on the concept that improved land use practices, conservation, appropriate use of natural resources and diversifying production activities on limited land resources are central to reducing poverty. The strategies stress building the productive capacity of human resources and emphasize the importance of training and education to achieve these goals.

Ethiopia has also adopted a new Education and Training Policy (1994), which introduced changes and reforms in the sector. Higher education in Ethiopia is expanding and being directed toward producing professionals and researchers capable of generating new development ideas geared towards solving the social and economic problems of the country. The strategy envisions substantially increasing student enrolment and emphasizes expansion of postgraduate programmes. This viewpoint is congruent with the national education policy of Ethiopia and The Ten Year Strategic Plan of University of Hawassa. WGCF and NR is in a competitively and comparatively advantageous position to play a key role in this transition in terms of faculty, facilities, and readiness of curricula, and with its long-standing high-level education and research experience in the areas of forestry and natural resources.

7.2 PARTNERSHIP INSTITUTIONS AND LOCATION

7.2.1 Wondo Genet College of forestry and natural resources, University of Hawassa

The WGCF and NR at the University of Hawassa is located in the Southern Region Nations and Nationalities State in the Rift Valley of Ethiopia, about 275 km south of Addis Ababa. It was established in 1978 as a Forestry Institute to train forest technicians (diploma level). The programme began with 20 students, and today has more than 900 students. Today, most of the foresters working in the fields of forestry and related natural resources fields in governmental and non-governmental organizations in Ethiopia are graduates of WGCF & NR.

The WGCF and NR aspires to become a regional centre of excellence in forestry and natural resources education, research, and extension, and to be a leader in academic activities relevant to food security, poverty alleviation, and the conservation and sustainable management of natural resources. This vision will be achieved through enhanced education at the undergraduate, graduate, and professional levels, and through research and extension for the advancement of science and technology in forestry and related disciplines. The goals and objectives of the college are to:

Train a sufficient number of highly qualified graduates in forestry and NRM at different levels to satisfy Ethiopia's needs and to contribute to broader regional needs; and
Generate knowledge, produce, and disseminate client-oriented technologies needed to meet the country and region's natural resources demands.

Currently the academic programme at WGCF and NR is organized into two faculties, forestry and natural resources, each with three departments. The College offers five undergraduate and two graduate programmes. The College is well equipped with facilities that include specialized laboratories, computer and GIS centres, and a library. The students are provided with dormitories, a cafeteria, recreational facilities, and satellite television services. The existing staff and infrastructure provide a solid foundation for the development of new programmes.

WGCF and NR has close working relationships and collaborative educational and research activities with Alemaya, Mekele, Jimma, and Addis Ababa universities; the Ethiopian Institute of Agricultural

Research; the Ethiopian Biodiversity Institute, and many non-governmental organizations. The College has a long-standing partnership and support from the Swedish International Development Agency (Sida). The MSc. training offered jointly with the Swedish University of Agricultural Sciences (SLU) has produced over 100 students in seven cohorts. Since September 2003, the College has begun development of short-term training programmes and curricula for new natural resources educational programmes in collaboration with the College of Forestry (COF) at Oregon State University (OSU) through support from USAID. It has also a long-standing relationship with the World Agroforestry Centre (ICRAF) and Center for International Forestry Research (CIFOR).

7.2.2 Forestry Research Centre, Ethiopian Institute of Agricultural Research

The Institute of Agricultural Research (IAR) was established in February 1966, with a mandate to formulate a national policy for agricultural research and to implement that policy through coordinated research centres. In 1997, IAR was reorganized to form a national agricultural research system, the Ethiopian Agricultural Research Organization (EARO), to coordinate all related research undertaken by different institutions in different parts of the country. EARO is responsible for generating, improving, and adapting technologies, and for coordinating, encouraging, and assisting research to meet the current and long-term agricultural requirements of the country. Recently EARO has been renamed as Ethiopian Institute of Agricultural Research (EIAR) and has five Directorates: crops, livestock, soil and water, forestry, and dry land agriculture.

EIAR's Forestry Research Centre (FRC) has been doing forestry research since its establishment in 1974. Its mission is to improve the social, economic, and environmental well being of rural and urban communities and the people who, directly or indirectly, depend on forests and forest products. Research at FRC is demand-driven, client-oriented, participatory, multidisciplinary, and gender sensitive. Agroecology-based research generates knowledge and appropriate technologies for the development, sustainable utilization, and conservation of forest and woodland resources, thereby enhancing agricultural production and efficiency. The Centre has limited resources and research facilities and a staff of young scientists with little experience. Upgrading research facilities and providing advanced training to improve scientists' skills are priorities of the FRC. Through this partnership, FRC staff has received

short-term training in proposal preparation, scientific writing, and the preparation and presentation of scientific papers.

7.2.3 College of forestry, Oregon State University

Oregon State University (OSU) is one of only two American universities to hold the Land-, Sea-, Space-, and Sun Grant designations, and is a Carnegie Doctoral/Research-Extensive University. Faculty and staff of OSU's 11 academic colleges are committed to excellence in traditional undergraduate and post-graduate education, research, and extended education.

The COF at OSU is one of the world's premier educational, research, and outreach institutions focused on broad areas related to forestry and natural resources. The mission of the College is to educate and engage the next generation of scholars, practitioners, and users of the world's forest resources, to conduct distinctive problem solving and fundamental research on the nature and use of forests and related resources, and to share knowledge with others. The College prepares graduates to understand the complexity of forests and the economic and social systems that depend upon them; to work with nature to keep land healthy for future generations; to know the science, technology, and business associated with understanding, managing, and using forests and related resources; and to work effectively with others in a culturally diverse, global society.

The College's comprehensive research programme is at the core of one of the largest assemblages of forest scientists in the world. The OSU campus also is home to major research units of the U.S. Government. The College administers one of the largest and most effective extension forestry programmes in the country.

The OSU COF is at the forefront of international issues in forestry and NRM. The primary aim of the international programmes in the college is to enhance understanding of global forestry and natural resources issues through education and research about the international dimensions of forest resources and forest product trade. Many College faculty staff and students are actively involved in research, outreach, and education at locations spread across the world. Examples include work to strengthen forestry education and research in South Africa, a rural livelihoods improvement project in southern Africa (Malawi, Zambia and Mozambique), and enhancing the economic and environmental

sustainability of Mexico's forest sector. OSU professors also lead monitoring and validating the distribution and change in land cover across northern Eurasia, and serve on the Expert Advisory Committee of the AsiaFlux Research Network in Japan, China, Thailand and Indonesia.

The OSU College of Agricultural Sciences administers programmes in Rangeland Resources and Fisheries and Wildlife. There are strong, formal ties between the Colleges of Forestry and Agricultural Sciences in the areas of natural resources economics, agroforestry, entomology, soil science, and plant pathology via joint and courtesy faculty appointments. There is also a shared land grant mission and budget and programme planning coordination. The Agricultural Experiment Station, the Oregon Extension Service, and the Forest Research Laboratory comprise the state-wide public service units headquartered on the OSU campus. These three units represent the core of the major land grant functions of the university.

7.2.4 The partnership

The partnership, "Strengthening Natural Resource Education and Research in Ethiopia", was conceived about 5 years ago i.e. in 2002 to address the serious natural resource issues that threaten the survival of Ethiopia. The vision for this institutional partnership was initiated through formal visits made by institutional leaders and faculty of WGCF & NR, EIAR and OSU in January and July 2002. The Dean of WGCF and NR spent 6 months at OSU, working collaboratively to develop a teaching manual for agroforestry, and a partnership proposal to USAID. After much discussion and dialogue by e-mail, a Memorandum of Understanding was later signed between Debub University (now University of Hawassa), EIAR, and OSU to initiate collaboration in forestry and natural resources education, research, and outreach.

The purpose of this partnership is to build human and institutional capacity for the management of natural resources in Ethiopia and help prepare trained professionals to better manage existing natural resources and develop sound research to address food insecurity and natural resource and environmental problems. This partnership is congruent with the objectives of the Building Africa's Scientific and Institutional Capacity for Agriculture and Natural Resources whose acronym is BASIC (ANAFE, 2004). The BASIC model of institutional partnership includes an African university, an Agricultural Research Institute, and a Northern University.

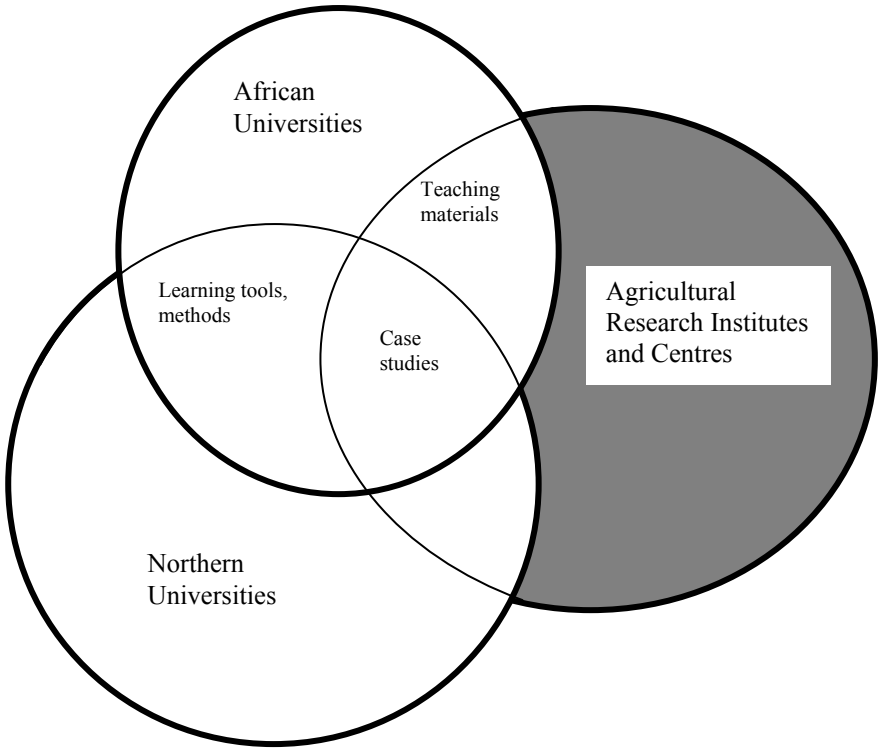

Figure 7.1: The Role of the Different Partner Institutions (ANAFE, 2004)

Figure 7.1 shows how the different partner groups will relate to each other. In this case, the collaboration was initiated by the University of Hawassa's WGCF, NR, and FRC at EIAR. OSU serves as the Northern University partner and assists both institutions in strengthening education and research capacity in forestry and natural resources. To achieve the specific objectives of the partnership four major activities were outlined: (1) natural resources curriculum development at WGCF & NR, (2) preparation of problem-solving, applied research proposals at FRC, (3) workshop on communications and scientific writing skills, and (4) workshop on communications, pedagogy, and the use of educational technology. Orientation and planning meetings were held at WGCF and NR and in Addis Ababa by project co-directors from OSU, University of Hawassa, and EIAR. The partnership established two task forces at WGCF and NR and three working groups at FRC. Subsequent paragraphs outline the achievements of this partnership (phase I) as outputs and outcomes.

Project funding in the amount of $124,000 was provided by the USAID/Higher Education for Development (formerly ALO) in Washington, DC; OSU and the Ethiopian partner institutions have also contributed $38,809 as cost share commitment to the project. The partnership has also secured additional funding of $12,000 from the USAID Mission in Addis Ababa, Ethiopia to run the Natural Resource curriculum review workshop at WGCF & NR.

An additional project document that identifies the needed manpower, facilities, equipment, and budget to start the new undergraduate and graduate natural resources programmes at WGCF and NR has been prepared by the partnership. This will be presented as work in progress of the partnership between WGCF and NR and OSU. This forms the implementation project document and leads to Phase II of the partnership (Bishaw et al., 2006; WGCF, 2005).

7.3 OUTPUTS AND OUTCOMES OF THE INITIAL PARTNERSHIP

7.3.1 Workshop on scientific communications and education

Two faculty members from OSU conducted workshops on Communications and Scientific Writing skills, and Pedagogy and Use of Educational Technology to faculty and staff members of WGCF and NR and FRC. The first workshop, on the preparation of scientific papers and reports, was held from January 12 to February 6, 2004. The objectives of the workshop were to introduce the principles of scientific communication, including written and oral communication strategies, audience analysis, organizational principles, and composition, editing and revising, and preparing a manuscript for publication; and to encourage participants to prepare their own research for publication as a peer-reviewed paper, extension publication, or grant proposal.

The workshop was presented in nine lessons and participants received in-class and take-home writing assignments. They were asked to furnish one of their own research papers to use in the workshop, with the goals of improving the communication of their own research and moving their papers closer to readiness for publications. At FRC, 18 staff attended on the first day, 12 of them received certificates of completion; at WGCF, NR 10 staff attended classes, and 4 of them received certificates of completion. This workshop conveyed much useful information and has

strengthened the partnership between OSU and the forestry teaching and research efforts in Ethiopia (Bishaw, 2005).

The workshops on communications and pedagogy were conducted from June 13 to July 23, 2004 at FRC and WGCF & NR. At FRC, the objectives were to strengthen presentation skills for classroom teaching and delivery of scientific papers and skills in use of educational technology (Microsoft PowerPoint for production of visual aids and posters, and digital photography). Additional objectives for teaching faculty at WGCF and NR were strengthening skills in pedagogy, particularly the development of measurable learning objectives and course syllabi; and evaluation of student learning and teaching using formal and informal feedback from students.

Workshops were broken into 3 days on presentation skills, 2 days on educational technology, and 2 days on pedagogy at WGCF & NR. Workshops at FRC were scheduled for 2-3 hour blocks once a day, with additional time available for individual instruction. At WGCF & NR, most workshops were offered twice daily to maximize the number of people able to attend. At FRC, 24 people attended at least one workshop and 12 received certificates. At WGCF & NR, 27 people attended at least one workshops and 13 received certificates. Overall attendance was highest at presentation skills sessions at FRC, and interest was highest in pedagogy at WGCF and NR (Bishaw, 2005).

At both institutions, no special time was set aside for participants to attend workshops and it appears that the workshops were scheduled during the busy time at both institutions. If possible, future workshops should be scheduled at intervals during the school or work year when participants' normal duties are light. It would be also helpful if administrators at the host institutions offered leave time to their employees to attend the workshops.

7.3.2 Faculty and staff exchange through the partnership

Faculty exchange is one of the major components of the partnership. Faculty and staff from both Ethiopian partner institutions have spent 5-6 months on research leaves and internships. Four Ethiopian faculty members from FRC and WGCF and NR have spent 2 weeks in the United States attending the USAID Conference in Washington, DC and visiting the OSU COF's education, research, and outreach facilities. During this time they also visited with faculty and university

administrators to discuss how to extend collaboration in the future. Two of the Ethiopian project coordinators have spent 4 weeks at OSU working on the curriculum development and preparation of an integrated watershed management research proposal. Three WGCF and NR faculty have spent 6 months each at COF on research leave. This has given the Ethiopian faculty more time to interact and exchange experiences with OSU faculty staff. One of the FRC faculty members also spent a 5-month internship at OSU and was mentored by senior OSU faculty. The State Minister of Higher Education in Ethiopia has spent 1 week at OSU working with COF administrators on developing the second phase of this project. He visited with university officials to explore possibilities for expanding the partnership and soliciting funding to support it. The partnership has now expanded; recently a professor from the Biology Department of Addis Ababa University visited the COF to explore possibilities for future collaboration.

Seven OSU faculty members have visited WGCF and NR and FRC. The project co-director from OSU visited for 3-4 weeks, attending the initial planning meetings, participating with task forces in the development of the Natural Resource curriculum at WGCF & NR, and in the development of the integrated watershed management proposal at FRC. Along with the Associate Dean of International Programmes and another programme administrator, he met with deans, directors, university presidents, State Ministers and USAID officials to discuss the progress, future, and benefits of the project. As noted above, two OSU faculty spent 4 weeks in Ethiopia to conduct training workshops. The Director of Communications from COF also visited WGCF and NR for 2 weeks and assessed the potential and limitations of the Internet Network at the College, and provided recommendations for improving the system. Internet communications was one of the major bottlenecks for partners to communicate effectively and share educational materials. A professor from COF spent 5 days in Ethiopia exploring the possibility of initiating a watershed management project in the Blue Nile Basin. He visited the Blue Nile region, met with experts and officials from FRC at the EIAR and the International Water Management Institute located at International Livestock Research Institute in Addis Ababa. He has now secured funding to hire a post-doctoral fellow to conduct a literature review and collect relevant information from the regional and international research centres located in Ethiopia.

7.3.3 Natural resource curriculum development

The Approach: Needs Assessment

The concept for developing an NRM programme arose during brainstorming exercises with WGCF and NR staff. A task force consisting of five members from WGCF and NR and one from OSU was assembled in March 2003 to assess concept's potential. The task force first developed a checklist and conducted a survey aimed at understanding human resources needs in NRM. About 110 respondents were identified, including prominent professionals in natural resources and related fields and from institutions such as major departments in the Oromia, Southern Nations, Nationalities and People Regional States, an Agricultural Bureau from Amhara Regional State, federal offices and organizations, universities, research institutions, and NGOs (Bishaw, 2004).

7.4 RESULTS AND INTERPRETATION

Ninety-three respondents were interviewed and the results indicated 18 different fields of specialization related to natural resources. In order of ranking, the six fields most often identified were (i) Soil Conservation and Watershed Management, (ii) Forestry, (iii) Water Resource Management, (iv) Wildlife and Fisheries, (v) Biodiversity, Nature Conservation and Ecotourism, and (vi) Economics and Policy (social issues). Forestry education was already well established at WGCF and NR, so it was omitted from the ranking. A curriculum for an undergraduate programme in General NRM was then prepared and reviewed by the College staff and some prominent professionals. The curriculum was approved by the Academic Commission of the College. University of Hawassa and the Ministry of Education accepted this undergraduate programme in August 2003. Currently there are two batches of students enrolled in the programme.

To assess the relevance of the new curriculum, the task force surveyed 150 summer students with 7-21 years experience as semi-professionals in the field of agriculture and forestry. The respondents felt that the curriculum was too broad and general and that such an approach might not allow graduates to be employed in specialized fields/projects. The task force went back to the original ranking results and raised the issue to the College staff at WGCF and NR. It was agreed that new programmes should be developed in Soil Resources and Watershed Management, Natural Resource Economics and Policy, Wildlife and Fisheries

Management, and Nature Conservation and Ecotourism. Sub-committees were formed to develop a curriculum for each individual programme. The work of the subcommittee was compiled by the task force and submitted for review to prominent scientists in the respective fields at OSU (Bishaw, 2004).

7.4.1 Curriculum enrichment at Oregon State University

The draft document was circulated to OSU faculty in Forestry, Rangeland Resources, Fisheries and Wildlife, and Natural Resources for review. The project coordinator from WGCF and NR spent one month at OSU consulting with faculty staff about the curriculum and revising the draft document, which was later distributed to participants of the curriculum workshops in Ethiopia.

7.4.2 Curriculum Review Workshop at Wondo Genet

A one-day workshop on natural resources curriculum review was conducted at WGCF and NR in November 2004. The participants were selected based on their professional background and experience. During the workshop, members of the task force responsible for curriculum development presented an overview of the draft curriculum proposed for the four departments showing the relevance of each department, the graduates' profile and career possibilities (sustainability and attractiveness of the programme), and lists of proposed courses, including common and specialized courses.

Based on workshop feedback, the following curricula were developed: (i) Soil Resource and Watershed Management, (ii) Nature conservation and Ecotourism, (iii) Wildlife and Fisheries, and iv) Natural Resource Economics and Policy. The programmes and their respective curricula were later approved by the University Curriculum Standardization committee. Detailed curricula and programmes for each of the departments are compiled as separate documents in the Proceedings of the Undergraduate Natural Resource Review Workshop (Bishaw, 2004).

7.5 PROJECT DESIGN AND IMPLEMENTATION (PHASE II)

The USAID-funded project (Phase I) culminated on September 2005 by developing the natural resource undergraduate curriculum for WGCF & NR, the integrated watershed management research proposal for FRC and provided training on scientific writing, communication and, pedagogy for

staff at FRC and WGCF & NR. OSU and the University of Hawassa continued their partnership by leveraging some funding from their own resources to support project development. Because of this effort, a project document to implement the natural resource education programmes and establish a centre of excellence for research and outreach in natural resources and biodiversity at WGCF and NR was prepared. This document is intended to form the bases for Phase II of the partnership. Highlights from the project document are outlined below.

7.5.1 Project structure and overview

The proposed project has three integrated components at WGCF & NR: enhancement of the undergraduate education programme, enhancement of the graduate education programme, and development of a Centre of Excellence for Research, Outreach, and Development in Natural Resources and Biodiversity for Africa (Figure 7.2).

The proposed project provides for related programme administrative expenses and is structured to allow development of each project sub-component separately, although administrative efficiencies and programme synergies are gained by implementing all three components simultaneously. Implementation of the three project sub-components will substantially enhance regional capacity for natural resources education, research, and outreach in Africa. Project implementation is anticipated to provide much-needed regional capacity for natural resources education, facilitate development of a new generation of African resource managers, researchers, and educators; create new, region-specific knowledge relevant to food security, poverty alleviation, and sustainable management of natural resources, and disseminate information on NRM and sustainable land use practices to Ethiopian farmers. Although substantial benefits are expected for Ethiopia, the project is designed to ensure broader regional benefits as well by providing travel grants and scholarships for Africans outside Ethiopia to attend training sessions and short courses in Ethiopia, and by initiating research activities across a broad range of agro-ecosystems that are relevant across much of Sub-Saharan Africa.

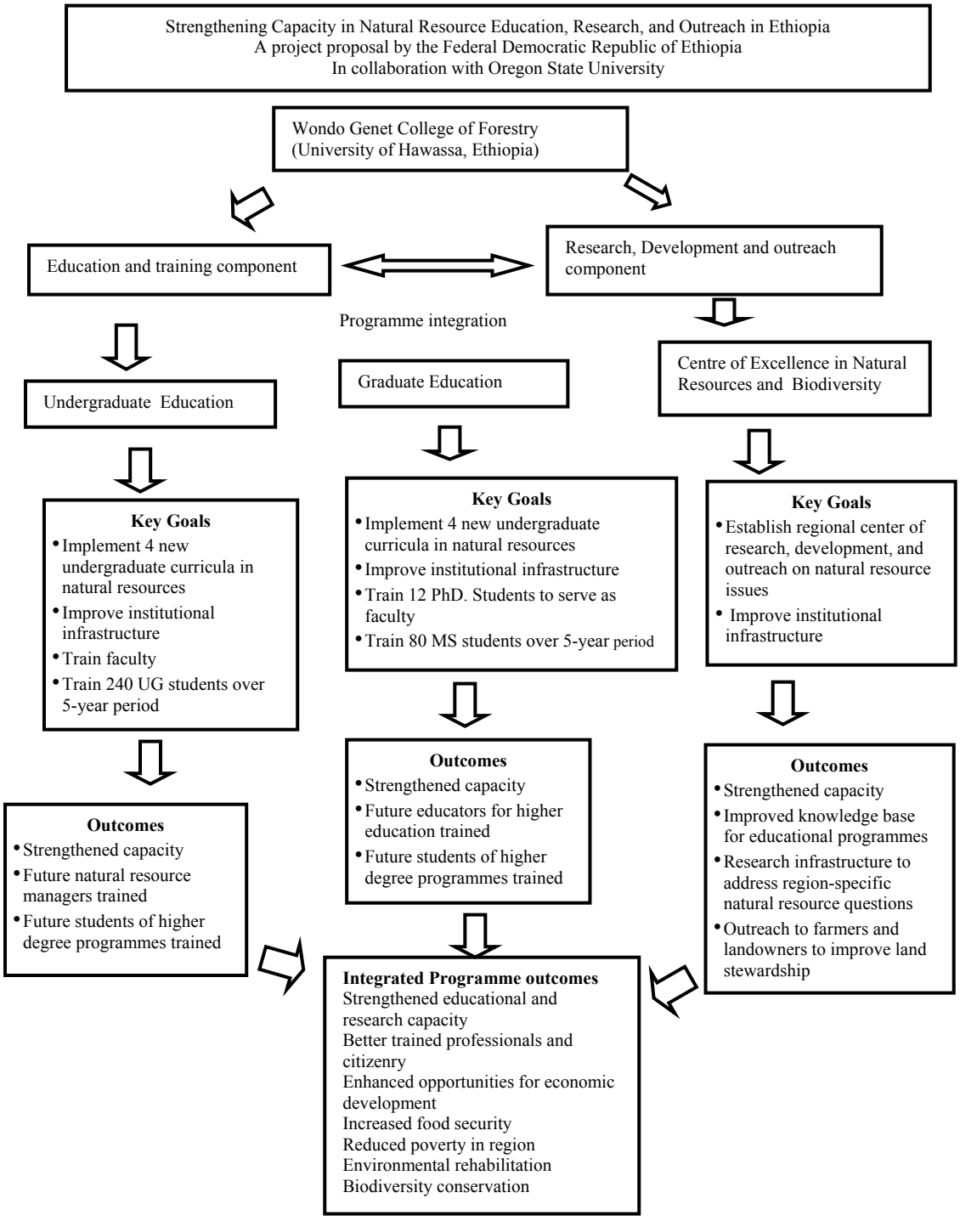

Figure 7.2: Wondo Genet Programme Structure for Natural Resource Education and Research

7.5.2 The need for a regional centre in natural resources education and research

BASIC is a new concept in capacity building in Africa. Its vision statement notes the need for Agricultural Universities in Sub-Saharan Africa to catalyze, guide and lead scientific and institutional capacity building nationally and regionally (ANAFE, 2004). The National Association of Professional Forestry Schools and Colleges (NAPFSC) in the United States also support development of higher education in natural resources around the world. NAPFSC sponsored a Forum on Forestry and Natural Resources for Africa at Virginia Polytechnic Institute and State University in February 2003, during which many issues affecting forestry and NRM and education in Africa were explored with help from USAID and other NGOs. One recommendation was the organization of a Natural Resources Partnership for Africa (NRPA) with membership open to any NAPFSC school. There were only nine U.S. universities at the forum (including OSU) with substantive African experience, however (Anonymous, 2003).

The overriding purpose of the NRPA partnership is to enhance the capacity of higher education in three geographic regions (west, south, and east) of Sub-Saharan Africa to provide long-term education and training for management of the forest, wildlife, water, and park resources. In its concept for educational capacity building, the forum considered the interrelationship among social, economic, health, and natural resource issues of Sub-Saharan Africa. NRPA proposed three goals: strengthen institutional curricula for training certificate, and degree programmes, develop long-term faculty development opportunities and work with selected institutions to acquire learning resources; and develop educational infrastructure (Anonymous, 2003). However, due to lack of funding and the reorganization of the Africa Programme within USAID, which sponsored the forum, the NRPA plan never materialized. We believe that the natural resource education partnership between OSU and WGCF and NR is congruent with the concepts of NRPA and can serve as a model to meet the proposed goals of the partnership for Africa.

7.5.3 Why Wondo Genet College of Forestry and Natural Resources?

Strengthening the capacity of African universities will help build the capacity Africa requires to develop endogenously driven innovation systems that will make African agriculture increasingly knowledge-based and rooted in sustainable NRM. WGCF and NR is uniquely located to

teach natural resources education and to serve as a centre of excellence for biodiversity research for Ethiopia and other Eastern African countries. WGCF and NR is located:

- Near globally recognized biodiversity conservation sites and national parks, in a country identified as among the top 25 in mega diversity and as a centre of origin for crop diversity;
- Within reasonable driving distance of eastern and western Great Rift Valley escarpments characterized by a wide ecological gradient, from arid to the afro-alpine ecosystems;
- In the midst of the seven Rift Valley lakes and eight wildlife national parks that make it ideal to teach hands-on fisheries and wildlife courses;
- Close to traditional agroforestry land management systems that are exemplary for ecological sustainability, as well as pastoralists, that together provide a learning centre for 40 ethnic groups on tradition and culture; and
- In proximity to the capital city Addis Ababa, with the international airport, various local, national, and international organizations, very good infrastructure, and first class asphalt roads.

Additionally, the already-established DOITAR Programme sets the foundation for conducting national research in integrated NRM, and creates opportunities for students to work with international scholars. WGCF and NR is thus uniquely qualified to play a leading role in coordinating the efforts of national and international institutions contributing to natural resources education, research, and development in the region.

7.6 PROGRAMME OBJECTIVES

The overall objectives of this project are broad ranging and address sustainable environmental, social, and economic improvements for the entire African continent. They include:

- Improving WGCF and NR institutional capacity through diversification of academic programmes and increasing the quality and relevance of core education and research activities;
- Creating a Centre of Excellence for Africa in NR and biodiversity education and research;
- Contributing to poverty alleviation, food security, and sustainable management of natural resources through education, research, and extension activities; positioning WGCF and NR to become a

leader in poverty alleviation efforts; and enhancing global competitiveness; and
- Training large numbers of highly skilled professionals who can directly contribute to improving social welfare, ecological sustainability, and economic development of Ethiopia and Africa.

7.7 OUTPUTS AND OUTCOMES

By the end of the project period, these outputs are expected for the undergraduate programme:

- Initiation of four new undergraduate degree programmes in the fields of Soil Resources and Watershed Management, Nature Conservation and Biodiversity, Natural Resources Economics and Policy, and Wildlife and Ecotourism at WGCF & NR;
- Enrolment of 240 students in the four new programmes during the first 5 years;
- Six short-term training sessions for 30 faculty members and administrators in Africa focused on pedagogy, teaching material preparation, curriculum development, research design and dissemination, networking, and higher education administration and management;
- Fifteen international educators serve the college for a period of one semester each, teaching courses and advising students in the new programmes;
- Sixteen short-term international educators serve the college for a period of 1-3 months and provide training for faculty and staff and college and university administrators;
- About 240 student action or development-oriented interdisciplinary thematic research topics are prepared and undertaken by undergraduates as partial fulfilment of degree requirements;
- Capacity to support education and research for undergraduate students is built. Classrooms, offices, laboratories, and libraries are constructed to serve additional students. Vehicles, office and teaching equipment, furniture, and books and journals are procured, improving the institutional capacity in teaching and research.

By the end of the project period, these outputs are expected for the graduate programme:

- Seven additional Master's level programmes are initiated in the fields of Forest Biology, Dryland Forestry, Agroforestry and Soil Fertility, Watershed Management and Soil conservation, Rural Development studies, Wildlife Management and Natural Resources Economics and Policy at WGCF & NR;
- Enrolment of 80 MS students in the seven new programmes during the first 5 years.
- Twelve WGCF and NR faculty are trained at PhD level, enrolled in universities abroad;
- Sixteen WGCF and NR faculty are trained at MS level, enrolled in Ethiopian/African universities;
- Six short-term training sessions conducted at WGCF and NR will be available for 24 faculty and staff from WGCF and NR and other institutions in Africa. Training will focus on pedagogy, teaching material preparation, curriculum review and development, research design and dissemination, networking, and higher education administration and management;
- Ten expatriate teaching faculties serve the college for a period of one semester each, providing courses in the seven newly launched MSc. programmes;
- Four expatriate faculty and staff provide short-term local trainings to faculty and staff of WGCF and NR and University of Hawassa;
- About 80 MSc. students conduct action or development-oriented interdisciplinary thematic research projects in partial fulfilment of degree requirements;
- Capacity to support education and research for graduate students is built, including 20 graduate student offices, 4 specialized laboratories, classrooms, laboratories, and libraries. Vehicles, office and teaching equipment, furniture, books and journals are procured and capacity for local printing and duplication is developed.

A Centre of Excellence for Research, Outreach, and Development in Natural Resources and Biodiversity for Africa is established at WGCF and NR to serve professionals, development partners, and the larger community of the sub-Saharan African nations. The Centre outputs include:

- Specialized laboratories, libraries, and research and demonstration sites are constructed and developed at WGCF and NR and in the major agro-ecological zones of Ethiopia to improve research, graduate training, and international networking;

- Five faculty and centre administrators receive short-term training abroad focused on strategic planning, techniques in research and development, international networking and collaboration, and administration and institutional management;
- Five East African scientists and administrators receive short-term training at WGCF & NR;
- Ten short-term, hands-on NR training sessions emphasizing tree production, protection and management, crops and livestock are conducted for farmers in different agro-ecological zones;
- Five short-term training sessions on NRM are given for mid-level professionals from NGOs and private organizations participating in extension and outreach programmes;
- Ten international researchers and educators serve the college by undertaking collaborative research with Ethiopian professionals and provide training for Ethiopian/African scientists;
- Four short-term international faculty and staff provide training to WGCF and NR faculty and staff and University of Hawassa on scientific writing, research planning, and administration; and
- Vehicles, office and research equipment, furniture, and books and journals are procured to improve infrastructure and institutional capacity.

7.8 OVERALL PROJECT RESOURCE REQUIREMENTS

To strengthen the institutional capacity of WGCF and NR and to start new undergraduate programmes, graduate programmes, and a centre of excellence, the anticipated financial expenditure required through the five years (2007-2012) of the project life is estimated to be $17,441,818. Of this, the Ethiopian government has agreed to contribute $6,522,815 and we are seeking outside support for $10,919,003. A budget narrative that explains assumptions used to calculate the costs associated with implementing the programmes is available upon request. Estimated financial resources needed are categorized by anticipated contributions from the Ethiopian government (Table 7.1) and requested donor support (Table 7.2).

Table 7.1: Anticipated Ethiopian Government Contribution (USD).

Inputs	2006/7	2007/8	2008/9	2009/10	2010/11	Total (USD)
Capital Investment						
Classrooms & offices	51,162	116,280	59,534			226,976
Laboratories	32,558	23,255	60,930			116,743
Library	162,790	116,280	72,095			351,165
Equipment	11,627	23,255	58,139	23,255		116,276
Furniture	5,815	11,627	23,255			40,697
Recurrent Budget						
Faculty & staff salary	312,790	344,070	378,488	416,280	457,907	1,909,535
Non-salary	525,349	630,465	693,372	762,674	838,953	3,450,813
Sub-total						6,212,205
Contingency (5%)	55,105	63,262	67,290	60,110	64,843	310,610
Grand total	1,157,196	1,328,494	1,413,103	1,262,319	1,361,703	6,522,815

Table 7.2: External Financial Resources Required by Programme (In USD)

Inputs	2006/7	2007/8	2008/9	2009/10	2010/11	Total
Undergraduate Programme	1,071,707	947,994	663,545	514,425	539,066	3,736,736
Graduate Programme	463,840	1,445,053	1,082,142	1,053,153	581,833	4,626,021
Centre of Excellence		593,722	613,891	226,146	238,362	1,672,121
Programme Administration	135,137	135,451	232,350	142,046	239,143	884,125
Total	1,670,684	3,122,220	2,591,927	1,935,770	1,598,402	10,919,003

7.9 PROJECT MANAGEMENT, MONITORING AND EVALUATION

Project managers in the COF at OSU and WGCF and NR at University of Hawassa will manage the project. Programme implementation will include continuous monitoring and evaluation within the existing system

of WGCF and NR and COF at OSU. The Dean of WGCF and NR and the Director of International Programmes, COF, will oversee coordination and implementation of the project.

Detailed work plans and budgets will be prepared annually, with semi-annual progress reports to the Dean of the COF at OSU, the University of Hawassa, and other entities as appropriate, on implementation of action plans and disbursement of finances. Major evaluations will take place midway through the project and at completion of the project. Both internal and external evaluation reports will form the evaluation process. The mid-term evaluation will focus on the effectiveness of the implementation of the project, successes and challenges faced during implementation, and possible modifications to better meet project objectives.

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8 Renewable Natural Resources Education in Nigeria: University of Ibadan Experience

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ABSTRACT

Renewable Natural Resources (RNR) Education in Nigeria pre-dated political independence from Britain in October, 1960. This paper, signposts activities in the Departments of Forest Resources Management and Wildlife & Fisheries Management, University of Ibadan. Issues addressed include historical background; international objectives of the programme; international students enrolment, current student enrolment; graduates from the two departments; capacity building; training and re-training; infrastructural facilities; availability of funds; Student Industrial Working Experience Scheme (SIWES); creation of Faculty of RNR; and the issue of quality assurance in the face of dwindling resources. To date, the two departments had produced 1,989 B.Sc; M.Phil; MSc; and Ph.D. graduates. Current enrolments at both undergraduate and postgraduate levels indicate a total number of 510 students. Mid-career capacity building through staff training abroad has been deficient in the two departments. The Practical Year Training Programme has been improved upon through the introduction of SIWES in both government and non-government renewable natural resources organizations. At the Postgraduate level a number of quality assurance mechanisms are in place to compensate for the increase in enrolment and shortfall in staffing. A proposed Faculty of RNR is receiving attention in the University. A holistic response should be evolved for emerging challenges in renewable natural resource education. This should include capacity building and

strengthening, national and regional collaboration among RNR institutions, curricula review and alignment to cater for emerging market realities, fostering and strengthening of e-learning among others.

8.1 INTRODUCTION

Renewable Natural Resources (RNR) Education at University level in Nigeria pre-dated the gaining of political independence from Britain in October 1960. The premier and the only university institution then, the University College, Ibadan (now University of Ibadan), was established in 1948. However, according to Adeyoju (1976) the International Bank for Reconstruction and Development had, in 1954, recommended that a Faculty of Forestry be established at the University College Ibadan to enable teaching start in the 1957/58 session. Unfortunately, no action was taken and although the *Ashby Commission Report* on higher education published in 1960 did reiterate the need; it did not however, emphasize the urgency for the programme in view of the relatively few numbers of professional foresters foreseen, compared with other disciplines. From all indications, the idea of a Department of Forestry at the University of Ibadan (UI) occurred at a momentous international political setting. It was conceived at an international gathering that was hatched through negotiations between Nigeria and the United Nations Organisation (UNO); and was designed as a training centre for Nigeria, West Africa and Africa in general. As at 1960, the predicted manpower needs of Nigeria for professional foresters stood at 8 to 10 a year. Undoubtedly, a class of 10 students was not only small but also grossly uneconomic in view of the basic capital outlay and expertise requirement and also because of inevitable laggards each year, which could reduce the final year class to seven or six. In order to establish a viable programme in which full and/or maximum utilization of capital resources were assured, it became imperative that the facilities being assembled at Ibadan should be available to other nations (Department of Forest Resources Management and Department of Wildlife and Fisheries Management, University of Ibadan, 1988).

Before 1960 Nigerian professional foresters were very few, only 27 of the 82 professionals during that period were Nigerians, the remaining 55 being expatriates. Also in that year there were about 20 Nigerians undergoing forestry degree courses mostly in Britain. However, it was evident that neither the expatriates nor the Nigerian foresters' possessed adequate knowledge and training exposure to the tropical environment to enable them undertake the relevant tasks efficiently. Consequently, at the

inaugural meeting of the African Forestry Commission in 1960 (sponsored by the Food and Agriculture Organization (FAO) of the United Nations in Ibadan) the resolution for the establishment of a professional Forestry School within the West Africa sub-region was adopted. It was further stressed at that meeting that the number of graduates required in Nigeria was sufficient to justify the setting up of a training establishment.

The Department of Forestry at UI began in October 1963 with the assistance of FAO, although the first set of students had been registered in the Department of Agriculture in the previous year. When the FAO assistance was terminated in October 1972, the Department had been fully established with a strong and resilient programme, and an undisputed reputation as a regional forestry training centre. It had, at one time or another, received students from Sierra Leone, Ghana, Cameroon, Ethiopia, Sudan, Kenya, Tanzania, Uganda, and Zambia, as well as Malaya and Fiji Islands. It is also of interest to note that in Cameroon, Kenya, Ghana, Sudan, Uganda and other forestry establishments in Nigeria a large number of the professional foresters who have held important management positions in forestry were trained in the Department. It became apparent by 1974 that the Department should take major step away from concentration on timber growing and production studies towards more comprehensive view of forest resources other than cellulose. To reflect this need, the Department changed its name from the rather restrictive title of "Forestry" to that of "Forest Resources Management" which embraces all forms of renewable natural resources. In August 1981, the Department of Wildlife and Fisheries Management emerged as a full-fledged Department from Department of Forest Resources Management.

The basic responsibilities of the Departments have always been to provide Nigeria with highly qualified personnel for the efficient management of her forests and wood-based industries, wildlife and fisheries. Clearly, the dimensions of these responsibilities have changed as the Nigerian economy develops and as international relations with developing and developed countries are intensified. Every aspect of the forest, including timber, wildlife, fisheries, water, recreation, wilderness, and the environment must now be provided for in the framework of integrated land and natural resources management. This will require the widening of skills, and the consequent increased demands for integrated land use forestry and water-based training.

Given the evolutionary stages through which the two departments have passed, the responsibilities now being discharged encompass the following:

- Teaching and research functions for five major renewable environmental resources: and, forest, wildlife, fisheries and eco-tourism;
- Primary obligation to produce high-level manpower for the public and private agencies (Federal and State Agencies, Research Institutes and Related organizations, Technical colleges, Polytechnics, Universities and several allied institutions). The responsibilities of these agencies encompass the whole gamut of renewable resources management;
- Postgraduate Training: The two existing Department have been playing a key role in producing man-power for other Universities; and
- International Obligations: The original Department of Forestry was a product of international cooperation. In its present form, it still retains vital links with virtually all forestry/renewable resources agencies under the International Union of Forestry Research Organization (IUFRO). It continues to fulfil its obligations to her partners in the Economic Community of West Africa States (ECOWAS). The two Departments that emerged from the original Department of Forestry have grown into several others, in both Nigeria and other West African Countries.

8.2 INTERNATIONAL OBJECTIVES OF PROFESSIONAL FORESTRY PROGRAMME IN IBADAN

The Technical School of Forestry on Jericho Hills, Ibadan had from its inception in 1941 served Nigeria, Ghana, Sierra Leone and even Liberia. In consequence, a professional university training department had to relate not only to the curriculum content of its technical forerunner but also in terms of its potential recruitment horizon or 'catchment area'. Although, there existed since 1955 a Department of Forestry within the University of Liberia, Monrovia, nevertheless, the participants at the 1960 FAO inaugural meeting of the African Forestry Commission seemed fascinated by the more diverse Nigerian ecology and longer forestry history than those of Liberia and therefore recommended a national project having potential international obligations within the sub region. Two major factors would appear to have compelled the enabling resolution of the African Forestry Commission meeting.

The first was the growing realization of the vast advantages of establishing training programmes for trainees in their own habitat where they were destined to work and contribute substantially to development. It had earlier been observed that the first crops of professional foresters who trained in Britain returned to their countries to re-learn local forestry for the first couple of years: an experience, which proved frustrating to majority of officers (Adeyoju, 1976). Thus an important objective of the Ibadan project was essentially to localize training in all its ramifications; assemble a body of direct instructional materials; teach students with live examples; and in particular, remove the dichotomy of learning European forestry for the management of tropical forests. Therefore, even if a school sited in Nigeria is "international" to Ghana, Kenya or Zambia as that situated in India, U.K. or USA, there are, nevertheless, the incontrovertible elements of ecological relevance, socio-economic perception and similar levels of technological development. In such circumstances, a Nigerian institution should, in the final analysis, be far more relevant to the needs of Ghana, Kenya and Zambia than its counterparts in India, U.K. and USA.

The second factor that favoured the idea of an international forestry department at Ibadan was the array of West African institutions in vogue at the time. For a very long time before Ghana's independence in 1957, the British Government had established common contributions for the four West African Anglophone countries of Gambia, Ghana, Nigeria and Sierra Leone. These included research, educational, judicial, military, airways and currency boards although nearly all of them became national responsibilities due to uneven development strategies spear-headed by Ghana. The idea of a sub regional department located in Nigeria therefore seemed feasible and acceptable since there were also thriving sectoral sub-regional institutions for Kenya, Tanzania and Uganda in Eastern Africa; for Malawi, Zambia and Zimbabwe in Central Africa; and Botswana, Lesotho and Swaziland in southern Africa.

8.2.1 International student enrolment

The fairly long planning period between 1961 and 1963 yielded positive results not only in terms of negotiating the project agreement between Nigeria on the one hand and FAO on the other, but also in terms of the international staff recruitment and general advertisement for the project. Since FAO had been associated with the project intent from the start, the international canvassing for funding and general support was not a problem. However, the fact that most Anglophone countries attained

political independence at the time the project was being launched and that it was a period to rapidly produce a crop of qualified indigenous staff to supplant the expatriates, there was an avalanche of enquiries for student placement from the first year.

The data presented in Table 8.1 relate to effective yearly registration rather than offers of admission or general enquiries. The first non-Nigerian student was registered in the first year of the Department. By the fifth year (1967/68), six foreign countries including Malaysia were represented in the Department with a total of 11 students. The following year saw another student from Fiji Islands in the South Pacific. Thus the two years (1967/68 and 1968/69) marked the widest geographical student representation within the Department. A key feature is the persistent presence of students from a couple of countries comprising Ghana and the English-speaking part of Cameroon. It would appear that the physical proximity of these countries to Nigeria and the similar educational approaches have sustained their interests in the Department.

On the whole, in spite of what looked casual or occasional interests by certain countries, the fact is that at one time or another, the Department has been patronized by 12 foreign countries. This is not necessarily an absolute indication of the popularity of the Ibadan programme. In addition to effective registration as shown in Table 8.1, torrents of enquiries have always been entertained from many African, Caribbean and South-East Asian countries for both undergraduate and postgraduate training. Some of the enquiries came from Angola, Congo, Gabon, Lesotho, Malawi, Rwanda and Zaire in Africa; Guyana, Puerto Rico and Trinidad in the Caribbean; Britain, Malta and Western Germany in Europe; and India, Pakistan, Sri Lanka and China in Asia.

The numerous offers of admission that had never been taken up have been of concern to successive administrators of the Department. On two occasions, two to four Zambians were duly processed for admission on the understanding that Canadian scholarships would be available for them only for the Department to be completely uninformed of subsequent developments. In addition, following the arrival of the two Ethiopian undergraduates in 1977/78, Sida consultants visited Ibadan twice in order to secure more placements for the following sessions, but for some unknown reasons, the candidates never arrived. Similarly, with the change in the political situation in Uganda 1972, Norwegian Agency for Development Cooperation (NORAD), the funding agency of the Makerere University Department of Forestry made desperate requests for

the transfer of about 14 students at various stages of their training to Ibadan. The Department signalled prompt and unconditional acceptance of the Makerere students. However, in the final analysis, both students and staff were transferred wholesale to the Morogoro campus of the then University of Dar es Salaam. The lapsed offers of admission also included those to: (a) a candidate from Trinidad and Tobago in the late 1960s; (b) the Ethiopian UNDP/FAO project postgraduate nominees for 1980/81 and 1981/82 and; (c) the Commonwealth scholars from India and Malaysia in 1985/86. There is no doubt that the utilization of all offers of admission to foreign students would have considerably enlarged the international services of the Department. In 24 sessions as shown in Table 8.1, a total of 167 students were enrolled in the Departments of Forestry and Wildlife and Fisheries Management. However, the number was very small; it was a remarkable reference to internationalization of the programme.

Five types of international activities are quite feasible for a University department such as ours. The first of these is the basic training opportunity it has, and continues to offer at both undergraduate and postgraduate levels. To some extent, the Department has endeavoured to acquit itself creditably in this respect. While the number of foreign students has declined in recent years, it should be noted that the reasons for decline are altogether beyond the control of the Department. For instance, during the years of petroleum boom (1973 to 1981), the cost of living in Nigeria shot up astronomically beyond the easy reach of other Africans. Consequently, the poorer nations found it rather difficult to sponsor many students in Nigeria. Similarly, the international funding agencies of training programmes found it more competitive to support their awards in non-Nigerian institutions. Moreover, other forestry schools have been established particularly since 1970, as viable partners in progress with Ibadan. Nevertheless, the international status of the Ibadan Department has grown remarkably since 1974 not only because of the quality and variety of activities taking place locally but also because of the involvement and meaningful contributions of its staff and graduates to many reputable platforms. Essentially, the other notable international activities in which the Department has featured may be grouped into four, namely: (a) hosting of conferences; (b) participation in overseas conferences; (c) assistance to non-Nigerian counterpart departments; and (d) consultancy services through international development agencies.

Table 8.1: International Student Enrolment in the Past and Present (Department of Forest Resources Management and Wildlife and Fisheries Management, 1988)

Year	Country												Total
	Cameroon	Ethiopia	Fiji	Ghana	Kenya	Liberia	Malaysia	Sierra Leone	Sudan	Tanzania	Uganda	Zambia	
1963/64	-	-	-	-	1	-	-	-	-	-	-	-	1
1964/65	1	-	-	-	2	-	-	3	-	-	-	-	6
1965/66	1	-	-	1	3	-	-	3	-	-	-	-	8
1966/67	2	-	-	1	3	-	-	2	-	-	-	-	8
1967/68	3	-	-	1	3	-	1	2	-	-	-	1	11
1968/69	3	-	1	-	4	-	1	--	-	-	-	-	10
1969/70	3	2	-	1	2	-	1	-	-	-	-	-	8
1970/71	2	-	-	3	-	-	-	-	-	-	1	-	6
1971/72	-	-	-	-	-	-	-	1	-	-	-	-	1
1972/73	1	-	-	2	-	-	-	-	-	-	-	-	3
1973/74	1	-	-	1	-	-	-	-	2	-	-	-	6
1974/75	1	-	-	1	-	-	-	-	1	-	-	-	3
1975/76	2	-	-	1	-	-	1	2	-	-	-	-	6
1976/77	1	-	-	-	-	-	-	-	1	1	-	-	3
1977/78	-	2	-	2	-	-	-	-	-	1	-	-	5
1978/79	-	2	-	4	-	-	-	-	3	-	-	-	9
1979/80	-	2	-	1	-	-	-	-	-	-	-	-	3
1980/81	1	2	-	1	-	-	-	-	1	-	-	-	7
1981/82	5	1	-	6	-	-	-	-	-	-	-	-	12
1982/83	4	1	-	4	-	-	-	-	-	-	-	-	9
1983/84	7	2	-	5	-	2	-	-	-	-	-	-	16
1984/85	7	1	-	3	-	1	-	-	-	-	-	-	12
1985/86	5	-	-	1	-	-	-	-	-	-	-	-	6
1986/87	7	-	-	1	-	-	-	-	-	-	-	-	8
Total	57	15	1	40	18	3	4	13	8	2	1	1	167

8.3 GRADUATES FROM RENEWABLE NATURAL RESOURCE DEPARTMENTS

The Departments of Forest Resources Management and Wildlife and Fisheries Management have produced a total number of 1,989 graduates (B.Sc; M.Phil/M.Sc. and Ph.D. degrees) in the last 41 years (Table 8.2).

Table 8.2: Graduates from Renewable Natural Resources Departments in 41 Years -1965 to 2006) (Department of Forest Resources Management and Wildlife and Fisheries Management, 1988)

Year	Department of Forest Resources Management			Department of Wildlife and Fisheries Management		
	B.Sc.	M.Phil/M.Sc.	Ph.D.	B.Sc.	M.Phil M.Sc.	Ph.D.
1965	3	-	-	-	-	-
1966	6	-	-	-	-	-
1967	7	-	-	-	-	-
1968	11	-	-	-	-	-
1969	14	-	-	-	-	-
1970	17	-	-	-	-	-
1971	18	-	1	-	-	-
1972	29	-	-	-	-	-
1973	17	-	-	-	-	-
1974	20	-	2	-	-	-
1975	27	-	-	-	-	-
1976	36	1	1	-	-	-
1977	21	2	1	-	-	-
1978	28	10	1	-	-	-
1979	44	9	1	-	-	-
1980	1	4	2	-	-	-
1981	47	6	5	-	-	-
1982	19	10	-	-	-	-
1983	45	1	1	-	-	-
1984	14	13	2	15	8	-
1985	40	13	6	30	15	-
1986	56	11	-	37	18	-
1987	45	13	7	16	7	3
1988	-	-	-	-	-	-
1989	-	-	2	-	-	1
1990	18	2	2	22	-	2
1991	20	20	5	20	16	3
1992	-	-	4	-	-	1
1993	10	18	-	33	15	2
1994	30	20	-	35	16	-
1995	26	17	-	31	27	3
1996	-	-	-	1	-	-
1997	27	22	6	35	24	11
1998	14	26	1	13	29	4
1999	2	-	1	4	-	-
2000	8	11	4	13	30	3
2001	6	18	2	17	11	10
2002	-	-	-	-	-	-
2003	14	31	12	36	46	7
2004	19	14	-	24	20	8
2005	24	-	4	29	2	11
2006	16	9	4	18	22	8
TOTAL	799	301	77	429	306	77

This number though very small for training needs in Africa in general, is significant for manpower development in Nigeria and other countries whose nationals were trained.

The two Departments recorded the highest number of B.Sc. graduates (56 and 37 respectively) in 1986 while the lowest number of BSc. graduates was recorded in 1980 and 1996 respectively (Table 8.2). No graduates were produced in 1988, 1989, 1992, 1996 and 2002. However, in the year 2005, only the Department of Wildlife and Fisheries Management did not graduate any student.

For higher degrees, the highest numbers of MSc. graduates (31 and 46) were recorded in Departments of Forest Resources Management and Wildlife and Fisheries Management in 2003 while the lowest were recorded in 1976 and 2005 in the two Departments (Table 8.2). The two Departments recorded no M.Sc. graduates in 1988, 1989, 1992, 1996, 1999 and 2002 respectively.

The Department of Forest Resources Management recorded the highest number of PhDs (12) in 2003 while it was 11 in 1997 and 2005 respectively in the Department of Wildlife and Fisheries Management.

Inconsistency in the trend of graduates at B.Sc., MSc. and Ph.D. levels was largely due to a number of reasons such as change in admission requirements, political instability, epileptic funding and lack of grants and fellowships to prospective students interested in renewable natural resource courses. Another important factor is the establishment of similar Departments in new and existing Universities in Nigeria and other West African Countries offering virtually the same renewable natural resources courses as does University of Ibadan

8.4 CAPACITY BUILDING

8.4.1 Staff on board

Is capacity building a continuous process in the Renewable Natural Resources Departments in university of Ibadan? The question may be answered using indices such as Optimum Staff Demand (number of staff on ground versus empirical norm); student enrolment; training and re-training of staff; availability of funds; Practical Year Training Programme and Student Industrial Working Experience Scheme (SIWES); infrastructural facilities

(modern/obsolete); electricity; laboratories; Information and Communication Technology (ICT), etc.

8.4.2 Optimum staff demand

This refers to the total number of academic members of staff at any condition that is most favourable for the achievement of an aim or result of teaching, research and community service. Therefore, the categories of members of academic staff at any given time for smooth succession and replacement of retired academics should include Professors, Readers, Senior Lecturers, Lecturers 1, Lecturers II, Assistant Lecturers, Graduate Assistants and Technicians. Also important is the distribution based on academic units in Departments.

The Department of Forest Resources Management has five academic units namely: Biology and Silviculture; Forest Economics and Management, Forest Biometrics; Wood Science; and Agroforestry. The corresponding academic members of staff are shown in Table 8.3. The Department of Wildlife and Fisheries has eleven academic units namely: Aquaculture and Fish Nutrition; Fish Processing and Utilization; Fishery Economics, Management and Marketing; Navigation and Seamanship; Biodiversity Management; Wildlife Nutrition; Wildlife Processing and Utilization; Wildlife Economics and Management; Wildlife Ecology; Tourism; and Wildlife Pests and Diseases. The corresponding academic members of staff are shown in Table 8.4.

In considering the roles and functions of renewable resources education in promoting sustainable development, the following should be addressed: increasing the relevance of teaching and research for societal processes leading to more sustainable patterns of life and discouraging unsustainable patterns and improving the quality and efficiency of teaching and research. Therefore, the optimum staff demand (OSD) in renewable natural resources education is a function of Structure of Employment; Category of Full Staff Strength; and Activity Level of Staff (Agbeja, 2007).

$$\text{OSD} = f(\lambda, \kappa, \pi)$$

Where,

$\lambda = \text{Structure of Employment}$

$$= \frac{\text{Number of Each Category of Staff}}{\text{Total Number of Staff on Board}}$$

κ = Category of Full Strength Staff
= Ranges from Graduate Assistant, Assistant Lecturer, Lecturer II, Lecturer I,
Senior Lecturer, Reader (Associate Professor) and Professor

π = Activity Level of Staff
= Actual Number of staff on Board
Full Strength of Staff based on Empirical Norm

Each academic unit should be endowed with optimum number of staff in accordance with empirical norm as follows: Professor (1), Reader/Senior Lecturer (1), Lecturer 1 (1), Lecturer II (1), and Assistant Lecturer/Graduate Assistant (1). The arrangement is such that it is flexible according to succession in hierarchy and also in line with promotion exercise. Considering the five academic units subsisting in the Department of Forest Resources Management, it should have at least 25 academic members of staff for effectiveness, efficiency and sustainability. However, the number of academic members of staff is inadequate due to inconsistent recruitment occasioned by bureaucracy and poor funding (Table 8.3).

Table 8.3: Staff on Board versus Empirical Norm in the Department of Forest Resources Management

Academic Units	Staff on Board	Status of Staff on Board	Full Strength of Staff based on Empirical Norm
Silviculture and Biology	2	Professor (1) Reader (1)	5
Forest Economics and Management	4	Professor (1) Lecturer 1 (3)	5
Wood Science	3	Senior Lecturer (1) Lecturer 1 (2)	5
Forest Biometrics	3	Professor (1) Senior Lecturer (1) Lecturer 1 (1)	5
Agroforestry	-	None	5
Total	12		25

Number in parenthesis ( ) represents the number of category of staff in each academic Unit

Table 8.4: Staff on Board versus Empirical Norm in the Department of Wildlife and Fisheries Management

Academic Units	Staff on Board	Status of Staff on Board	Staff based on Empirical Norm
Aquaculture and Fish Nutrition	4	Professor (2) Lecturer 1 (1) Lecturer II (1)	4
Fish Processing, Utilization and Gear Technology	1	Senior Lecturer (1)	2
Fishery Policy, Economics and Marketing	3	Senior Lecturer (1) Lecturer 1 (1) Lecturer II (1)	4
Oceanography and Seamanship	1	Lecturer 1(1)	2
Fisheries Ecology, and Management	4	Senior Lecturer (1) Lecturer 1 (3)	4
Wildlife Domestication, Nutrition and Utilization	1	Professor (1)	2
Wildlife Economics and Management	1	Lecturer 1 (1)	2
Wildlife Ecology and Protected Area Management	3	Professor (1) Lecturer 1 (2) Lecturer 1 (1)	4
Environmental Sensitivity and Impact Assessment	1	Lecturer 1 (1)	2
Ecological Recreation	1	Lecturer 1 (1)	2
Total	20		28

The activity level of the members of staff on board is 0.48 (48%) which is less than half. This indicates inadequate staff disposition and the lecturers on board are unduly loaded with courses which otherwise could have been taught by other specialists in the courses that have no lecturers. In the Department of Wildlife and Fisheries Management, the number of academic members of staff is fairly adequate (Table 8.4). The activity level of the members of staff on board is 0.71 (71%) which indicates almost ¾ of the staff requirement. This indicates good staff disposition.

8.4.3 Training and retraining of staff

Training and re-training of academic staff in renewable natural resource programmes both locally and abroad is pertinent. In considering the roles and functions of a university in promoting sustainable development through renewable natural resources, the following should be addressed:

- Increasing the relevance of teaching and research for societal processes leading to more sustainable patterns of life and discouraging unsustainable patterns;
- Innovation in teaching, research and community engagement; and
- Improving the quality and efficiency of teaching and research.

At the inception of the Departments of Forest Resources Management and Wildlife and Fisheries Management in 1963 and 1981 respectively, virtually all the lecturers on board were trained and re-trained both locally and internationally. This has not been so in the last one decade. In the professorial and readership cadres in both Departments, virtually all have received training locally and internationally. At Senior Lectureship level, only one out of five in the two Departments has had short training abroad. The rest had only local training. This falls short of expectation. In the Lecturer I cadre which has the highest number of academic staff in the two departments, only five (29.4%) out of 17 have had short training courses and workshops outside Nigeria. If productivity and efficiency are to be based on exposure, this cadre suffers most. In fact, it represents the mid-career cohort that must be trained and re-trained (Figures 8.1 and 8.2).

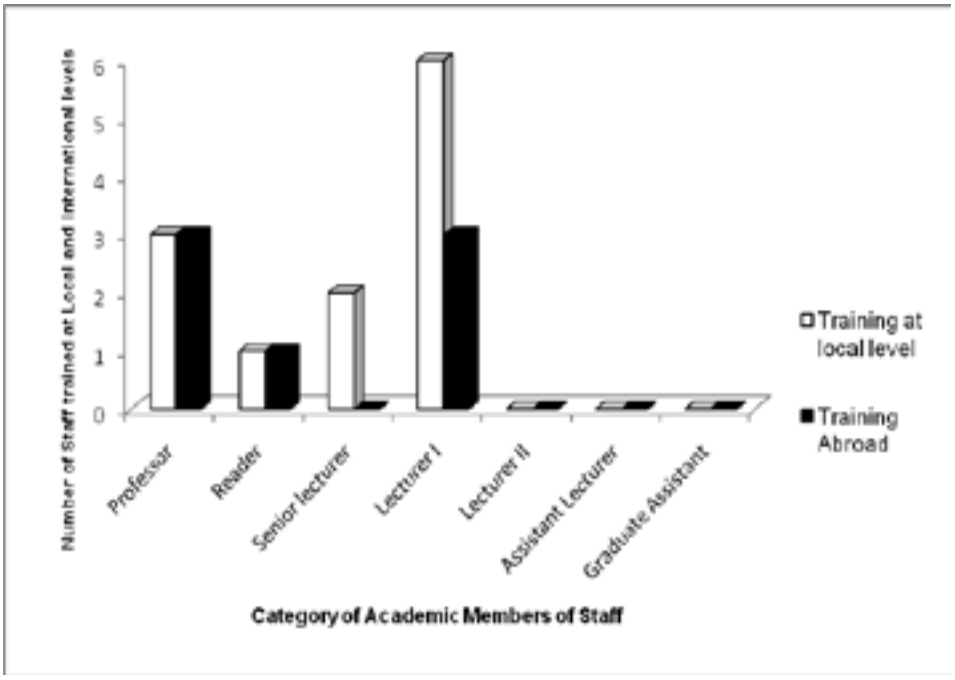

Figure 8.1: Training and Re-Training in the Department of Forest Resources Management

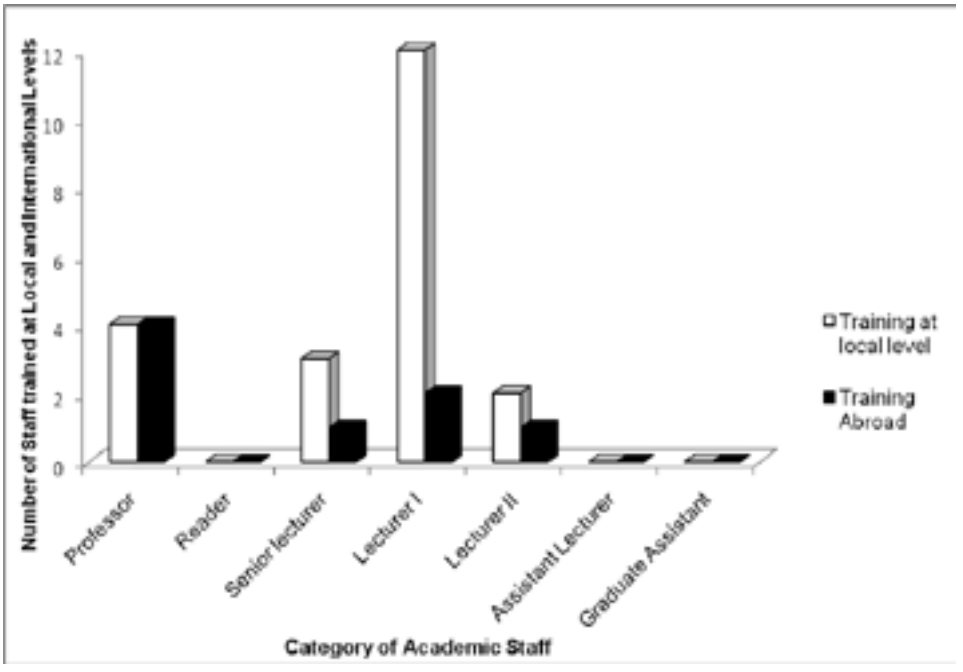

Figure 8.2: Training and Re-Training in the Department of Wildlife and Fisheries Management

In the Lecturer 11 cadre one out of two in the two Departments, has had international training. The challenge therefore, is how to ensure capacity building and strengthening that will guarantee smooth succession plan for sustainability of RNR education in Nigeria and the sub-region. In this regard, the vision, mission and activities of the African Forestry Research Network (AFORNET) have been providential. In the last one decade, virtually all the members of academic staff of the Department of Forest Resources Management have been involved in one intervention or the other by AFORNET, African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE) and African Academy of Sciences (AAS). These are mostly through research grants, training, travel grants and networking.

8.5 STUDENT ENROLMENT

Apart from 100 level students that are not directly resident in the RNR Departments in their first year of registration in the University, over the last five years, the two Departments have had a fair increase in the number of

students registered at different levels of academic programmes. At the undergraduate level (200 to 500 levels), currently, the total number of students is 232 while at postgraduate level (PGD, MSc; and Ph.D.), the total number of students is 180 (Figure 8.3). One key feature of the enrolment is the visible increase in female enrolment compared to the situation in the past. The percentage of undergraduate to Postgraduate enrolment shows 56.3% to 43.7%. The University aims at a target of 60:40 postgraduate: undergraduate enrolment. It is worthy noting that this level of enrolment into our undergraduate programme is not by choice of the candidates, but seven out of every ten undergraduate students in the RNR programme ended there after failing to obtain admission in such programmes as medicine, pharmacy and the sciences**.** By implication, therefore, RNR courses were the last line of action.

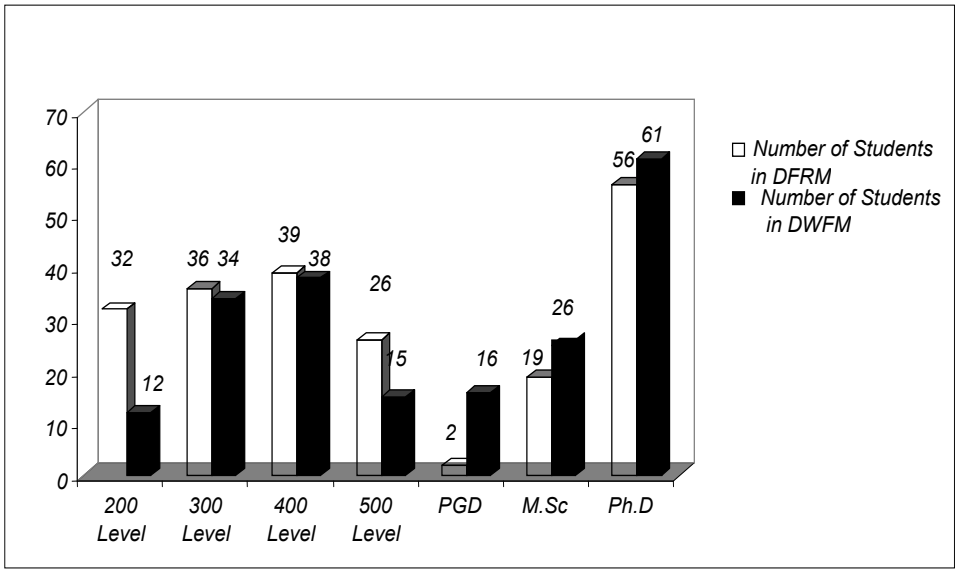

Figure 8.3: Total Number of Students at both Undergraduate and Postgraduate Levels in the Departments of Forest Resources Management and Wildlife & Fisheries Management in 2005/2006 Session.

It has however been observed over the years that six to seven out 10 such candidates end up showing keen interest in the programmes. In contrast, more applications into postgraduate RNR programmes have come from non-RNR first degree holders. The question to ask is: why do RNR programmes not appeal to applicants at the undergraduate level in the first instance? There are certainly some information gaps, which need to be filled through awareness at the elementary levels of education. The upsurge in enrolment

places great challenge on the dwindling staff disposition most especially in Forest Resources Management.

8.6 INFRASTRUCTURAL FACILITIES

The declining level of funding has rendered most of the laboratory equipment and tools in the two Departments obsolete in comparison with what is obtained elsewhere in the world. However, efforts are gradually being made to replace the old equipment the tempo is very slow. The Postgraduate School has introduced an equipment support scheme to academic units that can afford to pick the bill for 50% of total cost. This scheme is gradually retooling the laboratories. However, much support is still required. The Direct Teaching and Laboratory Cost (DTLC) introduced by government about four years ago is also playing a fair role in the retooling process.

8.6.1 Practical Year Training Programme (PYTP) and Student Industrial Training Programme (SIWES)

The Practical Year Training Programme (PYTP) for the 400 level students is a very crucial period in the RNR education programme. It is devoted to practical field training spanning about one year. The practical is fully backed by lectures. At the end of fourth year, students would have acquired a sound working knowledge of the subjects. It is asserted that PYTP was at inception, both national and international. Candidates travelled as far as some countries in West Africa and Europe for their practices. Within Nigeria common spots included Yankari, Kainji, Sapoba, AT & P, Sapele, Area J4, and Oluwa Forest_Reserve. The Department opened its own station at Ijaiye, Oyo State during the 1982/83 session. The Ajibode Demonstration Plot was established at Ajibode, Ibadan for PYTP, while the Fadama site at Parry Road, University of Ibadan Campus was also established for the same purpose. A Teak Plantation was established at North gate, of the University as early as 1952. The PYTP is complemented with the mandatory SIWES whereby the students are attached to relevant industries for hands on training and experience.

8.6.2 Information and communication technology

The two Departments having recognized the needs of staff, students and society in the area of ICT have provided desktop computers for all academic staff and a pool of desktops were installed for students' use. More importantly, is the linking of all academic staff members with servers to surf the internet.

8.7 PROCESS IMPROVEMENT FOR QUALITY ASSURANCE IN HIGHER EDUCATION.

In the last one decade, some thirty new universities (public and private) have been established in Nigeria. These bring the total number to 89 of which nearly half now offer courses in RNR education, particularly forestry, fisheries, wildlife and range management. Considering the age and status of the University of Ibadan, a challenge to concentrate more on postgraduate training to feed these new universities became pertinent, yet the university itself is facing the challenges of aging faculty, facilities and infrastructure and the need for quality assurance. These challenges are being surmounted, in part, through process improvement, particularly at the postgraduate level. Some of the measures include adherence to carrying capacity, the use of supervisory committees for research projects, mandatory presentation of seminars, rigorous process for registration of title of theses and appointment of quality academics as external examiners at *viva voce*. Master Degree programmes are now three semesters, while the minimum duration for the Doctor of Philosophy is six semesters for full time and eight semesters for part time.

8.8 CREATION OF FACULTY

Every aspect of the forest, including timber, wildlife, fisheries, water, recreation, wilderness, and the environment must now be provided for in the framework of integrated land and natural resources management. The dynamic and changing expectations of our people from these resources will require the widening of skills, and the consequent increased demands for integrated land use forestry and water-based training.

The Departments of Forest Resources Management and Wildlife and Fisheries Management submitted a proposal in the year 2006 for a proposed Faculty of Renewable Natural Resources that would have six academic departments namely, Departments of Forest Production and Products; Social

and Environmental Forestry; Landscape Management; Biodiversity and Ecotourism; Wildlife and Range Management; and Aquaculture and Fisheries Management. The proposal had been approved by the Board of Faculty of Agriculture and Forestry. Further processing for approval at higher management levels of the university is on-going.

8.9 CONCLUSION AND RECOMMENDATIONS

Renewable natural resources education has come of age in the Departments of Forest Resources Management and Wildlife and Fisheries Management, University of Ibadan. The basic goal for over 40 years has been largely achieved through the production of graduates whose training in various courses had enabled them to handle increasingly diversified problems of society. Significantly, several of the graduates are now able to operate on more encompassing levels and scales; even outside their areas of specializations. The most important fact about the two Departments is that they are the flagship in high-level manpower training in RNR education in all the 89 Nigerian Universities and indeed other countries in Africa.

8.9.1 Recommendations

The old world of campuses is being rapidly transformed by new modes of delivery, by new providers, new divisions of labour, and new ideas of curricula content and learning needed for sustainable development of society. The creation of the Faculty of Renewable Natural Resources at Ibadan is therefore urgent. Renewal of aging faculty and facilities are germane to achieving the overall objective of a sound RNR education in consonance with the objectives of the Millennium development Goals

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9 Declining Enrolment in Forestry: Experiences from University of Maiduguri

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ABSTRACT

The number of students applying to study forestry in the university has been on the decline, despite the recognized productive and protective benefits of the forests to the society at large. A survey was carried out among current students' of Forestry and Wildlife Department at the University of Maiduguri, Nigeria to establish reasons for the decline. Factors causing apathy towards candidates' enrolment to study forestry included lack of adequate knowledge/understanding of forestry, unfavourable public perception and unpopularity of forestry, strict forestry admission requirements, duration and rigour of forestry training and insufficient self employment opportunities in forestry. The need to popularize forestry as well as encourage students of agricultural education at the universities and colleges of education to take courses in forestry are highlighted.

9.1 INTRODUCTION

Forestry is offered as a course at the post secondary level in Nigeria. Majority of graduates of forestry, particularly after the 1970s, found themselves in the field by providence. The most frequently asked question by candidates admitted to study forestry is "what is this forestry all about". Many are not initially interested in studying the course because of the high level of ignorance about the field or the course. After admission, particularly at the university level, the candidates often request for change of course after

one or two academic sessions. Those who study forestry at the technical level do that as a last resort, except those trained by their employers.

Considering the recognized importance of the field to the national economy, sustainable agricultural practices and environmental protection (Enabor and Faturoti, 1988), more universities are now establishing forestry courses. The National Universities Commission has denied accreditation to Faculties of Agriculture without forestry component in their curriculum. Despite the increasing number of forestry academic departments in the Nigerian universities (Table 9.1) (Bada and Verinumbe, 2005), there is a decline in the number of students applying to study the course. The Department of Forestry and Wildlife at the University of Maiduguri was established in 2003-2004 academic year to produce high calibre work force required for effective management of the fragile sudano-sahelian ecosystems of the University's catchment areas. Even then, very few candidates chose Forestry and Wildlife in their applications for admission into the university. This is a worrisome development for the university and the state governments in the catchment areas. This paper presents results of a survey carried out among students of the Forestry and Wildlife Department at the University of Maiduguri, Nigeria.

9.2 METHODOLOGY

Structured questionnaires were administered on the current population of students in the Department of Forestry and Wildlife, University of Maiduguri. Hundred percent enumeration was carried out on the students, spread across years one to four, i.e. among students that have just been admitted and those in the practical year of the forestry and wildlife programme. Questions were sought about their secondary schools' background, previous knowledge about forestry, intended career in life, first course of choice in the University, current ideas about forestry and life ambition. Data were subjected to simple descriptive statistical analysis, using the SPSS Software package.

Table 9.1: Institutions Offering Forestry and Forestry Related Courses in Nigeria

Institution	Ownership	Location
A. Universities		
Adamawa State University	Adamawa State Government	Mubi
Bowen University	Baptist Missionaries	Iwo
Cross River University of Technology	Cross River State Government	Obubra
Delta State University	Delta State Government	Asaba Campus
Federal University of Technology	Federal Government	Akure
Federal University of Technology	Federal Government	Yola
Federal University of Technology	Federal Government	Owerri
Igbinedion University	Private University	Okada
Kano University of Technology	Kano State Government	Wudil
Michael Okpara University of	Federal Government	Umudike
Agriculture	Nassarawa State Government	Lafia Campus
Nassarawa State University	Ogun State Government	Ago-Iwoye
Olabisi Onabanjo University	River State Government	Port Harcourt
River State University of Technology	Ekiti State Government	Ado Ekiti
University of Ado Ekiti	Federal Government	Abeokuta
University of Agriculture	Federal Government	Makurdi
University of Agriculture	Federal Government	Benin
University of Benin	Federal Government	Calabar
University of Calabar	Federal Government	Ibadan
University of Ibadan	Federal Government	Maiduguri
University of Maiduguri	Federal Government	Port Harcourt
University of Port-Harcourt	Akwa Ibom State Government	Uyo
University of Uyo	Federal Government	Sokoto
Usman Dan FodioUniversity		
B. Colleges		
Federal College of Forestry	Federal Government	Ibadan
Federal College of Forestry	Federal Government	Jos
Federal College of Forest	Federal Government	Kaduna
Mechanization	Federal Government	New Bussa
Federal College of Wildlife	Imo State Government	Umuagwo
Michael Okpara College of Agriculture	Yobe State Government	Gujba
Yobe State College of Agriculture	Borno State Government	Maiduguri
Mohammed Lawan College of	Kano State Government	Dambatta
Agriculture	Taraba State Government	Jalingo
Audu Bako College of Agriculture	Nassarawa State Government	Lafia
Taraba State College of Agriculture		
Nassarawa State College of Agriculture		
C. Vocational Training Institutes		
Forestry Vocational Training Centre	Federal Government	Kano
Leventis Foundation Agricultural	Non Governmental Organization	Kano/Zaria/Ilesa
Training Schools	Lake Chad Basin Commission	Ngala
Regional Agricultural Training Centre		

9.3 RESULTS AND DISCUSSION

9.3.1 Students' demography

The total students' population in the Department is 84. The distribution shows that the majority (36.91%) were admitted in 2005/2006 academic session, while the minority (16.67%) were the first set, admitted in 2003/2004 session (Table 9.2). Majority (82.2%) are between 21 and 30 years old, while those in the range of 20 years are 16.7% (Table 9.3). With average secondary school leaving age of 18 – 19 years, this might be an indication that these students might have sought for admission without success for more than 2 – 3 sessions before they eventually found themselves in forestry.

Table 9.2: Population Distribution among Students of Forestry and Wildlife Department, University of Maiduguri, Nigeria.

	Distribution	
Year of Study	Population (*frequency*)	Percentage (%)
Fourth Year	14	16.67
Third Year	19	22.61
Second Year	31	36.91
First Year	20	23.81
Total	84	100.00

Table 9.3: Age Group Distribution among Students of Forestry and Wildlife Department, University of Maiduguri, Nigeria.

	Distribution	
Age group	Frequency	Percentage (%)
≤ 20 years	14	16.7
21 – 25 years	46	54.8
26 – 30 years	23	27.4
31 – 35 years	1	1.2
Total	84	100

9.3.2 Choice of forestry as a career

Among the science related courses in the University, the study of medicine is the ambition of majority (42.9%) while forestry is rarely (1.2%) the ambition of current students of forestry and wildlife (Table 9.4). Human medicine and pharmacy top the first and second choices of course of study during their application for admission with 78.6%, 13.1% and 39.3%, 44.0%, respectively (Table 9.4). Choosing a field study or area of specialization in life is influenced by a lot of factors, most importantly being interest. However, interest is also governed by knowledge of the field, popularity of the field, the potential of the field, professionalism, status or impact of a role-model in the field, the requirements to enter the profession, self employment opportunities, among others. The above factors are also put into consideration in the choice of forestry as a profession by a lot of candidates (Udofia and Ikojo, 2003). The following choice of career factors were considered as they affect forestry education in Nigeria.

- Knowledge/understanding of forestry;
- Public perception and popularity of forestry;
- Forestry admission requirements;
- Duration and rigour of forestry training;
- Professionalism in forestry; and
- Self-employment opportunities in forestry.

Table 9. 4: Ambition and Choice of Course of Study at the University of Maiduguri, Nigeria

Profession	Ambition		Course of 1st Choice		Course of 2nd Choice	
	Frequency	%	Frequency	%	Frequency	%
Human Medicine	36	42.9	66	78.6	33	39.3
Veterinary Medicine	20	23.8	3	3.6	7	8.3
Pharmacy	13	15.5	11	13.1	37	44.0
Engineering	11	13.1	1	1.2	3	3.6
Agriculture	3	3.6	2	2.4	2	2.4
Forestry & Wildlife	1	1.2	1	1.2	2	2.4
Total	84	100.0	84	100.0	84	100.0

9.3.3 Knowledge/understanding of forestry at secondary schools

More than 90% of the secondary schools attended by the students in forestry and wildlife did not have guidance and counselling units (Table 9.5). Agriculture was offered as a subject by 63.1% of the students while in the secondary school, only 2.4% heard of forestry before leaving secondary school while none (0%) was given career talk on forestry before the senior school certificate examination (Table 9.5). Every secondary school in Nigeria is expected to have guidance and counselling unit. The duty/role of this unit is to educate students (collectively and individually) on career of choice, based on their personal interest and subjects' combination, i.e. subjects where the students performed most in examinations. However, while agriculture is considered a discipline that students need to be educated on, branches of agriculture often considered important are crop production, animal production, soil science, agricultural economics, and agricultural extension. Fishery is also gaining ground now while forestry is rarely remembered. Until recently, forestry was not part of the syllabus at the secondary level, it is now taught under general agriculture, by agriculture educationists or pure agriculturalists. This group of teachers, often lack adequate knowledge of forestry and cannot clearly/interestingly explain to the students nor answer key questions on forestry. Lack of adequate knowledge of what forestry is all about at the secondary school level (Nwoboshi, 1988) makes it difficult for a student to choose a course he/she is not familiar with, hence low patronage or intentional choice of forestry when applying for University admission.

9.3.4 Public perception and popularity of forestry

At the community, village and town levels, forestry is represented by the forest guards (Nwoboshi, 1988) as well as the timber contractors in the rainforest and woodland savannah ecosystems, while it is represented by forest produce checkpoint officers and fire wood collectors in the sudan-sahelian savannah ecosystems. These field officers do not portray forestry as a discipline or profession, rather as a money touting group of officers. The activities of the professional officers in the office are not known to the public, hence no reason for getting degree education in forestry. At the mention of forestry what comes to public mind are timber logging, 100.0 milling and fire wood collection. The public does not see any relationship between the environment, agricultural production and forestry. In the early days of forestry, forest officers were like cult members, without close

interaction with the larger community. The above created non-favourable public image for forestry.

Table 9.5: Background Information to Choice of Career among Students of Forestry and Wildlife, University of Maiduguri, Nigeria.

Attributes	Response	Scores	
		Frequency	Percentage (%)
Availability of counsellor in secondary school?	Yes	8	9.5
	No	76	90.5
	Total	84	100.0
Ever attended career talk in secondary school?	Yes	67	79.8
	No	17	20.2
	Total	84	100.0
Ever had career talk on forestry?	Yes	0	0.0
	No	84	100.0
	Total	84	100.0
Offered agriculture as a subject in secondary school?	Yes	53	63.1
	No	31	36.9
	Total	84	100.0
Ever heard of forestry in secondary school?	Yes	2	2.4
	No	82	97.6
	Total	84	100.0

9.3.5 Strict admission requirements to study forestry

The basic requirements for admission into Nigerian universities and technical institutions are determined by the course, under the umbrella of the Faculty or the College. Each Department, however, can stipulate other requirements peculiar to its programme. These requirements are two fold: the ordinary level results and the scores at the Joint Matriculation Examination. Provisional admission/selection is based on a minimum score approved as the "cut-off point", annually for every course. This is based on the overall candidates' performance at each Joint Matriculation Examination while the ordinary level results are the basic requirements for admission into the programme. Without the ordinary level minimum qualification, even with very high scores at the Joint Matriculation Examination, candidates are not given final admission into any course. To be admitted to study forestry at the university level, a candidate is expected to pass the following subjects at credit level: English Language, Mathematics, Chemistry, Biology, and either of Physics, Agricultural Science or Geography, meaning a minimum of five credits. Other courses like Medicine, Pharmacy, Engineering, Food Science, and Agriculture also require the same entry qualification. This is a good

result by every standard; therefore candidates with such grades often opt for any of the above and not Forestry.

9.3.6 Duration and rigour of forestry training

All the science based courses mentioned in the above section are mostly classroom and laboratory based, except agriculture where the field activities are also located in settlements close-by. Intensive forestry education requires that students be exposed to working with nature; hence, they are taken to the wilderness to spend weeks/months. Majority of candidates would prefer working within living environments, rather than in the wilderness. Forestry is a five-year course like any Agricultural discipline. At postgraduate level, graduates of basic sciences find it much easier to enter forestry profession with a year masters degree in forestry. This sometimes discourages a prospective forestry candidate and therefore opt for a course where he/she can gain one year of training.

9.3.7 Lack of a strong profession body in forestry

Despite the duration of training, forestry like agriculture and its areas of specialties are not considered as professional courses. The conduct and practice of this discipline is not regulated by any institutionalized body. Beside the Forestry Association of Nigeria (FAN), a large umbrella of those involved and engaged in forestry practice and business in Nigeria, there is no regulatory body to guide and standardize the practice and training in forestry. Unlike what happens in other professional disciplines such as medicine (human and veterinary), law, engineering, accountancy, journalism, etc, where besides the training received in the tertiary institutions, there are national regulatory bodies to guide and standardize the practice and training of candidates interested in those disciplines. In fact, these bodies set the standards to be used for admitting graduates of all training institutions into the profession. Admission of graduates by these bodies, through their institutes is a pride and sign of belonging to a profession. This is completely lacking in Nigerian forestry, hence our inability to regulate and standardize the training given to graduates of forestry as well as project job creation for graduates of this discipline. Currently, FAN is working seriously towards establishing a Chartered Institute of Forestry in Nigeria.

9.3.8 Few self employment opportunities in forestry

Professionalism implies that graduates of a discipline are able to be self employed and or be employers of labour. After graduation, they undertake some level of tutelage under a very senior colleague to gain practical experiences, before they can stand on their own. In most of Sub-Saharan Africa, forestry is still a government business, with little encouragement of private investors. The capital outlay/requirement to practice forestry or set up consultancy in areas of forestry is quite high. Entrepreneurship potentials and self-employment opportunities of a profession greatly influence the desire of candidates to belong to such discipline. In Africa, choice of a career is primarily determined by how early and how much wealth a practitioner can make from it to be successful, while service to humanity and contribution to the promotion of a discipline is not a priority. The few self employment opportunities in forestry and forestry-related industries are not only capital intensive, but tie down capital for a considerable number of years before yielding profit, such as wood processing, timber and fuelwood plantation development, etc, making it difficult for individuals or young graduates to start, hence the search for government employment. In this era of decreasing availability of vacancies in government employment, choosing forestry as a career may not be encouraging.

9.4 CONCLUSION

In the African context, success of being in a career or profession is measured by the level of wealth acquired by the practitioners, not by their contribution to the well being of society. Parents' desire their children to go into professions that will make them wealthy and popular. This orientation needs to be changed, through massive public education. Despite the observed productive and protective benefits of the forest and the consequential effects of lack of forest cover, desertification, soil erosion, the desire to make life better for the society are not considered important.

The current efforts of FAN at establishing a chartered institute should be encouraged and supported. Also massive education of the public should be carried out on what forestry is all about and its potential. Organizations that require the services of a forester should be mandated to employ certified foresters only, including the Universities. Forestry equipment suppliers should have an African office or representative to make the acquisition of modern forestry equipment easier and affordable. Regular activities should be organized by forestry and forestry related institutions to popularize and

give a better image to the discipline. Excellence should be encouraged by initiating grants and awards for brilliant and foresighted students of forestry, while maintaining the entry standard.

Students of agricultural education at the universities and colleges of education should be mandated to take a few courses in forestry, to enable them understand the principles of forestry and educate secondary school students on the same. The observed trend is unfavourable to students**:** lecturer ratio and may result in the closure of some forestry departments.

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10 Efforts of Njala University at Addressing Environmental Degradation in Sierra Leone

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ABSTRACT

Before the colonial era, about 70% of the Sierra Leonean land mass was covered by rain and savannah forests. During post-independence, the conflict and post-conflict transitional periods, serious logging of preferred timber species took place leaving the whole countryside and hills denuded. All remaining forests are still being harvested for timber, firewood, construction poles and charcoal. Large parcels of forested lands are exposed to flooding, erosion and invasion of alien plant species and pernicious savannah weeds. Post-independence attempts at ensuring effective natural resource management, sustainable protected area system development and biodiversity conservation have been hampered by lack of financial resources and non-replacement of retired experienced workers. The new School of Forestry and Horticulture at Njala University teaches silviculture, management and wildlife, forest economics, protection, sustainable harvesting of forest products, rural sociology and forest extension to educate forest communities on how to sustainably utilize the forest for production and protection roles. The curricula for forestry Certificate, Diploma and Degree programmes include core courses such as Computer Science, Entrepreneurial skills, Impact assessment studies, Control of natural disasters and forest fires, so that graduates can stand on their own in addressing problems of forest degradation, carrying out rehabilitation and returning the land to its original status in order to contribute to the global carbon economy.

10.1 INTRODUCTION

There are three major vegetation zones in Sierra Leone: the coastal mangrove, the forest and the savannah. The forest and savannah zones have a less dense drainage pattern than the mangrove zone and tend to have fairly flat and narrow inland valleys that are seasonally flooded (FAO, 2005)

Recent surveys of the distribution and composition of forest fragments indicate that approximately 70% of the country was once covered by rainforest in the south and woodland savannah in the north (Dwumfour, 2006). Due to the earlier heavy logging during the colonial era, the post-independence period and the negative political factors that culminated in the decade-long civil war and the annual bush-burning, the forests have declined precipitously during the last century. Today, only about 5% of the original forests remain. This deforestation continues unabated at an approximately 2% per annum due to persistent anthropogenic pressures (Dwumfour, 2006)

10.2 EXTENT OF FOREST AND SAVANNAH WOODED LANDS DEGRADATION IN SIERRA LEONE

Table 10.1, gives the approximate extent of forest and other wooded lands of Sierra Leone and how they have declined over recent years.

Table 10.1: Extent of Forest and Wooded Land Degradation in Sierra Leone (FAO, 2005).

FOREST CATEGORIES	AREA (1000 ha)		
	1990	2000	2005
Forest	3,044	2,851	2754
Other wooded land (Savannah)	765	511	384
Forest and other wooded land	3,809	3,362	3,138
Other land	3,353	3,800	4,024
Other land with tree cover	-	-	-
Total Land Area	7,162	7,162	7,162
Inland water bodies	12	12	12
Total area of country	7174	7174	7174

The table shows that between 1990 and 2000, 6.3% of forestland was destroyed and between 2000 and 2005, 3.5% of same land was further destroyed by man. Taking into consideration all combined forest and savannah land, 11.7% of all wooded land was destroyed between 1990 and

2000 while 6.6% was destroyed between 2000 and 2005. It should be noted that as forest and other wooded land was decreasing, other land was increasing. Other land means land without forest cover.

10.3 CAUSES OF FOREST LAND DEGRADATION

The decline of forests in Sierra Leone today has been blamed on logging, agriculture, housing settlers and investors. Logging usually starts the degradation of the environment. When the large trees have been felled and taken away, the slash-and-burn farmers move in. In some other areas, logging and mining go hand in hand causing a lot of destruction not only to the vegetation but also to the land. The land is virtually torn apart.

As a result of these activities, valuable timber species along the coast became exhausted in the late 19th and early 20th centuries. Only *Ceiba petandra* appears to be found easily all over the southern parts of the country. Amongst preferred species exploited at that time were: *Terminalia ivorensis, Afzelia africana, Bertinia confusa, Heritiera utilis, Canarium schweinfurthi, Oldfieldia africana and Didelotia idea* (Dwumfour, 2006). By 2006, forty-two forest tree species were placed on the red list as "threatened species". These include very important timber species such as *Entandrophragma cylindricum* (Sapele), *E. angolense, Eribroma oblonga* (yellow sterculia), *Heritiera utilis, Khaya anthotheca* (white mahogany), *K. senegalensis* (African mahogany), *Lophira alata* (Azobe), *Lovoa trichilioides* (African walnut; Congowood), *Nauclea diderichii* and *Terminalia ivorensis* (black afara) (IUCN, 2006). These few species were handpicked as examples of over-exploited trees in Sierra Leone.

The rate at which construction poles are being deposited into various wood depots in the major cities of Sierra Leone daily supports the theory of "threatened species" propounded by the IUCN. A trip through the heart of supposed forest areas of southern Sierra Leone exposes one to bare hills and valleys that were once densely forested. This further confirms the IUCN data (IUCN, 2006).

Rather than allow the denuded forest lands to regenerate, slash-and-burn farmers, housing settlers and investors move in to clear the land for unsustainable use. Eventually, invasive alien weeds that had never been part of the original vegetation creep in and take over the land, putting it out of use by peasant farmers. Such invasive vegetation as observed by one of the authors includes the spear grass (*Imperata cylindrica*), *Hypperrhenia rufa*,

Tithonia diversifolia etc. A vast area of the southern part of Sierra Leone has been overgrown by these weeds. It is possible to travel many kilometres without encountering any forested area in Southern Sierra Leone now.

The Government of Sierra Leone is aware of this development and has decentralized the Forestry Services from the regional to the district level so that every part of the country can be reached by the services of the Forestry Division (FAO, 2005). The Government is also being supported by Non-Governmental Organisations (NGOs) and Community based groups such as: the Conservation Society of Sierra Leone, Catholic Relief Services, World Vision, Environmental Foundation for Africa, Action Aid, Royal Society for Birds, Friends of the Earth etc, but their efforts are too little to combat and ameliorate almost two centuries of constant degradation of the environment (FAO, 2005).

10.4 CONSTRAINTS TO IMPROVED GOVERNMENTAL ACTION ON FORESTRY

The main constraints to effective forestry services that could tackle environmental degradation problems in Sierra Leone include information vacuum, debilitated forest service, under-funding as a result of low revenue base and administrative weakness, dysfunctional communities as a result of the decade-long civil strife, weakened private sector, debilitated implementation capacity of the NGOs and poor inter-sectoral co-ordination (FAO, 2005).

The Sierra Leonean Forest Service is dysfunctional. The staffing structure is over-aged and as staffs retire, there are no replacements at technical or professional level. Little training has been carried out in past years and few professional staff have been trained in the new skills necessary to handle partnerships between stakeholders at the District level – such as team building, conflict resolution and the provision of unified extension services (FAO, 2005).

10.5 NJALA UNIVERSITY AND ITS EFFORTS IN ADDRESSING ENVIRONMENTAL DEGRADATION

Njala University was created by the Universities Act of 2005. Amongst other mandates, the University was empowered to start a School of Forestry and Horticulture in order to give professional training and impart knowledge on

the younger generation in the art of starting, nurturing, tending and maintaining the nation's forests.

The School has five Departments, namely: Forestry, Wood Science, Wildlife Management, Ecotourism and Biodiversity Conservation; Aquaculture and Fisheries Management; and Horticulture. Each Department has a unique curriculum but there are general courses that are designed to impart broad-based knowledge and skills in Management, Computer studies, Entrepreneurial skills and Impact Assessment Studies. This will empower them to cope with emerging problems related to our forests. The courses will also enable students to stand on their own as entrepreneurs after they have graduated.

As the School has geared itself into the production of highly skilled work force to shore up and ultimately raise up the battered forest services, the Government will use the graduates to improve the nation's forests. These graduates will become the subject-matter specialists and professionals who will contribute to the drafting and implementation of Forest Policies and Law.

In the curriculum for the Department of Forestry, there are courses in Forest Economics and Extension. The graduates are expected to educate communities at the District level about Government policies and laws on forests, forest management and biodiversity conservation, especially in the National and Protected forests. They will ensure that for any tree felled there should be an immediate replacement with seedlings of another or same species in order to prevent exposure of the soil to flooding, erosion and invasion by alien species. The curriculum of the Forestry Programme of Njala University is given in Appendix 1.

In the first year, students are taught courses that are common to almost all programmes in the University. These are African Studies, which educates student about their environment and their relationship with the whole of Africa at large. This course is taught in the first and second semesters. Communication and Language skills are also taught to students to improve their written English. This aspect is very poor in students throughout the University. Hence it was decided to give students instruction in this course for the first two years. The other common courses include Chemistry, Biology, Physics and Mathematics. This is to ensure that students are well grounded in these courses that they will be able to apply them to their future

courses in Forestry. Also in the first year, students are introduced to Soil Science and Plant Protection.

In the second year, students are introduced to aspects of Forestry such as ecology, silviculture, survey and mapping, economics, silvicultural techniques and Environmental Impact Assessment. Students take these courses in the first semester of their second year. In the second semester, courses in agroforestry and soil management, plantation silviculture, landscape horticulture, urban forestry, forest extension, forest engineering and computer science are taught to students. The course in Communication and teaching skills in Forest extension has been designed to teach students how to reach the communities in the rural areas and interact with them.

In the first semester of the third year, workshop processes, forest engineering, remote sensing and GIS, forest mensuration are the core courses that will be taught. Other courses that enhance the skills being imparted on the students include entrepreneurial skills and computer studies. In the second semester, community forestry and rural development programmes will be taught together with courses such as marketing of forest products and non-wood products, forest ecology and management, forest entomology and pathology, wood processing and utilization and industrial forestry. These will be enhanced by courses in agro-climatology, Environmental Impact Assessment and plant biotechnology.

In the final year, forest soil management, forest policy, land use economics, ecotourism, forest laws and international convention on the environment will be taught to students. Other courses include the processing of natural forest products such as rubber, oil palm, rattan, extraction or tapping of palm wine etc. It is in the final year that students undertake their research projects and write their reports, hence, their lectures are light to enable them undertake their field and laboratory studies.

In between the second and third years and between their third and fourth years, students will be attached to the Forestry Division for a period of six weeks to learn all aspects of forestry in the field. The remaining time will be spent in the school forest learning techniques in forestry, especially in seeds and seedling production.

The introduction of computer studies in the curriculum will enable students to be updated regularly with recent advances in forestry in the region and in the world, hence the “information vacuum” identified as a constraint to the

poor performance of the forestry sector will be outdated. Again, the complaint of the Government about the lack of human resources and information about forest resources (MOAFF-FD, 1992) will be a thing of the past.

At present, the National Forestry Service is short of manpower. In the last ten years, there has not been any new recruitment into the service. There has not been also any refresher course for the old existing staff, or workshops for the senior hierarchy of the Forestry Division of Sierra Leone. Before, during and after the civil war, students who were sent abroad for training in all aspects of learning refused to return to the country, having found greener pastures. Those that returned immediately went back because the remunerations were too poor for their liking. The old fears about the civil war still linger in their memory, and is keeping them away from the country. Sierra Leone, as poor as it is has been one of the worst hit by the so-called "brain drain".

The Universities are also badly affected by the brain drain. At Njala University, there is less than 20% of the staff who are holders of PhD degree. Most are M.Sc and M.Phil degree holders. The holders of the Masters degrees are registered for the higher degrees with the hope of passing and securing the Ph.D. Recently, the Vice-Chancellor embarked on visits to older universities to forge links programmes for the training of the staff that aspire to obtain their PhD degree. In addition, experienced staff of the universities that have links programmes are encouraged to spend their sabbatical leave at Njala University in order to give academic leadership to the various departments that lack experienced leadership. So far, there has been some success with the University of Ibadan, University of Ghana, Jomo Kenyatta University and three foreign universities are collaborating with Njala but these are not sufficient for the type of rapid development required by Sierra Leone to wake up and live. The School of Forestry has recruited six staff from Nigeria. For a Faculty with five departments, these are not sufficient.

The School therefore needs any form of assistance that can be given in terms of personnel, field and laboratory equipment, and funding in Forestry; Wood Science; Wildlife Management, Ecotourism and Biodiversity Studies; Aquaculture an Fisheries Management; and Horticulture. In the Forestry Division today, there are retired officers who are still retained for the management of the nation's forests. With the introduction of the new School of Forestry and Horticulture, the manpower needs of the country will be met

with time and new systems will be introduced to take place of the old ones and it is hoped that the Forestry Division will be rejuvenated.

At a time when "global warming" is threatening and is caused by greenhouse gases emitted by man through his activities, with few or no trees to absorb the most important of the gases (CO_2), the School of Forestry and Horticulture has a Production Unit which produces tree seedlings which can be planted in all denuded and degraded areas of Sierra Leone. Also, the University has set aside about 300 ha of land for the school forest which will be planted with fast-growing tree species such as *Acacia mangium, A. auriculiformis*, *Eucalyptus territicornis* and *E. camaldulensis* that can be harvested for firewood and charcoal and the rest of the land will be planted with tropical timber species such as *T. ivorensis, H. utilis, E. oblonga, K. senegalensis, N. diderichii*, *G. arborea*, *Tectona grandis* etc.

The Production Unit in conjunction with the Forest Extension Unit will embark on a massive sensitization drive to all communities surrounding the University campus at Njala on the effects of continued deforestation on the environment and the climate and what they can do to combat the tendency. The Njala University Forest Plantation will be used as an example for them to emulate, take charge of their own land and plant trees that will be useful to them in future. This campaign will be carried out in collaboration with the State Forest Division. Through the interaction with the National Commission for the Environment and Forestry, it is hoped that within five to ten years, Forestry in Sierra Leone can come alive again. This will improve the environment and the climate. With more trees being planted, more greenhouse gases will be fixed and transformed into forest biomass, leaving the environment clean and in pristine condition.

10.6 JOB MARKET

In order to make the Forestry Division of the National Commission for the Environment and Forestry to function properly, all the forests and the wooded savannah will have to be tended. There are 14 districts in Sierra Leone, each having its own peculiar forests, which range from the mangrove, rainforests, montane, wooded savannah and the savannah proper. Under normal condition, each forest should have a minimum of 15 Forest guards, 5 Forest rangers, 2 Conservators, 1 Senior Conservator, 1 Principal Conservator and a Chief Conservator of Forests. In addition, each district is supposed to have a Director and an assistant Director, to man the offices.

The decentralized system has created these positions to enable the Forestry Division cover all the forests adequately.

Unfortunately, these positions are largely vacant for lack of qualified manpower. The available manpower is so thinly stretched on the ground that they are not effective in manning the forests. Moreover, they are already either too old, have overstayed their time in the civil service or are rapidly approaching retirement. For the Forestry services to be jumpstarted, at least 339 qualified people need to be recruited. The graduates from the University annually, will gradually fill up vacancies created by retiring officers. This is where the establishment of the School of Forestry at Njala University has come in at the right time to help shore up the sagging Forestry services and in due course fill up all vacant positions created over the years by deaths and retirement. Njala University will also float refresher training courses and workshops for Forestry officers to update them with the art and science of modern developments in Forestry.

This cannot be possible without assistance from donors and collaborations with already established institutions for grants, fellowships for staff development and staff exchange. This is a medium through which we are requesting for these forms of assistance to help Njala University and indeed Sierra Leone rehabilitate its degraded and deforested lands and its environment

10.7 CONCLUSION

It is expected that with the establishment of the School of Forestry and Horticulture, at Njala University, environmental degradation can be halted through interacting and educating the communities in the rural areas where most of the trees are felled and the land laid bare. The new School of Forestry and Horticulture needs assistance, whether regional or international, to help it develop and contribute to satisfy national manpower needs in Forestry and help Sierra Leone regain its old status of the “universal bank for natural forest resources”.

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Appendix 1. Recommended Courses for the Proposed Department of Forestry for the Award of the Degree Of B.Sc, (Hons.) Forestry

FIRST YEAR

Course Number	Course Title	Theory Hrs	Practical Hrs	Credit Hrs*
	FIRST SEMESTER			
AFST 101	African Studies I	2	-	2
CHEM 101	General Chemistry	3	2	4
BIOL 101	Introduction to cell biology, Genetics and Microbiology	3	2	4
COMS 111	Communication and Language Skills I	3	-	3
MATH 101	Pre-Calculus	4	-	4
PHYS 101	Forces, Motion, Waves and Thermal Physics	3	2	4
FCS 111	Introduction to General Agriculture (Crops)	2	2	3
	TOTAL	17	14	24

* Theory and practical hours= Total of 615 hrs / semester= 1,230 hrs /Session.

	SECOND SEMESTER			
AFST 102	African Studies II	2	-	2
CHEM 102	General Chemistry II	3	2	4
BIOL 102	Introduction to Biology	3	2	4
COMS 112	Communication Skills II	3	-	3
MATH 102	Introduction to Calculus, Applied Mathematics and Statistics	4	-	4
PHYS 102	Geometric Optics, Waves, Magnetism and Electricity	3	2	4
SOS 112	Introduction to Soil Science	2	2	3
FSS 112	Introduction to Plant Protection	2	2	3
	TOTAL	19	16	27
	GRAND TOTAL			51

SECOND YEAR

Course Number	Course Title	Theory Hrs	Practical Hrs	Credit Hrs
	FIRST SEMESTER			
FBL 201	Introduction to Forestry and Wildlife Management	2	1	2
FCS 211	Introduction to Forestry and Silviculture	2	2	3
FBL 211	Forest Ecology	2	2	3
FEN 211	Forest Land Surveying and Mapping	2	2	3
FEX 211	Introduction to Rural Sociology and Forest Extension	2	2	3

COM 211	Communication and Language Skills	2	-	2
FEC 211	Forest Economics	2	1	2
FCS 212	Wood Science	2	2	3
GEOG 321	Environmental Impact Assessment	2	-	2
FCS 214	Silviculture Techniques	2	2	3
	Total	20	14	26

	SECOND SEMESTER			
Course Number	Course Title	Theory Hrs	Practical Hrs	Credit Hrs
SOS 221	Introduction to Agroforestry and Soil Management	2	2	3
FSS 221	Agroforestry	2	2	3
FCS 221	Plantation Silviculture	2	2	3
HORT 223	Landscape Horticulture	2	2	3
FEX 221	Communication and Teaching Skills in Forest Extension	2	2	3
FSS 223	Urban Forestry	2	2	3
FWC 322	Computer Science	2	2	3
COM 212	Communication and Language Skills	2	-	2
FEN 221	Forest Engineering 1	2	2	3
	TOTAL	18	16	26
	GRAND TOTAL			52

There shall be Field studies for a minimum of six weeks to be done between July and September. During this time, students shall be taught and made to produce tree crop seedlings for commercial purposes for the School.

THIRD YEAR

Course Number	Course Title	Theory Hrs	Practical Hrs	Credit Hrs
	FIRST SEMESTER			
SOS 311	Soil Genesis, Morphology and Classification	2	2	3
FEN 311	Workshop Processes	2	2	3
FEN 312	Forest Engineering 11	2	2	3

AGE 312	Agricultural Statistics and Computer Application	1	2	2
GEOG 312	Remote Sensing and Geographical Information System (GIS)	1	2	2
FMM 313	Forest Mensuration and Resource Assessment	2	2	3
HORT 313	Landscape Studies	2	2	3
ECON 316	Entrepreneurial Skills	3	-	3
FCS 312	Wood Science II	2	2	3
	TOTAL	17	16	25

SECOND SEMESTER

FCS 321	Plant Biotechnology	2	2	3
FEX 321	Community Forestry and Rural Development Programmes	2	2	3
FEC 321	Marketing of Forest Products and non-wood Products	2	2	3
FOP 321	Forest Fire Ecology and Management	2	2	3
FOP 322	Forest Entomology and Pathology	2	2	3
FWU 321	Wood Processing and Utilization	2	2	3
GEOG 331	Environmental Impact Assessment	2	-	2
FEN 323	Introduction to Agroclimatology	2	2	3
FEC 321	Industrial Forestry	2	2	3
	TOTAL	18	16	26
	GRAND TOTAL			51

At the end of the third year, there shall be Field Studies for a minimum of six weeks between July and September. During this time, students shall be taught to produce tree crop seedlings for commercial purposes for the School.

FOURTH YEAR

Course number	Course Title	Theory Hrs	Practical Hrs	Credit Hrs
	FIRST SEMESTER			
FSS 411	Forest Soil Management	2	2	3

FEC 411	Forest Policy, Land Use Economics and Ecotourism	2	2	3
FBL 411	Processes in Forest Ecosystems	2	2	3
FLIC 401	Forest Laws and International convention on the Environment	3	-	3
NRPD 412	Natural Rubber Plantation Development	2	2	3
NRPD 413	Natural Rubber Production, Processing and Marketing	2	2	3
HORT 414	Landscape Horticulture 11	3	2	4
	TOTAL	16	12	22
	SECOND SEMESTER			
FPR 498	Seminars			
FPR 499	Research Project Report writing			
	GRAND TOTAL			22

Research Project for B.Sc (Hons) in Forestry

The research project gives the students the ability to apply the knowledge gained in other subjects to a real resource based industry investigative problem; to undertake an independent research project including – developing a research proposal , undertaking a literature search and review, defining an appropriate research methodology in conducting the investigation, writing up the results , undertaking empirical analysis appropriate to the specific project (e.g. experimentation, survey, secondary data analysis) and to communicate effectively to both scientific and non-scientific audience. The project should be developed in close collaboration between students and academic staff advisers and its definition must be developed in the first semester of the fourth year.

11 Improving the Quality and Relevance of Forestry Education in Liberia

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ABSTRACT

The nature and latitude of the lingering constraints to good quality and relevant forestry education at the College of Agriculture and Forestry, University of Liberia, were identified, examined and the steps to resolve them proposed. These impediments include an outdated curriculum, poor teaching, and the lack of or inadequately trained and committed personnel and the lack of leadership. The principles and practices of Participatory Curriculum Development and Total Quality Management are suggested as initial steps towards finding a credible and lasting solution to these problems, as are recommendations to revise and upgrade the forestry curriculum, introduce forestry education in primary and possibly secondary schools and the public at large, and the establishment of a pedagogic unit at the University of Liberia.

11.1 INTRODUCTION

Forestry in Liberia is taught only at the College of Agriculture and Forestry of the University of Liberia, the oldest degree-granting institution in West Africa, founded in 1862. The College was created in 1952, ninety years after the birth of the University, and since then forestry education has been traditional. As such students are taught how to identify, grow, plant, manage and harvest trees, as well as process wood and construct logging roads. As

all of this happens, little or nothing is taught about wild animals, forest-people interrelatedness (in a country where more than 70% of the people live in and near forests), conservation and protection of forests, and why and how forests are to be managed as ecosystems. The Department of General Forestry of the College confers bachelor's degrees in forestry and its sub-degree or diploma level education prepares students for applied work in forestry and forest industry: sawmills, plywood, furniture making, nursery management, and machinery operation and maintenance. Graduates continue to fill positions mainly as managers in Liberia one of the world's largest rubber estates, Firestone, and as supervisors of reforestation projects and giant logging operations, and park administrators.

Recently, a document outlines the 7 basic objectives of Liberia's education philosophy (Education Law, 2002). The objective that mostly relates to the subject of this paper – and hence is worth quoting – reads thus: "to make the content of education flexible to reflect the aspirations and hopes of society, as well as the legitimate manpower needs of students and the nation in varying geographical and social settings, placing emphasis on responsible citizenship and developing an understanding of, and appreciation for, the culture of Liberia, Africa and other peoples". Clearly, forestry education must cease to be traditional if it is to meet these and related objectives of the nation's education philosophy. In other words, forestry education in Liberia is wanting in good quality and relevance. Quality, for purposes of this paper, is defined as the ability of a set of inherent characteristics of a product, a system or a process to fulfil the requirements of customers or interested parties. Relevance refers to the fit or the match between what a system delivers and what society expects of it.

This paper is specifically concerned about the quality and relevance of teaching, as opposed to academic or research programme structure and administration at the College of Agriculture and Forestry. Its ultimate objectives are to initiate and stimulate debate about the character and scope of the felt weaknesses in forestry education in Liberia, and to define related shortcomings and suggest where to situate the process of reform. This 3-part case material draws on reviewed experiences and insights of an increasing body of pertinent studies, re-enforced by the authors' practical knowledge, to achieve its objectives. As key thematic areas under which apposite subtitles are explored, the first section describes Liberia's education system. Second, the paper outlines and examines some of the elements that are central to curriculum development and teaching reform. Finally, section three presents conclusions and makes a number of considered recommendations.

11.2 LIBERIA's EDUCATION SYSTEM

11.2.1 Categories of schools

The substantive categories of Liberian education system consist of both regular and intermediate institutions and levels of learning. For the regular institutions, there are six categories. These are: (i) Early childhood education, (ii) Primary education, (iii) Junior secondary school (both academic and technical), (iv) Senior secondary school (both academic and technical), (v) Junior college and other post-secondary institutions, and (vi) Colleges and universities. There are 8 types of intermediate institutions, these are: (i) Teachers' education, (ii) Vocational training, (iii) Adult education, (iv) Literacy programme, (v) Non-degree theological seminaries, (vi) Seminars, (vii) Workshops and (viii) Conferences. The distinction or basic characteristics and levels of achievement of each category are discussed in detail elsewhere (Education Law, 2002). The focus of the paper is on college education.

11.2.2 The University of Liberia

The mission of the University is contained in six objectives, notably, to: (i) inculcate character, honesty, fair-play, thrift, and self-reliance sense of responsibility and the love of God and of people, (ii) encourage and develop in students the basic intellectual powers and tools that will prepare them effectively to live in a democratic society, (iii) guide students into habits of critical and logical thinking and in the choice of vocation, (iv) expose the students to problems of urban and rural areas, and a sympathetic understanding of agricultural life, and to stress the need for trained agriculturists, (v) emphasize the dignity of labour as an effective means of inducing every student to master a vocation while in school, regardless of future professional aspirations and (vi) shift teaching and learning tools from academic or verbal aptitudes to other dimensions of human nature – artistic ability, mechanical aptitude and ingenuity , master skills and dexterity, social sensitivity and resourcefulness.

For its academic programmes, the University has the following bachelors degree granting components: (i) Liberian College : The College of Social Sciences and Humanities, (ii) The William V.S. Tubman Teachers College; (iii)The William R. Tolbert College of Agriculture and Forestry, (iv) The College of Business and Public Administration, (v) The T.J.R. Faulkner College of Science and Technology, and (vi) College of General Studies. All

the colleges, except the college of general studies, confer bachelor degrees. The University has three professional schools and three graduate programmes. The professional schools are Louis Arthur Grimes School of Law, School of Pharmacy and A.M. Dogliotti College of Medicine; the Graduate School programmes are Graduate Programme in Regional Service, Ibrahim E. Babangida Graduate Programme in International Relations and Graduate Programme in Education Administration.

A variety of problems about the quality and relevance of education at the University and other levels involving disciplines other than forestry have been identified and critically assessed. These problems are common to all the academic, professional and graduate programmes of the University, including the College of Agriculture and Forestry. Chief among them are political interference in the affairs of the University, incompetence of leadership at that level, the lack of or inadequately trained and committed personnel, classrooms, and resources and fraud (The Analyst, 2007; Dolo, 2007; Gbessagee, 2002; Johnson, 2001).

11.3 CURRICULUM AND TEACHING AT THE COLLEGE OF AGRICULTURE AND FORESTRY

Besides being traditional, forestry as taught at the College of Agriculture and Forestry is denied the time it deserves. Students here continue to take some agriculture courses that rob them of the time they need to concentrate on core forestry courses. It is only in the second year of this 4-year degree course that this is possible. The need for reform in forestry education at this level is needed to bring about important changes, especially with the quality and relevance of what is being taught and who does the teaching. While revising a curriculum and improving instructional methods will not cover all that is required to improve forestry education, they are a vital pivot towards making good quality forestry education possible as first steps. A critical review of the curricula of the College undertaken on 16 August 2007, by Department Heads, shows the absence of basic statistics, experimental design and thesis preparation, and many other important subjects. Annex 1 shows the current curriculum of the Department of General Forestry, College of Agriculture and Forestry.

The curriculum clearly indicates, among other things, that students are not being prepared to carry out research that is so crucial to improving application of the knowledge acquired in college. Students at the Department of General Forestry do not take these courses in any college at

the University. Topor (2007) has developed a concept proposal that seeks UNDP's support to revise and upgrade the curricula of the College. Liberia's forests have both local and international value in the rich assortment of products and services they provide. Because of these and other reasons, forest management in Liberia must be credible, efficient, sound and equitable. Good quality and relevant forestry education will contribute to the efficient use and management of Liberia's forests. For details on the social, cultural, economic and biodiversity conservation functions of Liberia's forests, readers may want to review a body of work on the subject (McAlpine *et al.,* 2006; Tropical Forest Update, 2005; UNEP, 2004).

11.4 CURRICULUM AND TEACHING REFORM

An abundance of data suggests that education reforms under certain circumstances in the past have failed to remove the problems they were intended to solve. Dobyns and Crawford-Mason (1994) and Perkinson (1995) identified four of what they believe are overriding problems in education. They are: (i) an inadequate emphasis on academic subjects, (ii) a lack of standards, (iii) poor teaching, and (iv) an absence of leadership. These are the same problems that the University of Liberia faces today. The prevailing current opinion is that reform requires fundamental and comprehensive change (Herman and Herman, 1994). Schools that learn and improve are those that approach change from a systems perspective. The more systemic the change, the more the school embodies change in behaviours, culture, and structure, and the more lasting the change will be, experts conclude.

There are a number of ways to improve curriculum. Two of the major approaches are participatory curriculum development and curriculum mapping. Curriculum mapping is an interactive and collaborative process consisting of 4 steps: (i) planning and preparing; (ii) recording the taught curriculum and revising it for potential gaps and/or overlaps; (iii) aligning the taught curriculum with standards and assessment; and (iv) using student performance to validate alignment and plan for continuous curriculum improvement (Lyte, 2006; Jacobs, 2004). Our focus here is on participatory curriculum development (PCD) and Total Quality Management (TQM) for effective teaching.

11.4.1 Participatory curriculum development

Participatory Curriculum development (PCD) aims to develop a curriculum from the interchanges of experiences and information among the various stakeholders in an education or training programme. The rationale for this emerges from positive outcome due to increased participation of different stakeholders in extension and community development activities. Many authors (Pretty *et al.,* 1995; Chambers, 1997; Hagmann et al., 1999) have described participatory processes leading to more successful outcomes and increased effectiveness in planning, implementation and evaluation of rural development programmes.

Building on lessons learned from field-based practice, a critical, formative element of PCD is the identification of stakeholders. These may include academics, researchers, policy makers, extensionists, foresters and farmers. Rather than belonging to a small, selected group of experts, PCD involves a wide range of stakeholders in a meaningful way. It draws upon their experience and insights in a structured approach to curriculum planning, implementation and evaluation (Rogers & Taylor, 1998). This mosaic of stakeholders normally contributes to setting aims and learning objectives, engages in development of the subject matter being taught, and participates in the processes and experiences, which lead to clearly defined objectives.

The workshop process involves a series of nine steps, which are shown in Annex 2. Basically, such workshops are often divided into two main parts. The first part in this case is shorter and more structured, the second longer and more flexible, and is mainly dedicated to writing up the curriculum guide. The first part also aimed at creating a feeling of involvement among participants, since they are expected to work closely together in developing the detailed content of the guide during the second part of the workshop. For this reason the process must be quite participatory, and formal presentations should be kept to a minimum.

Step 1 and 2 of the process are designed to give participants the opportunity to reflect on experiences of forestry curriculum development in universities and other teaching institutions. After introductions, expectations, and a brief fact-finding exercise related to participants' background in forestry curriculum development, groups have to discuss their perspectives on what is involved in curriculum development. This is important since experience of other events had shown that there are often widely differing views about the nature of a curriculum and the approach used in its development.

Step 3 involves a short presentation on PCD so that some consensus could be reached in the group about terms and concepts. Steps 4-7 are all under the first part of the exercise. Steps 8 and 9 constitute the second part of the workshop process, which is to be devoted to planning and writing the main sections of the guide. Facilitators usually help in proposing a structure for the guide, based on the outcome of the first part of the workshop. The proposal is then discussed in a plenary to reach a consensus, and the participants are asked to individually sign up for any of the chapters to which the guide is agreed to be composed of. The groups will then be asked to include and elaborate on the main learning points which should be addressed, the main content, suggestions for appropriate learning methods and materials (ideally based on real practical experiences), and how learning would be evaluated. These steps and the process involved here are not written in stone. Practitioners may adapt these steps to their own circumstances and situation.

11.4.2 Total quality management and effective classroom teaching

Total quality management (TQM) was first introduced as a business management approach in the post-World War II era to reinvent shattered economies. More recently, education leaders have begun to recognize the potential for TQM applied to educational organizations. Quality management provides a connection between outcomes and the process by which outcomes are achieved. If, as many people realize, the cause of failures in education is a problem in design, quality management may be regarded as an ideal systemic process for managing change in public education (Frazier, l997). Recent papers in engineering education describe quality-based models for classroom instruction (Shelnut and Buch, 1996; Summers, 1995; Bellamy *et al.,* 1994) and curriculum reform and revision (Latzko, 1997; Stedinger, 1996; Jensen and Robinson 1995), and that improvement and management of education require the same principles used for the improvement of any process, manufacturing or services (Deming, 1994).

The decision to use TQM principles to guide change in schools is made for a variety of reasons. Some institutions are encouraged by business partnerships and training; others see the similarities with effective schools research (Lezotte, 1992). In some instances, it is a legally mandated redistribution of power and resources that led educators to embrace quality as a key part of the process of change. For Liberia, the impetus has been the legacy of more than 14 years of a senseless war that, among others, forced the few competent professors the nation once had into their graves or in exile.

Whatever the determining incentive, where quality management has been applied to education, it has made a huge difference (Dobyns and Crawford-Mason, 1994). Quality is creating an environment where educators, parents, government officials, community representatives, and business leaders work together to provide students with the resources they need to meet current and future academic, business, and societal needs (Arcaro, 1995). As has been the case in industry, when quality management comes to education, some long-held ideas, specifically about how to manage the teaching/learning process, have to change. In some instances, the ideas are not new but had long been ignored. In any case, education can be improved through quality management (Tribus, 1993).

There appear to be three levels of application of quality management in education. The first level is the management processes of a school. Sample school processes include strategic planning, recruiting and staff development, deploying resources, and alignment of what is taught, how it is taught, and how it is assessed. The next level is teaching quality to students. Students are recognized as both customers and workers in the educational system. Administrators need to involve students in their own education by training them to evaluate the learning process and accept responsibility for their learning. What the learning will look like is no longer predefined.

Educators know what they want to evaluate, but there are many choices as to how the students arrive at the goals set by them and by their teachers (Herman and Herman, 1994), hence students must be involved in this process. The highest level of quality principles is in learning. This is where it impacts the classroom. To achieve the desired results, educators must question their core teaching and learning processes and methods. Quality standards are established for each work process that results in improving grades and test scores. When the focus becomes instructional processes and student learning, the impact of quality management is the greatest (Felder and Brent, 1996).

Almost every known strategy for teaching effectively cited in standard pedagogical references has counterparts on a list of TQM components compiled by Grandzol and Gershon (1997). Examples include writing instructional objectives (clarity of vision, strategic planning), student-centred instruction (customer focus, empowerment, driving out fear), collaborative or cooperative learning (adopting a new philosophy, teamwork), assessment (measurement, benchmarks, continuous improvement) and training and

monitoring new faculty members (human resource development, employee training).

Even if effective teaching strategies are known and validated by extensive research (as they are), there is still much to be done to make teaching effective. TQM principles cannot be applied effectively on few individuals because it is a strategy that has meaning only if it is agreed upon and implemented by the staff of an organisation. TQM was developed by identifying problems with existing manufacturing practices and then applying a combination of sound economic and psychological principles to devise a better approach. Improving teaching requires identifying problems with existing academic practices and then applying a combination of sound educational and psychological principles to devise a better approach.

11.5 CONCLUSION AND RECOMMENDATIONS

11.5.1 Conclusion

In sharp contrast with traditional forestry education, it is evident that modern forestry education must have to prepare students for a world that expects more than technical knowledge and skills. Graduates must be good professional foresters but, in addition, will need the capacity to contribute to rural development, food security, sustainable natural resources management, poverty reduction and biodiversity conservation. Take for example the role forestry plays in the lives of Liberia's forest-dependent majority in goods and services. It is quite impractical to have developed a forestry curriculum, as the Department of General Forestry has, that informs state forest policies and management strategy, which contrasts markedly with local traditions and the culture, that nurtures them.

Some of the areas that will demand a place in the modern forestry curriculum would include: (i) public sector and community joint management of forest resources, (ii) forestry and its role in biodiversity conservation and protection, (iii) forests as recreation sites including eco-tourism, (iv) partnerships with the private sector for research, management, and timber processing, (v) forests as carbon sinks and the international implications of trading in carbon sink credits, (vi) civil society information delivery relating to forest and forestry issues, (vii) forest policy formulation and implementation, (viii) forestry education and training for non-traditional target groups and (ix) inter-relationship of forestry with other sectors such as agriculture, natural resources management, education, tourism,

infrastructure, and trade. Clearly, most of these topics will demand training of or a change in the composition of faculty members, while others could be dealt with by linking with other parts of the education system and creating cross department teams that can effectively deal with the new areas of interest and concern.

The solution will not be to overcrowd the curriculum with new subjects, although this would to some extent be inevitable, but to teach students to learn through life long interdisciplinary education. The Department of General Forestry is one of many Departments in the College of Agriculture and Forestry and other colleges in the University. The University needs to develop a culture germane to building the foundation of higher education that is student focused, differentiated to serve a broad spectrum of skill, career and labour market needs. Investment needs to be made in research, scholarship, leadership, and innovation. As is true with the Department of General Forestry, the University of Liberia needs to make education in Liberia of good quality and relevance to the nation's needs. To all of this, the principles and practices of curriculum development and total quality management will contribute significantly.

11.5.2 Recommendations

i. Implementation of at least four key sections of forestry education: Suggested to be considered here as a working hypothesis, forestry faculty at the College should be developed along the lines of 4 sections or departments : (i) forest environment (land classification, soil fertility, biology , ecology, wildlife, conservation), (ii) management and silviculture (dendrology, botany, statistics, genetics, scaling, logging, legislation , policy, tree physiology, reforestation), (iii) wood processing (organization and planning of industries, panels, pulp and paper industries, sawmills, wood chemistry and timber physics, and (iv) community-based forest resource management (community forestry, rural sociology, public education).
ii. Introduction of forestry education in primary schools: There is a need to introduce forestry education to primary school children (and possibly also secondary schools), through an environmental programme. It seems that such a programme would have its beginning with a National Policy on forestry education. Environmental consciousness should inform teaching in schools and must permeate all ages and sections of the Liberian society. A primary school forestry initiative will have implications for the

higher education curriculum and will affect students and faculty members. Curriculum implications would include the provision of a course or courses on children's education to enable future foresters to understand how children, youth and adults learn, what types of activities appeal to them and are likely to be most effective in conveying the desired forestry messages.

iii. Such an approach to forestry education can, at relatively low cost, produce future generations of people who understand the role of forests in sustainable natural resources management, in watershed management, biodiversity conservation, global warming, and the production of timber based products for home and export markets. An opportunity exists to bring these critical messages to large numbers of children, young people and adults through the primary and secondary school system and through non-formal education (literacy and adult education) and this opportunity should be grasped without delay. The course should also deal with communications methods likely to get the attention of primary school children and likely to encourage them to participate in learning activities. Such courses in higher forestry education can be team-taught or custom ordered from Faculties of Education in the larger university system.

iv. Forestry education for the public at large: Because many areas of forest management are far different from the traditional methods of land use, such as shifting cultivation, education of the public at large should be an integral part of the forestry education system. The other reasons why public education must be at the core of forestry education are that (i) forestry, as a natural science, is far behind agriculture as regards the backlog of accumulated knowledge and much has still to be learned by a trained forester, its clear what the situation must be with farmers; and (ii) majority of Liberians live in or near a forest of some sort and has developed forest environment relations that are deeply anchored in religious traditions.

v. Public forestry education could play a pivotal role in advocating for expanded access to basic education (primary, secondary, literacy and basic skills for life) for those who live in remote forest areas often not served by schools and who do not have any influence on decision-making about how forestry schools are structured and managed. The forestry case, to promote in remote communities the understanding of the importance of sustainably managing the resource, can be powerful enough to influence ministries of education to invest in schools in such areas especially when forestry educators will be active participants in the education programme of these schools.

vi. Successful advocacy, in addition to taking the forestry messages to young people, would contribute to: (i) increasing access to basic education for forest area communities, (ii) improving overall quality of education for such communities. This includes improving and broadening basic education curriculum quality in general by the inclusion of a forestry unit within an environmental education programme and (iii) building the capacity of education and forestry sector policy makers and managers to address the above mentioned tasks.

vii. Allotment of sufficient time to forestry education. Modern forestry includes not only the physical and biological sciences, which now dominate the current curriculum of the College of Agriculture and Forestry, but also the human, and social sciences, economics, and engineering. For example, the development of large forest areas requires considerable skills and a considered regard for people living in or near the forest who are highly likely to be affected by forest management activities such as logging and the construction of logging roads. The organization of forestry courses should therefore be done with the cooperation of all other disciplines, but it should be separated from an agriculture course. Modern forestry is sufficiently developed and has enough challenges of its own, to require the allotment of the whole time available in order to give students proper training and pertinent orientation.

viii. Establishment of a "pedagogic resource unit" at the University of Liberia: The quality and relevance of training to the reform process is too important to be left to persons without authentic pedagogic training, recognized as well as credible skills. A "pedagogic resource unit" should be established at the University level. The objective of such a structure would be to assist as a matter of priority, young teachers or experienced teachers wishing to: (i) improve their teaching methods through a revised curriculum, (ii) resolve certain difficulties encountered in teaching, (iii) organize more relevant, valid, reliable and economically formative or certificatory evaluations, (iv) promote the training of new teachers and assist the institution to carry out education-based missions. To be credible, such a unit should have some degree of independence vis-à-vis academic authorities in matters concerning teachers and should demonstrate its efficiency though concrete results. Furthermore, the persons representing the unit should periodically be involved in teaching so that they are not totally excluded from practice. Such a

unit should be capable of establishing exchange networks and participating in this regard, in continued training sessions.

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ANNEXES

Annex 1.Curriculum of the Bachelor's of Science Degree in General Forestry, Department of General Forestry, College of Agriculture and Forestry, University of Liberia*

Year 1	Credits
Engl. 101 Freshman English	3
Math 107 – Pre-calculus	4
Boil. 103 – General Biology I	3
Chem. 101 – General I	4
Fore. 101 – Introduction to Forestry	2
ROTC 101 – Military Science	0.5
Eng. 102 – Freshman English	3
Math 108 – Math for Decision Making	4
Biol. 104 – General Biology II	3
Chem. 102 – General Chemistry II	4
Fore 102 – Introduction to Agriculture	2
ROTC 102 – Military Science	0.5
Vacation period: Fore 121-Freshman Forestry Practice	1
Year Two	
English 201- English	3
Fore 201 –Dendrology	3
Fore 203 – Forest Ecology	3
Phys 105 –Physics	3
Phys 111 – Physics Lab	1
Econ 203 – Introduction to Economics	3
ROTC 201 –Military Science	0.5
Engl 202 – English	3
Fore 202 –Wood Biology	3
Fore 204 – Forest Policy, Law & Administration	3
Phys 106 –Physics	3
Phys 112 –Physics Lab	1
Econ 204 –Introduction to Economics	3
ROTC 202 –Military Science	0.5
Vacation period: Fore 221 –Freshman Forestry Practice	2
Year Three	
Fore 301 – Forest Mensuration	3
Fore 303 –Forest Survey	3
Fore 305 –Forest Engineering	3
Fore 307 –Nature & Properties of Soils	3
Fore 309 –Wood Behaviour	3
Fore 311 –Tractor Operation & Maintenance	1
Fore 302 –Forest Inventory	3
Fore 304 –Forest Mapping	3
Fore 306 –Forest Engineering	3
Fore 308 –Soil Fertility & Fertilizers	3
Fore 310 – Forest Practice	1

Fore 312 –Foundation of Silviculture	3
Vacation Period: Freshman Forestry Practice	3

Year Four

Fore 401 –Forest Management	3
Fore 403 –Forest Economics I	3
Fore 405 –Primary Timber Industries	3
Fore 407 –Practice of Silviculture	3
Fore 409 –Forest Protection	2
Fore 411 – Forest Practice (Management)	1
Fore 402 –Forest Working Plan	3
Fore 404 –Forest Economics II	3
Fore 406 –Forest Utilization	3
Fore 408 –Silvicultural Systems	2
Fore 410 –Natural Rubber Production	3
Fore 412 –Forest Practice (Management)	1

Electives for Junior/Senior

First Semester:

- Fore 413 –Forest Research 3
- Fore 415 –Timber Mechanics 3
- Fore 417 –Advanced Dendrology 3

Second Semester:

- Fore 414 –Forest Research 3
- Fore 416 –Wood Furniture Design 3
- Fore 418 –Advanced Dendrology 3

*The minimum requirements for B.Sc. in General Forestry are 134 hours, 128 hours of courses taken during the semesters and 6 for the Forestry Practices conducted during vacation periods in the Freshman, Sophomore and Junior years. There are two semesters per year.

Annex 2. Key Points, Methods and Outputs of a Workshop Approach to Participatory Curriculum Development

Step	Key points	Method	Output
1.	Participants' background in forestry, how forestry is taught	Participants place marks in matrix on poster	Range of forestry curriculum that the Guide would need to address
2	Who is involved in curriculum development	Merry-go-round brainstorming Presentation on PCD approach	List of participants; perspectives on what is involved in curriculum development, compared with existing theory
3	Curriculum development methods and teaching/learning approaches in participants' institutions	Completing matrix of curriculum development approach versus teaching/learning approach on poster	Participants' agreement on desirability to move in the direction of more learner-oriented teaching approaches and more participatory curriculum development
4	Stakeholder analysis	Listing stakeholders and their interests, importance and influence matrix, stakeholder participant matrix	Potential roles and responsibilities for a list of identified stakeholders
5	Why this guide is needed	Focused conversation	Consensus about what needs this guide should address
6	Stakeholder perspectives on forestry education	Presentations of case studies (by a professor, a practicing forester, an employee and a former forestry student)	Issues raised about the job and characteristics of a forester in each of the countries represented, as well as the regional implications arising
7	Knowledge, skills and attitudes which the guide should address	Listing on cards (group exercise), posted on wall	Consensus on categories and lists of knowledge, skills and attitudes to be addressed by the guide
8	Planning and writing the main sections of the guide	Groups writing detailed content	Agreed structure and main content of the guide; detailed sections of the guide written, presented and agreed
9	Evaluation	Positives and negatives chart, satisfaction dartboard; process versus product graph, "overall feeling" chart	Participant evaluation of workshop

12 An Approach for Development of a Competences-Based Training in Forestry: Vocational and Technical Education in Vietnam

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ABSTRACT

Today it is commonly accepted that an efficient forestry vocational and technical education and training system (FVTE) should be responsive to the demand of the labour market in the forestry and forestry related sectors. The FVTE should ultimately be conducive to livelihood improvement of those living in remote rural areas, with a particular focus on the disadvantaged groups, e.g. the poor, women and ethnic minorities. In order to meet the above mentioned needs, and to support Vietnamese forestry development strategies, the FVTE in Vietnam is witnessing radical changes both in terms of system structure, as well as in training contents and methods. It is advocated that a special focus is required for those people, living in the rural and forest areas. One of the most important issues is to build and strengthen training capacities within vocational technical schools in order to create more jobs resulting possibly in the better living condition of the population in mountainous regions in Vietnam. This article presents preliminary efforts and results of a programme to strengthen and improve quality of a demand-driven agroforestry vocational and technical education and training System" (VocTech-Programme). The main purpose of VocTech-Programme is to

develop training modules based on required competences for a variety of forestry related occupations to create value at grassroots level for forest, Agroforestry and fruit farmers, small-scale fruit processors, village extension workers, small business leaders for village nurseries and urban forestry workers.

12.1 INTRODUCTION

In Vietnam, forests take up a large proportion with precious wood and economically valuable forest products. Forestry is a specific technical economic sector and it includes all activities connected with commodity production and services from the forest, such as reforestation, afforestation, harvesting, transportation, production and processing of forest products, and providing environmental services related to forests. The forestry sector plays very important roles in the protection of the environment, biodiversity conservation, and poverty reduction; particularly for the people in the mountainous areas, contributing to social stability and to national defence security (FSSP, 2006).

The country has experienced a rapid socio-economic transition after its "Doi Moi" policy was adopted in 1986. There is need for increased number of skilled labour in order to fill the gap of all economic sectors in general as well as that of forestry sector, in particular. However, the existing labour force of about 30 million has only 12% who have been trained properly. In the agricultural field, farmers account for about 80% of the population, but more than 90% of agricultural labourers have yet to be trained. On the other hand, due to use of old curricula, the graduates from most vocational technical schools often lack the needed skills (MOET, 1994). The demand-driven agroforestry vocational and technical education and training System Programme (VocTech-programme) was started in 2005 and one of the main purpose was to develop training modules based on required competences for a variety of forestry related occupations in order to create value at grassroots level, for forest, agroforestry and fruit farmers, small scale fruit processors, village extension workers, small business leaders for village nurseries and urban forestry workers. This article presents the initial effort and key achievements of VocTech programme as an important part of competency-based training in case of Vietnamese Forestry VocTech education.

12.2 FORESTRY VOCATIONAL AND TECHNICAL TRAINING SYSTEM IN VIETNAM

The existing forestry secondary technical and vocational education system is a part of national education system (see Figure 12.1), which consists of four sub-systems:

- Pre-school education;
- General education (lower secondary school, upper secondary school, college);
- VocTech Education (Primary school, secondary school and professional college); and
- Higher education (Undergraduate, master and doctoral degree).

The Octet Education System in Vietnam has been developed with more than 700 training institutions of diversified forms and is able to train labourers for simple trades, semi-skilled workers, skilled workers and technicians with their long-term and short-term vocational training programmes. It has provided millions of labourers for various socio-economic sectors in the entire country. During the past years, efforts were made within the VocTech training system to adapt to the development of the national economy. The training has gradually changed from a centrally planned mechanism to a market-oriented one, in which the training programmes and curricula are revised and also developed based on needed competences of labourers.

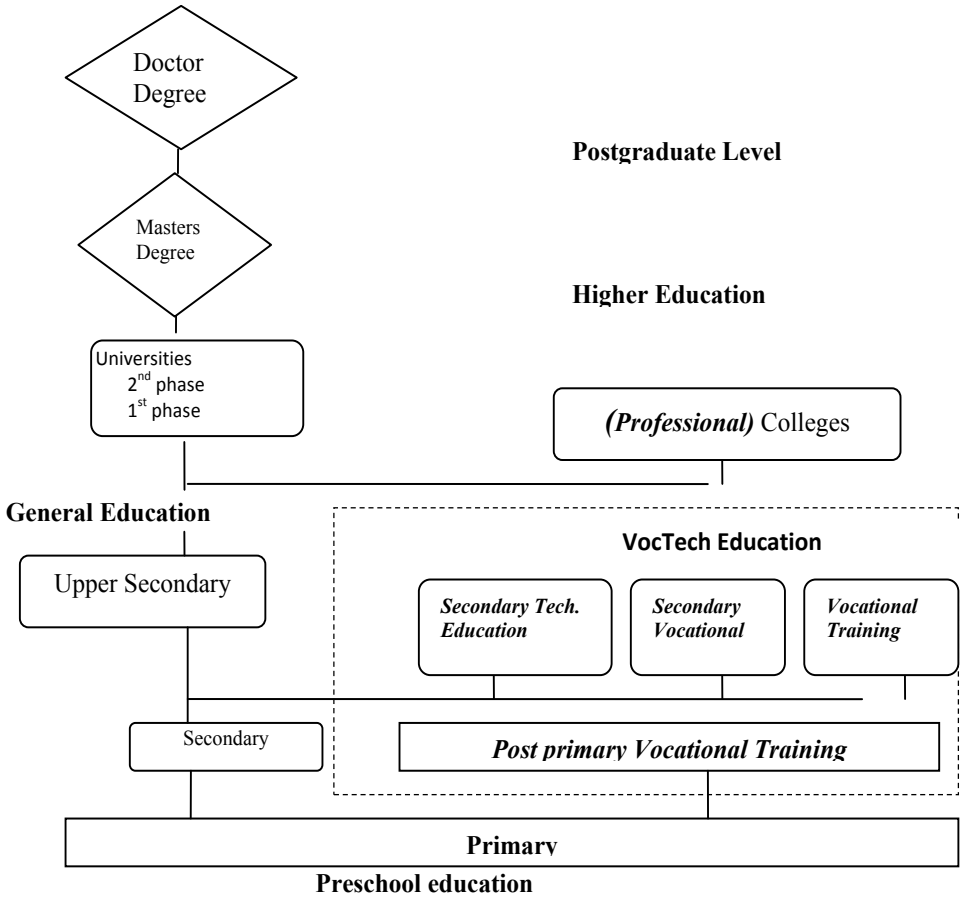

Figure 12.1: The Education System of Vietnam (Based On UNESCO, 1996)

12.3 VOCTECH PROGRAMME AND THE PARTNER SCHOOLS

The VocTech Programme officially started in 2006. The programme's beneficiaries are nine forestry vocational and secondary schools under the Ministry of Agriculture and Rural Development (MARD). The VocTech schools are located in different parts of Vietnam (Figure 12.2). In order to support schools, the programme focuses on the following objectives and activities:

- Improvement of the employment rate of graduating students through the delivery of high quality vocational training. To achieve this, there are innovations in various capacity areas; staff development, curriculum and

modules development, improving facilities and infrastructure in the schools and centres;

- Enhancement of institutional development of the partner schools through the development of institutional collaboration with leading ministries, institutes, projects for better working performance; and
- Improvement of school-management capacities for better positioning in the areas through co-operation with extension centres in the emerging markets for training services as well as with private and state sectors.

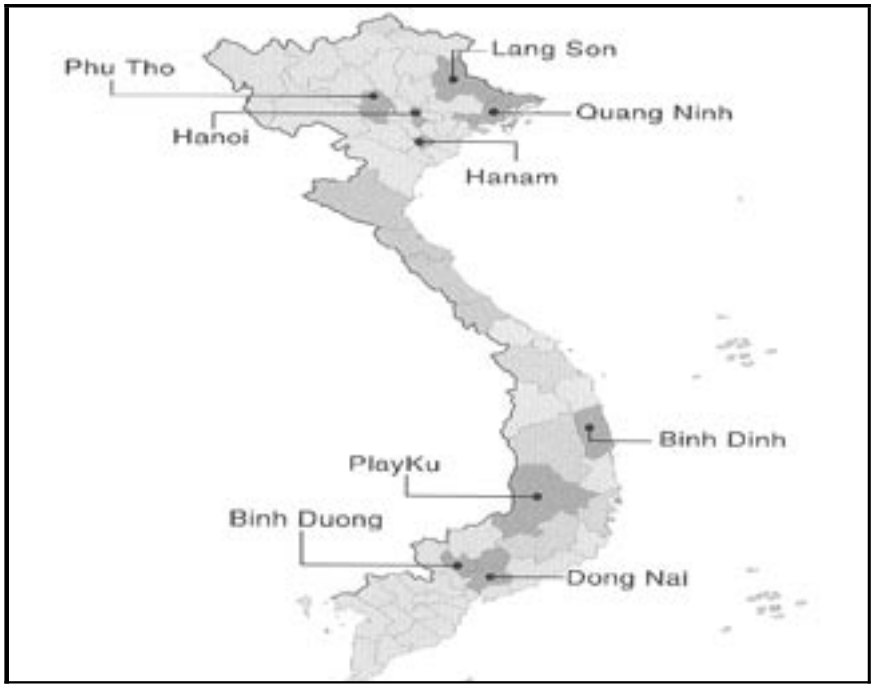

Figure 12.2: Locations of the Nine Schools of VocTech Programme in Vietnam

At present, the level of employment of the forestry VocTech graduate is low. One reason of this is that VocTech do not use or update information about the changing labour market and new opportunities in their training programmes and curricula. Previous methods to get into the labour market system have failed because the graduates' competences do not meet the requirements of current labour market. As a consequence, students' interest in forestry VocTech schools has been declining and enrolment has stagnated (VocTech, 2005). In order to attract more students as well as to improve the quality of graduates, the VocTech schools should do a number of improvements, whereby an important component; they should firstly focus

on, is to develop the competency-based training modules and programmes in order to meet a broad objective need for skills training. Aiming for development of competences implies attitude changes in students and teacher capacity. It is clear that the forestry VocTech schools will not be able to achieve complete self-sufficiency, thus the VocTech Programme should play an essential role in facilitating and supporting schools to fulfil their mandates.

12.4 COMPETENCY-BASED TRAINING MODULE DEVELOPMENT INITIATED BY VOCTECH PROGRAMME

According to the rapid school assessment (RSA), which was carried out at the beginning of 2006 by VocTech Programme, there is no linkage between training, production and manpower requirement. There is lack of stakeholders' participation in developing training curricula and programmes. This has resulted in curricula and programmes that are outdated compared with requirement of labour market. There is an acute lack of skill standards for different sectors, which can serve as a base for proper training curricula and programmes. The training curriculum only focuses on theory and is divorced from production needs. Training goals, contents and structure were developed long ago to meet the need of the State Forest Enterprises, which is characterised by the centrally planned mechanism. Thus, training programmes have become inflexible and out of date. There is a shortage of continuity in training goals and curricula between short and long term and between vocational training and secondary technical education (VocTech, 2006).

It has been proposed to develop short-term training modules, and programmes based on labour competencies required by the labour market. This process is regarded as an essential school improvement objective. Starting with three workshops on awareness creation on curriculum and module development (CD/MD) in March 2007 for all 9 VocTech schools in the South and North of Vietnam, the MD has been carried out following the procedure below:

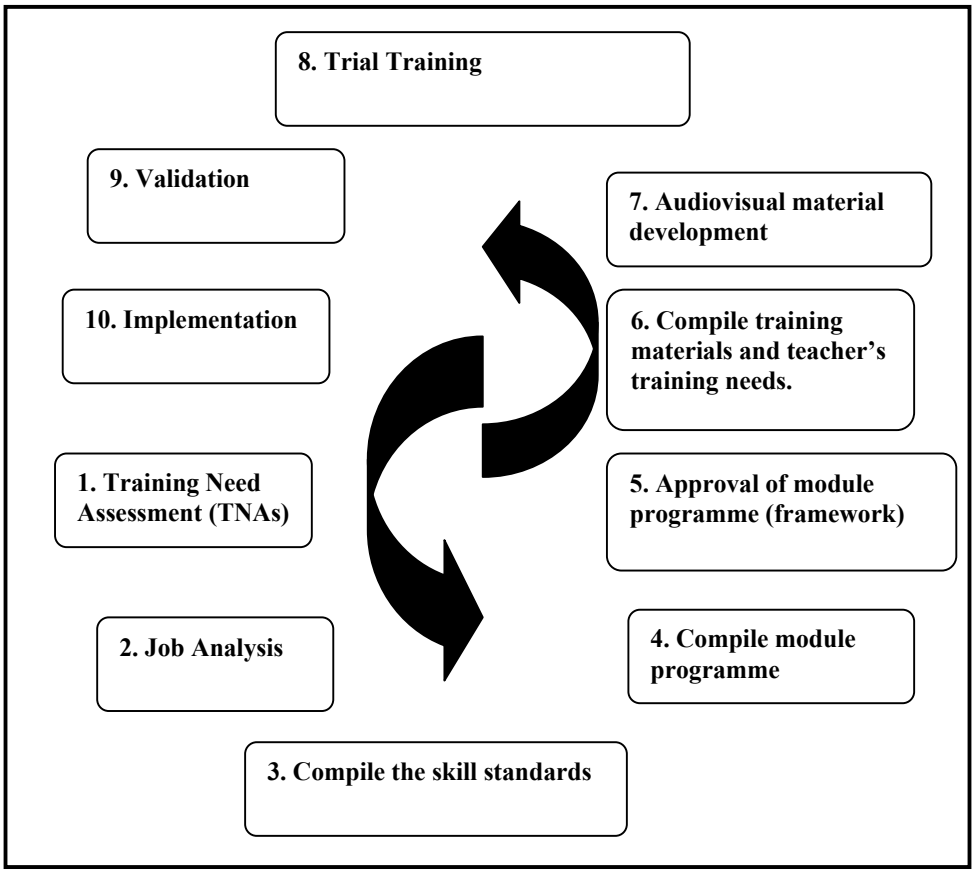

Figure 12.3: Procedure for Curriculum and Module Development

The proposals for modules development are initiated by schools themselves based on the list of school improvement activities (SIAs), which was a result of RSA process. In the year 2007, VocTech schools have started to develop different modules namely agroforestry extension, finger joint, wood drying, asexual-seedling production and kick-off business based on requirements from regional labour market.

In developing module of agroforestry extension, a collaboration network among three schools namely Binh Duong, Lang Son and Gia Lai were built up. This network has been managed by a host school – Binh Duong School with the support of the programme officer on CD/MD. This working method will provide schools with opportunities to ensure the quality and appropriateness of the developed module. Besides their team work ability will be improved through the participatory working process inside the schools and the intra-school team.

The key achievements from competency-based module development process have been listed as follows:

- Training Needs Assessment survey have been carried out for defining the programme needed to be developed. In addition, from that survey, working context, job activities of the graduates as well as target training groups have been clearly identified;
- Job analysis were implemented with Developing a curriculum (DACUM) methods, which resulted in different DACUM charts indicating required competences for each working position. All the results have been verified and finalized by experts and other stakeholders;
- The competences serve as training objectives of each module and provide evidence for tests and testing methods. Module outlines were prepared according to the standard criteria and developed by teachers at the VocTech schools;
- MD on extension-Network (with school teams, MD-expert, extension experts, village extension workers, forest enterprises, farmers, etc) was set up and put into action;
- Framework of module programmes will be compiled in September 2007 aiming at the production of various concrete results indicated in the competences. It will be validated by a committee appointed out by schools; and
- There has been intra-school staff development for school module teams. Training courses on needed professionals, developing occupational skill standards, compiling modules and other related skills that have been organized by the schools for the MD-teams with the support of VocTech Programme.

12.5 LESSONS LEARNED FROM COMPETENCY-BASED MODULE DEVELOPMENT

From the initial activities and key results, a number of important lessons can be drawn:

- Using this approach for developing modules encourages collaboration and sharing of experiences between training organizations and production stakeholders. The training objectives will reflect requirement of labour market and the teaching staff will increase their knowledge and professional skills;

- A constraint of the module development using this approach is that many persons have not yet recognized the significance and role of this method. They are still used to the traditional view of education, and specifically forestry. Moreover, the module development process requires sufficient time as well as a large amount of resources for application, which are often limited. The broad participation of many interested stakeholders requires a mechanism to combine activities in a flexible and coherent way. In addition, the difficulty that affects module development process is the fact that most of the trainers are lacking the necessary supply of information and documentations relating to training fields, both inside and outside Vietnam;
- An opportunity for this approach is that the Vietnamese Government pays attention to developing rural areas. Many projects and programmes for forestry development pursue a people-centred development tendency. The education and training system is being reformed in a direction that meets the demands of society, increasing quality and promoting the integration with other countries. This speeds up the process of change in forestry education. The Ministry of Education and Training has many directives to revise objectives, contents and teaching methods. Still, developing curricula using this approach is a long-term process. The effectiveness of the approach and its long-term impacts need time to be determined;
- There remain, however, challenges to be faced with possibly the biggest challenge being to create a process for the development of module using competency-based approach, which is sustainable. In the early stages of the introduction of the new approach, there has been much dependence on extended financial support and information. If there is no clear policy or objectives for the long-term development of human resources - especially the training of specialist staff, long-term and sustainable development can not be ensured. Changes in, and lack of consistent policies are also challenges to the development of sustainable forestry training programmes; and
- It is important to pay special attention to approaches and methods that integrate the development of content, teaching methods and learning materials. When training units lack basic resources, infrastructure and materials for teaching and learning, developing effective learning materials has a very strong effect on improvement of teaching methods.

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PART II

CURRICULA, TEACHING AND LEARNING EXPERIENCES, TOOLS AND METHODS

13 Forestry Education for Sustainable Development in Kenya: The Case of JKUAT

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ABSTRACT

In virtually all countries of the world, forestry is a livelihood, economic, environment and health matter. Forests provide food for humans and animals and raw materials for pharmaceutical, cosmetic and fibre industries. Despite its pivotal role, forestry as a subject has attracted a declining interest in education systems. Currently, JKUAT offers forestry in bits and pieces in various faculties including faculty of Science especially Department of Botany; Faculty of Agriculture and Institutes of Biotechnology Research (IBR); Energy and Environmental Technology (IEET); School of Human Resources Development (SHRD) and Geometric Engineering and Geospatial Information Systems (GEGIS). The result is a lack of specialization, while overlap and contradiction are quite prevalent. Given Kenya's vision 2030, there is need to review training, research and innovation in natural sciences including forestry in order to integrate them into a business oriented course with forestry as a major component. JKUAT is preparing to address it from a new perspective. JKUAT has to link with society, industry and business, and undertake education and innovation with results and technological solutions that farmers, manufacturers, service providers in agriculture, health, environment, transport, hospitality, and education and trade sectors can utilize to solve the challenges facing them and the nation at large. To achieve this, interdisciplinary integration with a view to enabling all disciplines to support each other and avoid duplication of effort and contradictions is critical, while breaking

interfaculty and interdepartmental 'walls'. These are the issues addressed in this paper with regard to forestry.

13.1 INTRODUCTION

Forestry education in Africa is declining in terms of both relevance and quality. The impact of this decline is becoming visible in research, teaching, extension and practice on the ground. The long-term effects are hard to predict, but they are likely to be adverse in the areas of agricultural sustainability, biodiversity and environmental conservation, health, and availability and affordability of wood and tree products - all of which have wider implications for livelihoods and the economic development of Africa.

Although the student numbers have declined over the years, this needs not be the case. However, this subject must be made more market driven, which means making it more relevant for business and direct application in meeting the challenges facing the society. This approach will definitely make forestry and other natural sciences more appealing to students, and hence making a popular course, thus enhancing the competitiveness of the university offering such a course. One hopes that this is what Wesonga and colleagues had in mind (Wesonga *et al.,* 2006).

In Canada for example, enrolment in post-secondary forestry programmes at technical/technologist and university levels has been in dramatic decline for several years. This trend has been linked to such perception factors as a negative industry image, mischaracterization of the sector as embracing low technology, and lack of diversity both in human resources and job description. This contrasts predictions of an impending shortage of technical and professional workers in the forest sector. In addition, these predictions are an imminent reality (Drummond *et al.,* 2006).

However, before we assess how to improve forestry training and hence increased enrolment, it is important to ask the question why some programmes continue to attract many students within and outside the institution despite the competition between institutions. Some characteristics of a good programme to name but a few may include the following.

- Reviewed course theme, purpose and objectives to depict a market driven course content and delivery methods, associated with clear economic value chain, related trade, and forward and backward

linkages, and giving an indication of the benefits in terms of business and high income generation for the investors and the workers;
- Employment opportunities, formal or self employment, including prospects for consultancy;
- Social status and prestige derived from forestry as part of natural and life sciences;
- Technological compliance and attractiveness;
- Goodwill from former graduates;
- Successful professionals and role models;
- Competitive curriculum with application in industry, enterprises; and
- Technology driven activities in forest plant and tree production, processing, marketing of forest plants and trees, accommodation for wild animals, and technological support for industries in form of packing materials, construction materials, wood fuel, and several other related by-products.

13.2 CAUSES OF DECLINE IN STUDENT ENROLMENT IN FORESTRY

13.2.1 Inadequate focus on forestry education

Like all other related courses, reduction in student enrolment may be attributed to various factors. First, there is the question of importance attached to forestry education and training by the country itself. Forestry is not covered at the primary school level except as few topics under Geography History and Civics (GHC). At the secondary level, some aspects are covered under geography and partly under biology and ecology. The problem is further aggravated by the fact that forestry at the college and university level is classified as a professional course, but after training those who qualify are not considered as professional cadres in the job market. The reason may be associated with the fact that so far most forestry related jobs are mainly found in the Government sector and the numbers of graduate absorbed by this sector is reducing. There are however upcoming opportunities in Non Governmental Organizations (NGOs). The Government has also continued to support forestry training for the private sector, but the sector does not seem to be developing fast enough to absorb the graduates. Still some of the qualified foresters quite often find themselves without employment.

Such experiences, together with the fact that they are not recognized as consultants and their emoluments are lower than those of other professionals, make training as foresters quite unattractive to the young people who are keen to find good

employment or business opportunities after training. This may be known as the key push factor discouraging training in forestry and related matters.

Secondly, like many traditional courses offered in universities, the present character of forestry suggests less than dynamic and market driven challenges to be able to appeal to would be students. This is the case primarily because it is completely wanting in terms of business value chain and decent livelihood for the people in the profession. In addition, many curricula are outdated and wanting in terms of relatively new topics such as community forestry, biodiversity conservation, integrated natural resources management, communication and agroforestry (FAO, 2002).

13.2.2 Negative impact of rural connotation in forestry education

Again the kind of training offered under this course is not very different from agriculture, itself on the decline over the last ten years. It therefore lacks a character of its own, and has no clear direction in terms of applied purpose and economic sense. Equally, its rural orientation as a course repels many students whose ambition is to steer clear of rural related activities in their lives, thus trying to avoid courses with a rural connotation. This puts off many young people most of who have been brought up in the urban areas and who do not see any economic or social benefits accruing from "soiling" their hands in either crop or forest farming. In stead they associate any form of farming with poverty, low social status, and source of bondage. This puts off many young people especially those who have no association with farming or agro-business, yet they could set up businesses if given the correct information on to the subject.

13.2.3 Inadequate entrepreneurial and marketing skills

Insufficiency of attention to the need for entrepreneurial and marketing skills in forestry products and business is another factor that has contributed to the decline in enrolment in the field. Most forestry training curricula were orientated towards production and employment in the public service. Training lacks applied component and produces graduates who do not have an idea of what to do with their qualifications in economic terms. Investors are not sensitized on forestry as a viable economic venture and the sector is therefore undercapitalized leading to serious neglect. To aggravate the situation entrepreneurial and marketing skills are not emphasized in many forestry training programmes. The forestry graduates, therefore, find it very difficult to use their scientific knowledge outside formal employment.

13.2.4 Policy inadequacy and inadequate investment in forestry

Changes in, and lack of, consistent policies are also challenges to the development of sustainable forestry training programmes. Due to this deficiency, there is inadequate investment in the forestry, agricultural sector, life sciences and technology in agriculture to attract effective private sector participation. Indeed, forestry graduates, who may be willing to gainfully use their skills, do not have adequate resources, especially land and initial capital to invest in forestry. This has resulted in most young people moving from the rural areas to urban areas, exerting immense pressure on the facilities within the urban areas. The increased pressure on the facilities in the urban areas is one of the contributing factors to environmental degradation. There is, therefore, urgent need to address the question of rural development with the view of curbing rural-urban migration. Agriculture, being one of the main activities in the rural areas, is naturally a potential target for development in these areas. The growth in the sector depends on, among other factors, availability of skilled human resource.

Arising from such concerns as analysed here, the Jomo Kenyatta University of Agriculture and Technology (JKUAT) is one of the institutions of higher learning reviewing the purpose and goals of forestry, agriculture and related courses with a view of revamping them and giving them a new and market driven direction.

13.2.5 Suggestions of ways of improving forestry training

To deal with these problems some countries have come up with forestry programmes that are properly focused, thus motivating interest in regeneration of forestry as a viable field of research and training. They have, for example, come up with what is known as carbon farming involving forestry farming, medicinal trees and plants farming, ecotourism e.g. nature trail tourism like Kakuma canopy walk in Ghana and Costa Rica natural forest trails. The need for a policy set up and definition, and the need for a clear definition of the social and economic goals of forestry will necessitate a paradigm shift in the way forestry education is conducted. In this respect a few suggestions can be fronted with a view to initiate discussions on the need for a reviewed approach to forestry education in Africa.

13.2.6 Creating a demand for foresters and related professionals

There is need to create sustainable demand for forest products, thus creating opportunities for preservation, expansion, and development of forest-related professionals. This would demonstrate seriousness on the part of the policy makers and business people as regards the need for sustainability and stewardship of

forests, followed by a commitment to support existing post secondary capacity creation in technical and professional programmes in this field (Drummond *et al.,* 2006).

13.2.7 highlighting the importance of forestry to the economy and healthy life of the local communities.

Emphasize the importance of forestry to the economy at all levels of education, by making sure that forestry is given more emphasis as part of the natural resources education at the primary and secondary school levels. This development of course calls for serious investment in forestry and forestry-related products research as a means of creating new academic, social and economic initiatives and opening new opportunities for professionals in this field. It will also reveal tangible benefits to the local communities in terms of incomes, employment business opportunities, all leading to improved living standards. Such a development will be complete if a total forestry value chain is established from the seed or tissue-culture seedlings to the table, building, furniture, medicine, and others in the market. The benefits will also be forthcoming in form of carbon farming aimed at reducing carbon dioxide in the environment and injecting it into the soil, thereby assuring the society and the local communities of cleaner, healthier, and safer environment.

13.2.8 Stakeholder's participation, curriculum development and inclusiveness in forestry education and research

In the development of a curriculum in this field, it is critically important to involve all the key stakeholders. This would help in identifying areas of optimal utility including the social and economic benefits, as well as the physical products to be realized from forestry, agroforestry and related activities. It would equally help in decision making regarding the kind of businesses and industries to be established and developed, the kind of consumers of forestry products, and the kind of graduates the country requires in order to improve economic, environmental, and health productivity. This message is depicted in Figure 13.1, which shows the factors that drive a viable natural science with forestry as an important component. This is also the key indicator of the kind of curriculum that maybe suitable and sustainable for the type of natural science and technology a country should develop in order to reach the market. The crucial stakeholders that need to be involved in the development of forestry curriculum are shown in Figure 13.2.

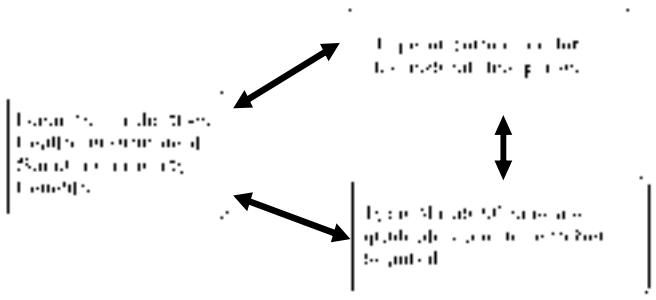

Figure 13.1: Factors Driving Forest-Related Science and Technology Curriculum, Training and Research Activities

The products anticipated from a viable forestry education in Africa are similar to what has happened to other countries such as China, Australia, US, among others. They include building materials, medicinal products, tourism, fuel wood, farming tools and machinery, processing equipment, fuel-wood burning equipment.

13.2.9 Reviewing curriculum on forestry education: Aspects to consider

A review of forestry education curriculum is essential for the emergence of a programme that is aimed at enhancing relevance and quality management, supported by regular internal and external evaluation. Nowadays, a sound programme should also have both national and international focus, and be entrusted to a faculty with a capacity to implement innovative ideas and drive them forward.

Curriculum development for forestry education must be linked to natural resources development. It must be closely linked with existing or potential business ventures and trade, the need for cleaner and safer environment in the community, scientific research, and overall country's need for natural resources and forestry science training research and innovation. The quality of a curriculum depends very much on the combination of three activities: training, research and extension. In this regard, there is need for increased collaboration of researchers from different academic disciplines to enrich integrated forestry research and curriculum development (MacNab, 2005). By integrating these activities, staff members

increase their knowledge and skills, as well as broaden their attitudes, ultimately enhancing the quality of the teaching, learning process, discovery and engagement.

This would call for a review of the existing approaches and seek to integrate the development of content, teaching methods, learning materials and application. When training units lack basic resources, infrastructure and materials for teaching and learning, developing effective learning materials is difficult, thus adversely affecting efforts to improve teaching methods with a view to encourage learning, discovery, and entrepreneurship in the forestry and natural resources industry.
The establishment of a training network between training, research and agriculture-forestry extension organizations is an effective way to channel support and co-operation. All this demands establishment of suitable mechanisms and incentives for stakeholders' responsibilities for establishment of a sustainable curriculum in the integrated disciplines of natural resources, forestry, agriculture and related business process.

In addition, instead of offering one general degree course, institutions could offer two- or three-pronged degrees (e.g. a B.Sc. in Community Forestry, Agroforestry and Rural Development) to enhance diversity and perhaps create more opportunities for foresters in a dispersed job market. These should be well structured and allow specializations, particularly at the MSc level. New fields, such as biotechnology, chain management should be offered**.** Figure 13.2 illustrates the crucial stakeholders in curriculum development

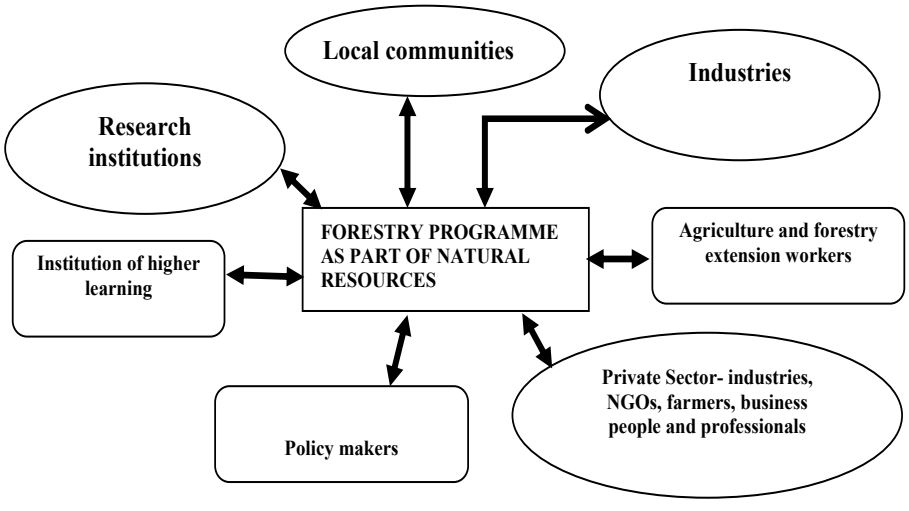

Figure 13.2: Important Stakeholders in Forestry/Natural Resources Curriculum Development

13.3 CURRICULUM DELIVERY HUMAN RESOURCES

Related to curriculum review is the availability of competent human resources to undertake curriculum delivery. This means that the process of developing an integrated curriculum for forestry education incorporating forestry and natural sciences and related technologies must take into account the requisite human resources for related training institutions, especially with regard to the new approach to the delivery of the curriculum based on a wider view of the field. Where deficiency is identified, all efforts must be made to rectify it through training and recruitment from other institutions or countries.

13. 4 REVIEW OF GOVERNMENT POLICIES

There are also other important issues to address when dealing with forestry as a national and global concern. In the first place there are issues of governmental policy review and awareness creation among political, community and industrial leaders on role of forestry in human social, economic and environmental survival. Such an approach would make it mandatory for every nation (especially 'those' unaware of these world vital issues) to seek national and international coordination of policies on forestry with a view to making it beneficial to all and "offset" the adverse carbon effects on the atmosphere, a factor that is deemed to account for the ongoing global warming and its attendant consequences (Ogueri, 2004).

Such policies would best be taught and practiced in formal education i.e. schools, colleges and universities, since this is the place the lasting values and attitudes toward the role of forestry would be inculcated in the entire human society. This will help create the awareness of these global issues and challenges in youngsters who are future influential decision-makers. Thus, introduction of some related subjects such as forestry and environmental education in Kenyan education syllabus/curriculum could act as a step forward in creating awareness to these planetary issues.

13.4.1 Emphasis on forestry as a business and as a field with efficient technologies

The syllabus should re-orientate the subject to forestry as a business right from the beginning. Emphasis should be placed on cheap technologies like use for example wood processing technologies and biotechnology that the graduates can use for processing and value addition. This should extend to local fabrication of implements and machinery locally.

13.4.2 Encouraging private sector participation in extension service.

Forestry extension service delivery should be participatory, *exploitation of natural resources* inclusive of *and both public and private stakeholders* participation. Although the ultimate object is environment conservation and development, the effort must provide opportunities for value addition and marketing of forest and other natural resources products for enhanced incomes to the farmer, industries or the professionals.

13.4.3 Regional specific training in forestry

Universities should start region specific satellite campuses in different regions of Kenya, each tackling challenges in that region, that is, all research and courses offered should address challenges facing that region. This is because the foreign programmes may have limited relevance to Africa's needs, especially if thesis research is not done in an African environment (Temu, 2002). This will mean each campus of universities develops region specific technologies addressing different challenges of the economy of this country and avoid duplication of efforts. Marginal areas also need to receive special attention so that the potential is tapped by bringing on board non-traditional areas.

The curriculum should prepare students for self-marketing and employment within and outside the country. The Great Lakes region offers a suitable opportunity for agricultural and forestry college graduates e.g. Rwanda, Southern Sudan, etc

Forestry training has a vital role in achieving Kenyans economic, social and environmental goals. Effective strategies and action are needed and are summarised in Figure 13.3.

13.4.4 How JKUAT Striving to Improve Forestry Education

The University is creating awareness on opportunities that there are in forestry and agricultural related courses through academic advisors and mentoring students in the University. The marketing awareness effort is extended to secondary and primary schools through visits, professional talks and distribution of brochures. Use of field trips is an important component of forestry training. This needs to be encouraged and students should be able to visit for example the “water towers” of Kenya and appreciate the impact of forests in environment, particularly in water and biodiversity conservation. Field trips also make the courses interesting and

enrich the outputs from lectures. Field trips should be treated as an important part of the continuous assessment (practical) which accounts for 15 marks out of the 30 at JKUAT.

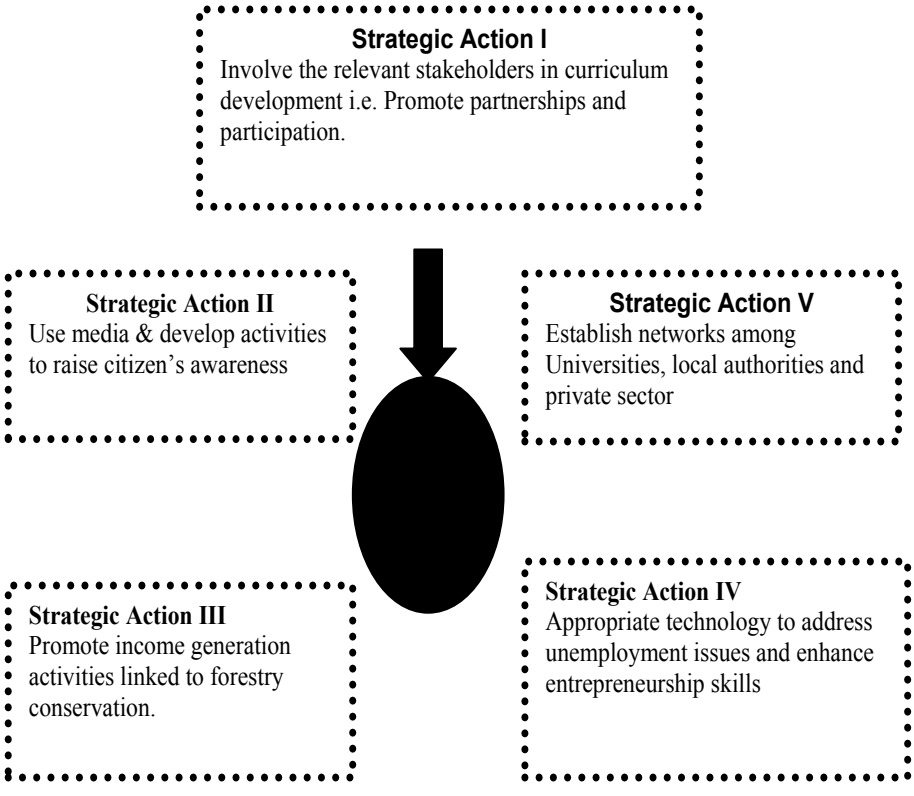

Figure 13.3: Strategies for Enhancing Forestry Training for Socio-Economic Development

The emphasis on practical work and establishment of botanic gardens, agroforestry plots and conservation sites within JKUAT is helping display the importance of forestry as well as serve as demonstration plots for use during practical and fieldwork. In addition agroforestry and forestry business products especially in biomedical sector like production and packaging of medicinal products and material health products is being encouraged.

Collaboration with industry is key to successful training in forestry. This necessitates constant review of the curriculum to keep in touch with the current industrial and business needs and relevance. This is usually done after one four-year cycle and input from industries/market where students go on attachment is

particularly key. It is also subjected to thorough scrutiny from the department, faculty, deans committee and finally senate that approve the programme. This is part of quality control to ensure that the laid out requirements are met.

Collaboration with industry with a view to improve the quality of the graduates that JKUAT produces includes partial practical accreditation by professional organizations during their training. This kind of industrial attachment not only helps the students to understand the true realities faced by industry, but it also makes them self-reliant when they graduate.

Effort has been made to adding value to the foundation degree programmes in forestry by incorporating computer courses and human resource/entrepreneurship courses relevant to the sector. This is because agriculture and forestry must be seen as a business first, and as an occupation second; and people must be attracted to forestry and agriculture as a source of decent livelihoods (Wanjohi, 2006). This can be achieved for example through short postgraduate courses such as business plan development in forestry, agriculture, project management certification, environmental management and leadership.

In addition, industrial collaboration helps to focus teaching on the current and future demands in the forestry sector. This involves strengthening teaching and incorporating the current methods in the forestry sector. It means using current and practical examples to enrich learning. At the same time, industrial attachment helps to update students on regulatory-compliance requirements and current and upcoming policy issues in the sector. Equally, students use industrial attachment to conduct research and develop solutions to the problems that industries in the forestry sector face.

Forestry innovations must be encouraged as part of learning if the profession has to grow in tandem with the rest of the economy. JKUAT, therefore, actively involves students more actively in seminars, university presentations and Agricultural Society of Kenya (ASK) shows. This has been seen to build confidence in the students in the programmes they are engaged in and encourages them to come up with forestry related scientific and technological innovations. These could include new or improved methods of plant propagation, pharmaceutical products, forestry equipment, and new uses of forestry products. It also provides them with a unique opportunity to interact with potential employers, mentors and their lecturers in the process of developing their discovery capabilities. Collaboration has also to be extended to other research institutions. For JKUAT efforts are made to work with and encourage exchange programmes with other universities, especially the University of Nairobi, Egerton and Moi Universities, and research institutions such

as World Agroforestry Centre (ICRAF), Kenya Forestry Research Institute (KEFRI) and Kenya Agricultural Research Institute (KARI), among others, both within and outside the country.

Finally, JKUAT proposes to have forestry taught as an interdisciplinary subject under natural science and resource management. This means amalgamation of all aspects of forestry in order to have a comprehensive approach to training and research. The forestry programme may then be hosted in the plant sciences (Botany) but the new syllabus should draw from the Faculty of Agriculture and SHRD, ITROMID, IEET, IBR, Departments of Zoology, Chemistry, and GEGIS. Such an integrated multidisciplinary approach is expected to yield more comprehensively educated forestry graduates to give new life and benefits to the profession, forestry farming, and the forestry industry. This is the idea illustrated in the following diagram (Figure 13.4) depicting inputs and outputs and/or products in forestry education and industry.

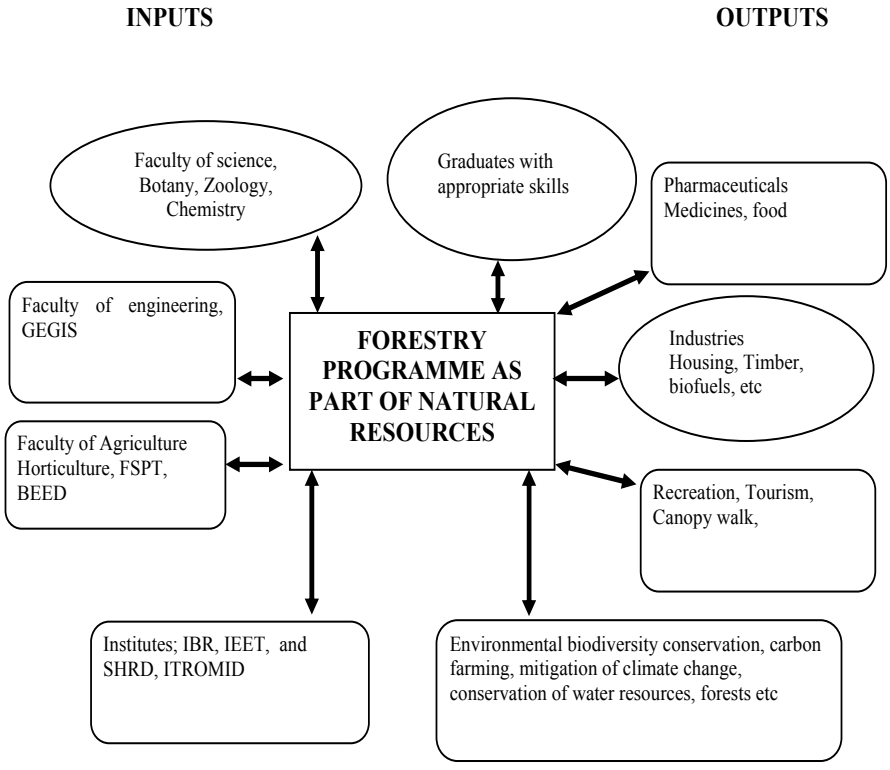

Figure 13.4: Forestry Education Inputs and Outputs and/or Products

13.5 CONCLUSION

Review of forestry education in Kenya needs the participation of the current stakeholders from government, universities, research institutions, business, health environment etc and consumers of forestry products and services. Though each stakeholder has their own interests, motivations and viewpoints with regard to curriculum development, a vision of the whole curriculum development process can be created through an examination of stakeholder economic interests, functions, roles and influences. It is important to change our curricula to reflect more of the international forestry agenda. The forestry programme should cover the whole value chain of forest science i.e. Environment, Socioeconomic and Management. There is therefore an urgent need to make agricultural training more relevant to the societies' needs through creation of market oriented curriculum with all stakeholders, development of enabling policies that are sensitive to the commodity value chain, increased investment in forestry and agricultural sector to attract private sector.

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14 Changes in Forestry Training Over the Last Three Decades at Makerere University, Kampala, Uganda

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ABSTRACT

Undergraduate training in forestry in Uganda started at Makerere University in 1970. The then Forest Department has over the years evolved to become the Faculty of Forestry and Nature Conservation. Undergraduate programmes have increased from one to three. These changes have occurred shortly after financial and technical support from the Norwegian Agency for Development Cooperation (NORAD) was terminated due to political instability in the country. The curriculum has evolved from the one with duration of 3 years to 4 years due to the ever changing demands of society. This paper presents processes leading to this evolution of professional training in forestry and discusses the successes and challenges of forestry training in Uganda.

14.1 INTRODUCTION

Undergraduate training in Forestry in Uganda started at Makerere University in 1970 as a Forest Department under the then Faculty of Agriculture and Forestry. One degree programme was offered then with the financial and technical support coming from the Norwegian Agency for Development Cooperation (NORAD). The training was intended to cater for the Eastern African Region. Unfortunately, due to political instability during that time, the Norwegian Government was forced to stop the support and eventually

supported the development of a similar programme at the University of Dar es Salaam, Morogoro Campus now the Sokoine University of Agriculture (SUA) in Tanzania. However, Makerere University's Forestry Department was not closed. The government sought and secured Food and Agriculture organisation (FAO)/United Nations Development Programme (UNDP) support, which provided two expatriate staff and funds for staff development. NORAD returned in 1996 and has helped the institution greatly to consolidate gains through capacity building among others. The Department evolved to become the Faculty of Forestry and Nature Conservation (FFNC) in October 1999, with four departments (Forest Biology and Ecosystems Management, Forest Management, Forest Products and Engineering, and Community Forestry and Extension) offering three undergraduate programmes. The Faculty is the major source of human resource development in the forestry sector through education, training and research. The student population presently is over 300. Nyabyeya Forestry College, the only other forestry related training institution, offers technician level training to certificate and diploma levels.

Forestry training at Makerere University has evolved within the wider context of major centres of excellence in forestry education (Obua *et al*., 2004). The decentralization policy (Banana *et al*., 2005) has affected the developments in the forestry sector and consequently forestry training. The university has moved from a small and entirely government supported student population to a large predominantly privately sponsored student population.

Globally, forests and allied vegetation types are critically important ecosystems. They provide significant economic, social and environmental benefits to society. Population growth, migration, urbanization, industrialization, large-scale agriculture, changes in technology and climate change are among the factors that influence the ways in which forests are perceived, managed, conserved and used.

Overall, far more will be expected of foresters now than in the past. There is an increasing need for multi- as well as inter-disciplinary research and training in forestry. Numerous institutions inside and outside the traditional forest sector now address forest issues as part of their activities. In Uganda, for example, National Agricultural Research Organisation (NARO), and Uganda Wildlife Authority (UWA) are involved in forestry related work. The private sector has also picked up interest in forest business particularly in relation to plantation forestry, timber industry and non-timber forest

products. Also new modes of governance have emerged that emphasize collaboration, networking, and decentralization. There is however, a distinct decline in political and financial support to forest management and forest research in Uganda. This is the result of shifting priorities of government, policy makers and donors.

The job market of forestry graduates has changed greatly from the situation in the 1970s to early 80's where government was the biggest employer to other agencies such as the private sector and civil society organisations. The graduates of today may find less employment opportunities in government.

The Uganda government policy towards funding mainly science based courses creates an opportunity for the Faculty of Forestry and Nature Conservation to train graduates who can meet challenges of the present and future generations by promoting sustainable development. There is also challenge for the forestry sector to execute research that responds to issues of global warming, desertification, climate change and increasing dependence on forests especially in the developing countries and making the findings known to all stakeholders. This should contribute to the attainment of the targets of the Millennium Development Goals.

14.2 EVOLUTION OF THE FORESTRY CURRICULUM

14.2.1 Undergraduate Programmes up to 1991

The duration of the B.Sc. Forestry course was three years from 1970 until 1992 when the duration was extended to four years. During this period, the term system was in operation in Makerere University. The academic year was divided into three terms during which course unit examinations were done and also university examinations at the end of the year. A summary of the courses taught is presented in Appendix 1. The pass mark was 40%. The focus of this programme was to produce graduates with knowledge of raising trees, logging practices, conversion of wood into various products, and marketing. The course also equipped learners with management, policy and administrative skills. These prepared the graduates to meet the needs of the job market, mainly the Forest Department and sawmills.

14.2.2 Programmes between 1992 and 1999

After 1992, the B.Sc. (Forestry) Programme continued to evolve. In 1989, a major curriculum review was undertaken where the B.Sc. (Forestry)

Programme was converted from three years to four years commencing in the academic year 1992/1993. This was necessary because several new courses were introduced (Makerere University, 2002). One group of courses (Environment Protection, Recreation and Landscape Forestry, Zoology, non-wood Forest Products and Resource Management) were in recognition of global trends putting emphasis towards more environment protection and the realization that forestry was not entirely about raising and harvesting trees. The Rural Sociology, Agroforestry and Community Forestry courses were in recognition of the need to involve the local communities more into forestry while Agroforestry was introduced to develop manpower for both foresters and agriculturists who are required to enhance farm productivity. Basic carpentry was introduced to equip graduates with skills necessary for the furniture industry where some of them would find opportunities to be employed or create employment. There was also a felt need that the duration of the course should be revised upwards to four years to take care of the new courses and create more time for field practical. A summary of the curriculum over this period is presented in Appendix 2. During this period, examinations were conducted only in the second and fourth years. The pass mark was elevated to 50%.

14.2.3 Current programmes

When the then Forest Department evolved into a Faculty status, two new programmes were formulated in consultation with the key stakeholders i.e. Forest Department and other relevant agencies. These are the Bachelor of Community Forestry and the B.Sc. Wood Science and Technology. The Faculty now runs three undergraduate programmes whose objectives and contents have been revised to address the evolution of Uganda's development challenges. The programmes are shown in Appendix 3. The aims and objectives of the programmes are summarized in the following sections:

B.Sc. Forestry

This programme provides training to impart knowledge and skills for managing forest resources, the environment and allied natural resources (biodiversity, water, wildlife). Emphasis is on natural tropical forests, plantation forests, farm forests and urban forests. Training is uniquely tailored to provide knowledge, skills and attitudes for efficient and improved use of forests. The programme prepares graduates to pursue and specialize in various aspects of forest sciences and technology such as tree breeding and

genetics, tree biotechnology, forest ecology and management, seed science, taxonomy, plant physiology, forest pathology and entomology.

Bachelor of Community Forestry

This programme aims at building capacity for effective extension to grassroot communities for participation in forestry, agroforestry and natural resources management. Under this programme, appropriate extension and communication technologies are emphasized. The teaching/learning processes are designed to re-enforce understanding of the role of forestry in poverty reduction, food security and sustainable livelihoods. This programme is very important in attracting the private sector and local communities involvement in forestry thereby mainstreaming forestry into national development and poverty alleviation.

B.Sc. Wood Science and Technology

This programme focuses on planning and management of wood industries with emphasis on wood properties, processing, preservation, diversified use, energy and marketing of wood and non-wood products. Presently there is a lot of wastage and misuse of the scarce wood resources in Uganda with high risk of rapid forest loss and environmental degradation. The programme prepares graduates who can pursue careers in forest industries.

Postgraduate Training

Postgraduate forestry training started in Makerere University at the same time with the start of the B.Sc. (Forestry) programme but suffered a big blow when expatriate staff left. The building of local capacity to supervise postgraduate students took a long time so the numbers of graduates with M.Sc. was indeed very small until 1994. Currently two M.Sc. programmes (M.Sc. Forestry and M.Sc. Agroforestry) are available. This development was necessary to meet the demand for highly trained professionals in the field and also those that could carry out research targeting problem solving in these disciplines. The programmes comprise of one year of coursework and one year of research and thesis writing. Most of the graduates of these programmes are Ugandans with the exception of a few from Rwanda, Democratic Republic of Congo, Nigeria and Kenya. The MSc. Programme are shown in Appendix 4. The main features of these programmes are summarized as follows:

M.Sc. Forestry

The programme offers opportunity for advanced training in all aspects of forestry including developing research and analytical capacity to address Uganda's forestry problems, help the forestry sector to grow and increase its contribution to national development, enhance employment opportunities and alleviate poverty.

M.Sc. Agroforestry

The link between forestry and agriculture is strongly built in this programme whose focus is to address farmers needs in a more robust and holistic manner. Aspects such as Ecophysiology and tree-crop interaction, agroforestry business and entrepreneurship and environmental conservation for sustainable agriculture are emphasized. Graduates acquire research and analytical skills for identifying and addressing farmers problems and increasing farm productivity.

PhD programme

The Ph.D. programmes in Forestry and Agroforestry build on the two MSc programmes to produce highly qualified personnel. Currently the Ph.D. is by research only but there are plans to introduce a coursework component. Graduates acquire research, analytical and scholarly writing skills that can be used to address various types of forestry/agroforestry and allied natural resources problems.

Nature of Teaching

Each of the training components has mandatory or core courses taught to all students and electives. Practicals are conducted during the semester as well as intensive fieldwork during the recess term (holiday between academic years). In the 3rd year (for Bachelor of Community Forestry) and 4th year (for B.Sc. WST and B.Sc. Forestry) the students carry out individual research projects. The students are also attached to various organizations as part of their training where they acquire additional hands-on practical experience under the supervision of field staff. They are encouraged to work mainly upcountry and be exposed to rural development issues.

Staff Capacity and Infrastructure

The Faculty has a total number of 68 established academic staff positions of which 37 (54%) are filled. A total of 18 members of staff are Ph.D. holders. There are 16 members of staff pursuing further studies. Of these, 11 are pursuing PhD and five are pursuing M.Sc. Because many of the Faculty members have completed training, we have reduced the number of part time lecturers from 20 in 2004 to 12 in 2006. The Faculty also relies on teaching staff from the Faculty of Agriculture for some of the 1st year courses, but also offers some teaching to students from the Faculty of Agriculture in courses such as Agroforestry; Land Use, Policy and Law. Although forestry is believed to be a male dominated profession, the Faculty has a gender sensitive staff recruitment and development policy; 8 out of 37 academic staff are female.

Teaching and Learning Facilities

The Faculty has a total of 98 computers (39 of them for staff and 59 for the students). A computer kiosk for internet access is hosted in one of the Faculty buildings. This is part of the ICT development initiatives in the university aimed at integrating ICT in learning and teaching. The Faculty has two teaching and research laboratories for conducting students' practicals and staff research activities. More research laboratories will be needed as more staff return from further studies and win research grants. The Faculty runs a computerized library service. There are various reference books and additional volumes are acquired annually through the book bank with financial support from Carnegie Corporation. A total of 288 TEEAL CDs are available and both staff and students have access to over 100 e-books secured by the main University Library to enhance learning. There are small, medium and large lecture rooms for different class sizes.

Research

Research in the Faculty is tailored to address national and international research priorities. Faculty staff are also involved in research activities that build capacity of forestry professionals to find solutions to problems related to agricultural modernization, environmental degradation and socio-economic development. Topics such as biodiversity inventories (e.g. Eilu *et al*., 2004), remote sensing (Vogt *et al*., 2005), and crop raiding (Tweheyo and Obua, 2005) have gained prominence. Current research projects include:

- Bridging restoration and multi-functionality in degraded forest landscape of Eastern Africa, Madagascar and Indian Ocean Islands. Supported by the EU/INCODEV;
- Socio-economic analysis of Kenya and Uganda's Forest Management and Conservation Policies. Supported by AFORNET;
- Sustainable Agriculture and Natural Resource Management Collaborative Research Support Programme (SANREM-CRSP);
- Biodiversity importance of tropical forest fragments: a comparison of ground beetle diversity in the Budongo Forest Reserve and native forest fragments on agricultural landscapes in western Uganda. Supported by the British Ecological Society;
- The distribution and impact of *Leptocybe invasa* (Eulophidae) on Eucalyptus species in East Africa. Supported by the African Forestry Research Network (AFORNET);
- Assessment of farmers' indigenous knowledge and the entomophagous fungus, *Metarhizium anisopliae*, for controlling pestiferous termites in agroforestry in Uganda. Supported by the International Foundation for Science (IFS);
- Threatening tree diseases on small-scale farms in East Africa. Supported by The Sida/SAREC; and
- Comparative assessment of environmental, community and nutritional impacts of consuming fruit and vegetables produced locally and overseas. Supported by Rural Economy and Land Use (RELU) Research Council.

The Norwegian Government is supporting the following programmes:
- Relationship between access to forest and tree resources and livelihoods;
- Phenotypic characterization, ethnoecology and marketing of *Tamarindus indica*; and
- Privatisation reforms to the forestry sector: potentials and challenges for poverty alleviation and sustainable development.

14.2.4 Outreach activities

The Faculty runs several outreach programmes in line with the new mandate of extension. The Department of community Forestry and Extension spearheads outreach activities. Examples include linkages with the National Agricultural Advisory Services (NAADS), Plan for modernization of Agriculture (PMA), and National Forestry Authority. Faculty staff participate in various consultancy activities thereby contributing to solving

forestry related problems and contributing to outreach. Faculty members conduct training workshops in various districts of the country to increase demand for forestry extension services, in collaboration with FAO/Uganda Forestry Working Group. The students benefit from interactions with farmers, forest user groups and extension staff. They are attached to local Non-Governmental Organisation (NGO) e.g. Vi-Agroforestry, Environment Alert and BUCODO. The Faculty participates in national and international exhibitions as part of outreach. The Faculty has been involved in some short training programmes, some of them, geared towards the management of biodiversity and promoting agroforestry.

14.2.5 International linkages

The Faculty has maintained linkages with other universities in Africa, Europe and America. The major linkages are with the Sokoine University of Agriculture, Indiana University and University of Life Sciences in Norway. The faculty is linked with other institutions such as World Agroforestry Centre (ICRAF), Center for International Forestry Research (CIFOR), CIRAD, Kenya Forestry Research Institute (KEFRI), and Ford Foundation.

Funding Sources

The major funding sources for the Faculty include the government of Uganda, private students, donors e.g. Norwegian Government, Sida SAREC, European Union (EU), Carnegie, United States Agency for International Development (USAID) and others. The funds from donors are mainly secured out of competitive proposals.

14.3 CHALLENGES

The majority of students in the Faculty as in many other Science based faculties continue to be government sponsored. The inability to attract private students may be attributed to the few number of science candidates in A-level schools. Consequently, the Faculty cannot locally generate the required funds to implement its plans when compared to units in the humanities.

Many members of staff in the Faculty are young and require continued training up to PhD level. Therefore, funds must be obtained to continue the staff development programme. Once a critical mass of trained staff has

been achieved then the research programme in the Faculty will become stronger.

14.4 THE FUTURE

A process has begun where the present curricula will undergo major revisions. This has been brought about by the increased demand for professionals who have skills in forest plantation management, nature conservation, wildlife ecology, and conservation biology. New degree programmes are being mooted, for example in plantation forestry. Linkages will be developed with other universities such as Nelson Mandela Metropolitan University, Stellenbosch, University of Pretoria, and Witwatersrand University in South Africa. There is room to explore other linkages to strengthen research and staff exchange.

14.5 CONCLUSION

The importance of the Faculty of Forestry and Nature Conservation to Uganda's education continues to grow from strength to strength. There are various challenges arising out of the changing demands on the sector. The faculty continues to adjust to these needs of forestry and will continue making a major contribution. Whereas the forestry sector presents new challenges for the Faculty of Forestry and Nature Conservation, it creates new opportunities. It is critical to strengthen teaching and learning to emphasize skills development, research and innovation for the benefit of forests and people (by addressing in a more effective and proactive manner the changing research needs and priorities related to forests and trees). This can be achieved by promoting quality research and developing scientific capacity, and by strengthening the administrative, financial, and academic functions. It will be vital to expand strategic partnerships and cooperation both within the broader scientific community and with the non-scientific world. This will enhance communication within the scientific community and with potential users of scientific knowledge. It is important to note that success of the Faculty can be attributed to two major factors: staff commitment and donor support.

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Appendix 1. Courses for the Degree of BSc. Forestry between 1970 -1991

YEAR I COURSES	**YEAR II COURSES**	**YEAR III COURSES**
Course Units	**Course Units**	**Course Units**
AS 101 Entomology	AE 202 Surveying	AE 202 Surveying
CS 101 Botany	FO 201 Forest Silviculture	FO 301 Forest Fire Protection
CS 102 Genetics	FO 202 Forest Mensuration	FO 302 Forest Pathology
CS 103 Plant Physiology	FO 203 Management Planning	FO 303 Forest Entomolgy
CS 105 Ecology	FO 204 Logging Operations	FO 304 Timber Transportation
FO 101 Economics	FO 205 Forest Economics	FO 305 Policy and Law
FO 102 Forest Biology	FO 206 Primary Wood Industries	FO 306 Forest Administration
FO 103 Forest Hand Tools	FO 207 Wildlife Ecology	FO 307 Panel Products
FO 104 Statistics	SS 203 Geology	FO 308 Forest Management & Planning
FO 105 Wood Utilization	SS 204 Soil Science	FO 309 Work Science
SS 103 Biochemistry		
SS 104 Microbiology		
SS 105 Soil Physics and Chemistry		

Appendix 2. Courses for the Degree of BSc. Forestry between 1992 and 1999

YEAR 1 Courses	**YEAR III Courses**
AE 102 Mathematics	AE 303 Principles of Agriculture
AE 103 Climatology	FO 301 Forest Fires
AS 101 Zoology	FO 302 Forest Pathology
AS 103 Cytomolecular	FO 303 Forest Entomology
CS 101 Agricultural Botany	FO 304 Operations Research
CS 102 Mycology	FO 305 Logging Operations
CS 103 Entomology	FO 306 Accounting/Budgeting
CS 104 Introductory Bacteriology /Virology	FO 307 Agroforestry
CS 105 Introductory Genetics	FO 308 Management Planning
CS 106 Plant Physiology	FO 309 Wood Preservation
CS 108 Ecology	FO 310 Panel Products
FO 102 Wood Anatomy	FO 311 Pulp and Paper
FS 101 Introductory Food Science	FO 312 Wildlife Ecology
FS 104 Biochemistry 1	FO 313 Minor Forest Products
FS 105 Biochemistry 2	FO 314 Community Forestry
RE 101 Introductory Economics	FO 315 Recreation and Landscape Forestry
RE 102 Introductory Statistics	EE 303 Visual Aids I
SS 101 Microbiology	EE 304 Research Methods
SS 102 Introductory Soil Science	SS 302 Pedology
SS 103 Geology	
YEAR 1I Courses	**YEAR IV Courses**
AE 201 Basic Mechanics	FO 401 Forest Policy and Law
AE 203 Field Engineering	FO 402 Legal Procedures/Processes
AE 204 Principles of Surveying	FO 403 Forest Administration
CS 202 Weed Science	FO 404 Resource Management
CS 203 Biometrics	FO 405 Long Distance Timber Transport
FO 201 Silviculture I	FO 406 Basic Carpentry
FO 202 Silviculture II	FO 407 Environment Protection
FO 203 Forest Mensuration	FO 307 Forest Work Science
FO 204 Forest Road Construction	

Appendix 3: Current Undergraduate Courses in the Faculty of Forestry and Nature Conservation, Makerere University

a) Bachelor of Science in Forestry

Course Code	Course Name	Course Code	Course Name
	Year I Semester I		**Year I Semester II**
FBM1101	Forest Botany & Plant Physiology	FBM 1201	Introductory Genetics
FOM1102	Introductory Statistics	FBM 1202	Introductory Entomology
FPE 1101	Biochemistry I	FBM 1203	Introductory Plant Ecology
FBM1102	Introductory Soil Science	FOM 1201	Basic Computing Skills
FOM1101	Introductory Economics	FPE 1201	Biochemistry II
FPE 1102	Basic Mathematics	AEN 1201	Climatology and Field Engineering
FBM 1301	Practical in Forest Soils	FPE 1202	Wood Anatomy
FOM 1301	Field Attachment for general Forestry practices		
FPE 1301	Practical Skills in Forestry Survey and GIS		
	Year II Semester I		**Year II Semester II**
FBM2101	Silviculture	SOS 2201	Soil Fertility & Plant Nutrition
FPE2101	Forestry Engineering	FOM 2201	Forest Resource Assessment & GIS
FOM2101	Biometrics	FBM 2201	Reproductive Biology & Tree Improvement
FPE 2102	Surveying	FBM 2202	Dry Land Forestry Practices
CFE2103	Forestry Extension Methods	EEE 2204	Rural Sociology
FOM2102	Forestry Economics	FPE 2201	Work Science and Egonomics
FBM 2301	Practical Skills in Biodiversity Conservation		
FBM 2302	Practical Skills in Silviculture		
FOM 2301	Practical Skills in Forest Resources Assessment and GIS		
FOM 2302	Computer Skills		
FPE 2301	Practical Skills in Logging and Sawmilling		
	Year III Semester I		**Year III Semester II**
CFE 3101	Community Forestry	CFE 3202	Agroforestry
FBM3101	Wildlife Ecology	SOS 3201	Soil Conservation & Land Reclamation
FBM3102	Forest Protection	FOM 3201	Forest Management and Planning
SOS 3101	Pedology & Land Use Potential	FPE 3207	Wood Physical Properties
FPE 3101	Primary Wood Industries	FBM 3201	Plant Ecology

b) Bachelor of Community Forestry

Course Code	Course Name	Credit Units	Course Code	Course Name	Credit Units
Core	**Year I Semester I**		**Core**	**Year I Semester II**	
FBM1101	Forest Botany & Plant Physiology	3	CFE 1201	Communication in Forestry	3
FOM1102	Introductory Statistics	3	CFE 1202	Forestry and Food Security	3
FOM1102	Introductory Economics	3	FBM 1203	Introductory Plant Ecology	3
CFE 1101	Forest Extension Methods I	3	FBM 1204	Tree Seed Technology	3
			FOM 1201	Basic Computing skills	3
CFE 1103	Rural Sociology	3	FBM 1205	Introduction to Animal Ecology	3
CFE 1102	Community Dynamics	3	CFE 1203	Functional Adult Literacy	3
FBM1102	Introductory Soil Science	3			
CFE 1301	Field Attachment for Extension Clinics-I	10			
Core	**Year II Semester I**		**Core**	**Year II Semester II**	
FBM2101	Silviculture	4	FOM 2201	Forest Resource Assessment & GIS	4
CFE2103	Forestry Extension Methods II	3	FOM 2202	Resource Economics	3
FOM2101	Biometrics	3	CFE 2201	Indigenous Knowledge in Resource Management	3
FBM2102	Introduction to Forest Protection	5	CFE 2202	Youth & Gender Programme Development	3
CFE 2102	Social Research Methods	3			
CFE 2101	Bee Keeping	3	FBM 2202	Dry Land Forestry Practices	3
FOM 2103	Natural Resources and Environmental Management	3	SOS 2201	Soil Fertility & Plant Nutrition	3
CFE 2301	Field Attachment for Extension Clinics II	10			

Core	Year III Semester I		Core	Year III Semester II	
FOM 3101	Programme Planning and Evaluation	3	CFE 3202	Agroforestry	3
CFE 3106	Problem Solving Skills in Forestry Extension	3	CFE 3201	Leadership Development	3
CFE 3104	Forestry for Rural Development	3	FPE 320	Forest Utilization	4
FOM 3204	Introduction to Land Use Policy and Law	3	CFE 3209	Extension Case Study Report	5
CFE 3105	Ethnobotany	3			
CFE 3102	Rural Education and Outreach	3			
Electives			Electives		
CFE 3103	Planning Forest Development Programmes	3	CFE 3203	Conflicts in Forest Management	3
FPE 3102	Non Timber Forest Products	3	FPE 3201	Introduction to Biomass Energy Use & Conservation	3
FBM 4101	Biodiversity Conservation & Management	3	FOM 3203	Forest Business	3

c) Bachelor of Wood Science and Technology

Course Code	Course Name	Code	Course Name
	Year I Semester I		**Year I Semester II**
FBM1101	Forest Botany & Plant Physiology	FOM 1201	Basic Computing skills
FOM1102	Introductory Statistics	FPE 1201	Biochemistry II
FPE 1101	Biochemistry I	FPE 1203	Engineering Mechanics
FPE 1102	Basic Mathematics	FPE 1202	Wood Anatomy
FOM1101	Introductory Economics	FBM 1202	Introductory Entomology
FPE 1301	Practical Skills in Forest Survey and GIS	FBM 1201	Introductory Genetics
FPE 1302	Industrial attachment		
	Year II Semester I		**Year II Semester II**
FBM2101	Silviculture	FPE 2201	Work Science and Ergonomics
FPE2101	Forestry Engineering	FPE 2202	Mechanical Properties of Wood
FPE 2103	Wood Chemistry	FPE 2203	Physical properties of Wood
FPE 2104	Physical Processing of Wood		
FOM2102	Forestry Economics	FBM 2201	Reproductive Biology & Tree Improvement
FOM 2302	Computer Skills	FOM 2201	Forest Resource Assessment & GIS
FPE 2301	Practical Skills in Logging and Saw milling		
	Year III Semester I		**Year III Semester II**
EEE 3105	Research Methods	FPE 3202	Panel Products
FPE 3103	Wood Biodegradation and Preservation	FPE 3205	Timber structures & design
FPE 3102	Non Timber Forest Products	FPE 3203	Technical Drawing
FPE 3104	Chemical Processing of Wood		
EEE 3101	Programme Development and Evaluation	CFE 3202	Agroforestry
CFE 3101	Community Forestry	FOM 3205	Economics of Forest Products
FPE 3301	Basic Carpentry and Joinery		
	Year IV Semester I		**Year IV Semester II**
FPE 3309	Industrial Attachment for Case Study	FPE 4201	Biomass Energy Production, Use and Conservation
FOM4102	Environment Protection	FOM 4201	Land Use Policy and Law
FPE 4102	Forest Based Rural Industries	FNC 4201	Special Project
		FPE 4202	Marketing of Forest Products
FOM4105	Human Resource Management	CFE 4202	Rural Development
FOM4104	Operations Research	CFE 4201	Land Scaping and Urban Forestry
FBM 4101	Biodiversity Conservation & Management MSc. (Forestry)	FOM 4203	Accounting and Budgeting

Appendix 4. Postgraduate Courses

Course Code	Course Name	Course Code	Course Name
	Year I Semester I		**Year I Semester II**
FOM 710	Applied Statistics and Biometrics	FOM 7201	Forestry Resource Assessment
FOM 710	Natural Resource Economics	FBM 7201	Tropical Forest Ecology and Management
FBM 710	Advanced Silviculture	CFE 7201	Forestry Research Methods
FNC 7101	Graduate Seminars	FNC 7201	Graduate Seminars
FOM 710	Land Use Planning & Watershed Management	FOM 7202	Natural Resource Management
FBM 710	Advanced Forest Soils	FOM 7203	Environment Management
FPE 7101	Forest Products	FOM 7204	Forestry Business Management
CFE 7102	Agroforestry Systems, Practices and Technologies	F0M 7205	Natural Resources Project Planning and Management
CFE 7103	Dryland Agroforestry	FBM 7202	Tree/Crop Improvement
CFE 7104	Advanced Community Forestry	FBM 6203	Advanced Biodiversity Conservation
SOS 7101	Soil Fertility and Plant Nutrition	FPE 7201	Forest Harvesting Systems
Year II	Research and thesis write up	CFE 7203	Forestry Education and Extension
	MSc. (Agroforestry)		
	Year 1: Semester I		**Year I Semester II**
CFE 7102	Agroforestry Systems, Practices and Technologies	CFE 7201	Forestry Research Methods
F0M 7101	Applied Statistics and Biometrics	FOM 7204	Forestry Business Management
SOS 7101	Soil Fertility and Plant Nutrition	FBM 7204	Eco-physiology and Silviculture/Agronomy
FNC 7101	Graduate Seminars	FNC 7201	Graduate Seminars
CFE 7103	Dryland Agroforestry	CFE 7202	Gender Issues in Agroforestry
CFE 7104	Advanced Community Forestry	CFE 7203	Forestry Education and Extension
FOM 710	Land Use Planning and Watershed Management	CFE 7204	Advanced Forestry for Rural Development
FBM 710	Advanced Silviculture	FOM 7201	Forestry Resource Assessment
FPE 7101	Forest Products	FOM 7205	Natural Resources Project Planning and Management
ANIM 71	Animal Production in agroforestry	FBM7202	Tree/Crop Improvement
	Year II Research and thesis write up		

15 Professional Forestry Education in Tanzania: Towards Integrated Natural Resources Management

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ABSTRACT

Professional forestry education at the Faculty of Forestry and Nature Conservation, Sokoine University of Agriculture (SUA) started in 1973 at the then Faculty of Agriculture of the University of Dar es Salaam, with a curriculum that aimed at preparing students for positions in the public sector. The curriculum had much emphasis on plantation forestry. Since then, the curriculum has been revised three times to reflect the emerging needs and challenges within the forestry profession and beyond. The most dramatic revision of the curriculum occurred in 2001 when a semester system was adopted university-wide. Among other things, the 2001 revision was aimed at facilitating the implementation of the SUA Corporate Strategic Plan (1997 – 2005), which requires the University to become more competitive by providing conducive working environment and demand driven programmes in a cost effective and yet flexible manner. The new curriculum was operational from 2001 to 2007 when a third revision was undertaken. During the implementation of the semester system, training needs assessment, job market surveys and tracer studies were conducted to examine the adequacy of our training in addressing actual demands in the field. The studies indicated a number of challenges facing the programme. The challenges were addressed in the 2007 revision, making the training at SUA more responsive to the demands of the dynamics in the forestry profession, the job market and the shrinking levels of support. New courses have been introduced to address emerging challenges in the forestry sector and are tailored towards the increased demand of professional foresters with new vision on sustainable

management of natural resources. Further, the revision has adopted a more realistic and effective way of conducting field practicals given the low funding levels at the university and professional demands in the field.

15.1 INTRODUCTION

In 1970, a Forestry Department was established at Makerere University with the objective of training professional foresters for East Africa. In July 1973, political events in Uganda made it difficult for the project to achieve its objectives, so the Government of Tanzania with the support of the Norwegian Development Cooperation (NORAD) established a Department of Forestry at Morogoro, under the University of Dares Salaam. In 1974, the Department was elevated to a Division, giving it the mandate to develop itself further into a Faculty. In July 1984, the Division of Forestry became a fully-fledged Faculty of Forestry when the Tanzania Government enacted Act No. 6 of 1984 establishing Sokoine University of Agriculture (SUA) (Faculty of Forestry, 1992).

The Faculty of Forestry and Nature Conservation has six academic departments at SUA main campus. They are: Forest Biology; Forest Economics; Forest Engineering; Forest Mensuration and Management; Wood Utilization, and Wildlife Management. The Faculty offers BSc in Forestry; BSc in Wildlife Management; MSc in Forestry, MSc in Management of Natural Resources for Sustainable Agriculture (MNRSA), MSc in Wildlife Management and PhD degree Programmes. In addition, the Faculty conducts research and extension in forestry/wildlife and related fields. The main objective of the professional forestry education in Tanzania is to produce high quality professionals with competency in sustainable management of tree and forest resources.

The specific objectives of the programmes are:

- To produce high quality and relevant professional level forestry graduates to address the manpower needs of Tanzania and other African countries;
- To conduct basic and applied research in forestry and wildlife and paying special attention to the problems of the region; and
- To disseminate research findings to users through extension programmes.

This paper reviews the BSc. Forestry Programme at the Faculty of Forestry and Nature Conservation at SUA. Specifically, it discusses how

the Faculty has been reorienting its professional forestry education in Tanzania since 1973. Developments in human and physical resources over time are also highlighted. Lastly, the constraints experienced are pointed out.

15.2 THE CURRICULUM

The BSc (Forestry) curriculum has been reviewed three times. The reviews were done in 1988, 2001 and 2007. The following are the salient features of the curricula.

15.2.1 The 1973 BSc (Forestry) Curriculum

The curriculum aimed at preparing students for professional positions in forestry and forestry industries (Annex 1). The curriculum laid emphasis on forestry plantations and forest industry subjects, but with limited emphasis on management of other forest resources (Division of Forestry, 1978). However, the field practical training was much emphasized with a total of 25 weeks distributed as follows: 6 weeks during first year; 12 weeks during second year and 7 weeks during third year. The field excursions and practicals were conducted at the University training forests as well as other forestry related projects in the country.

15.2.2 The 1988 BSc (Forestry) Curriculum

The main aim of the 1988 review was to incorporate into the curriculum those aspects of forestry, which are important in the East African Region but had not received adequate emphasis hitherto. Topics such as agroforestry, arid land afforestation, forestry extension and catchment forestry were considered of immediate importance (Division of Forestry, 1991) (Annex 2). In addition, the distribution of the various courses over the years was reorganized to achieve a better-balanced workload. In addition, weights of courses were reviewed to put more emphasis where it was due. Field practical duration remained as before. However, the assessment of field practicals was strengthened.

15.2.3 The 2001 BSc (Forestry) Curriculum

The most dramatic revision of the curriculum occurred in 2001 when a semester system was adopted university-wide. Among other things, the 2001 revision was aimed at facilitating the implementation of the SUA Corporate Strategic Plan (1997 – 2005), which required the University to

become more competitive by providing conducive working environment and demand driven programmes in a cost effective and yet flexible manner.

In addition to moving into the semester system, new courses were also introduced to address new challenges in the forestry sector. Moreover, the curriculum was tailored towards the increased demand of professional foresters with new vision on sustainable management of natural resources. The 2001 curriculum is shown as Annex 3.

The major change that occurred was the reduction of field practical duration from 25 weeks to 13 weeks distributed as follows: 3 weeks for year 1; 5 weeks for year 2; 5 weeks for year 3. This significant reduction in field practicals duration has negative impacts on students acquiring practical forestry skills. It is the financial constraints that contributed to this reduction.

15.2.4 The 2007 B.Sc (Forestry) Curriculum

During the implementation of the semester system, training needs assessment, job market surveys and tracer studies were conducted to examine the adequacy of our training in addressing actual demands in the field (Afrozone, 2005). Accumulated experience revealed the following challenges:

- Inadequacies existed in the training programmes offered at the Faculty in relation to the expected performance of graduates in the field;
- The job market requires more versatile graduates who can cope with changing global demands in terms of poverty reduction, self-employment, market economy, environmental concerns and emerging challenges;
- Modalities of conducting field practicals were constrained by budgetary allocations and increasing number of students over years and yet academic excellence needs to be maintained; and
- Graduates generally lacked basic science and communication skills to perform their duties optimally, despite efforts to incorporate these aspects in previous curricula.

These challenges were addressed in the revised curriculum (Annex 4), making the training at professional education at SUA more responsive to the demands of the dynamics in the forestry profession, the job market and the shrinking levels of budgetary allocations and donor support.

The revision is justified considering the fact that new courses have been introduced to address emerging challenges in the forestry sector and is tailored towards the increased demand of professional foresters with new vision on sustainable management of natural resources**.** New courses include integrated ecosystem assessment, ecological impact assessment and environmental planning, biodiversity measuring and monitoring, climate change, entrepreneurship skills, gender and development, introductory marketing and financial accounting, and job market preparation skills. Further, the revision has adopted a more realistic and effective way of conducting field practicals given the low funding levels at the University and professional demands in the field. Field practical duration has been increased but with more time spent at the University training forests.

The Faculty student output to date is shown as Annex 5. Other than Tanzania, students have come from the following countries: Botswana, Ethiopia, Gambia, Ghana, Kenya, Malawi, Mozambique, Rwanda, Sudan, Zambia, and. Zimbabwe.

15.3 RESOURCES

15.3.1 Human capacity

Academic staff

The Faculty started with 6 expatriate staff and 1 Tanzanian in 1973. Through an enviable staff development programme supported by NORAD the number of academic staff had by 1983 increased to 26, with 17 Tanzanians and 9 expatriates (Division of Forestry, 1983). In 1991, the staff position showed a different picture. The number of academic staff had increased to 28 all Tanzanian with expatriates being available on part time bases (Ishengoma and Shemwetta, 1998). The Faculty has also a number of technical and administrative staff. To date (2007), the staffing position is shown in Table 15.1. Overall, there is adequate number of qualified staff to run the courses.

Technical and Administrative Staff

The Technical and Administrative staff currently stands at 77 people. This figure includes 41 and 5 staff working at SUA Training Forest, Arusha and Mazumbai Forest Reserve in Lushoto. The Technical and Administrative staffs are trained at various levels and these include 6 MSc and Advanced Diploma.

Table 15.1: Human resources at Faculty of Forestry and Nature Conservation in 2007

Department	BSc	MSc	PhD	Total
Forest Biology	0	2	6	8
Forest Economics	0	4	4	8
Forest Engineering	1	2	3	6
Wood Utilization	1	0	7	8
Forest Mensuration and Management	0	4	4	8
Wildlife Management	1	3	4	8
Grand Total	3	15	28	46

15.3.2 Physical resources

Infrastructure (classes & Laboratories) at SUA Morogoro Campus

SUA Morogoro campus is the seat of the Faculty where all administrative and academic decisions are made. All theoretical and laboratory exercises are carried out here. The Faculty has two modern lecture theatres with a capacity of holding 50 students. Several office blocks for staff, three laboratories for wood utilization, forest management and zoology, a computer unit and a reprint collection room for self-learning for staff and students. There is also a wood workshop equipped with various carpentry and wood working machines for specimen preparation. A forest engineering workshop equipped with modern equipment and machines for workshop technology and design of structures for practical and research activities. The Faculty has visitors hostel at SUA main campus for use by visiting researchers/staff.

Field Stations

The Faculty has 3 field stations that are used for plantation and natural forests field practical training, research activities and demonstration functions by staff and students. SUA Training Forest at Arusha and Mazumbai Forest Reserve campuses have student dormitories and staff

guesthouses for housing staff during field training and research. These stations are as follows:

SUA Training Forest, Arusha: The forest plantation covers an area of 840 hectares and is located in Olmotonyi, Arusha. This forest has been leased from the Forestry and Beekeeping Division of the Ministry of Natural Resources and Tourism. This lease is renewable every ten years. The forest is used to provide practical training for forestry students in plantation forestry and serves as a field research laboratory and is utilized for demonstrations and excursions. It can also serve as a facility for hosting seminars, short courses and conferences on forestry. The campus has student's hostels, a classroom, cafeteria, a workshop accommodating a garage, a store and a saw doctor's workshop, and two guesthouses reserved for visiting scholars. There is a sawmill and adequate equipment for forest operations.

Mazumbai Forest Reserve: This is a montane natural forest covering an area of 320 hectares with a forest of more than 80 tree species, growing up to 50 m tall, with an estimated biomass of 1200 tonnes per hectare. This forest is owned by SUA. The campus has a visitors' hostel and a camping ground. The forest attracts scientists of varying disciplines such as zoologists, ornithologists, soil scientists, microbiologists and botanists. More than 138 bird species, 15 mammal species, 300 plant species and over 60 orchids have been recorded here.

Kitulanghalo Miombo Forest: This forest was leased in 1993 from the Ministry of Natural Resources and Tourism. It is a Miombo forest, covering an area of 500 hectares and located in Morogoro region, about 60 km from Morogoro municipality. This forest is used for forest management planning exercises and research.

15.4 CONSTRAINTS

The following are the main constraints in the running of BSc. (Forestry) programme:

- Financial Resources from the Government: Government allocation of funds for training has decreased significantly. This has largely affected the conduct of field practical training;
- Equipment for field practical: There is an acute shortage of field training equipment as those purchased under NORAD support are old

and need replacement. It has been very difficult to replace these due to financial constraints;

- Large Class sizes: The number of students per class has increased from 25 to between 40 and 50 on average. This has resulted in difficulties in conducting field practical training because of the need to move around large number of students. In addition to close supervision of the students by staff in the field becomes difficult;
- Literature: There is shortage of up to date reference material though over the years the introduction of the internet on campus has largely improved the situation. The introduction of teaching Compendia prepared by academic staff members has been of great help to the students. These are sold to the students at a subsidized price; and
- Student intake trends: There has been a decline in students' enrolment in professional forestry education in Tanzania. One reason is that the students are now joining those courses that guarantee them employment opportunities upon graduation, as there are very limited job opportunities in the natural resources sector.

15.5 CONCLUSION

Based on the foregoing we can conclude that the offering of professional forestry education must be more responsive to the demands of the dynamics in the forestry profession, the job market and the shrinking levels of budgetary allocations and donor support. The changing of the basic orientation and areas of concentration of the curriculum through the abolition of old irrelevant courses and institution of new courses must be done in curriculum reviews. The institutions have to adjust to the needs and challenges of new global forestry paradigms that develop.

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Annex 1: 1973 B.Sc (For) Curriculum

Code	Title	Credit Hours
Year 1		
FO 101	Forest Biology	2.0
FO 102	Forest Hand tools and machinery	1.2
FO 104	Structure and Chemistry of wood	1.3
FO 103	Introduction to forest economics	2.0
FO 105	Mathematical Statistics	1.8
FO 106	Biochemistry	2.2
FO 107	Botany	1.5
FO 108	Principles of Plant Physiology	1.0
FO 109	Genetics	1.5
FO 110	Ecology and climatology	1.3
FO 111	Introduction to Soil Science	1.2
DS 100	Development in historical perspective	2.3
YEAR 2		
FO 201	Silviculture	2.7
FO 202	Works study logging and construction	3.0
FO 203	Forest economics	2.7
FO 204	Properties and Utilization of solid wood	2.7
FO 205	Forest Mensuration	2.0
FO 206	Management Planning	1.3
FO 207	Wildlife Management and beekeeping	1.5
FO 208	Soil and water engineering	1.0
FO 209	Soil Formation, morphology and classification	1.2
FO 210	The Challenge of Development	2.3
YEAR 3		
FO 301	Forest Protection	2.0
FO 302	Long Distance Transport	1.3
FO 303	Land Use, law and Policy	2.0
FO 304	Wood Based materials	1.3
FO 305	Forest Management and administration	2.7
FO 307	Special Project	4.0
FO 306	Management plan	4.0
Grand Total		

Annex 2:1988 B.Sc (For) Curriculum

Code	Title	Credits Hours
Year 1		
FO 101	Forest Ecology	2.5
FO 102	Introduction to Forest Engineering	1.7
FO 103	Introduction to forest economics	2.0
F0 104	Wood Science	1.3
FO 105	Introduction to statistics	1.8
FO 106	Biochemistry	2.7
FO 107	Botany	1.5
FO 108	Principles of Plant Physiology	1.0
FO 109	Genetics	1.5
FO 110	Nursery Techniques	1.3
FO 111	Soil Formation, Classification and Mapping	1.2
DS 100	Development in historical perspective	2.3
YEAR 2		
FO 201	Silviculture	2.7
FO 202	Logging, Roads and Ergonomics	2.7
FO 203	Forest economics	2.7
FO 204	Properties and Utilization of solid wood	2.7
FO 205	Forest Resource Assessment	2.0
FO 201	Management Planning	1.3
FO 207	Wildlife Management and beekeeping	2.0
FO 201	Introduction to Soil Science	1.5
FO 201	Soil and water conservation	1.0
FO 201	Alternatives and Intervention strategies for development	2.3
YEAR 3		
FO 301	Forest Protection	2.0
FO 302	Timber Harvesting and Transportation	2.0
FO 303	Forest Policy, law and land use economics	2.0
FO 304	Wood Based materials	2.0
FO 305	Forest Management and administration	2.7
FO 308	Forest Management plan	4.0
FO 309	Special Project	3.0
Grand Total		62.1

Annex 3: 2001 B.Sc (For) Curriculum

SEMESTER 1

COURSE ANTE	COURSE TITLE	CREDITS
CORE COURSES		
FBL 101	Forest Botany	2.0
FBL 103	Introduction to Soil Science	2.0
FEN 101	Introduction to Forest Engineering	2.0
FMM 102	Surveying and Mapping	2.0
FWU 101	Wood Chemistry	2.0
SC 100	Communication Skills	2.0
Sub Total		12
MB 100	Mathematics	2.0
PS 100	General Chemistry	1.0
DS 100	Theories and Principles of Developments	2.0
G Total		19.0

SEMESTER 2

CORE COURSES		
MB 101	Introductory Statistics	2.0
CIT 100	Introduction to Microcomputers	2.0
FBL 102	Forest Ecology	2.0
FEC 101	Introduction to Resource Economics	2.0
FWU 101	Wood Anatomy and Quality	2.0
Electives		10.0
FEN 102	Workshop technology and design of structures	2.0
AA 104	Introduction to Micro and Macro Economics	2.0
BS 100	Biochemistry	2.0
Grand Total		16.0

SEMESTER 3

CORE COURSES		
FBL 201	Silviculture	3.0
FBL 202	Tree Improvement	1.0
FBL 204	Soil Classification, Surveying & Land Evaluation	1.0
FEC 201	Resource Economics	2.0
FEN 201	Logging and Roads	2.0
Electives		9.0
FBL 203	Wildlife Management and Beekeeping	2.0
FEC 202	Introduction to Environmental Economics	2.0
AE 212	Surveying	3.0
DS 200	Intervention Strategies of Development	2.0
Sub-Total		9.0
Grand Total		18.0

SEMESTER 4

CORE COURSES		
FWU 203	Non-Timber Forest Products	2.0
FMM 201	Introduction to Remote Sensing and GIS	2.0
CIT 200	Computer Applications	2.0
CS 202	Genetics	2.0
AA 205	Microeconomics	1.0
AA 206	Macroeconomics	2.0
HT 206	Plant Biotechnology	2.0
Sub-Total		13.0
Grand Total		23.0

SEMESTER 5

CORE COURSES		
FBL 301	Forest Protection	2.0
FEC 301	Business Administration and Accounting	2.0
FEC 303	Resource Policy, Legislation and Land Use Economics	2.0
FEN 301	Timber Transportation	2.0
FMM 301	Forest Management Planning 1	2.0
FSP 300	Special Project	1.0
Sub-Total		11.0
FEC 304	Entrepreneurship and Feasibility Studies	2.0
FEN 302	Work Study and Ergonomics	2.0
AA 302	Operations Research	2.0
DS 300	Planning and Management of Development	2.0
Sub-Total		8.0
Grand Total		19.0

SEMESTER 6

CORE COURSES		
FEC 302	Extension Education in Nature Conservation	2.0
FMM 302	Forest Management Planning II	3.0
FWU 301	Wood Based Materials	2.0
FBL 303	Watershed Management and Conservation	2.0
FSP 300	Special Project	2.0
Sub-Total		11.0
FBL 302	Forest Soils Management	2.0
FBL 304	Ecological Restoration	2.0
Sub-Total		4.0
Total		15.0

Annex 4:2007 B. Sc (For) Curriculum

Semester 1		
CODE	Course Title	CR
Core courses		
FEN 101	Introduction to Forest Engineering	2.0
FBL 101	Forest Botany	2.0
FWU 101	Wood Chemistry	2.0
FEC 101	Introduction to Economics	2.0
SC 102	Communication Skills	2.0
Sub total		10.0
Elective courses		
MB 100	Basic Mathematics	2.0
MB 130	General Mathematics I	2.0
DS 100	Theories and Principles of Development	2.0
Semester 2		
Core courses		
FBL 102	Forest Ecology	2.0
FBL 103	Introduction to Soil Science	1.5
FMM 101	Introduction to Surveying and Mapping	1.0
FMM 102	Introduction to Remote Sensing and GIS	1.0
FWU 102	Wood Anatomy and Quality	1.5
CIT 100	Fundamentals of Computing and Networks	2.0
MB 101	Introduction to Statistics	2.0
Subtotal		11.0
Elective courses		
FEN 102	Workshop Technology	2.0
DS 109	HIV/AIDS and Impact on Society	1.0
Semester 3		
Core courses		
FBL 201	Silviculture	3.0
FBL 202	Tree Improvement	1.0
FEN 201	Logging and Ergonomics	2.0

FEC 201	Resource Economics	2.0
FMM 202	Forest Biometry	2.0
Sub Total		10.0
Elective courses		
FBL 203	Wildlife Management and Beekeeping	2.0
FBL 206	Integrated Ecosystems Assessment	1.0
FBL 207	Ecological Impact Assessment and Environmental Planning	2.0
DS 200	Intervention strategies for development	2.0
DS 201	Introduction to Gender and Development	2.0
Semester 4		
Core courses		
FBL 204	Soil Classification, Surveying & Land Evaluation	2.0
FBL 205	Agroforestry	2.0
FMM 205	Forest Resource Assessment	2.0
FWU 201	Wood Properties and Utilization	2.0
FWU 202	Sawmilling	2.0
Subtotal		10.0
Elective courses		
FWU 203	Non timber Forest Products	2.0
FBL 208	Climate Change and Natural Resources	2.0

Semester 5		
Core courses		
FBL 301	Forest Protection	2.0
FBL 302	Integrated Watershed Management	1.5
FEN 301	Timber Transportation Planning and Roads	2.0
FEC 303	Resource Policy, Legislation and Land Use Economics	1.5
FMM 301	Forest Management Planning 1	1.5
FEC 304	Entrepreneurship and Feasibility Studies	1.5
FSP 300	Special Project I	1.0
Sub total		11.0
Elective courses		
FBL 303	Forest Soil Management	2.0
DS 301	Issues in Gender and Development	2.0
SEMESTER 6		
Core courses		
FEC 305	Introductory Marketing and Financial Accounting	1.5
FEC 302	Extension Education in Nature Conservation	1.5
FMM 302	Forest Management Planning II	3.0
FWU 301	Wood Based Materials	2.0
SC 303	Job Market Preparation Skills	1.0
FSP 300	Special Project II	2.0
Sub total		11.0
Elective courses		
FBL 304	Ecological Restoration	2.0
FBL 305	Biodiversity Measuring and Monitoring	2.0
DS 300	Planning and Management of Development	2.0
FEC 301	Principles of Administration and Management	2.0

Annex 5: Professional Forestry Graduates from SUA 1973 – 2007

Year	Total graduates
1973-1983	138
1984	19
1985	22
1986	21
1987	16
1988	22
1989	25
1990	23
1991	21
1992	21
1993	20
1994	44
1995	35
1996	32
1997	40
1998	26
1999	N/A
2000	,,
2001	,,
2002	,,
2003	,,
2004	,,
2005	,,
2006	50
2007	38

16 Role of Distance Education in Promoting Forestry Extension in Pakistan: Problems and Prospects

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ABSTRACT

Pakistan remains a highly wood deficient country. Forests cover about 5% of the total land mass. Unfortunately, due to indiscriminate felling and cutting of trees, forests are disappearing at an alarming rate causing many social and ecological problems. In the country, formal education system at the school and college level places little or no emphasis on forestry and forest related issues in the curriculum. There are only 3-4 agricultural universities in the country offering graduate degree programmes in Forestry. The graduates of these institutions are expected to be professionally trained to look after the state forests and exercise administrative and regulatory roles, yet most of them often lack social skills. Pakistan Forest Institute (PFI) is the only institution, primarily focusing on Forestry and Forest Sciences. The other formal educational institutions mainly focus on basic sciences and pay little attention to forestry extension. Under this situation, the country badly needs forestry extension educators. Keeping in view the importance of the subject, Allama Iqbal Open University (AIOU) has taken an initiative to launch the MSc. Forestry Extension Programme through Open Distance Learning (ODL). The university strives to enhance the educational levels and upgrade the social skills of in-service foresters. The results of ODL in promoting forestry extension and education seem very encouraging. The

purpose of this paper is to share our experiences with other forestry educational institutions.

16.1 INTRODUCTION

Distance learning is playing a key role in facilitating those students who cannot otherwise continue their education from formal universities due to one reason or another. The programmes designed by the Department of Agricultural Sciences (DAS) of the Allama Iqbal Open University (AIOU) Islamabad, are directly helping in upgrading educational levels and enhancing technical and scientific knowledge at a large scale, especially in the rural areas of Pakistan. The MSc. Forestry Extension offered by DAS has been quite successful in meeting the needs of the in-service personnel who are directly working in the government Forest Department, non-government and semi government organizations that are involved in forestry related projects. The data shows that about 90% of the students are satisfied with the courses and delivery of the programme and think that after getting training through this course they will be able to contribute towards the development of the forest and rural sectors in a better way by having an understanding of the forests and people. This programme provides DAS an opportunity to educate the students to meet their educational needs, equip them with the most updated knowledge and practically prepares them to serve their respective institutions in an effective and efficient manner and help their rural clienteles with the missionary spirit so that they can make right and wise decisions to help themselves (AIOU, 2003).

16.2 ALLAMA IQBAL OPEN UNIVERSITY: THE HUB OF OPEN DISTANCE LEARNING

Allama Iqbal Open University (AIOU) is located in the capital of Pakistan, Islamabad. Established in 1975 as the first Open University in the region, it has been offering correspondence courses in income generation activities for rural women since 1986. Practical course topics range from poultry farming and garment making, to selling of home made products. Tutorial support is provided through local study centres. The popularity of the programme is reflected in an enrolment, of about 4 000 learners per semester since 1996.

AIOU is one of the mega universities and has potential capacity of 600, 000 students coming from the cities, villages and even from very remote areas. It has a large campus and a network of centres all over the country.

It provides education from grassroots level to Ph.D. in technical, scientific and professional fields by generally using distance education mode for instruction and utilizing face-to-face methodology for skill oriented courses and programmes.

The university has established over 780 study centres where tutorials are held and about 70 of these study centres are equipped with audio/visual aids. In addition, the university also has 105 full time study centres where coaching is provided to the students in the morning and evening classes (AIOU, 2003; AIOU, 2006).

The AIOU was the second Open University in the world and the first in Asia when it was established in 1975. During the last 33 years, AIOU have proved that distance education can open up new opportunities for many people especially female and can supplement the effort of the federal and provincial governments in a big way. The idea of distance education assumed greater relevance and acceptance in Pakistan due to poverty and relative deprivation of females (AIOU, 2006).

The university has a firm belief in meeting the present and future needs. Professional and technical education in Pakistan is becoming very costly, especially in the recent years due to the government policy to encouraging private sector activities/involvement. The lower strata of the society are being marginalized and their children are left with very little chance to acquire higher education in fields like business administration, computer science, medicine and engineering. AIOU is attempting to meet this challenge and to keep a window open for these classes. It is serving every class through network of 66 Regional/Sub-Regional coordinating offices that are established in different parts of the country with the main aim of providing assistance to the students (AIOU, 2003; AIOU, 2006).

AIOU is trying to harness information technology for solving students' problems by providing connectivity to database at the main campus. It is planned to use information technology (IT) for supporting instructions and turn this institution into a virtual university (AIOU, 2003). According to Khan (2001), the use of appropriate communication and information technology allows to overcome the barriers of time, space and socio-economic factors and bring a variety of learning resources to meet the educational needs. He maintains that new communication and information technology, if used effectively can be a powerful tool for providing distance learning opportunities to students.

16.2.1 Distance learning and forestry extension

The use of distance learning strategies in developing countries is by no means novel. The potential connections between distance learning and development processes have been recognized for decades, as the following passage from Kabwasa and Kaunda (1973) demonstrates: "Correspondence education has yet to make an impact in Africa. We feel it is our responsibility to give it as much publicity as we can, so that our people know its potentialities and possibilities, and how they can go about making greater use of it in the development of our continent."

Though forests and natural resources in all countries are in stressed conditions around the globe, the situation is particularly severe in developing countries. Forestry in Indo-Pak has been practiced for nearly two centuries on more or less regular and scientific lines. However, the resources of Pakistan forests are limited and the country has to import timber and wood products. Today there is a growing demand for wood due to industrialization, increase in population with rising standard of living and for better environment (AIOU, 2003).

Nazir, (2001) reports that there is a long history of over-exploitation of forests and rangelands in Pakistan. Consequently, fragile ecosystems have been severely degraded. Out of Pakistan's total landmass of 87.98 million ha, state owned forest area consists of 4.25 million ha (4.8%). According to Nazir, (2001), Pakistan is deficient in timber production. Growing needs of wood and wood products are met through imports.

Nazir, (2001) establishes that self-sufficiency in wood production from meagre 4.8% of public forests cannot be attained due to priority assigned to agriculture for resource allocation in physical and financial terms and climatic limitations. To meet the growing wood requirement of the potential lies with cultivated area spread over 20.85 million ha, uncultivable area of 25.63 million ha and cultivable but un-developed plain of 9.30 million ha. Promotion of social forestry/agro-forestry will directly expand the forestry resource base. Expanded forestry resource base will contribute to meet 53% of household energy needs and wood-based industry, stabilize environment, reduce pollution, generate income-earning opportunities and alleviate rural poverty (Nazir, 2001).

The Department of Agricultural Sciences is making earnest efforts aimed at supplementing, supporting and reinforcing extension services and offering agriculture related programmes at different levels. The MSc.

Forestry Extension looks into issues of resource degradation, impact of decreasing resources on communities, declining bio-diversity, global climate change, and highlights the factors, which lead to change, both planned and spontaneous. The role of extension in the management of forest and tree resource is becoming increasingly important. The foresters and other professionals involved in the forestry and environment sectors view the programme as a blessing for them. With great sense of satisfaction, it is reported that at present there is not a single institution in the country, offering Forestry Extension programme at postgraduate level. Allama Iqbal Open University is, therefore, the pioneer to offer this programme through Open Distance Learning (AIOU, 2003).

The general objectives of the MSc. Forestry Extension programme are:

- To develop greater understanding of the role of forest and tree in the context of changing environment;
- To achieve sustainability in agriculture, forestry and other rural land uses;
- To develop approaches which optimize the involvement of communities in extension process for forest and other natural resource management and for their own professional development;
- To develop understanding of the exiting approaches;
- To develop linkage with other institutions like forest projects;
- To provide sufficient knowledge and understanding of the major problems, socio-cultural and economic conditions of rural areas;
- To elevate the competence in dissemination of technological knowledge to optimize the income of rural communities and alleviate poverty; and
- To upgrade the knowledge of our students and their skills in stimulation of social mobilization and securing higher community participation in natural resource management programmes (AIOU, 2003).

The target group includes:

- In-service graduates in forestry sector;
- Unemployed graduates in the field of forestry;
- NGOs employees in related field; and
- Environment related graduates with three years experience.

The programme is offered throughout the country. Candidates possessing B.Sc. or M.Sc. Forestry degree with at least second division from national

or internationally recognized institutions or BSc. or MSc. degree in related field with three years experience are eligible for admission. Admission for new students is made after every two years (biennial). Applications for admissions are invited through the national press and the selection of candidates is made strictly on merit as per university policy. After the admission process, the students can have option to register for a maximum of two full credit courses, the selected students must register for the courses offered in a semester by prescribed dates and the students will be assigned a dissertation advisor after completing the Research.

For the award of MSc. Forestry Extension, the students must fulfil the following requirements:

- Earn 8 full credits of course work out of these, 6 full credits from compulsory and two credits from elective courses. The courses are given in Table 16.1;
- Qualify viva-voce of dissertation, which accounts for two credits; and
- M.Sc. Degree is awarded upon the submission of dissertation preferably based upon the original work. The panel of experts for supervision of dissertation are recommended by the Chairman of the Department and their names are finally approved by the Vice Chancellor. The dissertation is assessed according to the University policy.

16.2.2 Mode of teaching and method of instruction

Open Distance Learning

These include self learning printed texts and supplementary study material including course books, assignments, tutorial schedule, radio/TV schedule, general student guide, student course guide and assignment forms.

Table 16.1: Courses Offered at Allama Iqbal Open University

Compulsory Courses			
Course		**Code**	**Credit**
1	Rangeland Management in Pakistan	2501	Half
2	Tree Management	2502	Half
3	Participatory Forestry	2503	Half
4	Research Methods	2504	Half
5	Diffusion of Innovations	2505	Half
6	Mass Communication	2506	Half
7	Forestry Extension Education	2507	Half
8	Economics of Forestry	2508	Half
9	Social and Community Forestry	2509	Half
10	Agro-Forestry	2510	Half
11	Soil Conservation and Water Shed Management	2511	Half
12	Statistics	794	Half
13	Thesis	798	(2 Full Credits)

Elective Courses

1	Principles of Rural Sociology	2513	Full
2	Approaches of Rural Development	2514	Half
3	Nurseries Management	2515	Half
4	Environment and Forestry	2516	Half
5	Wood Energy in Pakistan	2517	Half

The following methodology has been adopted for this programme:

- The medium of instruction is English;
- The study material consists of print material; and
- For continuous academic guidance, supervision and assessment, the University provides fortnightly tutorial support to all students through its Regional Centres subject to an adequate number of students in a geographical area.

The schedule of tutorial meetings and dates of submission of assignments are mailed along with reading materials (Table 16.1). For each course, the registered students are assessed for continuous assessment through written assignments and workshop and final three hours written examination. The assignments and final examination contribute 40% and 60% to the

student's final course grade respectively. The pass percentage in each component is 40% and the aggregate required for passing the course is 50%. The final grade is determined by following the scale: 50 – 64% (C), 65 – 79% (B) and 80% and above (A).

16.2.3 Field visit activity assignments

Assignment are undertaken by the students and it encompasses field visit activities and literature based nature course. Having field visit activities, the assignments carry 40% marks (20% from regular assignments and 20% field visit activities based assignment). The tutor of the subject concerned supervises/monitors the field activities. The students submit their assignments to their tutors who return the same after assessment and provide necessary academic guidance. A full credit course requires four assignments while a half credit course demands two written assignments (AIOU, 2003).

16.2.4 The workshops

The term workshop here refers to the lectures and tutorials being arranged to guide and assist the students. The workshops are conducted in the programme and provide an opportunity for students to discuss issues raised in the courses and explore the answers to their questions. These workshops add significance to the courses and help students in their professional development and growth.

16.2.5 Semester-wise scheme of courses

The programme consists of 10 credits and spreads over 17 courses. Twelve courses are treated compulsory and 5 elective (Table 16.2). The programme can be completed within a maximum period of two and half years (AIOU, 2003).

16.2.6 Success of the programmes

At times, we have received the feed back from the students and others on the effectiveness of the programme. The data gathered clearly indicate that the higher percentage of the students considered the programme a success and appears to be fully capable of meeting their needs, expectations and educational requirements whereas a very small group rated it as unsuccessful. Out of the total number of 82 students, 86% students considered it successful while only 14% stated that it was not up

to the mark and they did not seem very much satisfied and impressed. To improve the situation, immediate steps were undertaken and possible changes made, keeping in view the valuable suggestions of the students.

Table 16.2: MSc. Forestry Degree Course offered at Allama Iqbal Open University

Course	Code	Credit
First Semester		
-Range Land Management in Pakistan	2501	Half
-Tree Management	2502	Half
-Research Methods	2504	Half
-Principle of Rural Sociology (the other alternate)	2513	Half
Second Semester		
-Soil Conservation and Watershed Management	2511	Half
-Mass Communication	2506	Half
-Statistics	794	Half
-Environment and Forestry (the other alternate)	2516	Half
-Principle of Rural Sociology (the other alternate)	2513	Full
-Wood Energy in Pakistan	2517	Half
Third Semester		
-Agroforestry	2510	Half
-Diffusion of Innovations	2505	Half
-Forestry Extension Education	2507	Half
-Nurseries Management (the other alternate)	2515	Half
-Approaches of Rural Development	2514	Half
Fourth Semester		
-Economics of Forestry	2508	Half
-Participatory Forestry	2503	Half
-Social and community Forestry	2509	Half
-Nurseries Management (the other alternate)	2515	Half

16.2.7 Room for programme improvement

The students explained that most of them were working in forest department, and Non-Governmental Organisations (NGOs) and they had taken this programme for their professional growth and development to enhance their knowledge about forests, forestry, natural resources, environment and to improve their skills on dealing with people and capacity-building. They stated that the programme had covered up to 80% of their expectations. They expressed that this programme was a very useful initiative that enabled them on one hand to convert their experience into qualifications and enriched their experience to contribute more efficiently to their serving organizations.

Some of the forestry professionals were of the view that the course contents were not quite relevant to Pakistani context and measures should be taken to present books in South Asian or at least Indian context. The participants also suggested that these workshops should be participatory in future; e.g. presentations by the participants and group discussions besides lectures delivered by the resource persons/forestry experts. The use of modern techniques and multimedia was highly appreciated by the participants.

16.3 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the following subjects need to be included in the programme

The following subjects may be included in the programme; Gender studies/Women studies, Social development, Development studies, Micro financing. The programme should be conducted using modern distance learning education techniques and methodologies e.g. use of internet, email, presentations, yahoo group discussions etc. TV Programmes may be introduced covering the courses thus making it easier for students to understand the subjects without the help of tutors. Students should be provided with the facility to get in touch with the international students studying abroad as well as national students studying within the country for pooling out their experiences.

The text material for Forestry Extension should be in local language and should be available on CDs. Since not very many projects in social forestry or forestry, extension have been launched so far in the country, the executors of the successful projects be invited as guest speakers and their experiences included in the text material. Fast Internet facilities should be made available to the students. The text

material may be developed with the collaboration of the developing countries. Timely mailing of text books must be ensured to avoid any unjustified wastage of time of the students. Continuous revision and up grading of curricula relevant to the needs of country is highly desirable with the help, assistance and cooperation of the national and international scientists who have practically worked with people and forest related sectors in Pakistan.

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17 E-learning in Tropical Forestry: Constraints and Options

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ABSTRACT

E-learning has been widely discussed in theory but less is done in practice. An analysis of experiences in two online forestry courses shows great opportunities but also points of weaknesses. Forestry courses provided online can be an advantage to both the learner and the institutions offering them. The advantages to the learner include flexibility to use time, improved performance and more democratic space. For those in a career, there is the ability to learn from home and work while attending to other social responsibilities. Institutions benefit mainly by attracting a wider audience of different kinds of students hence increasing their competitiveness. Some of the challenges with e-learning such as scepticism and cheating can be handled by the manner in which the course is set and managed. However, ways to handle generic challenges such as administrative huddles and copyright issues are coming up with development in e-learning. The opportunities in e-learning fit in forestry, like many other disciplines, and can be used to inject the much needed energy and dynamism in forestry learning.

17.1 INTRODUCTION

On a global scale, the roles of forests are changing. Forestry education institutions need to focus on increasing graduates success in the labour

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market by offering a variety of non traditional skills. Internet based learning and integrating communication tools can open avenues to provide for and facilitate existing forestry education world wide. As part of the two year international MSc programme in Sustainable Tropical Forestry (SUTROFOR) the University of Copenhagen has implemented two online courses in Forestry: Applied Socio-economics in Tropical Forestry and Participatory Forestry Management (PFM). Both courses involved the use of a learning management system (LMS), a collection of tools available through a shared administrative interface. It can be thought of as a platform in which online courses or online components of courses are assembled and accessed (Nichols 2003).

E-learning was structured around five main components: (i) Module overviews from the teacher provided online, (ii) Compendium material in hardcopies or electronic copies, iii) online asynchronous group discussions on the compendium material, (iv) Multiple choice questionnaires and (v) occasional face to face discussions. Students are required to read the module overview and compendium material in order to handle the multiple choice questionnaires and the group discussions. It is in the group discussions that the exchange of experiences as online learners is widely carried out. The aim of this paper is to present first hand experience with e-learning in tropical forestry with an emphasis on learners' perspectives rather than technology, a concept discussed by Bates and Poole (2003). The strengths and weaknesses of e-learning in forestry are explored and recommendations for future e-learning options are presented.

17.1.1 Background information: reasons for converting to e-learning

Educational institutions today are confronted with the challenge of finding innovative ways to attract students, improve course quality and flexibility (Längin *et al*. 2004). One way to gain a strategic advantage is to develop new forms of teaching that increase access; this will in turn increase the potential number of students as well as provide the foundation for establishing closer working relationships with partner universities (e.g. by cutting costs related to student and teacher mobility). You could call this the strategic angle. A similar view is given by American Academy of Political and Social Science on the increasing interest by universities to provide their resources to a wider audience. In this case, the interest is driven in part by the need for funding but also carries possibilities for effective education of a larger and more widespread number of students (Cheol, 2003).

In addition, the flexibility of asynchronous, any time, any place online discussions can be employed to suit both the learner and the teacher. The inherent nature of the courses (tropical forestry and participatory forest management) was also a good reason to go for e-learning: This gives students who do not have the time or money to go to Denmark the opportunity to enrol in and complete the courses, and give the programme access to a wider audience of different kinds of students beyond what traditional teaching could offer. In addition, e-learning is a new way of learning, adding one more tool to the learning tool box.

17.2 METHODS

Feedback from two participants' e-tivities namely: "*Identifying elements of good online learning*" and "*Leave your foot prints*" was analysed from the e-learning courses. An e-tivity is an online exercise, which is mainly in form of a guided discussion (Salmon, 2002). Both of the above e-tivities were aimed at getting feedback from students on their experiences in the two courses, and were strategically placed in the middle and the end of the course. On a broader perspective, experience from implementing the two courses in the last two years is drawn upon by the responsible teachers through a discussion. A literature review from articles was used to enrich the discussions in the paper as well as experiences of one of the authors as an online learner.

17.2.1 Use of Scaffolding model in e-learning

The five stage scaffolding model by Salmon (2004) was used to structure the e-learning and gradually developing the skills required by students to complete a course. The use of the model proved a success and resulted in well structured and meaningful discussions. Consistent with the findings by Tuckman (2005), the scaffolding model was found to be helpful especially by students in avoiding procrastination. For further details on the setting up of e-learning, software development and use of the scaffolding model see Olsen *et al*. (2004) and Olsen and Monty (2006).

17.2.2 General evaluation of student performance

The Applied Socio-economics in Tropical Forestry course was done in autumn of 2006 by 26 participants. It involved a lot of moderator input since most participants were being involved in e-learning for the first time. The PFM course had 30 participants with over 70% having participated in the Applied Socio-economics course. The learning was

therefore smoother except for the few newcomers into e-learning. Participation in both courses was good and of high quality. In order to gain access to the final exam, participants had to successfully pass 75% of exercises, which every participant did. All students passed in both courses, with notably better performance, compared to previous traditional learning in the same courses.

17.3 OVERALL EVALUATION OF E-LEARNING

17.3.1 Major strengths of e-learning

E-learning is mainly advantageous in presenting distance learning opportunities to more students from different parts of the world. This can potentially increase revenues through course fees for the institution offering courses through e-learning, but should not be used as the sole basis for shifting to e-learning because so far no empirical evidence supports this. The cost for the students to undertake the courses are lower in e-learning, especially if they are located far from the institution offering e-learning courses, since they do not need to travel to take the courses. In participating in the courses, students acquire writing/communication skills and IT skills, which can be applied in a working environment. The following is a comprehensive list of advantages of e-learning extracted from the experience with the two online courses:

- Creating an open platform for students with different qualifications to freely express their knowledge, thus utilizing the potential and expertise drawn from students with varying backgrounds;
- Flexibility: This ranges from students' use of their time, to courses being taken by students from different universities, participation by students without limit of geographical locations;
- The possibility of inviting professionals in forestry and related disciplines to virtual classes and share their knowledge without making them leave their duties, for instance, in the Applied Socio-economics course, staff from Center for International Forestry Research (CIFOR) and Food and Agricultural Organisation (FAO) had direct discussions with students, thus giving students professional views as well as networking opportunities;
- Ease in reaching more students, an advantage to the providers as well as receivers of knowledge;
- It is a new teaching tool suiting new demands for long life learning. Life long learners are interested in qualifications that can be built from

small modules and courses, and in learning that can be done at home and fitted around work, family and social obligations. Such is the opportunity offered by e-learning to a new dynamic breed of foresters;

- An analysis (Olsen and Monty, 2006) of the two online courses indicated that the drop out in online courses was the same as in other traditional forms of teaching;
- Investment in time and money is needed to switch from ordinary face to face teaching to online learning but the trade off is worth it (Längin *et al*., 2004; Olsen and Monty 2006). The course material in digital form is thereafter available at the click of a mouse and updating is made easier;
- From an evaluation of online courses at LIFE, (Olsen and Monty, 2006) noted a rise in average student performance from grade 8 in ordinary face to face teaching to grade 9.17 using the scaffolding model. (This was based on Danish 13-scale system, the higher the number, the better the performance);
- Democratic space: All students have a chance to express themselves and there is more liberty to discuss every student's point of view, unlike traditional face to face discussions which may be dominated by more expressive students; and
- No "hiding" of students: It is common knowledge that some students are left out of discussions in face to face learning. This is not the case in cyberspace; e-tivities are compulsory and the students' contributions in discussions are graded as pass or fail which contributes to the final grade of the course.

17.3.2 Challenges faced in the e-learning courses and possible ways of overcoming them

E-learning can be a challenge in the initial stages especially for slow learning students who often complain of the fast learners dominating in discussions. The quality of discussions in e-learning varies with the possibility of high quality discussions in one group (or from a few students) while others may be quite poor. The ability of the e-moderator to guide the students on how to post quality discussions is therefore highly relevant. Other possible challenges in e-learning, not necessarily experienced in SUTROFOR, include:

- Repetition in postings by students resulting in "stagnative" rather than "progressive" discussion. However after discussing the issue, course participants come up with various remedies to the problem: The following discussions should simply start with "I agree with"

instead of repeating what the first respondent has already said; Questions posed in the e-tivities by the teacher should be more geared towards generating a discussion rather than requiring a clear cut answer; The teacher should explicitly state before the beginning of the course the criteria for evaluation. Discussions are not about posting messages, but participating meaningfully;

- Administrative huddles: E-learning needs a lot of institutional support, and to change from traditional face to face to a new form of learning is not a walk over, especially in administration terms. The idea of e-learning mainly starts with one daring person, who sources for "like minded" personalities in the department to work with, and with time, they can form a team that can work with the rest of the administration. This one man outset is normally referred to as "the lone ranger concept" and takes time to materialize;
- The scope for cheating: Some students will do anything to obtain a certificate or pass exams, including cheating (Graf, 2002). Learning has a long history of cheating and traditional forms of learning have established ways to prevent cheating. E-learning introduces new ways of learning but the students are still the same. Possible ways of cheating online include *plagiarism* (when students use published material without proper acknowledgement), *ghost writing* (when someone other than the registered student does work instead of the registered student) and *breach of copyright* (when students use substantial amount of someone else's work, even if it is acknowledged (Bates and Poole, 2003);
- Copyright issues: Obtaining permission to distribute learning materials in electronic form is often difficult, time consuming and costly; and
- Other causes for debate on e-learning in a developing country's context are the digital divide, i.e. availability of computers for students and restricted and inadequate bandwidth.

17.4 CONCLUSION AND WAY FORWARD

E-learning in forestry can and has been successfully implemented in some universities. E-learning supports transfer of knowledge even when the instructor and student are separated by time, location or both. The best e-learning ways are student-centred, constructivist, provide learner support and use integrated technology environment (Raab and Abdon, 2005). Most problems with e-learning are well handled by students and teachers discussions in the course, as experienced in the two online courses by

SUTROFOR. However, generic issues such as copyright and cheating are still debatable, thought not yet reported in these two cases.

Experience from the two online forestry courses shows that e-learning has much to offer. There is need to offer forestry courses that are widely accessible and that can compete with other disciplines and give back the lost glory that is so needed in the forestry sector, and the role of e-learning in this case should not be overlooked. At the moment, there are no full degree courses available online in tropical forestry.

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18 Developing the curricula and quality of the joint educational programmes – two examples from Europe

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ABSTRACT

The universities in European countries have taken the challenge of Bologna process and the European Higher Education Area (EHEA) with great enthusiasm. Curriculum development and description of teaching and learning processes, defining the learning outcomes based approach to higher education, have been carried out intensively. The development process of the EHEA has adopted standards and guidelines for quality assurance of higher education in Europe. Jointly approved procedures of quality assurance are preconditions for recognition of curricula offered by universities in the future. Providing joint cross-border education widens the range of educational offer of institutions. Co-operation and partnerships provide a way to prevent and combat the possible lack of human, physical and financial resources in individual institutions to respond to new issues in forestry and related fields. A successful joint educational programme should provide a clear added value to all interest groups putting their resources into the programme. Furthermore, cross-border education and especially joint study programmes serve effectively as a tool in achieving common standards and mutual recognition in higher education. The development of joint European Master's Degree Programmes in the framework of ERASMUS Mundus plays a key role in the development of recognition. The University of Joensuu is involved in several cross-border joint educational programmes. Two of those are presented in this article, MSc European Forestry and the Finnish-Russian

Cross-Border University. Experiences of developing and implementing cross-border joint education in Europe are providing good basis for creating and contributing global partnerships and cross-continental study programmes in higher forestry education.

18.1 INTRODUCTION

18.1.1 High quality forestry education in Europe

The European Higher Education Area (EHEA) is developing fast. In this moving context, the ministers of education of the participating countries have decided on a framework for qualifications comprising three cycles (BSc – MSc – PhD), generic descriptors for each cycle and credit rangers for the first and second cycle. The universities in various countries have taken this challenge seriously. Curriculum development and description of teaching and learning processes, defining the learning outcomes based approach to higher education, have been carried out intensively and with great enthusiasm.

The processes of teaching and learning at universities in the integrating Europe have to be open, transparent and of high quality. The development process of the EHEA, which started in Bologna, has adopted standards and guidelines for quality assurances (EHEA, 2007). The participating countries have committed themselves to introducing the proposed model of peer review by quality assurance agencies on a national basis. These agencies will be linked to the joint European register of quality assurance.

In some education areas, transnational evaluation and accreditation is envisaged. One of these highly international fields is forest sciences. Integrated study programmes, such as joint and double degree curricula, require collaborative effort of the national accreditation agencies or a fully new approach, such as a Europe wide accreditation in a specific field of higher education. Some new European quality labels will be tested, among them the label for life sciences and rural development. For this purpose, the Association for European Lifestyle Universities (ICA) has launched a project QUALITY: Quality Assurance and Accreditation of International Master Degree Programmes in Life Sciences and the Rural Environment (EU funded project 2006) for developing a new international agency of quality assurance. Jointly approved procedures of quality assurance are preconditions for recognition of curricula offered by universities in the future. This is a very basic right of the students in the integrating Europe. The development of joint European Master's degree

programmes in the framework of ERASMUS Mundus plays also a key role in the development of recognition. Participating countries have started modifying their legislations but still universities face great problems when promoting international cooperation and partnership.

The European Union supports 80 joint and/or double degree Master's Programmes, 19 of which have even an additional dimension of non-EU partnerships (Education and Training 2007). In the domain of the SILVA Network, three Erasmus Mundus Master's programmes have been implemented. Hence, the SILVA Network has a special need to participate in the development of international quality evaluation and accreditation procedures.

ICA's mission with respect to quality assurance is "to enhance the quality of degree programmes in life sciences and the rural environment, through quality assurance and international accreditation. The aim is to award the European Accreditation Agency for Higher Education in the Life Sciences quality label to degree programmes in institutions that have achieved the appropriate quality and standards in their educational provision.

The role of the SILVA Network is to improve the opportunities of higher education institutions to modify their teaching and learning processes to meet the demands of the developing EHEA. Experiences of developing and implementing cross-border joint education in Europe are providing good basis for creating global partnerships and cross-continental study programmes in higher forestry education.

Globally the fundamental questions remain the same: How to develop and define a joint mission for curricula that promotes global dimension without loosing the touch to special local circumstances? How to adopt appropriate and relevant methods and tools? How to spread good practices for increasing attractiveness and competitiveness of the academic forestry education?

18.2 CROSS-BORDER EDUCATION

Numbers of students enrolled in educational institutions outside their home country has been rapidly growing. At the same time, the number of educational institutions providers' operating abroad has been increasing, offering their educational programmes to foreign students who remain at home (OECD, 2004). In general, academic cross-border education refers

to all situations where the students, teachers, course materials, programme, or provider of education cross national borders.

Providing joint cross-border education widens the range of educational offer of institutions, increases flexibility and choice of the students. Co-operation and partnerships provide a way to prevent and combat the possible lack of human, physical and financial resources in individual institutions to respond to many new issues in forestry and related fields. Joint cross-border education can be seen to be more enhancing the brain circulation than effecting brain drain, and can be used to increase human resource capacity in each participating institution. Furthermore, cross-border education and especially joint study programmes serve effectively also as a tool in achieving common standards and mutual recognition in higher education.

Delivering joint educational programmes sets new conditions for the educational institutions and also for the provided education. One of the most pressing issues concerning education programmes and providers across national borders is the issue of quality assurance; how to monitor and assure the relevance and quality of the education programmes and qualifications being offered. Joint education brings a need by each institution in the consortium to ensure jointly and severally the quality of education given by other members of the consortium. A successful joint educational programme should provide a clear added value to all interest groups putting their resources into the programme which, as a result, produces a win-win –situation.

High quality joint educational programme is thus, typically a base-to-top -process which has been born to meet the demand in the market and the distinctive needs of each participating institution, and which is developed and co-organised between trusted partners. The development process of any joint curriculum, in general, consists of at least the following main steps: (i) Defining the new demand, which the existing education can not meet, (ii) Formulating the areas of competency in each potential partner university, (iii) Formulating the combination of the universities for optimal consortium structure, (iv) Formulating the core competences of the consortium, (v) Formulating the sub-competences of the consortium, and finally, (vi) Formulating the curriculum for the joint programme.

The University of Joensuu is involved in several cross-border joint educational programmes. Two of those are presented in this article. The first example is Master of Science in European Forestry -programme,

coordinated by the University of Joensuu and delivered jointly by six European universities. The programme has been awarded the ERASMUS Mundus label by the European Union as recognition of high quality and true European dimension. Another example of successful cooperation crossing the national borders is the Finnish-Russian Cross-Border University, launched in 2004 by five Finnish and four Russian universities.

18.2.1 MSc European Forestry

The six well-established and recognized European universities, all partners of the SILVA Network, introduced a joint master's course in European Forestry in 2002 to meet the challenge of changing operational environment in the forestry sector; especially globalization and rising environmental, social and political questions (Education and Training, 2007). As a result, the MSc European Forestry (MSc EF) master's programme started, first as a one-year programme but in year 2004, a full two-year programme with 120 ECTS of studies was launched. The programme language is English. The aim of the MSc in European Forestry programme is to provide academic education in forestry, focusing on the international forest resource management and utilization as well as policy aspects of sustainable forest management, supported by a sound understanding of the ecological conditions and their dynamics in Europe. The focus of the programme is in the issues formulated in the EU Sustainable Development Strategy.

The partners are the University of Joensuu (Finland), Swedish University for Agricultural Sciences (Sweden), Albert-Ludwig University Freiburg (Germany), Vienna Agricultural University (Austria), University of Wageningen (The Netherlands), and University of Lleida (Spain). The consortium took the challenge to develop a programme that could meet the national requirements set for higher education in six different countries. The 120 ECTS studies are consisted of obligatory and optional studies that are provided by the European partners together. As a result the programme awards double degrees for the graduates and is heading towards awarding a joint degree in the future. All countries participating in the MSc EF have committed themselves to the Bologna declaration, a major initiative to achieve greater convergence between higher education systems in the EU that has been a substantial advantage in the development process of the joint curriculum. During the first year, students attend common courses, co-organised at the different partner universities and carry out an internship at a forest institution or company.

The first year provides the students with a complete background in European forestry and familiarizes them with the 6 partner universities and with other forest institutions. During the second year, the students attend courses and carry out their Master's thesis at the partner universities, according to an individual study plan in agreement with the supervisor.

In 2004, the MSc EF programme was honoured with the ERASMUS Mundus label by European Commission. The programme enables students and visiting scholars from around the world to engage in master's level studies at European universities, as well as encouraging the mobility of European students and teachers. The ERASMUS Mundus Programme includes a global scholarship scheme for third-country nationals (students and teachers). Partnerships between EU Master's Courses and third-country institutions are also encouraged by scholarships for Europeans to study and teach at non-European partner institutions. In the MSc EF programme, the non-European partner universities are in China, South Africa and Brazil.

The MSc EF programme is open to well motivated students, who have successfully completed a BSc degree in forestry or related fields and have good knowledge in English language. The student enrolment is around 30 students per year. Currently the programme is hosting 61 students (first and second year) from 26 different countries from all over the world.

By supporting the international mobility of scholars and students, ERASMUS Mundus intends to prepare EU participants and partner countries for life in a global, knowledge-based society but also to promote the attractiveness of the EU as a centre of excellence in learning. Experiences of the joint master's programme have been very good, although the development process is continuous and challenging. The clear value-addition for the participating universities has been, for example, greater number of degree students and graduates, wider offer of courses, seminars and presentation, mobility grants for scholars (both incoming and outgoing), continuously increasing global network of researchers and experts, and also increasingly international atmosphere at the host university campus.

18.2.2 The Finnish-Russian Cross-Border University

Another example of joint educational programmes is the Finnish-Russian Cross-Border University (CBU®) that operates across the EU's borders

and thus includes also aspects of the cross-border policy of EU, as well as Finnish higher education and neighbourhood policy (The Finnish-Russian Cross Border University, 2007). The basic idea of developing process and implementation are the same as in any other joint programme between several institutions. A special emphasis in this cooperation is put on the implementation of the Bologna process in Russia.

The CBU® is part of the Finnish government's action programme, *Finland, Russia and international co-operation 2003-2007*. The CBU® aims at complementing implementation of the Bologna Process in Russia and Finland, with a commitment to strengthening co-operation between higher educational institutions through, e.g., ECTS-credit implementation, joint curricula development, governance, assurance of quality, and student and teacher mobility. A solid basis for the CBU is in the deep and long-term experience of Finnish-Russian co-operation, which many of the universities in the consortium already have.

The universities currently involved in CBU® in Finland are The University of Helsinki, The University of Joensuu, The University of Kuopio, Lappeenranta University of Technology and The University of Tampere, and in Russia St. Petersburg State University, St. Petersburg State Polytechnic University, Petrozavodsk State University and The European University at St. Petersburg. The CBU® Development Unit (DU), located at the University of Joensuu as an independent institute, serves as the administrative unit of the CBU®.

The nine CBU® universities are together offering Master's Degree Programmes in six study fields, combining the strengths and expertise of the partner universities. The study fields are Business and Administration, Forestry and Environmental Engineering, History, Information Technology, International Relations and Public Health.

The CBU® Master's Degree Programmes offer a unique possibility to carry out master level studies in English both in Finland and Russia. The two-year (120 ECTS) master's courses include studies in at least one Finnish and one Russian university. The CBU® students can fully exploit the expertise of the CBU® partner universities and actively move between these universities. The joint programmes are accordant with the Bologna process and form a part of the European Higher Education Area –process in both countries. In addition, the curricula have to meet the requirements of national (Finnish and Russian) regulations and internal regulations of the CBU® partner Universities. The programmes are based on

professionalism and theoretical studies and have a strong orientation to the realities of working life. The graduates will be trained and qualified to work across national boundaries in an international and intercultural environment.

The basic requirements for applicants are a BSc degree and a good command of academic English. Annual student intake in each CBU® Master's Programme is approximately 20 students. All six master's programmes started in September 2007. The total number of students enrolled during the first year was around 80, of which 34 started their studies in Finnish universities and the rest in Russian universities. The graduates are currently provided with either a double degree or one national degree of the home university, diploma supplement and a CBU® certificate.

Joint efforts for increasing collaboration in educational programmes, as well as mobility of students, academic staff and professionals have stimulated the CBU® consortium to create a shared quality assurance system (QAS). The CBU® programmes have a three-level structure for governance, development and quality assurance; the master's programmes, individual universities and the CBU® consortium. Consequently, the programmes have to meet not only the quality standards of different countries and universities, but also the quality elements essential for joint international cross-border education are emphasized. The CBU® quality assurance system is developed to jointly guarantee the high quality of the Master's Programmes and providers, but also to provide an international framework for cross-border education. The CBU® QAS is to provide an additional element for existing national and university specific systems.

Quality assurance in CBU® is regarded as a shared and integrated responsibility of the network as well as a responsibility to be taken by each participating institution alone. The guidelines are based on the principle of mutual trust and respect and on the recognition of the importance of international collaboration in higher education. They also recognise the importance of national authority and the diversity of higher education systems.

The fundamental principle in the quality assurance of the CBU® education is to assure and demonstrate students, employers and the society of the good quality of education offered and of the good quality of the institutions offering that education. The value-added of the CBU®

QAS shall be realized in a better market value of the joint international educational products with the highly recognized CBU® brand, as well as in deep mutual trust and respect.

18.3 CONCLUSION

A successful joint educational programme should provide a clear added value to all interest groups putting their resources into the programme. In the core of the HEA Erasmus Mundus courses promote the EU as a centre of excellence in learning around the world. It supports European top-quality Masters courses and enhances the visibility and attractiveness of European higher education in third countries. Furthermore, cross-border education and especially joint study programmes serve effectively as a tool in achieving common standards and mutual recognition in higher education in different countries in Europe. Co-operation and partnerships in joint degree programmes provide a way to prevent and combat the possible lack of human, physical and financial resources in individual institutions to respond to new issues in forestry and related fields. The Finnish-Russian Cross-Border University is a new initiative and a good example for improving the integration of higher education between the EU and the neighbouring countries. Experiences of developing and implementing cross-border joint education in Europe are providing good basis for creating and contributing global partnerships and cross-continental study programmes in higher forestry education.

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19 Meeting the Challenges - Facing Today's Forestry Education in the University of Helsinki

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ABSTRACT

Forestry education today faces several challenges and yet the role of forestry-related education has been diminishing in the university curricula around the world. Several programmes have been terminated or merged with other disciplines such as natural resource management. Global trends such as, liberalization, decentralization, and the increasing role of the private sector and local communities are affecting the way forestry is being taught. The challenges of the forestry education are taken seriously within the University of Helsinki. The education has been developed and adapted to the needs of present day labour market without compromising the traditional forestry education. Amongst the various international activities are the International (Russia/Finland) Cross Border University (CBU) and the Master's Degree Programme in Forest Sciences and Business (MScFB), which started in 2006. In forestry today, there is a growing need of well-trained professionals with up-to-date skills and local-global perspective. The objective of the Global Industrial Forestry Network (GIFN) is to educate qualified professionals for growing needs of plantation forestry and to enhance research on the topic. Networking can help gain larger teaching staff and possibility to concentrate on relative strengths. Having close ties with the Finnish Forest cluster and joining and initiating international networks promote the University of Helsinki as an active and interesting partner for the global forest industry. The faculty can help secure the future success of global forest industry by

producing well qualified graduates with the necessary professional skills (e.g. sustainability, communication, social, environmental) to meet the challenges facing the forest sector today.

19.1 INTRODUCTION

Forestry education today faces several challenges. The role of forestry-related education has been diminishing in the university curricula around the world. Several programmes have been terminated or merged with other disciplines such as natural resource management. The FAO (2001) paper clearly identifies the difficulties facing forestry education in selected developing countries and in countries with economies in transition. There is also declining student enrolment, in the Nordic countries (Rekola, 2004) and in North America (Innes, 2004). However, the globalisation of the forest industry is making great strides. For example, Finnish companies are involved in pulp mill projects in South America (Dahlin *et al.,* 2007). The fast development of forestry sector creates challenges for higher forestry education. Global trends such as, liberalization, decentralization, and the increasing role of the private sector and local communities are affecting the way forestry is being taught (FAO, 2001). Education has to adapt in order to adequately prepare students for a dynamic future (Pelkonen *et al.,* 1999). Besides the good knowledge base of basic forest sciences, broader skills in communication, language and technical knowledge are among the required skills in today's forestry education (Vuillermoz & Kostilainen, 2005).

While University level forestry education in Finland has not suffered a significant decline in student enrolment (Figure 19.1), there is no room for complacency. In this paper higher forestry education in Finland is described and the ways in which the challenges facing forestry education are being met outlined.

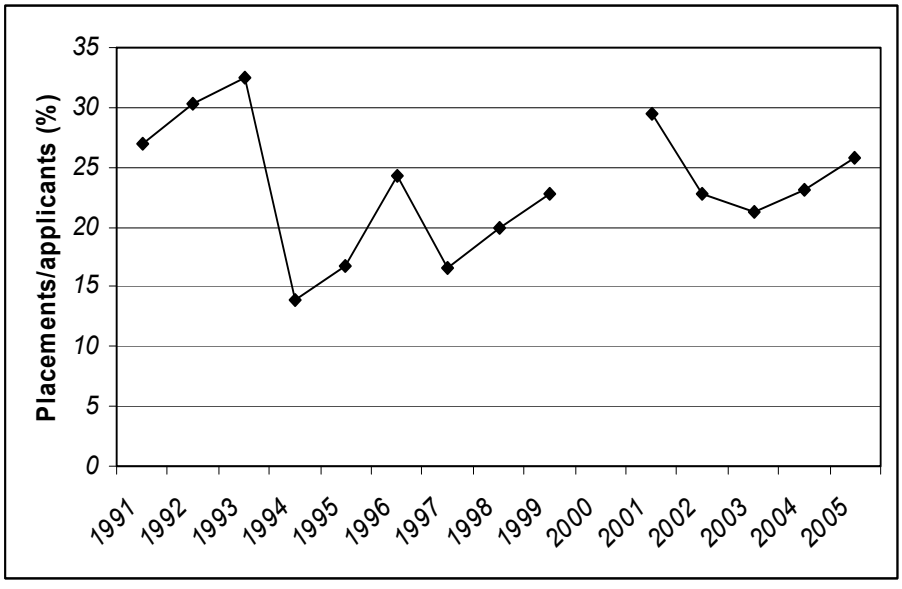

Figure 19.1: Number of Study Placement as a Ratio of Applicants in Forest Sciences in University of Helsinki (Faculty of Agriculture and Forestry, 2007.)

19.2 FORESTRY EDUCATION IN FINLAND

The forest cluster in Finland values research and education. The national strategy is to retain Finland's international position in forestry amongst the highest ranks. Research and education in the forest sector is being developed keeping this aim in mind (NFP, 2006). Forestry education in Finland is available in two universities, 8 Applied Universities and in 27 vocational schools (Table 19.1). In 2006 the number of graduates from the universities was approximately 120 students studying forestry at university level (Table 19.1). So far it has been easy to recruit young people to join forestry especially in the university level but the situation might change in the near future.

Table 19.1: Forest Education Units in Finland and Annual Average of Graduate Students

	Area of specialization					
	Forestry		Wood		Paper	
Level of Training	No. of Institutions	No. of Graduates	No. of Institutions	No. of Graduates	No. of Institutions	No. of Graduates
Youth education						
Vocational schools	27	400	60	600	18	280
Applied Universities	8	270	6	90	3	90
University level	2	100	2	20	6	135
Youth educ. total	37	770	52	710	27	505
Adult education						
Indenture		35		300		200
Vocational- and special vocational qualification degrees		95		200		
TOTAL		900		1210		705

19.3 FORESTRY EDUCATION IN THE UNIVERSITY OF HELSINKI

The University of Helsinki (hereafter referred to as UH) is one of the two universities offering forestry education in Finland. The forestry education began in 1908 in the Faculty of Agriculture and Economy. The Faculty of Agriculture and Forestry was founded in 1924. In 1939 a separate building; the Forestry Building, was put up specifically for forestry education. In 2001 forestry education was moved to Viikki campus where Faculty of Agriculture and Forestry is situated together with three other Faculties; Faculty of Biosciences, Faculty of Pharmacy and Faculty of Veterinary Medicine. The Viikki Science Park has more than 6,000 students, making it one of the largest concentrations of students of biosciences in the world.

The Faculty of Agriculture and Forestry consists of 9 departments specializing in 18 disciplines and has over 3200 students, of which 600 are postgraduates. There are three forestry departments; the Department of Forest Ecology, the Department of Forest Resource Management and the Department of Forest Economics. The specialization lines (majors) are as follows:

- Forest Ecology: Forest Soil Science, Forest Tree Ecology, Peatland Ecology and Forestry, Silviculture, Tropical Silviculture, Forest Pathology, Forest Tree Breeding, Forest Zoology, Wildlife Management;

- Forest Resource Science and Technology: Forest Resource Inventory, Forest Planning, Forest Technology, Wood Technology;
- Forest Economics: Forest Economics and Policy, Forest Economics and Management; and
- Forest Products Marketing.

19.3.1 A brief history of English-language forestry education at UH

The history of international forestry students at UH goes back to 1960s. Most of the first students studied tropical silviculture. Since 1980s all forest departments have had some English courses (Rekola, 2004).

In 1988 - 1991 the number of foreign students went up significantly when an international MSc programme in forestry was introduced. The master's programme focused on developing countries and thus majority of the students also came from developing countries. The programme was financed by the Ministry for Foreign Affairs of Finland. The financing ceased due to the recession in the beginning of 1990s (Rekola, 2004).

Around the same time, 1987 - 1998, run another international joint programme in Forest industry. The partners in the programme were the UH, Helsinki University of Technology and Helsinki School of Economics and Management (Opinto-opas, 1998). Once the Universities in Finland launched co-operation agreements (JOO-agreement) which made it possible to complete studies in other universities, there was no longer need for this programme (Rekola, 2004).

Nowadays also in the Finnish programme many of the bachelor level and majority of the master's level courses are taught in English in all the three forest departments (Study guide 2006-2008). When there have not been English master's programmes, foreign students have been entering the Finnish programmes with some adjustments (Valsta and Orenius, 2007). The percentage of graduated foreign students studying in the Finnish programme has been low, less than 50%. One evident reason for that was the poor integration of students into the Finnish university system, for instance, an introduction courses for foreign students was lacking (Rekola, 2004).

19.3.2 Master's degree programme in forest sciences and business (MScFB) at UH

A Master's Degree Programme in Forest Sciences and Business (MScFB) was launched in 2006 and 11 students started their studies in the programme. Students came mainly from China, but also from Ghana, Germany and the United States. In 2007, 12 students from 8 different countries (Bangladesh, Canada, China, Congo, Finland, Latvia, Portugal and United States) began their studies in MScFB Programme.

The MScFB Programme aims to promote the sustainable use of forest resources and human wellbeing through education based on scientific research. The two-year programme emphasizes an international and multidisciplinary perspective on the forest sector. The majors are same as in the Finnish programme (mentioned above in the chapter "Forestry education in the University of Helsinki"). For specialised studies it is possible to choose either Science-based specialized studies or theme-based, multidisciplinary specialized studies. Science-based specialized studies consist of theoretical and methodological studies in chosen subject major and in theme-based, multidisciplinary specialized studies students participate in courses organized by each department. Students also perform a group investigation, which covers ecological, economic, technical, and social aspects of the problem at hand.

According to the amount of credits the foreign students have attained during their first year of studies, it can be noted that it has been beneficial for the students to have a separate programme. An intensive Introduction Course and a Master's Thesis Seminar have been tailored for the needs of foreign students. Taking the rest of their courses together with the Finnish students also enhances the integration of foreign students into the study culture and education system at UH. At the same time, the students in the Finnish programme have been provided an international classroom as well as a possibility to increase their intercultural communication capacity that is an elementary aspect in forestry today. This education strategy can be called a win-win situation for foreign students recruited in the MScFB programme as well as domestic students studying in the Finnish programme.

19.3.3 An international Cross Border University (CBU) Master's degree programme in forestry and environmental engineering

An International Cross Border University (CBU) Master's Degree Programme in Forestry and Environmental Engineering started in autumn 2007. The CBU Programme is based on bilateral and international collaboration in the fields of forest sciences and environmental engineering with aims to promote the ecologically and socially sustainable use of nature resources. As well as teaching based on high level scientific research the aim of this programme is to develop student's cross-cultural understanding and knowledge of different working environments. The programme creates competence to act in the field both in Finland and in Russia. The working language is English, and the studies are made both in Finland and Russia (Masters Degree Programme, 2007).

There are five partner universities in the programme: University of Joensuu, Lappeenranta University of Technology, University of Helsinki, Petrozavodsk State University, and St Petersburg State Polytechnic University (Masters... 2007).

19.3.4 The Global Industrial Forestry Network (GIFN) training initiative

There is a growing market of fibre in South and globally for bio-energy. As there is only limited growth in wood production potential in the North, plantations in tropical and sub-tropical areas the most promising means to meet new demand. Sustainable plantations require global and local social acceptance. Establishment of industrial plantations becomes more demanding task as environmental, social and economic aspects need to be considered and silvicultural practices, management and logistic need to be tuned to high productivity. Thus, there is a growing need of well-trained professionals with up-to-date skills and local understanding (Nikinmaa, 2007). Education on modern industrial plantation forestry is not commonly offered. Old fashioned (technical problems solved already in 60´s and 70´s) education in narrow perspective (within any single discipline) is not very interesting (Nikinmaa, 2007).

The objectives of GIFN are to educate qualified professionals for growing needs of plantation forestry and to enhance research on the topic. Recruitment of the best students is possible only where there is still interest in forestry. Today there is interest in forestry in countries where

forestry is advanced (advanced discipline with good reputation, global actors, working opportunities in science, global institutions and companies) and in countries where plantations are growing (working opportunities in expanding sector). The best teachers for this can be found from universities that posses good resources in forest education, well established research capacity (capacity on teaching formal methods of problem solving), good knowledge on whole sector of forestry and related fields (economy, management, logistics, silviculture, environment, and social aspects) and good knowledge on the local conditions (Nikinmaa 2007).

Through the GIF Network, it is possible to attain improved efficiency by streamlining the teaching, reducing overlap and focusing on existing gaps especially in the field of plantation forestry. Networking can help to gain larger teaching staff and possibility to concentrate on relative strengths. The initiating group of the GIFN is University of Helsinki, University of Sao Paulo and Stellenboch University (Nikinmaa 2007).

In August 2007 the University of Helsinki organised a seminar as a starting point for GIFN. Stakeholders and representatives of four universities took part in the seminar. The needs of forest industry, governmental, intergovernmental and non-governmental institutions regarding industrial forest plantations were mapped and the participating universities brought forward their strengths and possibilities for cooperation concerning the GIFN. Several means for cooperation, from exchange of teachers to joint excursions and parallel Master Programmes in the network of universities were discussed. The need for a training network was identified and it was agreed of the establishment of the GIFN (although the name of the network might be changed).

19.3.5 The strengths of forestry education in UH

The University of Helsinki has a two year MSc forestry programme both in Finnish and in English. The students choose one of the four majors (Forest Ecology, Forest Resource Science and Technology, Forest Economics or Forest Products Marketing) but they are not limited to their major subject studies. The teaching consists of a broad repertoire of teaching in different forest related topics and education can be completed with courses from other Finnish universities/faculties (e.g. law, business, development studies, social studies etc). The flexible degree structure allows the students to form individual education packages. Thesis topic can be chosen according to one's own interests and there are many paid

thesis positions available in Finnish companies. Writing a thesis for a company is also a good way for getting into working life.

In UH there is great flexibility in study methods and lecture attendance and therefore students can choose the study method that suits them best. Small course sizes, 10 - 30 students/group allow interactive teaching. Next to traditional teaching methods, Internet based learning is utilised and IT skills are taught and practised throughout the studies. Pedagogic courses and assistance are available on campus to support teachers and to help them develop their teaching. UH is strongly a research University as teaching is based on latest research results. Thesis work forms a big part of studies, which prepares students for scientific reporting. Problem solving skills are also emphasised during studies.

In UH the staff is easily approachable and the university administration is based on democratic system where students have a say in matters concerning education. There are student representatives on each steering group of department, faculty and university level. An interesting fact is that the gender distribution among students is even. Among staff the gender distribution is still very uneven as only one third are females. There are for example 14 male and 4 female professors as well as 13 male and 2 female lecturers. Researchers' gender is more evenly distributed as there are 40 male and 31 female researchers. The distribution is slowly changing and female employees are fairly young compared to male employees.
Another interesting fact is that there is no tuition fee and thus higher education is available to all regardless of social background. The students are admitted to universities based on entrance exams, which makes it possible to choose only the most qualified students. Students for Masters Programmes are chosen via credit based application procedure. To ensure an adequate amount of student enrolment in the future, actions need to be taken to make the programme interesting for students. Figure 19.2 is an example of such actions.

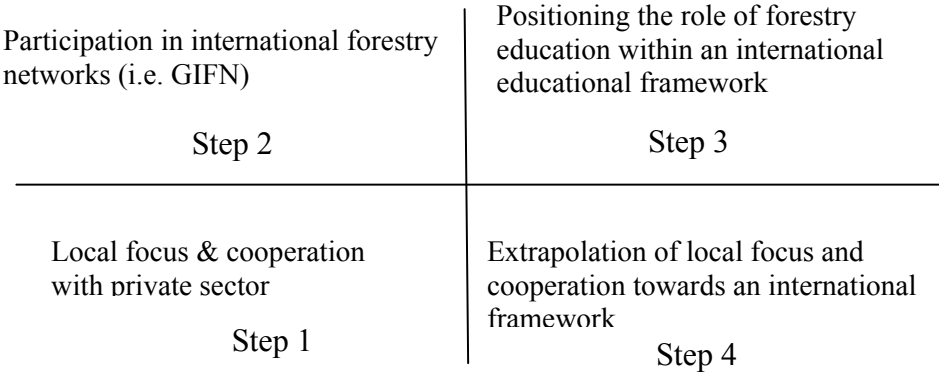

Figure 19.2: An Example of International Approach for Securing Student Enrolment

The Faculty of Agriculture and Forestry is an international learning environment. There are foreign lecturers and students as well as Finnish students who have studied abroad. Students and lecturers have generally very good language skills, which makes it easier for foreign students to blend in and offers a great advantage for graduates in the domestic and international labour market. Language classes are offered for free in the university language centre.

One of the key strengths of the Forest Departments in UH lies in their close ties with the forest cluster (Annex 1). The cluster has been successful in transferring the increasing industrial production and export into socially sustainable development. That is, the benefits from forest industry driven cluster have been divided into different groups, such as forestry and forest industry workers, private non-industrial forest owners, and forest company shareowners. The Forest Departments have close cooperation with the forest cluster and the professionals are often made good use of in teaching and thesis supervision. The needs of the labour market are also taken into consideration when courses are planned. These close ties result in various unique benefits that allow especially a broad selection of thesis possibilities, chance of suitable employment following graduation, encouragement and good possibilities to carry on with Ph.D. studies

19.4 CONCLUSION

The challenges of the forestry education are taken seriously in the University of Helsinki. The education has been developed and adapted to

the needs of present day labour market without compromising the traditional forestry education.

Traditional strengths of UH forestry education have been the wide variety of disciplines and flexible degree structure as well as the close connections with the Finnish forest cluster.

In the future, new education programmes and networking in particular result even wider possibilities for students to specialize. Forestry is to be understood more as a global activity and the education should follow the current trend.

The model of Finnish forest cluster could be beneficial in other countries too. The role of universities their networks can be significant when initiating such a cluster idea into their respective countries.

International networks highlight the UH, making it even more interesting as a cooperation partner with forestry universities abroad, resulting in more opportunities for international studies/research and exchange of knowledge.

All these promote UH as an active and interesting partner for the global forest industry. The UH can help secure the future success of global forest industry by producing well qualified graduates with the necessary professional skills (e.g. sustainability, communication, social, environmental) to meet the challenges facing the forest sector today.

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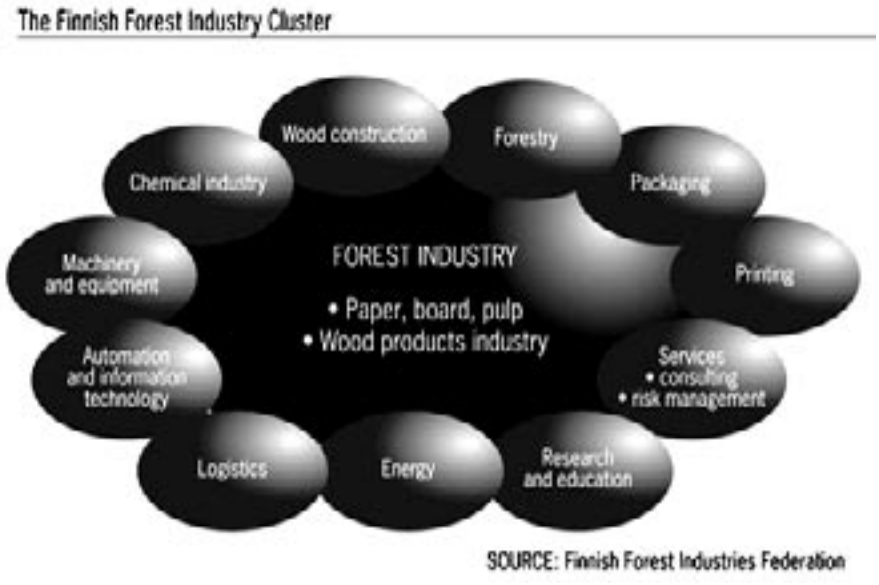
Annex 1. Finland's Forest Cluster



20 Constraints to Choice of Forestry as a Career by Potential Undergraduate Students at the Department of Forestry and Wood Technology, FUTA, Akure, Nigeria

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ABSTRACT

Over the years, serious decline in enrolment of students for forestry course has been recorded. This paper looked at the rate of decline in enrolment for forestry courses by students using the Department of Forestry and Wood Technology, Federal University of Technology, Akure, Nigeria as a case study and the various reasons why prospective students are not willing to register for the course. Low enrolment is peculiar to all universities offering forestry as a course in Nigeria. Data for the study were collected from Departmental admission records, school hand book and University calendar. Interviews with 100 students of the department with well-structured questionnaire were carried out. The factors responsible for this lack of interest include ignorance of how lucrative forestry as a profession is, fear of not getting job after graduation, the fact that forestry cannot be practiced by private individuals after graduation without waiting to be employed and tedious practical aspect of the course. It was discovered that more that 60% of those admitted presently came to forestry Department by accident. They accepted forestry as their last resort since they were not offered admission in the courses of their first choice. Suggestions and recommendations are

made on how to improve enrolment in forestry and wipe off the ignorance on forestry profession in the mind of prospective candidates. One of the recommendations is the inclusion of forestry into the curricula of both primary and secondary schools and intensive career talk to make the course more popular and interesting.

20.1 INTRODUCTION

Forestry is the art and science of planting trees and managing natural forests and woodlands for profitable end uses. Forestry, when well managed, could go a long way to provide several goods and services for both urban and rural livelihood. These benefits cannot be dispensed with by the ever growing population of Nigeria. Greatest proportion of Nigerian population, dwelling in urban, semi-urban or rural areas, relies solely on the forest and forest products for livelihood. The goods from the forest include timber and non-timber products. The non timber forest products are wildlife, chewing sticks, herbs for curing various aliment, poles, edible mushrooms, fruits and nuts, spices and soup condiments etc. The services are recreation, nutrient cycling, soil fertility improvement, air purification, maintenance of ozone layer, shelter for wild animals and provision of employment opportunities.

The area under natural forest cover in Nigeria was reported to be decreasing mainly due to conversion into agricultural uses. Ten percent of Nigeria's total land surface is forest reserve of which the rainforest is only 20% (the rest been savannah zone) and has further been depleted (FAN, 1989). The rate of deforestation is over 5180 km^2 per annum while shifting cultivation removed another 2590 km^2. World Bank (1991) reported that between 17 and 20 million hectares of world rainforest ecosystem are being lost annually and the destruction of roughly $7.5x\ 10^6$ ha annually was reported by FAO/UNEP (1981) and Lanly (1982). Oyebo (2006) reported that the natural forest is disappearing at an alarming rate of 3.5% (about 350,000 – 400, 000 ha) per annum in Nigeria. Some of the principal causes of deforestation are conversion into agricultural land, rural poverty, population growth, animal grazing, uncontrolled bush burning, poor organization, management and funding of forestry activities, indiscriminate and illegal logging, industrial development and urbanization (Schmidt 1991, Adekunle, 2007). If the current rate of forest reduction is not checked, it could lead to wood deficit, loss of biodiversity and the potentials of plant and animal species to rural development and harsh environmental conditions.

The development of forest resources management in Nigeria could be divided into three phases. These phases are the reservation phase, which was between 1899 and 1930, the exploitation phase between 1930 and 1960 and the development phase from 1960 to date. The first phase was pioneered by the colonial authorities. It involved the demarcation and establishment of tracts of forest land as reserves, provision for their protection and controlling of exploitation. This began in 1899 by one Mr Thompson, a serving British Forest Officer transferred from India to Nigeria (Enabor, 1981, Adekunle, 2007 and Oyebo, 2006).

Management of tropical forests for economic production, biological and environmental conservation should not be handled with levity by any nation lucky to be endowed with these natural resources. Presently, the existing tropical rain forests are not properly managed in a real sense of the term in Nigeria. There is generally lack of emphasis on forest management, qualified personnel and inadequate funding. Continuous exploitation without adequate regeneration strategies has led to structurally and genetically degraded forest, which are extremely difficult and expensive to rehabilitate. While a lot of useful tropical hardwood species have gone into extinction, many are vulnerable, rare or endangered in Nigeria forest ecosystem. This is why forestry education should not be handled with levity as it is only education that could change the old belief that the forest is a free gift of nature that could be used freely without due regard to proper management.

In spite of the great potential of forestry and its significant contribution to national development, Gross Domestic Product (GDP) and government Internally Generated Revenue (IGR) potential, Nigerian undergraduate students have relegated forestry as a course and by extension as future career to the background. Youths in Nigeria today prefer to choose from occupations where in their own opinion; "quick money" could be made (lucrative) like medicine, banking, engineering etc. In the past, agriculture was the main source of income in Nigeria. Then, agriculture and agricultural related courses were enrolled for by many youth. Today, the presence of crude oil has brought about the shift from agricultural driven economy to oil driven-economy. The 'oil boom' situation in Nigeria also re-directed the interest of youths to courses in the field of petrol chemical, politics and buying and selling.

As a result, enrolment into forestry departments in Nigerian universities by candidates has decreased while there is tremendous increase for the so-called more lucrative courses. In view of this, the study examined the

causes of the dwindling level of enrolment into forestry departments in Nigerian universities., Its implications on forest resources management, and how forestry education could be improved using the Department of Forestry and Wood Technology, Federal University of Technology, Akure as a case study.

The Department of Forestry and Wood Technology is one of the departments that make up the School (Faculty) of Agriculture and Agricultural Technology of the Federal University of Technology, Akure, Nigeria. It was established in 1982 to give prominence to technological training and to provide the much-required impetus for rapid technological and industrial development in forestry and wood technology.

By virtue of its mission, the programmes of the department give due attention to areas that ensure efficient exploitation and utilization of the country's forest resources. It was also designed to give the required academic and practical background in areas of afforestation, inventory, biodiversity and environmental conservation, pulp and paper technology, wood residue utilization and development of agroforestry to meet the increasing demand for food and wood. Postgraduate programmes (Masters of Agricultural Technology in Forestry and Wood Technology and Doctor of Philosophy) were introduced in 1991 to train high-level manpower capable of conducting the much-needed research in forestry, agroforestry and wood science. The current student enrolment is 180 undergraduates, 46 MSc. students and 8 Ph.D. students.

20.2 METHODOLOGY

20.2.1 Study area

Federal University of Technology, Akure (FUTA) is located in Akure, Ondo State capital in south western Nigeria. FUTA is one of the seven Universities of Technology established by the Federal Government of Nigeria between 1981 and 1983 and it formerly came to existence in 1981. It was to use as its temporary campus, the site of the Federal Polytechnic at Akure while the Polytechnic was to relocate to Ado Ekiti then in the old Ondo State but now in Ekiti State. The university occupied a total land area of 640 ha divided into two sections popularly referred to as "Obakekere and Obanla". Academic activities began in the first half of the land (Obakekere) occupied by the Polytechnic while gradual development into academic core of the second half (Obanla) began in 1986.

20.2.2 Method of data collection

Data for this study were obtained using well-structured and pre-tested questionnaires. Secondary data were also collected from relevant university and school handbooks. The questionnaire was administered to 20 students in different levels of study. Since there are five different levels of study, twenty questionnaires were administered on each level and as a result, 100 questionnaires were involved. The questionnaires were in English language and were distributed to students and later retrieved. The information collected were student's demographic data, preferred choice of courses, reason for not pursuing his or her heart-desired course, awareness of forestry as a course before coming to the Department, benefits of forestry to national development and reasons for low enrolment in forestry as a course.

20.2.3 Method of data analysis

All the 100 questionnaires distributed were collected, collated and analyzed. Descriptive statistics, which involved the use of frequency, percentage and graphs, was used for data analysis. In addition, the one-way analysis of variance (ANOVA) was employed to test for the presence of significant difference in students' enrolment in the departments in School of Agriculture. Where significant difference was discovered, mean separation was done with Duncan Multiple Range Test (DMRT).

20.3 RESULTS AND DISCUSSION

Table 20.1 shows the demographic characteristics of the respondents, i.e. the 100 students sampled. The table revealed that majority of the students (74%) are in the age group of 21-25 years. This is followed by those in the age of 26-30 (22%). Only two percent is in the age group of between 15 and 20 and 31 and 35. One of the admission criteria in Nigeria is that a potential undergraduate student must attain the age of 16 years before he can be considered for admission into any Nigerian University. All these students are still in their youthful age. Those in the age group of between 31 and 35 are in their final class (500 level). A greater proportion (68%) of the respondents are male students while 32% are female. This is expected in a university of science and technology like FUTA. It is very common to find more females enrolling for arts and social sciences courses in Nigeria while only few of them are in the sciences.

Table 20.1: Age Group, Sex, Marital Status and Religion of the Respondents, Department of Forestry and Wood Science, FUTA, Nigeria

Indices	Frequency	%
Age groups years		
15-20	2	2
21-25	74	74
26-30	22	22
31-35	2	2
Sex		
Male	68	68
Female	32	32
Marital status		
Single	98	98
Married	2	2
Religion		
Christianity	95	95
Islamic religion	5	5
Traditional religion	0	0
Total	**100**	**100**

Ninety-eight percent of the respondents were single while only two percent had wedded. The married students were female and had attained the age of between 26 and 35 years. The religious background of the students tended toward Christianity as only 5% were Muslims and there was no traditional religion. Table 20.2 shows the position of the students in their respective families. It was noted that 43% of the respondents were in the second position while 25% and 21% were in the 1st and 3rd positions respectively. Also 7% and 4% of the respondents were in the 4th and 5th positions respectively. Adekunle and Bakare (2004) reported that Nigerians used to have large family sizes to serve as source of labour on their farms.

Table 20.2: Positions of the Respondents among Their Siblings in the Study Area, Department of Forestry and Wood Science, FUTA, Nigeria

Positions	Frequency	Percentage
1st	25	25
2nd	43	43
3rd	21	21
4th	7	7
5th	4	4
Total	100	100

Information on the type of secondary school attended by the students before joining the university was also obtained and is presented in Table 20.3. As shown in Table 20.3, the greatest percentage of parents could not afford sending their children to private schools due to poverty. Despite the daily increase in the number of privately owned secondary schools across the country, the highest percentage of the respondents (74%) attended public schools (school owned and financed by State governments). Only 12% of the respondents were able to attend private schools while 14% gained entrance into one of the 102 Federal Government Colleges.

Table 20.3: Type Of Secondary School Attended By The Respondents in the Department of Forestry and Wood Science, FUTA, Nigeria

Type	Frequency	%
Private	12	12
Public	74	74
State Unity	0	0
Fed Government	14	14
Total	100	100

The results of this study also revealed that parents in all occupations and professions know the value of university education. Forty-four percent of the respondents reported that their parents were civil servants (engaged by the government in public services). These categories of parents are learned and have adequate knowledge of choice of career for their children. This was followed by parents who are business men (32%). Students whose parent's major occupation was farming were only 6% while those in other occupation like clergy/pastoring was 11%.

Table 20.4: Major Occupation of Respondent's Parents, Department of Forestry and Wood Science, FUTA, Nigeria

Occupation	Frequency	%
Farming	6	6
Civil service	44	44
Business	32	32
Artisan	7	7
Others	11	11
Total	100	100

Table 20.5: Initial Heart- Desired Course of the Respondents in the Study Area, Department of Forestry and Wood Science, FUTA, Nigeria

Course	Frequency	%
Health sciences (Medicine, Pharmacy, Nursing etc)	42	42
Engineering	10	10
Sciences	6	6
Agriculture: Forestry	32	32
Other	10	10
Total	100	100

Today, potential undergraduates want to pursue a career that is popular in the society, lucrative and well remunerated. Courses in the health sciences, most especially medicine, is rated the most lucrative and respected in Nigeria. This is partially because of the special salary scale approved for medical doctors by the Nigerian Salaries and Wages Commission due to the fact that their services have to do with lives. As a result, an average Nigerian candidate wants to pursue medicine. This is why 42% of the respondents opted for medicine as their first choice of course.

The high percentage (32%) of those who made forestry as their choice of career is those who are limited by their secondary school and University Matriculation Examination results. Therefore 68% of students in the department today are there by chance and this has great impact on their academic performance and willingness to remain in the forestry profession and assist to manage forest resources adequately. The reasons why these students could not pursue their heart-desired career include their inability to obtain the required score in the University Matriculation Examination of their first choice (58%), financial constraints (8%) and external influence (parent- 12% and peer-2%).

The proportion of respondents without awareness of forestry as a profession before joining the department was 66% while only 34% reported to be aware of forestry as a course in the University. The various sources of awareness for the 34% only are FUTA Staff (13%), career talk (29%), FUTA prospectus (26%) friends (19%) and other sources e.g. the media. Highest percentage of the students reported that potential students are ignorant of forestry as a career and how lucrative it is when they were in the secondary school. This represents 40% of the total respondents. Others (32%) noted that the course is been jettisoned today because it may not be easy to be self employed after graduation as unemployment

rate in the country is increasing. Students want courses where self reliance is possible if white-collar job is not secured. Another reason for the poor enrolment include the fear of getting job after graduation (14%) as the number of employment opportunities for forestry graduates has decreased following the closing down of big forestry and wood based industries in the country. The rest 10% of the respondents reported that the programme curriculum needs updating to meet the present requirement in forestry sub sector.

An increase, over the years, in the number of students coming into forestry department was recorded but this number is still very low when compared with student's population in the other five departments in the school (faculty). When enrolment into forestry is compared with enrolment into other departments in the other Schools/Faculties in the University, it was observed that the number of students in forestry is the least. Table 20.6 shows students enrolment from 2000/2001 session to 2006/2007 session according to level of study in the Department while Table 20.7 shows enrolment in the school.

Table 20.6: Students Enrolment into the Department of Forestry and Wood Technology, FUTA from 2000/2001 to 2006/2007 Academic Sessions

Session	No of students according to level					
	100L	200L	300L	400L	500L	Total
2000/2001	15	15	14	9	18	71
2001/2002	32	14	13	10	10	79
*2002/2003						
2003/2004	37	38	14	17	10	140
2004/2005	34	37	38	14	17	140
2005/2006	29	34	38	33	34	160
2006/2007	31	38	39	37	35	180

* Cancelled academic session due to industrial actions

Table 20.7: Students Enrolment in different Departments in the School of Agriculture and Agricultural Technology, FUTA during 2006/2007 Academic Session

	No of students according to levels					
Department[#]	100L	200L	300L	400L	500L	Total*
AEE	68	65	61	56	48	298a
APH	40	43	42	33	45	203b
CSP	38	41	45	39	26	189b
FST	58	60	59	63	54	294a
FWL	40	50	37	42	28	190b
FWT	31	38	39	37	35	180b
TOTAL	275	297	283	270	236	1,361

[#]AEE- Department of Agricultural Economics and Extension, APH – Animal Production and Health, CSP – Crop, Soil and Pest, FST – Food Science Technology, FWL – Fisheries and Wildlife and FWT – Forestry and Wood Technology.
*Values with the same alphabet are not significantly different ($P \leq 0.05$)
*Values in the same column followed by the same letter are not significantly different at $P \leq 0.05$

Table 20.8: ANOVA Table for Enrolment in the Departments at FUTA, Nigeria

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Departments	2931.77	5	586.35	16.079	.000*
Error	875.20	24	36.47		
Total	3806.97	29			

* Significant $P \leq 0.05$

The total number of undergraduate students in the school for 2006/2007 academic session is 1,361 and only 13% are in the Forestry Department. There is significant difference ($P \leq 0.05$) in the number of enrolment in the different departments. The mean separation test with DMRT shows that there were significant differences with enrolment in AEE and FWT. Generally, enrolment into the School of Agriculture is very low when compared with other schools in the University because of the country shift from agriculture-based economy to crude oil based economy (Figure 20.1). This corroborates with the findings of Azeez and Olatunji (2005) that there is general poor enrolment into forestry departments in Nigerian Universities.

All the students reported that they were aware of the contribution of forestry to national development and rural livelihood; the need to manage

the forest sustainably and the role of education in achieving sustainability in forestry resources. The potential places where graduates of forestry could be gainfully employed were also listed by the respondents. Among those listed are Federal and State Government Forestry Departments, Universities (lecturers, taxonomists and Agroforestry experts), Forestry Research Institutes, wood based industries, panel products industries, pulp and paper mills, large scale plantation projects and sawmills. These job opportunities are well available to graduates of forestry but the present economic recession in the country has led to the total collapse of many of these industries.

20.4 CONCLUSION AND RECOMMENDATIONS

This work has considered the plight of forestry education in Nigeria and the constraints to enrolment into the Forestry Department by potential undergraduate students. It was found that youths generally are not willing to choose forestry as a future career due to ignorance or non lucrative nature of the profession according to them, fear of not getting job as majority of the establishments that could recruit graduates of forestry have closed down and the 'make money quick' syndrome which is the aftermath of the oil boom. It was also found that some were of the opinion that self-reliance may not be easy with forestry. Other reason is lack of awareness of the content of the course.

Generally, students in the department are there by chance, as a last resort when they could not secure admission to their heart desired course. However, the need to increase the number of graduates with forestry education cannot be over estimated. The forest ecosystem in its present state and the ever increasing pressure on it needs good managers. The role of agroforestry in soil fertility maintenance, biodiversity conservation, conflict resolution and food production can be enhanced by giving informal education to few still engaged in farming. Such informal education could only be given by those with formal education. It is therefore recommended that forest education should be accorded the right place in Nigeria. Career talk on the potential of forestry and agroforestry as a profession should be improved upon. This could arouse the interest of youths in the profession. Forestry profession is as lucrative as other courses with high enrolment today and forestry graduate could be self employed too. Involving well trained personnel in forest resources management will go a long way to reducing the high rate of deforestation and forest encroachment. The government should engage the services of the present graduates of forestry to manage the forest resources. Fund

should be made available to train and retrain professional foresters. More hand are needed in the profession to manage these vast renewable natural resources. The inclusion of forestry into the primary and secondary schools programme will make the profession more popular and desired.

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21 Incorporating Environmental Education into Grassroots Reforestation Efforts: The Gambia All Schools Tree Nursery Competition

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ABSTRACT

Under the guidance of the Department of Forestry, the Regional Education Directorate, and Peace Corps/The Gambia, the Gambia All Schools Tree Nursery Competition, an environmental education programme, was developed to introduce practical environmental education in The Gambia. Data for this report were collected using a rapid appraisal approach. Students learned the technical elements of nursery management (water supply, fencing, daily care, pest protection) while learning the value of trees in the environment and how humans contribute to deforestation. The most successful schools had strong stakeholder support from faculty and communities that reinforced technical and educational elements.

21.1 INTRODUCTION

Deforestation and desertification are two of the most glaring problems one witnesses when visiting The Gambia. But while the country has had a long-standing problem with deforestation, this problem has grown rapidly over only the past century. Today only about 41.6% (4710 sq.km.) of The

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Gambia is forested (World Bank, 2006). As recently as the mid-1940s data show that the country's forest cover was as high as 81% (EC-FAO Partnership Programme, 1999).

For outsiders, it can be difficult to see the country in such environmental despair with the people, seemingly, not working to reverse the problems. Farmers recognize the impact environmental degradation has on their households. However, with a poor rural life, farmers often have little time to focus on broader and less immediate environmental problems.

The Gambia All Schools Tree Nursery Competition (Paulete, 2006) is a grassroots environmental education programme developed with the Gambian Department of Forestry (DOF) and Regional Education Directorate (RED) to have students learn the value of trees in the environment and how humans contribute to deforestation. They also learn the relative ease with which trees can be raised to replenish and supplement the nation's forests and woodlots as well as how to introduce trees into agricultural practices. By evaluating this competition, the elements necessary for successful implementation of both technical and learning components can be determined. From this evaluation, conclusions as to effective uses of time in the coordination of the project can be determined.

21.2 METHODS

The Gambia is located in West Africa, surrounded by Senegal on all but its western Atlantic border. The country has an area of 11,300 sq km, with the Gambia River and its small tributaries covering 11 % (1,300 sq km) of the total area (CIA, 2006). The country is broken into six political divisions. The Upper River Division (URD) and Central River Division (CRD) were chosen for the study because of the support provided by the division administrations and location of Peace Corps project coordinators. These districts also have the most severe degradation of woodland areas and, therefore, were logical places to establish an environmental education programme focusing on tree planting (EC-FAO Partnership Programme, 1999).

As in many environmental education programmes, schools were selected as the target group for the competition. Children are an obvious group to carry education into the communities. Schools provided a pre-existing structure, allowing an easier means to facilitate communication. The Gambia has four levels of public schools: Lower Basic schools (LBS),

Upper Basic schools (UBS), Basic Cycle schools (BCS), and Senior Secondary schools (SSS). Schools are governed through the six political divisions by RED.

The project was designed to work with the teachers, children, and communities by introducing effective and current nursery management techniques while communicating regional environmental awareness. Schools were responsible for the development of their own nursery throughout the year. Each school was given a competition manual which explained all steps necessary to build and maintain a healthy tree nursery, from seed collection to out-planting, and provided environmental education activities for school clubs and classes. Since sustainability of the project was an important factor, no other supplies were given to the schools. After receiving the manual, it was largely up to the schools to initiate the project. The manual developed included resources to help schools identify useful species and appropriate seed collection, nursery management, and species use techniques. Each school selected which and how many species it would include in its nursery. Awards were given to the top three schools in each district.

A workshop was organised for the teachers in the CRD. Four, one-day workshops were held covering the technical aspects needed to build and operate a tree nursery. Teachers also discussed means to incorporate environmental education into curricula and Environmental Education (EE) club activities. The request for the workshop in the CRD came from the RED officers overseeing the competition. Based upon limited interest on the part of the RED a workshop was not held in the URD.

The data cover four groups of information: physical aspects of nursery maintenance (shade, fencing, proximity to water source, use of natural pesticides, use of fertilizer, number of species), school demographics (grade levels, location, size), types of outside help (workshop, Peace Corp Volunteer (PCV) or forester assistance), and outcomes (health, survival). Quantification methods are shown in Table 21.1. Data, with the exception of workshop provision and attendance, were collected through interviews and field observation using rapid appraisal over the course of ten days at the end of the school term in June 2005 (Kumar, 1987). Data on workshop provision and attendance were collected at the time the workshops were conducted.

Table 21.1: Method of Measurement for Variables Used in the Environmental Education Study, the Gambia.

Variable	Method of Measurement
Health	Quality of trees surviving, 0 = all trees in critical condition and dying, 1 = most trees in critical condition and dying, 2 = most trees alive, 3 = all trees alive but some stressed, 4 = all trees alive and thriving
Survival	Number of trees surviving
Lower Basic school	Dummy variable, 1 = in category, 0 = not in category
Upper Basic school	Dummy variable, 1 = in category, 0 = not in category
Central River Division (North)	Dummy variable, 1 = in category, 0 = not in category
Central River Division (South)	Dummy variable, 1 = in category, 0 = not in category
Upper River Division (North)	Dummy variable, 1 = in category, 0 = not in category
Upper River Division (South)	Dummy variable, 1 = in category, 0 = not in category
Number of students	Number of students enrolled in school.
Forester assistance	1 = school used external professional assistance, 0 = school did not use external assistance
Workshop provided	1 = school was offered help through a workshop, 0 = school was not offered help through a workshop
Workshop attended	1 = at least one person from the school attended the workshop, 0 = nobody from the school attended the workshop
Number of species	Number of tree species used in the school's nursery
shade	0 = not provided, 1 = provided, but not maintained, 2 = provided, adequate, and maintained
Fencing	0 = not provided, 1 = provided, but not maintained, 2 = provided, maintained some holes in fencing, 3 = provided, adequate, and maintained
Proximity to water source	0 = greater than 100 m, 1 = 50 to 100 m, 2 = less than 50 m
Use of natural pesticides	0 = not used, 1 = used
Use of Fertilizer	0 = not used, 1 = used

Some prior knowledge of Peace Corps Volunteer or Gambian forester assistance was known; however, the numbers shown in the data were collected during the evaluation trek. In addition to data collected, a sum of the physical aspects, excluding number of species, was calculated to represent general nursery maintenance. Univariate statistics are shown in Table 21.2.

Table 21.2: Mean, Standard Deviation, Minimum and Maximum Values (N=75), Environmental Education Study, the Gambia.

Variable	Mean	Standard deviation	Minimum	Maximum
Survival	217	846.94	3	7371
Lower basic school*	0.89	0.31	0	1
Basic cycle school*	0.09	0.29	0	1
Upper basic school*	0.01	0.12	0	1
Central river division (North)*	0.28	0.45	0	1
Central river division (South)*	0.41	0.5	0	1
Upper river division (North)*	0.07	0.25	0	1
Upper river division (South)*	0.23	0.42	0	1
Number of students	320.84	269.66	72	1540
Forester assistance*	0.31	0.46	0	1
Workshop provided*	0.71	0.46	0	1
Workshop attended*	0.59	0.5	0	1
Number of species	6.65	8.28	1	60
Shade	1.45	0.76	0	2
Fencing	2.32	0.68	0	3
Proximity to water source	1.24	0.71	0	2
Use of natural pesticides	0.43	0.5	0	1
Use of fertilizer	0.76	0.43	0	1

*indicates a dummy variable where 1 indicates the school is in the category and 0 indicates it is not.

It should be noted that, due to time constraints, data were only collected from schools where, upon arrival, there was at least one tree alive. Some schools had begun participating in the competition but had not carried out the competition to completion. In addition, all data were collected by the same person to eliminate inconsistencies in the evaluation of the measurements, which required subjective interpretation.

Pearson correlation coefficients were calculated to determine the strength of relationship of the variables in relation to the outcomes and other independent variables. The test variables for the project were the health and the survival of the trees.

An Analysis of Variance (ANOVA) test was run for all six parts of the physical aspects, their sums, survival, and health of the trees to see if the schools that had the workshop provided had performed better than those that had no workshop provided. District was used as the categorical variable (Steel and Torrie, 1960).

21.3 RESULTS AND DISCUSSION

21.3.1 Tree performance in the nursery

Independent variables which show a significant correlation to health and survival (the two test variables) are shown in Table 21.3. Table 21.3 also shows the correlation between the two test variables. Correlations were considered significant when $p \leq 0.1000$. P values are reported to allow analysis at other levels of significance. Not surprisingly, the strongest correlations for the two test variables come from the physical aspects and their sum. The Gambia has a harsh, sub-Sahelian climate, leaving vegetation prone to desiccation and predation from insects and animals alike. Schools that made an effort to protect their nurseries from these elements faired best in the competition. Commitment to protection from the elements shows a better understanding of environmental hazards.

Table 21.3: Correlation between Health and Survival (Test Variables) and Significant Independent Variables, Environmental Education Study, the Gambia.

Attribute	Correlation (r) and significance (p)	Sum	Survival or health	No. of species	PCV or forester assistance	Fencing	Proximity to water source	Pesticides
Health	r	0.4181	0.2684	0.4342	0.0122	0.3640	0.2365	0.3878
	P	0.0002	0.0199	<0.0001	0.9170	0.0013	0.0411	0.0006
Survival	r	0.2527	0.2684	0.8226	0.2128	0.1735	0.1553	0.2007
	p	0.0287	0.0199	<0.0001	0.0667	0.1365	0.1833	0.0842

The number of species present in the nursery is correlated with the largest number of other variables and is strongly correlated with the two test variables, health ($r = 0.8226$, $p = <0.0001$) and survival ($r = 0.2684$, $p = <0.0001$). A larger number of species is an early indicator of nursery success, as seed collection has to be done early in the process of constructing a nursery. The top three schools in each region all had numbers of species above the mean ($\bar{x} = 6.65$). In evaluation interviews, it was learned that these schools had started their involvement in the competition by educating students on the importance of species diversity in the nursery and their environment.

The correlation between the number of species and fencing ($r = 0.2882$, $p = 0.0121$) and proximity to water source ($r = 0.2726$, $p = 0.0180$) further substantiates this idea. Early and proper planning of these factors shows that the schools were thinking more seriously about the competition and had learned the importance of these elements in maintaining the nursery.

Number of species is also correlated with PCV or forester assistance in the project ($r = 0.2845$, $p = 0.0133$). Seeking outside help from extension agents further shows schools' seriousness in the inclusion of education and proper practices in the competition.

The correlation between the number of species and the use of natural pesticides ($r = 0.2984$, $p = 0.0093$) and the sum of the physical aspects of the nursery ($r = 0.3952$, $p = 0.0004$) shows that schools that had made a substantial initial effort, were motivated to adequately maintain the nursery through to completion, further supporting the importance of education in promoting a commitment to the project.

Beyond these technical aspects, three areas were found in common with the top competing schools that allowed them to perform at higher levels and increase the effectiveness of the environmental education given to the students: PCV or forester assistance, community support, and ownership of the competition on a school level and regional level. Schools which incorporated these social aspects were more likely to be successful and have students with a greater understanding of the environment.

21.3.2 Peace Corp Volunteer or Forester assistance

Survival of the trees is correlated with outside assistance from PCVs or foresters ($r = 0.2128$, $p = 0.0667$). This correlation suggests repeated, small-scale assistance to be more beneficial than a one-time, large-scale effort. The schools that had received PCV or forester assistance also had a clearer understanding of the competition and its importance in the education of students about deforestation. Visits to the schools and interviews with the teachers indicated they saw a greater purpose in the development of a nursery than merely entering and winning a competition.

Additionally, many PCVs who lived in villages with schools visited these schools weekly to assist EE clubs and to oversee the schools' progress. Having a volunteer working in a community or school generates a sense

of pride and ownership. A failed tree nursery would have been a failure for them and their PCV.

21.3.3 Community support

Song Kunda Lower Basic School received second place for the URD. One of the more remote schools to compete, it grew 526 trees of 22 species. Trees were planted in a variety of containers including black polypot bags, recycled sugar bags, and large 'mintie' bags that had originally contained individually wrapped candy. The students had constructed a thick grass shade structure to protect the trees from the sun during the heat of the day. The school was applying manure tea to the trees and had prepared an *Azadirachta indica* mixture when insects had attacked the *Senna siamea* and *Cajanus cajan* trees.

The school received support from their local PCV on a regular basis and also coordinated a programme with the local foresters to discuss the environment of The Gambia. The PCV conducted EE club meetings, incorporating the progress of the nursery into the curriculum. The students drew a mural on the back wall of the sixth grade classroom repeating the DOF campaign of 'No Trees, No Life'. In addition, the volunteer also adapted the words to the United States Department of Agriculture (USDA) Forest Service Woodsy Owl song "Help Woodsy Spread the Word" to refer to deforestation problems in The Gambia and taught it to the grade six students.

While the sixth grade students had been charged with most of the maintenance, teachers knew the importance of all students being involved in the nursery and made efforts to include all the grades. School-wide assignments were given to collect polypot containers and a competition for seed collection was spearheaded by the local PCV.

Shortly after the competition started, the school's garden fence was damaged and would not have protected the trees from foraging animals. After discussions with the community of the importance of this competition to the students and the education they were receiving, the community loaned the school chain link fencing to use to protect the trees throughout the school year.

The school would have had a much more difficult time protecting the nursery had the community not loaned the school the chain link fencing. The positive response by the community motivated the school to succeed,

as the project was more than just theirs now for the community had invested in it. The school responded to this support by giving trees to the community to out plant after the competition.

Not all schools were that fortunate. Fass LBS in the CRD reflected the results of community disinterest. The village of Fass is a rural conservative community that valued Islamic education more than western education. Upon arriving for the evaluation trek at Fass, the school had only 47 trees of four species which were still surviving. The teacher showing the nursery was sad as to the state of what he said had been a much bigger nursery in the beginning. When asked what had happened, he reflected that the school's water pump had broken down and that the nearest one was in the village. The community had told the school to stop using its pump to collect water, not only for the nursery and garden, but also for the basic needs of the children. Whenever possible, water was brought from a village more than a kilometre away in large quantities. Teachers and cooks at the school would bring small amounts of their personal water supplies to supplement the school's water supply. With water allocated to cooking and cleaning, it was difficult to spare much for the nursery.

21.3.4 Ownership

The second place school in the CRD was Dalaba LBS. This school grew a total of 421 trees with twelve species. The teachers at Dalaba added their own element of competition to the school's participation. Under the guidance of each respective teacher, each grade within the school constructed individual nurseries and competed with each other. Teachers allowed students to make their own decisions as to the construction and elements of their nursery and only provided 'how to' guidance. Students were able to learn from each other's successes and failures and learned what elements were critical for a nursery. Students were given notebooks and pencils as prizes, paid for by the teachers although the teachers in The Gambia are not well or regularly paid. This monetary commitment by the teachers to the competition shows the importance which the teachers at this school placed on the inclusion of environmental education in the project.

Saruja LBS, the CRD first place school, had substantial community and school level ownership. This school outdid every other school in the competition, growing 7,371 trees of 60 species. Every teacher in the school was involved in the creation of the tree nursery. They also

motivated the students to work, instead of merely ordering them. Students took interest in the project and learned how to identify trees and their uses in their environment in addition to how to collect and grow them.

The school kept a nursery journal in which the maintenance and watering schedules were listed for all teachers to know. Problems with the fence or pests were logged and dated with means used to correct the problem and success of method. Dates of seed collection and planting by species were also listed in the journal.

Students kept a running board of trees in the nursery listed by name along with uses and number in the nursery posted in the garden. The numbers were updated weekly to account for new germination or seedling deaths. With five trees, students had found the seeds but did not know the names to put on the board. They reserved a few seeds and leaves in a bag and attached it to the board in hopes that the evaluating team would be able to help them identify the species. The community supported the school project by showing interest in buying the trees they were growing and by working with the school to make sure a guard was provided and that children were attending the nursery after school hours for watering and maintenance.

The importance of school-level ownership is evident when comparing two schools which both had assistance from a PCV. Diabugu BCS and Naude LBS were the top two schools in the competition during the 2003 – 2004 school year, the first year of the competition. Why would one school participate the second year of the competition and the other would not? The differences lie in the schools and communities themselves.

Diabugu was a politically created school. Having a school of its size and level gives the community a certain level of status above the surrounding villages and with the regional offices. However, for the status the school gives the community, this community gives the school very little support. The community does not value western education and has a history of limited support for the school. Only a few parents motivate their children to invest a reasonable effort into their studies. A large portion of the students in the upper grades is from neighbouring villages.

Naude LBS is a small school located in a small, poor Fula community. The community takes pride in the school and makes sure the children attend. This village has a respect for western education, with an unusually large proportion of families sending their children off to other schools to

receive education beyond grade six. The staff at each school were also different. At Diabugu, there were three teachers who were interested in the project. At Naude, it was primarily the headmaster who took interest in the project.

During the PCV's time working with these schools, she noted that having multiple faculty interested in the project, as in Diabugu's case, made a great difference, as they were collectively able to get more students motivated in the project. Students at Naude had seemed to simply follow the headmaster's instructions without a real motivation in place.

Diabugu received first place the first year, creating an impressive nursery of 738 trees with more than 20 species. Their success and motivation in the competition the first year made their lack of participation the second year a surprise. The school was mistakenly listed as a competing school the second year and was therefore visited during the evaluation trek. Upon arrival, the teacher who had been the most motivated the previous year confessed that they had not been able to begin the project this year; they had not been allocated time in the schedule to do it. The headmaster of the school did not see it as a valuable use of time now that the PCV was not there to promote the competition's benefits and boost the reputation of the school with her repeated visits.

Naude had received second place in the competition's inaugural year. The second year, the school nursery was almost an exact duplicate of the nursery it had created the year before, utilizing the same location, polypot alternatives, and species as the year before. The scale and effort were impressive, seeing as there had been no technical assistance to the school other than the manual this year. When asked if they had had outside assistance, the teachers smiled and said they had not; the year before they had the support of the PCV, but, they had learned from her, and this year they had done it themselves. Naude received first place the second year.

Diabugu had been motivated to compete in the project, but, at least at the headmaster's level, for the wrong reasons. Being a politically defined school, the motivated teachers could not pursue the competition the following year without the headmaster's approval. With the PCV no longer visiting the school, the headmaster was no longer motivated to allow the teachers to invest time in the project.

Multifaceted stakeholder involvement builds more appropriate technologies within regions and communities. Additionally, schools and

communities understand the need for environmental projects when presented in relevant local terms. Interest and ownership develop, allowing the project to continue and adapt as technologies bring about changes, increasing the educational benefits to the communities (Bunch and López, 1995; McConville, 2006).

21.4 CONCLUSIONS

Results of this grassroots environmental education project involve both technical aspects with quantifiable results and analysis of more conceptual qualitative information indicating sustainable success. The more technical elements of the competition are significant for the health and survival of the trees in the nursery and are indicators of efforts towards environmental education included in the competition. Quite obviously, if these elements fail, the trees will fail to grow; a nursery cannot succeed if these elements are absent.

However, the extent to which they work or the presence of motivation to undertake the technical aspects rely heavily on stakeholder support on both the large, project level and on the smaller, individual school level. Both levels can be seen in this project. There was greater participation on the large, project level in the CRD, where stakeholders took a more active role. Schools such as Song Kunda LBS and Dalaba LBS had strong support of the communities and teachers, producing bigger and better nurseries at these schools.

Success of the competition as a project was completely dependent on involved and motivated Gambian stakeholders. The involvement from planning to completion was vital for communication and in conveying purpose to the schools. Participation was greatly improved when the stakeholders took an active role in the progress of the competition. Additionally, support from the community and the cooperation of all the teachers within the school were important characteristics of the top schools in the competition. Ideally, twenty years from now, the competition will have moved on to new levels, having left behind orchards in which students learned grafting and woodlots in which they learned multi-resource forest management. Furthermore, the students of today will have begun incorporating the new concepts and technologies that they learned through the competition into their daily lives.

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PART III

GLOBAL FACTORS INFLUENCING THE FORESTRY PROFESSION AND TREE / FOREST MANAGEMENT PRACTICES

22 A Look over the Horizon at Climate Change Issues Relative to Forestry: Opportunities for Relevant Forestry Research toward 2030

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ABSTRACT

Climate change is posing considerable threats to the development aspirations of African countries. The forestry sector on the continent has not been particularly active in the climate change discussions, yet the concerns for forestry are significant. Following an overview of climate change in Africa and the significance of this for the forestry profession, I outline a research agenda for Africa to support better responses to climate change in the forestry sector. Subjects outlined include the role of African forests in the global C cycle and the potential for improved forest management and agroforestry to increase the resilience of rural Africans. A short discussion on the likely costs of adaptation and mitigation, and the possible role of carbon markets in improving rural livelihoods is presented. The paper concludes by underlining the need for new knowledge and the need to integrate climate related information into the training of the next generation of African forestry professionals.

22.1 INTRODUCTION

Over the past two decades, climate change has become an overriding environmental issue. The expectation that climate change will continue to accelerate has led to widespread concern beyond environmental circles and it is now seen as an issue of development and security. It is not hard

to understand that climate has widespread influence on humans. Climate affects the distribution of vector-borne diseases, affects agricultural productivity, influences plant growth, controls the sea level, affects water availability, and so on. It is inevitable that changes to the Earth's climate system will influence resource availability and human well being.

Solving the problem of climate change and reducing its inevitable negative effects requires global cooperation. Unfortunately, there is little to raise hope in the international policy arena. The Kyoto Protocol has been ratified, but most of the signatories that have committed to reducing emissions of greenhouse gases (GHG) will not achieve their targets during the first commitment period. The USA, the largest polluter, has opted out of the Kyoto Protocol and is pursuing a voluntary approach to reducing emissions. On the positive side, Australia has just signed the Kyoto Protocol. At the most recent Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC) and the Meeting of the Parties to the Kyoto Protocol (COP/MOP) in Bali, the US is beginning to show signs of softening its opposition to continued talks. Parties to the Convention were able to agree on the framework for discussion on the measures that the community of nations could take as a next step beyond the current agreements.

It is within this political context that the forestry profession needs to elaborate plans to tackle the challenges that climate change will pose in the coming decades. We need to recognize that we are not talking about climate changing from one known and steady state to another steady state. Global conventions are not sufficiently effective to halt the increase of atmospheric greenhouse gas (GHG) concentrations, and we must accept that the primary drivers of climate change are not going to be brought under control. Mitigation efforts will therefore only provide a partial softening of the effects of climate change.

Yet, even as climate changes, food and fibre production must increase, environmental services must be maintained or enhanced, and rural livelihoods in developing countries must improve, and not just be maintained. Developing countries in particular, are faced with urgent need for development, to improve food security, reduce poverty and provide an adequate standard of living for growing populations. Thus, the increased stresses associated with climate change need to be understood, not as an issue separate from others (Verchot *et al*., 2007); rather, we need to understand how climate change interacts with other factors that also pose challenges such as population growth, globalization and the associated

changes to international markets, changes to input markets, land-use change, etc. At the same time, there is a need for greater engagement of the forestry profession in the political arena of climate change, both on the continent and in global policy fora.

This paper, presents a brief summary of some of the elements of what is known about the effects of climate change on Africa. It outlines issues confronting the forestry sector with the objective of highlighting key areas for research and training to prepare the next generation of professionals in the forestry field.

22.2 CLIMATE CHANGE IN AFRICA

Tol *et al*. (2003) summarized a number of studies that have estimated the total cost impact of climate change in different regions of the world. Table 22.1 shows aggregate impact for a doubling of atmospheric carbon dioxide on the current economy and population. The numerical results are based on a number of assumptions and simplifications, which are not consistent across the two studies presented in the table. Thus, the numbers are indicative of relative impact and should not be interpreted as actual estimates of the magnitude of impact. Rather, they provide insights on direction, orders of magnitude, and patterns of vulnerability. In both estimates, Africa suffers the greatest impact to its economy than any other region. One of the reasons for the high level of impact on African economies is the high dependence of these economies on agriculture and natural resources. Thus, climate has a direct impact on the economy at both the national and household scale.

The Fourth Assessment Report of the IPCC (Boko *et al*., 2007) summarized the current climate trends for the continent. In general, the continent is warmer than it was in the past and decadal warming rates since 1960 in different regions range from 0.1 to 0.3^0 C. The story for rainfall is not as simple because of spatial and temporal variability across the continent. Inter-annual variability is high across the continent and some areas have very high inter-decadal variability. In West Africa, the decrease in average rainfall has been severe (20 to 40%) across the region, but some areas, notably the Guinea coast has seen a 30% increase in rainfall over the past 30 years. Rainfall in the equatorial rainforest belt has decreased only slightly (1 to 4%). In southern Africa, no long-term trend has been noted, but since 1970 there has been an increase in rainfall anomalies, with more intense and widespread droughts. In some parts of the region, more frequent intense rainfall events have also been noted.

Eastern Africa has seen increasing rainfall amounts over the northern parts of the region and decreasing amounts over the southern portion.

Table 22.1: Climate change impacts on a society with today's economic structure, population, laws etc. Estimates are expressed as per cent of Gross Domestic Product. Positive numbers denote benefits, negative numbers denote costs (Tol *et al*., 2003).

Region	2nd Assessment Report	Tol *et al*., 2002
North America	-1.5	3.4
OECD Europe	-1.3	3.7
OECD Pacific	-1.4 to -2.8	1.0
E. Europe and former USSR	0.3	2.0
Middle East	-4.1	1.1
Latin America	-4.3	-0.1
South and Southeast Asia	-8.6	-1.7
Africa	-8.7	-4.1

Vegetation and land cover play an important role in regulating the physical climate. An increase in vegetation density can produce a year-round cooling of about 0.8^0 C (Bounoua *et al*., 2000). Complex feedbacks associated with forests and land cover also play a role in inter-annual climate variability and have been cited as one of the reasons behind the persistent drought in the Sahel (Nicholson, 2001; Semazzi and Song, 2001; Wang and Eltahir, 2000, 2002; Prospero and Lamb, 2003; Zeng, 2003). Understanding the relationship between land cover, climate and the complex feedback between the two is an important area for scientific inquiry.

22.3 TOWARDS A CLIMATE RELATED RESEARCH AGENDA IN AFRICAN FORESTRY

African forests in the global C cycle

It is important for a number of reasons for African forestry science to provide better quantification of the forest area and rate of change of forest area on the continent. The Intergovernmental Panel on Climate Change (IPCC) has just published its fourth assessment of the state of knowledge concerning climate change. The Forestry chapter of Working Group III (Nabuurs and Masera, 2007) indicates that deforestation in the tropics remains one of the main factors responsible for carbon emissions, while forest re-growth in temperate and boreal zones continues to contribute significantly to carbon dioxide removals from the atmosphere. It has been very difficult to quantify emissions from the forestry sector globally as

there is disagreement among the different estimates for the carbon flux. Methods for estimating deforestation losses still have considerable uncertainty and most budgets consider that there is an unknown net terrestrial carbon sink. These budgets generally assign the sink to re-growing forests in the temperate and boreal regions (Houghton, 2003), but there has been some dissention over the years and suggestions that there is also a significant sink in tropical forests (Malhi and Grace, 2000).

Estimates from Houghton (2003) suggest that deforestation in sub-Saharan Africa accounts for 15 percent of the total global deforestation flux of carbon dioxide to the atmosphere (Table 22.2). Notably, the forestry sector in North Africa is a sink for atmospheric carbon. Improving our understanding of deforestation rates and rates of land use change in Africa is important not only for the practical information that this provides to natural resource managers, but also from a global perspective in improving our knowledge of the global carbon cycle and understanding Africa's role in these global changes.

Table 22.2: Annual carbon flux (± standard error) from changes in land use and land management, based on land inventories (Houghton, 2003). Positive values represent the sink of carbon, negative values represent source. (Source: Trines, 2007).

Region		C flux	
Sink regions			
	N. America	293 ±	733
	OECD Pacific	0 ±	733
	Europe	0 ±	733
	Countries in Transition		
	N Africa	623 ±	3,593
	Global total sinks		
Source regions			
	SSA	-1,238 ±	733
	Caribbean, Central and South America	-2,750 ±	1,100
	South and Southeast Asia, Middle East	-3,997 ±	1,833
	Global total sources	-7,999 ±	2,933

Land-use, land use change and forestry (LULUCF) related emissions are highest in Asia, followed by South America and Sub-Saharan Africa. However, South America and Africa have the greatest loss of forest area in the period of 2000-2005 (Table 22.3). For Asia, where logging does not always result in deforestation, a growth in forest area is reported in the same period. The growth of plantation area in the region also contributes to increased forested area. On the basis of annual percent area loss of forest Central America and the Caribbean are losing forest at the highest rates, followed by Africa and South America (Trines 2007).

It is interesting to note that according to the Climate Analysis Indicators Tool (CAIT) of the World Resources Institute (www.wri.org), the least developed countries (LDCs) are responsible of over 20% of the deforestation emissions (1544 $MtCO_2$ in 2000). This offers an interesting opportunity for a future climate regime that could include a reward system for the reduction of emissions from deforestation in developing countries (REDD). African countries in general and LDCs in particular could benefit from financial support to reduce deforestation emissions as a means to moving toward more sustainable management of its forest resources. In order to do this, however, we need better estimates of baseline deforestation rates by country and by region.

Table 22.3: Regional summary of the carbon flux and deforestation rates based on the dataset from Climate Analysis Indicators Tool (CAIT) of the World Resources Institute and corresponding information from the FRA 2005 (Trines 2007).

Country	$MtCO_2$ in 2000	% of global LUCF emissions in 2000	Forest Area in 2000 (x1000 ha)	Annual change rate '00-'05 (x1000 ha)	Annual change rate '00-'05 (%)
Source	CAIT	CAIT	FAO	FAO	FAO
Asia	3,957	51.9%	566,562	1,003	0.18
South America	2,054	27.0%	852,796	-4,251	-0.50
Caribbean			5,706	54	0.9
Central America			23,837	-285	-1.2
Oceania	154	2.0%	208,034	-356	-0.17
Sub-Saharan Africa	1,399	18.4%			
Middle East & N. Africa	52	0.7%			
Africa			655,613	-4,040	-0.62
Europe	33	0.4%	998,091	661	0.07
North America	-338	-4.4%	677,971	-101	-
World	7,619	100.0%	3,988,610	-7,317	-0.18

22.3.1 African vulnerability to climate change

The fourth assessment report summarized the issues of African vulnerability to climate change and the confidence of our knowledge regarding the sources of variability (Boko *et al*., 2007):

- Africa is one of the most vulnerable continents to climate change and climate variability, a situation aggravated by the interaction of 'multiple stresses', occurring at various levels (very high confidence);
- African farmers have developed several adaptation options to cope with current climate variability, but such adaptations may not be sufficient for future changes of climate (very high confidence);
- Agricultural production and food security (including access to food) in many African countries and regions will likely be severely compromised by climate change and climate variability (very high confidence);
- Climate change will aggravate the water stress currently faced by some countries while some countries that are not at risk will become at risk of water stress (very high confidence);
- Changes in a variety of ecosystems are already being detected, particularly in southern African ecosystems, at a faster rate than anticipated (very high confidence);
- Climate variability and change could result in low-lying lands being inundated, resulting in impacts on coastal settlements (high confidence); and
- Human health, already compromised by a range of factors, could also be further negatively impacted by climate change and climate variability (*e.g.* malaria in southern Africa and the East African highlands) (high confidence).

There is little in the Assessment Report on Africa that specifically deals with the forestry sector. Much attention is given to agriculture and health. However, the analysis of the vulnerability of ecosystems lays out a number of challenges that are pertinent to African forestry and the knowledge gaps that impede appropriate responses. One of the key knowledge gaps is the likely regional-scale impacts of climate change on water availability. Because African populations are highly dependent on agriculture and natural resources it is important to anticipate changes in watersheds and river basins, and to understand the significance of complex interactions on water governance in these areas. Water quality and its relation to water usage patterns and rainfall variability are also important issues that need to be understood. In particular, research on the impacts of climate variability and change on groundwater is needed.

22.3.2 Agroforestry: a nexus for mitigation and adaptation

Climate Change Mitigation

Agroforestry (AF) provides a particular example of a set of innovative practices that are designed to enhance productivity in a way that often contributes to climate change mitigation through enhanced carbon sequestration, and that can also strengthen the system's ability to cope with adverse impacts of changing climate conditions. Of all the land uses analyzed in the LULUCF report of the IPCC (IPCC 2000), AF offered the highest potential for carbon sequestration in non-Annex I countries (Figure 22.1). Agroforestry has such a high potential, not because it is the land use practice with the highest carbon density, but because there is such a large area that is susceptible for the land use change (630×10^6 ha). Additionally, AF meets the conditions for an eligible afforestation/ reforestation (A/R) activity in the Clean Development Mechanism (CDM). Work through the Alternatives to Slash and Burn Program (ASB) has documented (Palm et al. 2005) the carbon sequestration potential of AF systems on the margins of humid tropical forests (Figure 22.2).

The carbon sequestration values for these AF systems are reported as time-averaged carbon, reflecting the fact that they are rotational systems with repeated harvest and re-growth. Agroforestry systems in these agroecological zones generally tend to be tree-based production systems such as the jungle rubber system of Sumatra, mixed cocoa and fruit tree plantations of Cameroon, peach palm systems of Peru, or pine – banana – coffee system of eastern Java. Conversion of primary tropical rainforests to agriculture or grassland results in the release of about 200 to 350 Mg C ha^{-1}. Managed or logged forests have about half the C stocks of primary forests. Agroforestry systems contain 30 to 75 Mg C ha^{-1} compared to row crops that contain < 10 Mg C ha^{-1}. Thus, converting row crops or pastures to AF systems can greatly enhance the C stored in aboveground biomass.

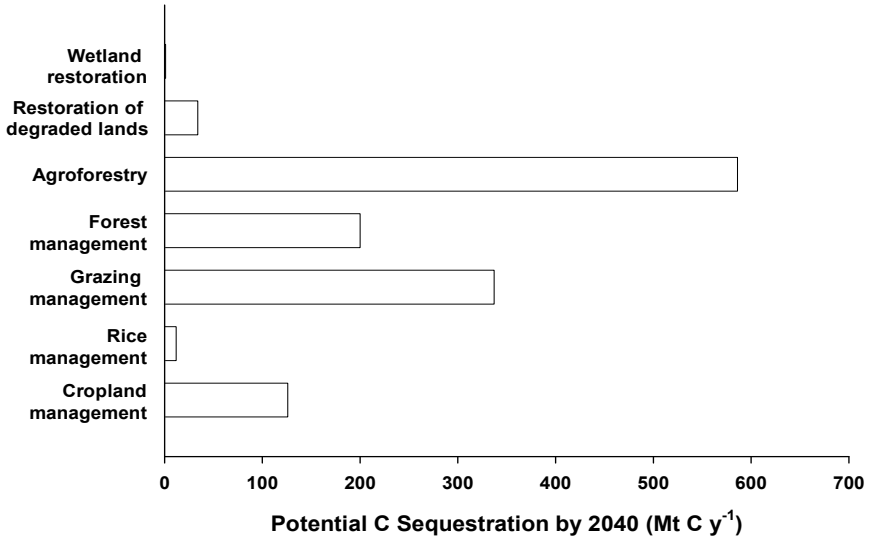

Figure 22.1: Carbon Sequestration Potential of Different Land Use and Management Options (IPCC 2000)

A more systematic analysis of the carbon stocks in African AF systems would be useful for providing information to project managers and investors about the carbon sequestration potential of projects. This would allow project developers to evaluate the possibility of using carbon finance as one of the income streams of a project.

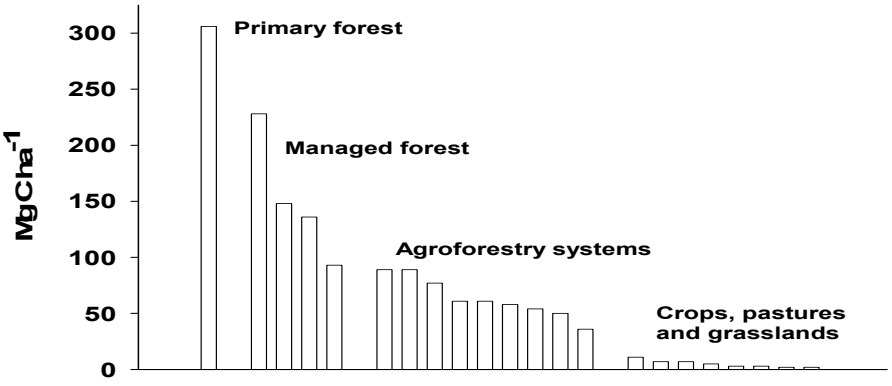

Figure 22.2: Summary of C Stocks in Different Ecosystems of The Humid Tropics. Data Are From the Benchmark Sites of the Alternatives to Slash and Burn Programme of the Consultative Group for International Agricultural Research (CGIAR).

Also under the ASB program, Gockowski *et al*. (2001) conducted a trade-off analysis between carbon storage and profitability of different forestry and AF systems in Cameroon and concluded that tropical deforestation is profitable and can sometimes lead to poverty reduction (Figure 22.3). Typically, there are tradeoffs between carbon stored and profit, and while there are no win-win (high carbon and high profit) land uses, there are certainly some no regret options with medium to high profit and medium carbon stocks. Policy makers and project developers could promote these options as part of a climate change mitigation scheme and contribute to poverty reduction at the same time. This information would be useful to guide investments. Increasing these types of analyses is also important to evaluate the potential for carbon markets to contribute to rural development.

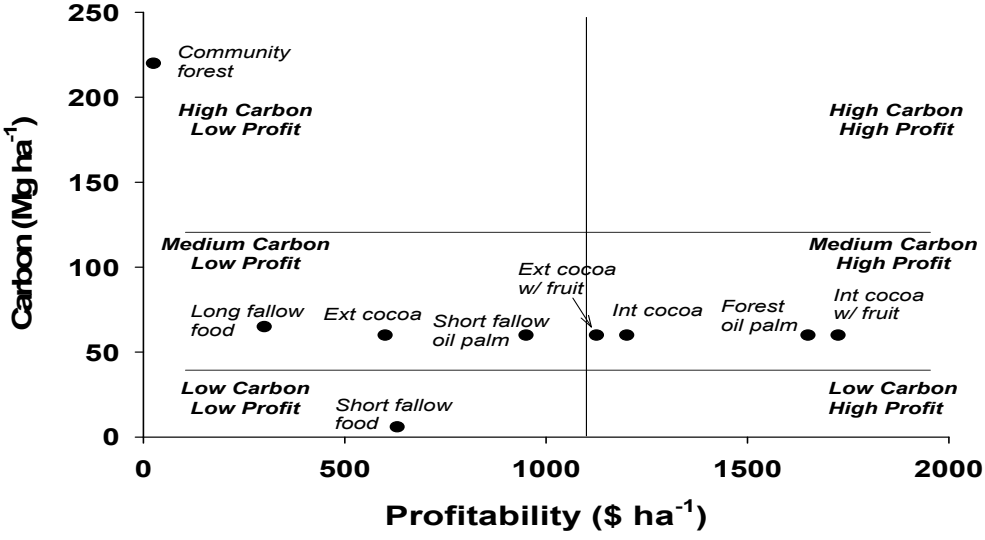

Figure 22.3: Tradeoffs Between Carbon Stocks and Social Profitability of Land Use Systems in Cameroon (Gokowski *et al.,* 2001).

Agroforestry also has an important carbon sequestration role to play in the sub-humid tropics. ICRAF has studied improved fallow systems intensively over the past 7 years. Improved fallows follow a rotation between cereal crops and tree-legume fallow. The duration of trees in the cycle depends upon the level of soil degradation and the nature of the rainfall. Coppicing fallows are a newer innovation, but follow a similar principle. These short rotation agroforestry systems have high potential to sequester C in both the aboveground biomass and the soil (Table 22.3).

While these systems are cut frequently, the average aboveground carbon stocks exceed stocks in degraded land, cropland or pastures. Belowground C storage in these systems represents the potential for long-term C storage, as long as trees remain in the rotation, but the storage capacity is largely dependent upon soil texture and total rainfall. Nitrous oxide emissions following the leguminous tree fallows was found to be almost 10 times that of unfertilized maize (Chikowo *et al*., 2003), but these levels were still extremely low in comparison to the amount of C stored.

Restoration of soil fertility using improved fallows has the potential not only to sequester significant amounts of C from the atmosphere, it also offers opportunities for improving rural livelihoods by turning unproductive land into productive land that can produce food, wood and other tree products, and generate income.

Adaptation

The last decade of the past millennium witnessed weather patterns and temperatures outside of the range experienced in the millennium as a whole for many places in the world. Yet, in many instances the trajectory of the transient climate will result in a migration of agroecological zones and we may consider the issue of 'climate shift'. Areas that are currently on the extreme of the distribution, such as tropical lowlands at the bottom of the elevation gradients as well as the latitudinal ones, may experience novel climates. One message for 'adaptation' is that answers to many of the location specific problems that will be due to a misfit of germplasm and management systems to future climates, may be resolved by learning from experience elsewhere.

While adapting to changes in long-term averages may be feasible through technology and germplasm transfer, increased climate variability, associated with increased frequencies of extreme events poses a greater challenge, particularly in the semi-arid tropics. Agroforestry may provide a means for diversifying production systems and increasing the resilience of smallholder farming systems. The most worrisome component of climate change from the point of view of smallholder farmers is increased inter-annual variability in rainfall and temperature. Tree-based systems have some obvious advantages for maintaining production during wetter and drier years. First, their deep root systems are able to explore a larger soil volume for water and nutrients, which will help during droughts. Second, increased soil porosity, reduced runoff and increased soil cover

lead to increased water infiltration and retention in the soil profile, which can reduce moisture stress during low rainfall years. Third, tree-based systems have higher evapotranspiration rates than row crops or pastures and can thus maintain aerated soil conditions by pumping excess water out of the soil profile more rapidly than other production systems during flood years. Finally, tree-based production systems often produce crops of higher value than row crops. Thus, diversifying the production system to include a significant tree component may buffer against income risks associated with climatic variability.

Research into the contributions of AF in buffering against climate variability is not well advanced. At ICRAF, we have begun looking at ongoing trials and reanalyzing results to see what we can learn about the performance of different systems in exceptional years. One system that we have looked at closely is the improved fallow system that is practiced in many areas of East and Southern Africa, described above. These systems greatly improve maize yields in soils where nitrogen is a limiting factor. A modelling exercise suggested that this system might maintain maize yields in dry years when traditional practices give very low yields, and this has been borne out in experimental results (Figure 22.4). This ability to maintain yields may be due to a number of factors that are improved with this system including soil physical properties, water holding capacity, biological properties, and soil nutrient status (Albrecht and Kandji, 2003).

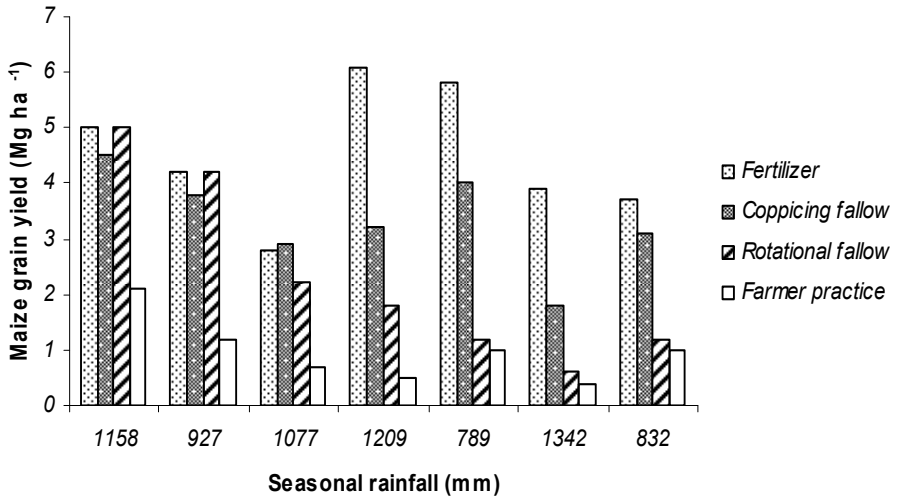

Figure 22.4: Performance of Improved Fallow Systems with Respect to Rainfall Variability Compared to Fertilizer and Farmer Practice in Msekera, Zambia (Mafongoya, Unpublished).

Fertilizer Gave the Best Response in Each Year, While Yields in Farmer Practice Plots Declined Over the Course of the Experiment. Coppicing Fallows Preformed Consistently Well Over the Course of the Experiment (P. Mafongoya, Unpublished). Another important AF system, which is well known to buffer against production risk, associated with climate variability is the parkland or scattered tree systems (Ong and Leakey 1999). In the traditional farmed parklands of West Africa, dense shading by shea nut trees (*Vitellaria paradoxa*) and néré (*Parkia biglobosa*) often reduces millet yield by 50 to 80% (Kater *et al*., 1992). Nevertheless, the trees are highly valued by farmers because economic yields from marketable tree products compensate for the loss of crop yield.

In semiarid Kenya, farmers have recently developed an intensive parkland system using the fast-growing indigenous species *Melia volkensii*, which is reputed to be highly compatible with crops and can provide high value timber in five to ten years (Stewart and Blomley, 1994). To determine whether growing *M. volkensii* trees in croplands is cost effective or not, Ong and Leakey (1999) compared the value of timber products gained with that of the crop value lost due to competition over an 11-year rotation at Kitui district, Kenya. The balance sheet does not take into account costs for seed, cultivation, tree planting stock or labour into account, which would increase the surplus of cash from the tree products

because in recent years, crop failure occurs 50% of the time. Their estimates show that at the end of the rotation, the accumulated income from tree products exceeds the accumulated value of crop yield lost through competition by US$ 10 or 42% during average years and US$ 22 or 180% with the assumption of 50% crop failure due to drought. (In this district of Kenya, on average six of the 16 cropping seasons studied failed). Factors which encourage farmers to plant *M. volkensii* include good financial returns in a relatively short time, strong demand for the product, high value timber and the ability to produce a range of products continuously even in drought years, when crops normally fail.

It is reasonable to expect that on poor soils, the long-term prospects of systems purely based on annual food crops are bleak and a transition into tree-based farming offers a better prospect. In practice, the transition to tree-based systems often depends upon temporary urban employment or remittances from overseas labour. Government support will be required to help smallholder farmers make the transition to tree-based production systems, particularly when the switch entails a few years of reduced production and reduced income security.

22.4 COSTS OF CLIMATE CHANGE MITIGATION AND ADAPTATION

The Stern report (2007) estimated that the opportunity cost of forest protection in 8 countries responsible for 70% of emissions from land use could be in the order of $5 billion annually. Since its publication, other analyses have indicated that this estimate may be on the lower side (summarized in Trines, 2007). Depending on the assumptions about the opportunity costs of alternative land use systems, a more appropriate estimate of the cost might be in the order of $11-15 billion per year (Grieg-Gran, 2006). Sathaye *et al*. (2006) used a dynamic partial equilibrium approach to the question and determined that costs in 2030 would be between 0.4 and 1.2 billion USD per year required to reduce deforestation by 10% (0.1 GtC y^{-1}).

There are many opportunities for mitigating non-CO_2 GHG and soil carbon emissions in agriculture. Emissions can be reduced by managing carbon and nitrogen more efficiently. Carbon can also be sequestered from the atmosphere and stored in soils or in vegetation. Crops and residues from agricultural lands can be used as a source of fuel to displace fossil fuel combustion, either directly or after conversion to fuels such as ethanol or diesel. Verchot (2007) showed that there are opportunities for

small emissions reductions at a net benefit or at zero cost. There is potential for abatement of all sources, but with current technologies and the prevailing economic conditions these potentials are all low. The analysis suggested that 11-13% of non-CO_2 GHG and soil carbon emissions could be abated at reasonable costs.

The opportunities and investments for the sector at different carbon prices are summarized in Table 22.4. Estimates for abatement potentials and costs in AF systems were calculated using data from the IPCC LULUCF report (2000) and using the ENCOFOR Financial Decision Support Tool available on-line (www.joanneum.at/encofor). This tool is a spreadsheet model that evaluates cash flow, costs and benefits of agroforestry and forestry enterprises. Compared to most options in the agricultural sector, agroforestry was cost effective, and comparable to the costs of avoided deforestation.

In the AF examples worked out in the report (Verchot, 2007), total costs for sequestration were on the order of \$10 per tCO_2e and the estimates of global feasibility were between 0.7 and 2.1 $GtCO_2e$ per year. Many of these practices are economically beneficial, but do not occur due to a number of barriers. Investment targeted at overcoming these barriers is much less than the total cost, and therefore, there are opportunities to share costs with other beneficiaries. The analysis suggested that the cost associated with overcoming these barriers is less than \$4.50 per tCO_2e.

Adaptation costs in the forestry sector were difficult to estimate given the uncertainties in climate change, particularly with respect to changes in rainfall distribution. The difficulty lies in defining the marginal costs of adaptation given the broader context on the continent of population growth, rapid deforestation and macroeconomic policy. Refining knowledge in this area must be a priority for African forestry science. Policy makers need to know what is required and where the priorities for investment lie.

Table 22.4: Summary of mitigation opportunities and additional costs in the agriculture sector.

		2010		2020		2030	
Source	Cost $/tCO$_2$e	MtCO$_2$e	$million	MtCO$_2$e	$million	MtCO$_2$e	$million
Non-CO$_2$ GHG							
Croplands	0	128	0	130	0	140	0
	30	183	5,478	168	5,037	180	5,392
Rice	0	109	0	114	0	116	0
	30	226	6,789	238	7,137	243	7,298
Livestock	0	76	0	83	0	92	0
	30	143	4,281	158	4,731	175	5,257
Total	0	314	0	323	0	350	0
	30	552	16,564	559	16,781	606	18,190
C sequestration							
Agroforestry (IPCC)	4.5			1,672	6,836	2,149	8,783
Agroforestry (ENCOFOR)	10			682	6,836	876	8,783
Bioenergy	20			640	12,800		
	50			2,240	112,000		
	100			16,000	1,600,000		

22.5 CONCLUSION

Impacts of climate change will be felt on several levels in the forestry sector: at the level of the individual tree species, the production system, and at the level of the natural resource base upon which rural communities depend. There are clear limits to adaptation within forestry, and this may put pressure on other sectors to absorb some of the impact. Impacts will be felt most by rural poor in developing countries, who are the most vulnerable because of their low adaptive capacity. The adaptive capacity of farmers in developing countries is severely restricted by heavy reliance on natural factors and lack of complementary inputs and institutional support systems.

The concepts of resilience and sustainability are well established in forestry and can be linked directly to the discussions within the climate

change arena about adaptation and mitigation. Thus, policy makers can draw upon a substantial body of knowledge on how to enhance the adaptive capacity and mitigation potential of agricultural systems. Agroforestry management systems offer important opportunities for creating synergies between actions undertaken for mitigation and activities undertaken for adaptation.

I have shown above, through the specific case of AF, that some forestry related mitigation options also provide opportunities to increase the resilience of agricultural systems. These cases, where there are synergies between mitigation and adaptation, ought to be given priority in the Clean Development Mechanism. However, if AF is to be used in carbon sequestration schemes such as the CDM, better information is required in several areas. For example, we need better data on aboveground and belowground C stocks and the non-CO_2 emissions of different AF systems. Whereas AF systems are primarily production systems, there will be periodic harvesting and marketing of wood products. The debate on durable wood products is ongoing, but provisions will be needed to allow farmers to market wood products from their agroforests and accounting methods will be needed to account for the lifetime of the C sequestered in these products. As small-scale farmers are enrolled in carbon offset projects, we will need to develop a better understanding of the implications for C sequestration by AF and what it means to livelihoods. Finally, the CDM has very stringent rules for participation that may be beyond the reach of small-scale farmers to understand or to provide evidence of compliance. There is a need to understand the institutional requirements to allow small-scale farmers to participate in the CDM and to put appropriate institutional frameworks in place.

In the attempt to develop adaptation strategies for the forestry sector, scientists and policy makers must consider the complex interactions of constraints created by changing climates in light of other stress factors. Government and international support in terms of research, education, and extension will be required to help farmers in developing countries cope with the additional stresses created by climate change and increased climate variability. Agroforestry can very likely contribute to increasing the resilience of tropical farming systems. However, our understanding of the potential of AF to contribute to adaptation to climate change is rudimentary at best. Better information is required on the role of AF in buffering against floods and droughts from both the biophysical (hydraulic lift, soil fertility) and financial (diversification, income risk) points of view. If we accept that farmers ability to adapt is not based on

their ability to keep on doing what they are doing, where they are doing it, but rather on their ability to continually adapt to changing biophysical and economic conditions, then we will need to determine the potential of tree-based production systems in vulnerable areas by quantifying the relationship between biodiversity and sustainability.

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23 Forestry Education and Global Change: a Case Study on the Contribution of Forest Plantations in Sri Lanka as an Adaptation Measure to Climate Change

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ABSTRACT

Global warming is a major global environmental issue. Among the major green house gasses which are significant in their contribution to green house effect are CO_2, CH_4 and N_2O. Terrestrial ecosystems especially forests play a major role in the earth's carbon cycle. The flux of carbon through the terrestrial biosphere is approximately 100 Gt/yr. World's forests hold approximately 90% (about 740 Gt) of all above-ground terrestrial carbon and 40% (570 Gt) of all below-ground terrestrial carbon. We quantified the carbon stored in standing teak plantations in Sri Lanka based on the forest inventory database – FORDATA of the Forest Department. Only the merchantable volume of the bole wood was considered in this study because that is the portion, which lasts for a long time without releasing its carbon to the atmosphere. Tree biomass was calculated from tree volume equations. Carbon content was estimated to be 50% of dry weight or biomass. The amount of carbon stored in each year was calculated. The results indicated that the mean carbon storage of teak plantations (rotation length taken as 50 years) was 133.79 tC/ha. The

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amount of carbon stored is a function of mean tree volume, increasing with age up to 49 years, and then stabilizing. The current carbon stocks in the state-owned teak plantations were estimated at 1.66 x 10^8 t. The amount of carbon dioxide stored currently without being emitted to the atmosphere by the teak plantations is 609 Gt. It is recommended that methods to estimate carbon stocks be taught in forestry.

23.1 INTRODUCTION

Carbon dioxide and six other gases (CH_4, N_2O, CFC, HCFC, SF_6, CF_4) referred to as green house gases contribute to the maintenance of the mean global temperature of 15^0C which is favourable for the survival of life on earth through a natural phenomena. However, this natural phenomena is now giving rise to a catastrophic situation called 'Global Warming' due to the unlimited enhancement of emissions of the greenhouse gases (Edmonds, 1992).

Among some of the ill effects of climate change on environment are, irreversible damage to land and water ecosystems and loss of production potential of the same, dearth of the availability of food to humans among others. Reports of increased climate variability and extreme events from around the world are becoming more and more frequent. In the absence of mitigation and response capacities, losses from damage to infrastructure and economy as well as social turmoil and loss of life will escalate substantially. It poses the following challenges to agriculture: changes in the flow and storage of materials, ecology of pests and diseases, dynamics of rainfall regimes and accumulation, plant responses to temperature and carbon dioxide concentrations, change of the salt tolerance of plants, biodiversity etc. Anthropogenic activities are a significant cause for this increased green house gases. The activities, which contribute significantly to this increase, are combustion of fossil fuel, biomass removal, conversion of forests to other land uses, abandoning managed land, paddy cultivation, burning crop residues, animal wastes, fertiliser applications, landfills and waste dumps, cement and lime production etc. (IPCC, 1990). Combating climate change is vital to the pursuit of sustainable development; equally, the pursuit of sustainable development is integral to lasting climate change mitigations.

In order to subdue the effects of this catastrophic climate change there are two major solutions namely, reducing the emissions of greenhouse gases to the atmosphere and finding and utilising effective sinks for greenhouses gases in order to maintain a static atmospheric concentration.

While paying attention to lessening the atmospheric carbon uptake, it seems prudent to try to increase the rate at which carbon is taken up and stored in earth's biophysical systems. Significant ways to increase terrestrial carbon storage include enlarging the area of trees and forests, and increasing the rate of tree growth on those that already exist. According to the global figures, the flux of carbon through terrestrial biosphere as a result of plant photosynthesis, respiration and decomposition is approximately 100 Gt/yr (Winjum *et al.,* 1992).

The search for carbon sinks is now an important priority activity because such a search will shift the focus of the carbon cycle programme towards a more comprehensive analysis of the issue, result in a quicker resolution to the problem, lead to more credible recommendations to world leaders with regard to the management of the budget and the biosphere and finally result in a better understanding of the function of the global ecosystem. Therefore, better understanding of the function of climate change and forestry is important and should be included in forestry curricula worldwide.

This study attempted to find out the ability of using forest plantations in Sri Lanka as effective sinks for greenhouse gases. The specific objectives were as follows:

- To quantify the total contribution of Teak (*Tectona grandis*) plantations in Sri Lanka in acting as sinks or long term stores for greenhouse gases in the atmosphere – to reduce global warming; and
- To quantify the carbon sequestration in plantations at different ages.

23.2 MATERIALS AND METHODS

The total standing volume of the state owned teak plantations was calculated from the diameter and height measurements of the teak plantations from the inventory database of the Forest Department, the FORDATA. This data was verified by field sampling in three major teak growing divisions in the country namely Kurunegala, Puttalam and Anuradhapura. From each division two ranges were selected randomly and from each range two beats were selected. From each beat two plots were selected to be measured for diameter at breast height (dbh), height and volume was calculated using the following formula:

V = g x h x f;
Where
V = volume
g = basal area
h = height
f = form factor

$g = \pi d^2 /40000$

g = basal area at breast height (in cm^2)
d = diameter at breast height (in cm)
$\pi = {}^{22}/_{7}$
h = total height (in m)
f was taken as 0.5 for Teak

23.2.1 Carbon storage

The chemistry of converting atmospheric carbon dioxide into carbon in the biomass is depicted by the photosynthesis equation:

$$6\ C0_2 + 6H_20 \longrightarrow C_6H_{12}0_6 + 60_2$$

The volume measurements of teak plantations given in FORDATA (Forest Department Data Base) were converted to biomass in m^3 using the formula:

Tree biomass (m^3) = 1.67 * volume of bole wood (m^3)

The tree biomass in m^3 was converted to weight measurements by the following formula:

1 m^3 of wood = 490 kg of dry weight

The carbon content is estimated to be 50% of the dry weight or biomass. Mean carbon storage is the average amount of carbon in site over an indefinite number of years as calculated from tree stem volume or where available the total biomass produced.

Mean carbon storage = carbon of the standing crop ($tCha^{-1}$)/n (years). Using this formula, the amount of carbon stored in each year or with the growth of the trees was calculated. The following formula was used to estimate the annual carbon storage by merchantable timber per unit area:

Estimated annual growth of merchantable timber for a ha * 534 (490 * 2.18/2) = Estimate of annual carbon storage in kg/ha/yr. The relationship between carbon content and carbon dioxide is as follows:

1 tC = 3.67 t CO_2

23.3 MAIN FINDINGS

23.3.2 The quantification of the total carbon locked up in forest plantations in Sri Lanka

The total carbon stored in the state owned teak plantations in the country by forest divisions is shown in Table 23.1.

Table 23.1: The Total Carbon Stored in the State Owned Teak Plantations in Sri Lanka by Forest Divisions

Division	Mean volume (m^3) per tree	Total divisional volume ((m^3)	Total biomass * 10^9(kg)	Carbon content (Gt)
Ampara	0.086	277514.92	6.66	33.320
Anuradhapura	0.145	161393.44	3.87	19.380
Badulla	0.001	14.83	0.000356	0.002
Gampaha	0.275	18870.05	0.453	2.270
Hambantota	0.198	91759.13	2.20	11.060
Kandy	0.001	44.37	0.001	0.005
Kurunegala	0.165	239053.45	5.74	28.700
Matale	0.137	112135.46	2.69	13.460
Moneragala	0.110	206045.62	4.95	24.740
Nuwara Eliya	0.013	33.19	0.0008	0.004
Polonnaruwa	0.319	64867.65	1.56	7.800
Puttalam	0.111	181868.85	4.37	21.830
Rathnapura	0.202	27785.56	0.67	3.336
Total		1381386.54	33.167	165.836

According to the above results, the current carbon content stored in the teak plantations of Sri Lanka is $= 3.32 \times 10^8 \times 50/100$

$= 1.66 \times 10^8$ t

As the total area of teak plantations in Sri Lanka is 24,815 ha. The current quantity of carbon stored in the state owned teak plantations as merchantable volume is = 166,000,000/24,815 = 6689.5 tC/ha

The mean carbon storage of teak plantations = 133.79 tC/ha (rotation length was taken as 50 years). The amount of carbon dioxide stored

currently without being emitted to the atmosphere for a long time is = 6689.5 * 3.67 * 24815 = 609,219,789 t = 609 Gt.

23.3.3 The quantification of carbon sequestration in teak plantations at different age classes

The growth of teak as depicted by the increase in volume with age is shown in Figure 23.1.

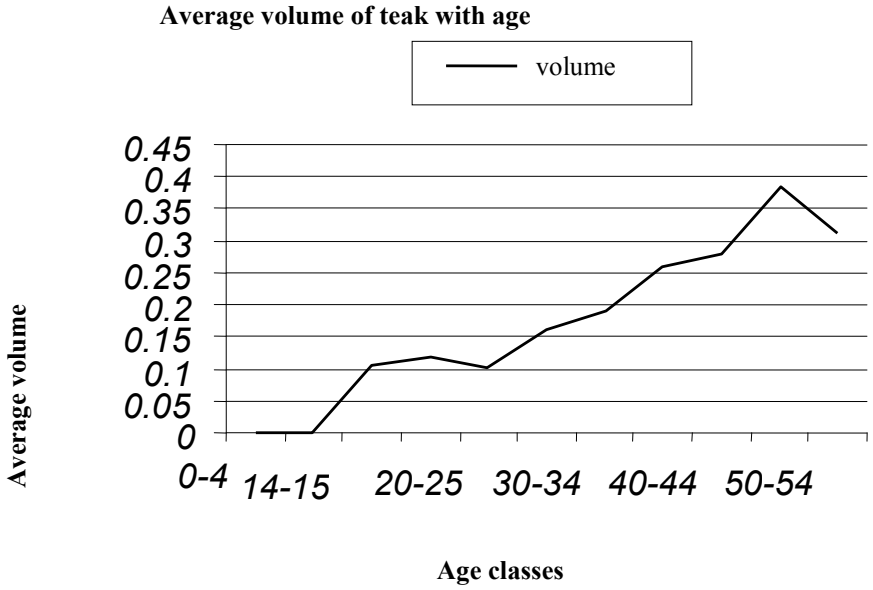

Figure 23.1: The Mean Tree Volume of Teak in Different Age Classes

Mean carbon storage in different age classes is shown in Table 23.2.

Table 23.2: Mean Carbon Storage in Different Age Classes of Teak

Age class (years)	Total volume (m^3)	Mean annual carbon storage (t C/ha/yr)
1-10	208.96	1.1
11-20	38310.23	64.7
21-30	322244.05	322.2
31-40	656753.37	466.4
41-50	94841.89	52.2

According to Figure 23.1, teak trees store carbon progressively up to 49 years of age.

23.4 DISCUSSION

According to the results obtained from the present study, about 24,815 ha of state owned teak plantations alone have stored an amount of 609 Gt C for a period of 50 years. Since these plantations are being continuously harvested and regenerated, this storage will be a long and perpetual one. Therefore, this can be considered as a sink for carbon rather than a storehouse. According to Winjum *et al*, (1992) the mean carbon storage for the tropical latitudes by forestry practices amounts to 66 t C/ha for a rotation length of 50 years. The scenario in Sri Lanka's teak plantations is much higher (133.66 t C/ha) for the same length of rotation.

The study also showed that after a maximum of forty nine years these trees reach a steady state in storing carbon in its bole wood. Therefore, after a tree had reached this age there is no net gain in carbon sequestration and therefore should be felled and regenerated. The felled timber should be used for construction purposes so that the stored carbon can remain in the same state for many more years to come.

23.5 CONCLUSIONS AND RECOMMENDATIONS

Current storage of carbon in the state owned teak plantations is 1.66×10^8 t C and the teak trees sequester carbon in the growing ages up to 49 years. The contribution of forest plantations (state owned) in Sri Lanka in acting as carbon sinks to reduce green house gases in the atmosphere can be quantified as the mean carbon storage of 133.79 t C/ha. The amount of current carbon dioxide offset by these plantations amount to 609 Gt C.

Much more comprehensive studies should be carried out in order to identify the potential sinks of atmospheric carbon locally, regionally and globally. If a database could be maintained on the potential carbon sinks and their costs and benefits, it would be of great value in decision making in the carbon offset strategies. Novel and globally recognised areas like this should be incorporated into curricula so that creative solutions can be made to this global problem.

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24 Biodiversity in Forestry Education: What Needs to Change?

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ABSTRACT

Education on forest genetic resources has largely focused on tree breeding of plantation species and conservation ecology to protect forest biodiversity under threat, with less attention to the livelihood or landscape dimensions of forest biodiversity. However, biodiversity values at ecosystem, inter- and intra-specific levels depend on how people use, manage and otherwise interact with forests and trees outside forests. Poor farmers often maintain tree diversity to secure livelihoods and mitigate risks, for example when climate or markets fluctuate, but they usually do not have access to improved germplasm for the wide range of trees they might want to cultivate. Domestication of high-value indigenous African tree species, including *Vitellaria paradoxa, Irvingia gabonensis, Adansonia digitata, Blighia sapida* and *Prunus africana,* is gaining attention, but many more local tree species need low-input improvement. Regional networks, such as Sub-Saharan African Forest Genetic Resources Programme (SAFORGEN) have been established to enhance collaboration and sustainable use of forest genetic resources. Biodiversity-friendly forestry and agroforestry practices are being developed and need to be incorporated into applied conservation strategies. Genecological zonation, based on ecological variation and expectations of gene flow, can be used to set priorities for conservation of intra-specific genetic variation. A second strategy is biodiversity

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conservation in fragmented landscapes, underpinned by connectivity, landscape heterogeneity, stand structural complexity, integrity, and risk-spreading. Such 'matrix management' will be important to meet the continued pressure on forest genetic resources. Forestry education will need to take into account these broader views of forest biodiversity. Curricula need to be enriched with socioeconomic and policy-related dimensions of forest biodiversity, including 'conservation through use' in mosaic landscapes.

24.1 INTRODUCTION

An estimated 1.6 billion people depend on forests to varying degrees for their livelihood and forests are home to more than 80% of the worlds' terrestrial biodiversity (World Bank 2007).

Interactions between people and forests, and the relations between forest areas and trees outside forests (TOF) play a critical role for the conservation and sustainable use of forest genetic resources. To ensure future adaptability of species and to allow for selection and breeding, intraspecific genetic variation must remain available (FAO, FLD and IPGRI, 2004). This requires combinations of *in situ* and *ex situ* conservation strategies, and the participation of local farmers, communities and other stakeholders. Protected areas need to be managed as part of a bio-cultural matrix and be linked to their ecological and socio-economic context (IUCN, 2003). Farmers' decisions on harvesting timber and non-timber forest products (NTFPs) and on managing trees on farms can have a significant impact on forest biodiversity.

Such dimensions of forest genetic resources are fairly new to many forestry education programmes. Tertiary education on forest genetic resources traditionally tends to cover two broad areas: i) tree breeding and seed technology to increase production and value of plantation forest species, and ii) conservation of biological diversity in natural forest ecosystems. The former has its root in a commercial temperate forest management paradigm; the latter has emerged as a result of alarming rates of deforestation and degradation, and a global conservation agenda. But that leaves graduates with significant knowledge gaps concerning the use of forest genetic resources for livelihoods, as well as about conservation strategies that focus on the whole landscape.

The aim of this paper is to review current issues related to forest genetic resources conservation and use with focus on Africa, and to discuss how

forest education should respond. The paper is structured as follows: It starts with a brief update on training and education on forest genetic resources in Africa. Secondly, the status of forest biodiversity is discussed, including threats to forest ecosystems and species level diversity. The third section deals with national planning of forest genetic resources conservation, including strategies for *in situ* and *ex situ* conservation. Fourth, the links between conservation and use of forest genetic resources are reviewed, with emphasis on livelihood dimensions, landscape-level management of forest diversity, and policy and institutional aspects. Finally, the paper suggests implications for forestry education and makes recommendations for curriculum development.

24.1.1 Forest genetic resources training and education

There is no up to date inventory of training and education on forest genetic resources in Africa. However, in connection with the establishment of the Sub-Saharan African Forest Genetic Resources Programme (SAFORGEN) in 1999, a series of country reports on the state of forest and tree genetic resources were published (Eyog-Matig *et al.,* 2001; Eyog-Matig *et al.,* 2002; FAO, 2007e). Most reports included a brief section on training and capacity building. With a few exceptions, the country reports discussed only the number of forestry staff and the availability of forestry training and education in general, without going into detail regarding specific knowledge gaps (Table 24.1).

In a separate study, SAFORGEN also found that research on indigenous fruit trees in Africa was hampered by 'an acute shortage of research staff in many forestry disciplines such as taxonomy, genetics, ecology, etc'. Existing research staff and technicians needed training on a number of technical, managerial and socio-economical areas. The survey recommended that more emphasis should be given to stakeholder participation in growing and conserving indigenous fruits as well as processing and marketing, (Chikamai *et al.,* 2004, Unpublished).

Forestry curricula in African colleges and universities have traditionally reflected the needs of the government's forestry ministries and industries. The introduction of exotic tree species led to various tree improvement activities. In Tanzania, for example, from the 1950s, the emphasis was on provenance testing, progeny testing, seed orchard and seed stand establishments, selection of plus trees and establishment of clonal banks (FAO, 2002).

Table 24.1: Selected Findings on Training and Capacity Building on Forest and Tree Genetic Resources in African Countries (FAO, 2007e; FAO, 2001).

Country	Training and Capacity Building: selected findings
Botswana	Critical shortage of technical foresters is having a deleterious effect on programmes aimed at reducing pressure on rapidly degrading woodlands.
Ethiopia	Training and development institutions carry out observations on nursery techniques and most of them maintain seed stands and arboreta.
Ghana	Staff of Forestry Department is hindered by lack of knowledge on sustainable productive potential of savannah woodlands, silviculture of woodland species, community issues, anthropological studies, effects of fire and grazing, coverage and extent of savannah woodlands, role of trees and reserves in farming systems and local economics.
Malawi	Malawi train its personnel in the management of forest resources at certificate, diploma and degree level.
Mozambique	There is need for specialized training courses and postgraduate studies for staff members working at institutions dealing with forest genetic resources.
Namibia	Training the national tree seed centre staff in long-term storage of forest genetic resources in necessary.
Nigeria	Training in breeding including species biology, vegetative propagation, clonal and progeny studies and orchard management have been provided to some field staff.
Sahelian and North-Sudanian Africa	The majority of countries in Sahelian and North-Sudanian Africa have training structures for technicians and forest engineers, but only Kenya, Nigeria, Sudan and Burkina Faso have further training structures (MSc and PhD) for forest genetic resources.
South Africa	The curriculum will have to broaden its scope and strength.
Tanzania	No major deficiency in the number of professional and technical level forestry staff.

A second major influence on forest genetic resources education can be traced to the environmental awareness from the 1970s onwards. Growing populations and accelerated human activities caused a rapid loss of habitat and biodiversity. This led to, again with Tanzania as an example, the establishment of large areas of forest reserves (12.5 million ha) and national parks (2 million ha) (FAO, 2002). The response in colleges and universities was to introduce courses in conservation biology/ecology in the forestry programmes.

In the past two or three decades, interest in social forestry, community forestry and agroforestry has led forestry education to also cover small-scale farmers' management of forests and trees. Tree domestication is now usually included in agroforestry curricula, albeit often as an elective course. However, tree seed education at agricultural and forestry colleges

in eastern and southern Africa still needs strengthening (FAO and ANAFE, 2005).

The continued transformation of the forest sector towards multi-stakeholder management goals and multi-disciplinary research is also leading to changes in forest genetic resources education. For example, the BSc Forestry and Natural Resources curriculum at Stellenbosch University in South Africa, developed in 2005, covers topics such as: conservation in utilized landscapes, invasive species, participation and conflict resolution, restoration ecology, environmental legislation, fragmentation and matrix modelling of populations (Stellenbosch University, 2007). Another example is Makerere University in Uganda, which has included courses on 'Practical Skills in Biodiversity Conservation', and 'Biodiversity Conservation and Management' in its BSc curriculum, and 'Advanced Biodiversity Conservation' in the MSc curriculum (Makerere University, 2006). Similar changes will be required in many forestry curricula in years to come.

24.1.2 Forest biodiversity

Status

Protecting forest ecosystems is necessary but not sufficient for the conservation of forest genetic resources. Conservation strategies need to take into account the whole gene pool of tree diversity, whether in forests, in other wooded land, or in trees outside forests. Strategies also need to cover not only the ecosystem level, but also the species and provenance levels, to ensure availability of intraspecific diversity upon which adaptability, selection and breeding depend.

FAO defines 'forest' as an area larger than 0.5 hectare, having trees of more than 5 meters tall with a crown cover of at least 10%, or having potential to reach these criteria (FAO 2004). The often-cited figures of deforestation are usually based on this definition of forests. However, this leaves out large areas of 'other wooded land' – where the canopy cover is 5-10% – which may contain important diversity of trees and shrubs, such as large areas of dry woodlands in Africa. This forestry definition also excludes trees outside forests (TOF): patches of forests smaller than 0.5 hectare, agroforestry and fruit tree plantations, and trees in urban areas. Such trees can play important roles both for *ex situ* conservation and for the connectivity and gene flow in landscape mosaics (Vinceti *et a,* 2004). TOF can also play a significant role in farmers' livelihoods.

The World's total forest area in 2005 was estimated to 3,952 million hectares or 30.3% of the total land area. In Africa, the forest area was 635 million hectares or 21.4% of the land area. In addition, as much as 406 million hectares of 'other wooded land' was reported in Africa in 2005 (Table 24.2). Data on TOF is limited, although there are indications of an increase. Education on forest genetic resources will need to cover this entire gene pool.

Table 24.2: Extent of Forest and Other Wooded Land (FAO, 2006)

	Forest, 1000 ha	% of land area	Other wooded land, 1000 ha
Africa	635,412	21.4	406,100
Total World	3,952,025	30.3	1,375,829

24.1.3 Threats to forest ecosystems

Forest biodiversity is under serious threat due to both habitat loss and degradation of forest ecosystems, as confirmed by key studies such as the State of the World's Forests (FAO, 2007c) or the Pilot Analysis of Global Ecosystems (Matthews *et al.,* 2000). Forest genetic resources need to be assessed at the level of ecosystems, species and within species (intra-specific diversity). Little is known about the patterns of threat and genetic erosion at these three levels (Vinceti *et al.,* 2004). For example, forest certification standards have rarely been based on scientific knowledge on species and habitats (IUCN, 2006).

Addressing this knowledge gap, FAO's Forest Resource Assessment (FRA) 2005 included several variables with relevance to forest biological diversity: area of primary forests, forest area designated for conservation of biodiversity, composition of forests, number of native tree species and threatened forest tree species. However, the quality of national reporting varied (FAO, 2006).

Loss of habitat is a major threat to forest diversity. FAO estimated that 3 % of the world's forests were lost between 1990 and 2005. For Africa that figure was more than 9% (FAO, 2006). During the 5-year period 2000-2005, the World's annual net loss of forest was 7.3 million hectares or 0.18% of its forest area. In Africa that loss was 4.0 million hectares per year, or 0.62% (Table 24.2).

Table 24.3: Change in Extent of Forest 1990-2005 (FAO, 2006)

	1990-2000, 1000 ha/yr	%	2000-2005, 1000 ha/yr	%
Africa	-4,375	-0.64	-4,040	-0.62
Total World	-8,868	-0.22	-7,317	-0.18

From 1990 to 2005, many countries reported increase in plantations and/or a natural expansion of forests, which partly compensated the deforestation in terms of area, but not necessarily for loss of biodiversity. In Africa, the area of forest plantations was reported to be 10.8 million hectares or 2.5% of the forest area (although data was not available for all countries) and increasing in all sub-regions except Northern Africa.

How do these changes influence the status of forest biodiversity? FAO observes that there are so many interrelated variables that it is difficult to identify trends (FAO, 2007c). On the positive side, many countries are increasing the forest areas designated for conservation. Nevertheless, six million hectares of primary forests is lost or modified each year. Many non-native tree species are used in agroforestry, commercial forestry and for combating desertification. Alien invasive species, both trees and other organisms spreading into new areas, can threaten ecosystems, habitat or other species. They can cause major harm to the economy, the environment and human health.

24.2 SPECIES LEVEL DIVERSITY

The number of native tree species varies greatly between countries. In Africa, 33 countries reported an average of 679 native tree species per country, ranging from 12 to 5,000. Globally, there were reported to be from 3 to 7,880 native species per nation, with an average of 671 (FAO, 2006). Information on threats to forest species was collected using the World Conservation Union (IUCN) red list categories and criteria: critically endangered, endangered, and vulnerable. At species level, the number of endangered and vulnerable species per country can be high, but data is incomplete. For example, 67 tree species were reported to be endangered or vulnerable in Kenya, 54 in South Africa and 22 in Ethiopia (FAO, 2006). Rare tree species and those highly valued for wood or Non-Timber Forest Products (NTFPs) are often in danger of becoming extinct over parts of their range. In Africa, 7% of native tree species in a given

country are vulnerable, endangered or critically endangered (FAO, 2007c). For most of these species very little is known about their genetics, ecology and population dynamics (FAO, FLD and IPGRI, 2004). The genetic diversity within forests is still largely unmapped and many species remain unknown to science (Matthews *et al*., 2000).

Meanwhile, the quality of forests is also degrading. Such genetic erosion may take place due a wide range of inter-related factors such as growing human populations, expansion of agriculture, poor logging practices, over-harvesting of timber, NTFPs or invasive species. Yet other factors include for example infrastructure development, extreme climatic events and the use of a narrow genetic base in forest plantations. A general economic growth which changes consumer preferences and increases their purchasing power also influences the supply chain of forest products, and can eventually affect forest genetic resources.

Given the continued rampant loss of natural forests and the poor knowledge of thousands of tree species and their associated ecosystems, appropriate conservation and management strategies urgently need to be identified. Forest managers need to be provided with the information and resources to support the implementation of such strategies. It is also timely to identify how 'biodiversity-friendly' decision making can be made the norm in the forest sector and in related sectors.

The rest of this paper will deal with strategies for the conservation and sustainable use of forest genetic resources, and the associated competences that foresters will need to develop in order to support the development and implementation of these strategies.

24.2.1 National planning of forest genetic resources conservation

With thousands of socio-economically important tree and shrub species, many of which are poorly known, it is difficult to develop individual conservation strategies and expensive to implement them. Yet, conserving intraspecific genetic variation is needed to ensure adaptation to natural changes or external threats. For example, climate change poses a substantial threat to the Amazon forests and constituent species (WWF, 2007). The availability of variation is also a requirement for selection and breeding programmes. Accordingly, sustainable development will be greatly influenced by the availability of genetic diversity in both indigenous and exotic tree species (Amaral *et al.,* 2004).

In contrast to agricultural crops where a network of gene banks is in place to conserve important diversity, the conservation forest genetic resources largely depend on natural environments. Protected areas, but also managed forest and agroecosystems, play major roles in conservation of forest genetic resources. *In situ* conservation also has the advantage of conserving ecosystems' functions (Thomson *et al.,* 2001). *Ex situ* conservation will be important for maintaining genetic variation in high-priority tree species or populations. In practice, a comprehensive genetic conservation programme will require some combination of *in situ* and *ex situ* conservation (Amaral and Yanchuk, 2004). To achieve this, a national strategy, developed with participation of all relevant stakeholders, is called for. The process includes the following logical steps (Kjær and Graudal, 2001; Graudal, *et al.,* 2004):

1. Setting overall priorities and identification of priority species based on potential socioeconomic value and conservation status;
2. Assessment of their genetic structure and variation;
3. Assessment of level of protection of the target species;
4. Identification of conservation requirements or priorities, at population level for single species, and at ecosystem level for groups of species;
5. Choice of conservation strategies and measures;
6. Organisation and planning of specific conservation activities, including identifying implementing partners; and
7. Provision of management guidelines.

The authors also point out that the scale and complexity of data calls for having a national focal point for implementation.

Which species to conserve? Setting priorities and identifying the most important genetic resources involves difficult cost-benefit considerations. Yet, is extremely important, because future activities will be based on the priorities given in this initial phase. The main criteria for including species in genetic resource conservation programmes will often be their value for present and possible future uses. However, species with large future potential, but little present awareness, should not be neglected. It is important to examine carefully the potential of highly valuable timber species, which may contribute little to the present economy of a given country simply because they are or have become rare.

Once priority species are selected, the next consideration is to investigate how genetic variation is distributed in these species. Reliable information

on the distribution of genetic variation - within and between geographic regions - is required to establish an effective and rational network of conservation populations. Genetic variation within tree species can be measured by various techniques. Variation in morphological and metric characters can be studied in field trials, and molecular markers can be studied in the laboratory. However, field trials and laboratory studies are expensive and time consuming. Accordingly for most species, conservation activities must be initiated in the absence of detailed genetic studies.

24.3 *IN SITU* CONSERVATION

The identification of populations to be conserved is carried out in steps 4 and 5 in the framework above. These populations, typically located in protected areas as well as managed forests, will constitute a network of stands with sufficient genetic variation for the species in question. Unfortunately, only rarely are genetic studies available (Thomson *et al.,* 2001). A genecological approach has been developed to select conservation stands in the absence of good data on genetic variation (Graudal *et al.,* 1997). A genecological zone for a priority species can be defined as an area with sufficiently uniform ecological conditions to assume similar phenotypic or genetic characters within that species. Such zonation is based on a compromise between the variation in ecological factors and expectations of gene flow between zones. Genecological zone criteria include (Thomson *et al.,* 2001):

- Information from genetic studies that may be available for the species, or similar species;
- Local distribution of forest ecosystems;
- Climatic information;
- Physiographic maps; and
- Geological or soil maps.

Conservation status refers to the present state of the genetic resources and the risks of depletion in the future. Questions to examine are: Have populations been lost? How well protected are remaining populations? Have remaining populations been subjected to genetic erosion? Assessment of the conservation status of a species and its populations will have to be based on knowledge of (i) past and present geographical distribution, (ii) prevailing utilisation patterns in the form of harvesting, planting and breeding of the species (including introduction of inter-

crossing species/provenances) or indirectly through changing land use patterns, and (iii) its possible occurrence in protected areas.

Which populations to conserve? Comparing the genecological zones with the conservation status of a species can help to identify the conservation requirements in terms of the geographical distribution and the number of areas to be sampled for conservation of genetic resources. All major gene pools should be conserved, but the number of conservation stands should on the other hand be limited to a manageable level. In practice more than one population per genecological zone is recommended to be conserved (Thomson *et al.,* 2001).

24.4 *EX SITU* CONSERVATION

More than 8000 tree species are threatened with extinction, the majority of which are not yet subject to any specific conservation measures (UNEP and WCMC, 2007). Only some 12% of these species are recorded in protected areas and 8% are known to be in cultivation. (IUCN 1998). Therefore, thousands of species will depend on conservation outside protected areas: either *in situ* in managed forests and agricultural landscapes, or *ex situ* in exotic plantations and improvement programmes, botanic gardens, arboreta, seed banks or gene field banks (Theilade *et al.,* 2004a).

Ex situ conservation deals with sampling and maintaining genetic variation within and among populations of target species. But such efforts have so far primarily targeted a limited number of commercial plantation species. Important features of an *ex situ* conservation programme are to (Amaral and Yanchuk, 2004):

- Act as a backup measure to *in situ* conservation;
- Ensure that the wide range of diversity in a species is conserved; and
- Manage regeneration of the species outside its natural range.

Because of the large number of species and the obvious resource limitations, priority setting will be required and decisions on strategies and *ex situ* conservation methods will be necessary. Questions regarding conservation objectives, origin of materials, present use and conservation status will need to be considered. Continued institutional capacity is also one of the main criteria for *ex situ* conservation (Amaral *et al.,* 2004).

The lack of knowledge of target species' distribution, genetic variation, ecology and reproduction and seed biology can be significant constraints for *ex situ* conservation programmes. Short-lived or recalcitrant seeds, common in tropical trees, often pose great challenges. *Ex situ* storage of seeds, pollen, *in vitro* cultures and DNA libraries may be necessary, or a complement to other conservation measures (Theilade *et al.,* 2004). In practice, some combination of *in situ* and *ex situ* conservation will be the norm for most target species.

24.4.1 Linking conservation and use of forest genetic resources

As agriculture and other land uses expand, forests continue to retreat to more marginal lands. Although the worlds' protected areas are increasing, they can only conserve part of the diversity in tree species or populations. Since *ex-situ* conservation measures can only be expected for a small fraction of the over 8000 threatened species, the role of agroecosystems becomes essential for the conservation of tree species and forest functions. In developing countries with predominant rural populations, small-scale farmers' land use decisions, and their use timber and NTFPs from forests and forest margins, therefore have key influences on forest biodiversity.

An estimated 1.2 billion people in developing countries use trees on farms to generate food and cash (FAO, 2007d). Woodfuel is by far the most harvested forest product by volume in developing countries. FAO estimated wood fuel production in Africa to 546 million m^3 in 2004, while the production of industrial round wood was 70.4 million m^3 (FAO, 2007c).

NTFPs and environmental services of forests are critical to the livelihoods of an estimated 600 million people in the developing world alone (FAO, 2007d). Income from NTFPs, can be significant. A study in two Kenyan districts, Nyeri and Mwingi, showed that tree crops within farming systems contributed to 51%, 40% and 18% of total farm income in high, medium and low potential areas, respectively (Njenga *et al.,* 2000). A study in western Burkina Faso found that daily household incomes from indigenous fruits varied from 0.06 to 4.7 Euro according to timing and type of fruit sold (Lamien and Bayala, 1996). In Central Burkina Faso, the sale of fermented seeds of *Parkia biglobosa,* (néré), generated 13.7 Euro per day to sellers (Nikiéma, 1997). In Cameroon, Awono *et al*. (2002) found that 11,000 tonnes of safou fruit (*Dacryodes edulis*) was commercialised in 1997, equivalent to a value of US$7.5 million. In

addition to income generated from the sale of indigenous fruits, value-adding opportunities abound. *Vitellaria paradoxa* butter (shea butter), *Parkia biglobosa* (néré) seeds and tamarind juice and syrup are but a few locally-processed products with good market potential.

Forest diversity also makes important contributions to human health and nutrition. Fruits are important sources of vitamins and minerals, especially important to people who are vulnerable to micronutrient deficiencies. Vitamins, iron and other essential minerals abundant in fruits are especially vital to the health of children and pregnant women (Bergeret and Ribot, 1990; Amouzou *et al.,* 2006). Medicinal plants are important locally and have a brisk international trade, which can often lead to over-harvesting and loss of the resources.

Poor farmers use forest diversity as part of the risk management strategies. When crop harvests fail or markets decline, people often turn to forest and tree resources for supplementing food and income and for mitigating hunger and malnutrition. Many communities have developed biodiversity-rich tree-based agroecosystems, such as the home gardens in northern Tanzania, tree-diverse rural allotments in Tonga, rubber agroforests in Indonesia, tembawan or forest fruit tree gardens on Borneo, or the Sahelian parklands. Farmers' management of forest genetic resources also have positive externalities such as preventing soil erosion and helping to conserve biodiversity, which may call for reward mechanisms for providing environmental services.

Traditional farming systems such as Sahelian agroforestry parklands host a great diversity of indigenous tree species, but despite their economic and environmental importance, many of these ecosystems have been degraded (Ouédraogo, 1994, Bonkoungou *et al.,* 1997). Parkland trees such as *Tamarindus indica* are ageing and dying without replacement due to shorter fallow periods and increased population pressure. In humid West and Central Africa excessive wild harvesting of fruits from highly preferred and increasingly rare forest fruits such as *Dacryodes edulis* and *Irvingia* spp are likely to contribute to their low levels of natural regeneration.

To reverse such trends and to help farmers increase their income, the World Agroforestry Centre (ICRAF) and Bioversity International together with national partners are involved in tree domestication programmes of *Vitellaria paradoxa, Irvingia gabonensis, Adansonia digitata, Blighia sapida* and *Prunus africana*, among others. Preferred fruit varieties are

identified with farmers in collaboration with NGOs and extension services. Both production biology and market chains are taken into account to improve agronomic traits and enhance market opportunities. High-quality germplasm is developed and disseminated, which also helps reduce pressure on wild-harvested stocks. Market intelligence helps identify consumer preferences. Public campaigns can help raise awareness on nutrition or other factors that help create value in niche markets. Traditional and formal tree seed supply systems are important in determining the genetic characteristics of the target species in the landscape. The domestication of tropical fruits is a good example of how diversity can add value to livelihoods and, at the same time, contributes to conservation.

24.5 LANDSCAPE-LEVEL MANAGEMENT OF FOREST GENETIC RESOURCES

All major conservation NGOs, such as Conservation International, IUCN, The Nature Conservancy and WWF, are moving rapidly into a landscape or ecosystems approach, working with concepts of landscape mosaics (Cunningham *et al.,* 2002).

Forest landscape restoration brings people together to identify and put in place a mix of land use practices that will help restore the functions of forests across the whole landscape. The aim is to deliver the forest goods and services that people and societies need, using a range of approaches at different scales (UNEP/WCMC 2007). This approach differs from conventional forest restoration programmes in that:

- It takes a landscape-level view;
- Restoration should result in both improved ecological integrity and enhanced human well-being;
- It is a collaborative process involving a wide range of stakeholder groups;
- It does not necessarily aim to return forest landscapes to their original state, but aims to strengthen the resilience of forest landscapes and keep future options open for optimizing the delivery of forest-related ecosystem services; and
- It can be equally applied to primary forests, secondary forests, forest lands and even agricultural land (ITTO/IUCN 2005).

Restoring landscapes with due consideration to both generic resources conservation and livelihoods requires a careful mix of approaches. Tree

planting is often only one of several options. Landscape restoration could for example include management of degraded primary forests and secondary forests, restoration of forests' ecological functions, promotion of natural regeneration on marginal or degraded land, plantations and agroforestry. In many environments, natural recovery of vegetation can be successful. For example, in the north of Cameroon, the scientists of the Agricultural Research Institute for Development (IRAD) used a natural recovery process to restore savannah diversity in ecosystems degraded by overgrazing, overexploitation for firewood, combined with soil erosion. Savannah cover and species were almost restored after three years following protection from cattle encroachment, or erosion control by digging small holes where vegetation cover had been destroyed (Peltier and Eyog-Matig, 1989). In other cases, encouraging the planting of multipurpose trees on agricultural land or smallholder fields may be enough to restore some degree of key forest functions, as experiences from East Africa show (Dudley and Aldrich, 2007).

A similar conceptual model – matrix management – is described by Lindenmayer and Franklin (2002). They suggest five general principles to meet forest conservation objectives, with the overarching goal of preventing habitat loss. These principles are the maintenance of: (i) connectivity (ii) landscape heterogeneity (iii) stand structural complexity (iv) integrity of aquatic systems by sustaining hydrologic and geomorphological processes and (v) risk-spreading.

On-farm management of TOF can bring important contributions to well-functioning landscape mosaics. This is particularly important for high value species, which are becoming rare or threatened in the wild, such as *Prunus africana*, which provides a bark in high demand by the pharmaceutical industry for treatment of benign prostrate hypertrophy. Whether planted by farmers or naturally grown, TOF seem to be increasing, although data on such trees at national level is scarce (FAO, 2007a). TOF can be 'corridors' between areas of dense forests and hence facilitate gene flow among tree and other species in forest fragments (Boshier and Amaral, 2004). TOF also contributes to maintaining ecosystems services, including watershed functions, carbon sequestration and below-ground biodiversity.

The Center for International Forestry Research (CIFOR) and ICRAF launched a Biodiversity Platform in March 2006 to focus on issues related to biodiversity conservation, sustainable use and equitable benefit-sharing

in landscape mosaics. A research programme has been developed with the following themes:

- Relationships between biodiversity and livelihood security in multifunctional landscapes;
- Ecological processes and spatial dynamics of biodiversity in landscape mosaics;
- Opportunities for and constraints to providing incentives for biodiversity conservation, sustainable use and equitable benefit sharing in landscape mosaics; and
- Potential for harmonization of customary and statutory rules and laws in relation to multi-functionality of landscape mosaic (Pfund *et al.,* 2006).

24.6 POLICY AND INSTITUTIONAL ASPECTS

The importance of institutional and policy aspects in conserving forest genetic resources is mentioned by many authors quoted in this paper. As already mentioned, the sub-Saharan African Forest Genetic Resources Programme (SAFORGEN) was formed in 1999 to spearhead collaboration among institutions and stakeholders. Similar networks exist in other regions. SAFORGEN promotes development of national programmes for forest genetic resource conservation and use, facilitates networking among members and generates knowledge on conservation and sustainable utilization of forest genetic resources. To date, sixteen countries have endorsed the programme and appointed national coordinators. SAFORGEN organizes its work with focus on priority eco-regions:

- Dry ecosystems in West and Central Africa (WCA);
- Tropical moist forest ecosystems in WCA;
- Dry savannahs in Eastern and Southern Africa (ESA); and
- Miombo forest ecosystem in ESA.

In addition, specific sub-networks have been formed for food species, medicinal and aromatic species, wood and fibre species, and fodder species. To reach its goals SAFORGEN has identified three research focus areas:

- The dynamic processes that shape forest genetic diversity;
- Strategies, methods and tools for the conservation and sustainable use of forest biodiversity; and

- Knowledge and information about conservation and sustainable use of FGR.

Finally, the global policy framework includes a range of conventions and treaties that relate to forests, including the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the United Nations Convention to Combat Desertification (UNCCD) and several others (Ruis 2001). The United Nations Forum of Forests (UNFF) agreed in 2007 on a Non-Legally Binding Instrument on All Types of Forests (United Nations, 2007). The International Treaty on Plant Genetic Resources for Food and Agriculture, which came into force in June 2004, relate to forest ecosystems, for example, regarding *in situ* conservation of wild crop relatives or regarding intellectual property rights, and access and benefit sharing (FAO, 2007b). The emerging markets for environmental services - including the development of carbon trading under the Kyoto Protocol to the UNFCCC - may have a considerable impact on patterns of trade in forest products and on forest management. Implementing such policies and integrating them in national programmes are now major needs.

24.6.1 Implications for forestry education

Universities and colleges generally teach tree improvement as a technical subject to enhance production and quality of a narrow range of plantation species. They also teach forest biodiversity conservation within the realm of protected areas. More recently, social forestry and agroforestry have frequently been added to the list of courses taught. However, this still leaves students with big knowledge gaps in areas such as *in situ* conservation and landscape-level approaches to forest conservation. There are also gaps in the teaching of the links between forest biodiversity and livelihoods. For example, a survey of agricultural and forestry colleges in eastern and southern Africa found that agriculture colleges offer very limited tree seed education. Foresters, and forest seed centres, who have good knowledge on tree seeds, have limited links with farmers; hence tree seed information does not reach the farmers (FAO and ANAFE, 2005).

As deforestation and forest degradation continues, TOF are becoming increasingly important both for the supply of tree-based products and services, and for the conservation and use of forest genetic resources.

Notably, such trees are usually managed by farmers, rather than by foresters. A wider approach to teaching forest genetic resources will be required for students to appreciate the real contributions of forest diversity to farmers' livelihood, as well as farmers' role in conserving forest diversity in mosaic landscapes.

Summing up, tertiary education institutions will need to prepare graduates for this wider view of forest genetic resources, their conservation and sustainable use. Old courses on forest genetics and tree breeding will need the company of 'new' concepts and approaches that often blend biophysical, socioeconomic and policy-related issues and participatory approaches. Courses on ecosystems conservation need to be enriched with concepts of 'conservation through use'. Students will need to appreciate the importance of making 'biodiversity-friendly' decisions throughout the forest 'sector'. Some universities with new curricula, such as Stellenbosch University in South Africa or Makerere University in Uganda have began to include such broader range of courses on forest genetic resources, but many others will need to address such issues in forthcoming curriculum reviews. Forest genetics curricula will need to include, among others:

- Planning national forest genetic resources conservation strategies and implementing them;
- *In situ* conservation approaches that covers both protected areas and managed agroecosystems, including using a genecological zone approach as a way of targeting conservation;
- *Ex situ* conservation, including priority setting, objectives and strategies, in a situation with big knowledge gaps and resource limitations;
- Invasive species;
- Livelihood aspects of forest diversity;
- Tree seed supply systems, including farmers' traditional seed systems, which are so important to the future diversity in agroecosystems;
- Domestication of indigenous fruits, including processing and marketing;
- Forest landscape restoration, 'landscape mosaic' concepts and conservation in utilized, fragmented landscapes;
- Policy and institutional aspects of forest diversity; and
- Participatory, multi-stakeholder processes, including conflict resolution.

Training materials will need to be enriched and expanded accordingly. Teachers will need training in research methods and policies that relate to forest and tree diversity beyond classic forest genetics and tree breeding and beyond conservation ecology. Because the knowledge in this area is changing, so fast, teaching and learning methods may need to be supplemented with experiential and learner-oriented approaches to forest diversity conservation and use. Additional skills in searching, synthesizing and critically analysing information on forest biodiversity will need to be developed in students and graduates. Such multi-disciplinary, process-oriented and integrated approach differs in many respects from way forest genetics has been traditionally taught in colleges and universities.

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25 Tree Species Diversity in Cultivated Landscapes: Investigation of Biodiversity Patterns through Training of African Researchers

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ABSTRACT

Agroforestry is aimed at diversifying and sustaining agricultural landscapes for increased social, economic and environmental benefits. As ecological research has demonstrated that diversification of a group of low diversity will have larger effect on ecosystem functioning than the same level of diversification of a group of higher initial diversity, we investigated tree diversity patterns within farming ecosystems to be able to target diversification efforts. Powerful and freely available statistical software for biodiversity and community analysis were developed (*BiodiversityR*) on the basis of experiences during a number of training workshops of African researchers for the analysis of on-farm tree diversity surveys. Some of the recommended modern statistical approaches that the *BiodiversityR* package enables are illustrated here with survey data collected from 4 landscapes in tropical Africa. These approaches include the use of exact species accumulation curves, accumulation surfaces of Rényi diversity profiles and constrained ordination analyses methods. Important differences could be observed between the dominant functions of trees on farms that allow targeting diversification efforts to groupings of species of lower diversity. The *BiodiversityR* software and *Tree Diversity Analysis* manual are available for free download from the website of the World Agroforestry Centre.

25.1 INTRODUCTION

Whereas the majority of species on a farm may be indigenous taxa, introduced exotic taxa account for many of the trees on a farm (Simons and Leakey, 2004). On the other hand, agroforestry is uniquely suited to provide ecoagriculture solutions that successfully combine objectives for increased food security and biodiversity conservation gains, especially by promoting greater use of native tree species in agroforestry systems (Atta-Krah *et al*., 2004; Garrity, 2004; McNeely, 2004; Simons and Leakey, 2004). These observations have led to the concept of landscape domestication that has as some of its objectives (i) diversification of the incomes from tree products for resource-poor farmers; (ii) increase the stability and productivity of the agroecosystem; and (iii) enhance the conservation of biodiversity in landscape mosaics (Kindt *et al*., 2006). Similar arguments as those for the diversification of the tree species assemblages of agricultural systems have recently been made for the diversification of forestry plantations, especially for the cultivation of indigenous tree species (Lamb *et al*., 2005).

Since agroforestry or forestry diversification can be most meaningfully planned on the basis of current tree diversity patterns, we initiated tree diversity surveys in a number of countries. Surveys were conducted in collaboration with partner institutions of the World Agroforestry Centre (ICRAF), which were preceded by training workshops on survey and data management methodologies and were succeeded by training workshops on the statistical analysis of biodiversity patterns. Based on a review of existing software packages, a new and free software package (*BiodiversityR*) was developed within the R statistical environment (R Development Core Team 2005) that provides a graphical user interface to the vegan community analysis package (Oksanen *et al*., 2005) together with some utility functions for the analysis of biodiversity. This package was developed for training workshops with African researchers on the analysis of tree diversity data, and was updated based on the experiences from the various training events in Kenya, Uganda and Mali. The software is accompanied by a free manual on biodiversity analysis (Kindt and Coe, 2005). Both the software and the manual can be obtained from the website of the World Agroforestry Centre URL; http://www.worldagroforestry.org/treesandmarkets/tree
Mainly through training of local researchers and by using real datasets it was possible to develop a user-friendly but powerful tool for biodiversity analysis.

25.2 METHODS

25.2.1 Survey areas

Complete tree inventories were made on farms in Cameroon, Uganda, western Kenya, and central Kenya. Farms, defined as all land managed by a household, were sampled in a random or stratified random manner within villages. Villages were sampled in a stratified random manner based on their distance to forests. This sampling strategy allowed us to separate between effects of villages, and effects of household characteristics within these villages, on tree diversity. From Cameroon, information was available from 39 farms, located in two villages. The villages belonged to a 6-village fruit species study targeted at the humid forest zone of West and Central Africa. Households were sampled based on a participatory wealth-ranking exercise (Degrande *et al*., personal observations).

The survey in Central Uganda collected information from 105 farms and 15 villages that were arranged in five axes that started from the Mabira Forest Reserve at angles of about 72°. On each axis, one village was selected within a distance of less than 1 km to the Mabira Forest Reserve, one village between 5-7 km to this forest, and one village at a distance between 12-19 km. Within each village, a randomly-stratified sample was taken based on the gender of the head and wealth of the household.

In western Kenya, we surveyed 201 farms located in four villages. The study area is located in the East and Central African Bimodal Highlands. Four villages were selected within the area, each located in a different stratum as identified by (Bradley *et al*., 1985) through interpretation of low level aerial photographs. Strata mainly differed in farm sizes and arrangement of woody biomass in the landscape. The selection of villages coincided with a gradient (distances of 2.5, 15, 25 and 32 km) towards the species-rich Kakamega National Forest Reserve. Selection of farms within villages was random. A 35-farm (3 villages) survey was conducted in central Meru district, adjacent to Mount Kenya National Park and National Forest. The survey followed the framework of participatory on-farm species screening trials that were implemented earlier. For the trials, three groups were selected within similar agro-ecological zones (Upper Midlands 2 and 3: Coffee and Marginal Coffee Zones), and based on different location towards the forest (0, 12 and 25 km). Farmers were selected that were willing to participate in tree planting trials, according to wealth and gender.

In each of the surveys, complete tree inventories were done through participatory interviews including farm walks on all sections of selected farms. Species were identified in the field where possible, while local names, herbarium specimens, and repeated field visits were used to identity species that were not identified during the first inventory. However, the botanical identity could not be established for all species. The number of botanical families may therefore be underestimated. The percentage of exotic species could be underestimated in case several unidentified specimens would turn out to be the same local species. Nevertheless, since 85% species were identified in western Kenya, 90% species in Meru, 93% in Uganda, and all species encountered in Cameroon, the general trends reported below should hold true.

In connection to the focus on agroecosystem productivity, we grouped species according to their uses documented by ethnobotanical surveys that complemented the biodiversity surveys, and explored ways of diversifying composition within each use-group. Informants explained the products and services that each species provided on their farms. Analyses were made for the main use-groups (Table 25.1).

Although the *BiodiversityR* package allows for a wider suite of biodiversity analysis methods, space limitations allowed us only to provide information on species accumulation patterns and Rényi diversity profiles. Species accumulation curves show the trend in which additional species are encountered when a larger area is sampled. The exact average species richness for random accumulations of sites (in the context of this article: farms) can be calculated by a new approach based on the hypergeometric distribution rather than through the previous less accurate and more lengthy Monte-Carlo procedure of calculating the average species richness of various random site sequences (Kindt *et al*., 2006a). Although many equate diversity to species richness, diversity is a function of the number of species and the evenness in distribution of species' abundances (Magurran 1988; Purvis and Hector, 2000). Rényi diversity ordering is a graphical method of diversity ranking that allows to distinguish between situations where ecological communities (or other different groupings of individuals such as the use-groups in this survey) can be ranked in diversity or situations where this is not conceptually possible. Since Rényi diversity profiles can discriminate between these two situations, they are more appropriate for biodiversity analysis than diversity indices (such as the Shannon or Simpson index). The approach of Rényi diversity profiles has recently been expanded into Rényi

diversity surfaces that enable for a joint analysis of the separate effects of sample scale, richness and evenness on diversity (Kindt *et al*., 2006b). For a detailed description of the used methods and interpretation of the results, we refer the reader to the cited articles or the Tree Diversity Analysis Manual (Kindt and Coe, 2005).

Table 25.1: Farm Frequencies, Alpha Diversity (Average Farm Diversity), Richness of Botanical Species and Families, Abundance on Farms Where the Group is Present and Proportions of Dominant Species (Dom.) and Exotic and Planted Species and Trees in Villages in Cameroon, Uganda and Kenya.

Survey	Group (all or use)	% farms	Alpha diver-sity	Species total (S_T)	% exotic species	Family Total	Abun-dance per farm	% abun-dance dom.	% abun-dance exotics	% abun-dance planted	% abun-dance planted exotics
Cameroon	All	100.0	29.5	119	12.6	42	171.8	13.8	29.9	48.2	28.2
(*n*=39)	Firewood	100.0	21.7	109	9.2	39	128.7	18.0	33.6	46.8	31.7
	Fruit	100.0	8.1	30	36.7	18	84.8	27.6	59.0	90.6	56.1
	Medicine (human)	100.0	13.6	84	9.5	37	88.3	16.0	30.8	54.6	29.8
	Construction	97.4	10.5	76	3.9	35	46.3	18.4	1.2	12.1	1.2
	Spices	97.4	2.0	18	11.1	12	9.8	55.0	0.5	33.8	0.3
	Tools	84.6	3.1	40	12.5	23	14.9	19.1	10.0	15.7	10.0
	Soil fertility	76.9	1.4	28	7.1	16	13.2	44.7	4.3	18.4	4.0
	Stimuli	64.1	1.0	5	0.0	4	5.6	82.3	0.0	90.1	0.0
	Gums	51.3	0.7	11	18.2	10	14.0	45.0	22.9	55.7	16.1
	Drugs	30.8	0.6	13	0.0	10	10.0	45.0	0.0	46.7	0.0
	Fodder / animal medicine	30.8	0.5	15	26.7	13	12.8	27.9	53.2	64.9	48.1
	Shade	25.6	0.8	19	10.5	15	16.8	16.7	23.8	37.5	23.8
	Vegetables	23.1	0.2	3	0.0	3	3.2	89.7	0.0	0.0	0.0
Mabira	All	100.0	27.9	249	23.3	62	210.7	12.6	31.7	37.4	22.6
(*n*=105)	Firewood	100.0	15.1	187	17.6	46	118.3	15.5	20.3	24.1	11.4
	Fruit	100.0	5.5	24	58.3	17	31.4	28.2	95.2	61.2	59.1
	Medicine	92.4	3.6	79	24.1	29	25.2	27.8	27.5	24.4	19.1
	Construction	89.5	2.4	70	9.5	30	41.7	59.5	15.9	25.2	10.9
	Timber	89.5	3.8	71	19.7	27	33.2	18.5	4.4	22.1	3.6
	Shade	80.0	3.0	93	33.3	36	24.5	32.0	16.9	46.7	10.3
	Boundary demarcation	78.1	1.4	19	36.8	12	32.3	43.2	51.0	67.9	42.9
	Soil fertility	60.0	1.0	32	21.9	12	17.5	22.2	28.7	55.4	27.4
	Leaves for cleaning utensils	41.0	0.4	1	0.0	1	4.2	100.0	0.0	1.1	0.0
	Charcoal	36.2	1.1	58	12.1	22	24.7	20.7	7.0	8.5	4.8
	Fodder	33.3	0.6	16	31.3	6	19.5	55.3	28.2	72.4	24.0
	Ornamental	24.8	0.4	31	48.4	18	4.3	20.7	47.8	78.8	45.1
	Stakes	24.8	0.3	6	16.7	3	46.1	93.4	93.6	91.0	89.2
western	All	100.0	16.6	175	22.9	49	508.1	16.9	72.3	80.2	62.6
Kenya	Firewood	100.0	15.2	156	25.6	45	476.7	18.0	75.9	79.4	65.7
(*n*=201)	Fruit	100.0	4.7	25	60.0	14	46.1	72.6	99.2	21.8	21.5
	Boundary demarcation	98.0	2.8	34	38.2	20	217.6	30.9	73.1	92.6	66.3
	Construction	98.0	1.9	20	50.0	11	111.6	78.4	80.3	82.9	79.3
	Furniture	97.5	3.9	49	28.6	23	142.2	61.9	92.9	93.3	90.3
	Shade	82.6	3.0	84	34.5	29	28.7	13.0	55.6	58.2	38.7
	Soil fertility	67.7	1.0	27	44.4	18	87.8	52.8	63.7	89.7	63.6

	Medicine	55.7	1.2	58	12.1	22	23.3	66.4	10.5	19.6	10.4
	Ornamental	47.8	1.0	53	35.8	23	55.0	50.9	56.2	94.8	52.3
	Charcoal	39.8	0.6	27	37.0	13	42.6	49.6	57.5	60.2	54.1
	Beverage	30.8	0.4	4	75.0	4	309.4	80.3	80.3	100.0	80.3
	Fodder	23.4	0.3	7	57.1	4	9.7	42.1	44.3	54.6	41.6
Meru	All	100.0	53.2	294	27.9	64	1798.5	32.0	61.8	71.1	59.4
(*n*=35)	Firewood	100.0	16.1	121	23.1	45	534.1	35.1	70.1	67.4	59.0
	Fodder	100.0	9.1	87	17.2	39	263.7	28.3	48.3	51.5	38.1
	Fruits or nuts	100.0	9.8	53	49.1	28	106.2	13.9	71.9	46.0	40.0
	Timber	100.0	8.1	54	24.1	29	191.3	45.7	65.7	62.8	51.3
	Boundary demarcation	97.1	7.2	73	26.0	47	508.4	26.6	51.4	81.0	55.5
	Cash	97.1	2.6	8	50.0	6	637.2	93.3	94.7	99.8	94.5
	Medicine	97.1	7.1	96	14.6	40	200.6	14.7	23.0	45.3	17.1
	Construction	91.4	4.2	49	26.5	27	126.2	28.5	63.1	55.9	47.3
	Ornamental	82.9	3.6	51	70.6	24	46.1	34.1	86.9	98.2	88.5
	Plant support	62.9	1.2	16	12.5	11	122.7	40.9	37.1	91.3	37.1
	Animal traps	51.4	0.9	15	0.0	2	15.0	34.1	0.0	13.7	0.0
	Charcoal	45.7	1.1	20	10.0	14	27.8	24.0	6.1	9.4	4.3
	Tool handles	45.7	0.6	9	0.0	8	25.2	42.9	0.0	34.7	0.0
	Shade	42.9	0.6	13	53.8	11	7.9	49.6	79.8	65.5	53.8

25.3 RESULTS

25.3.1 Overall species diversity patterns in the landscapes

Figure 25.1 shows the overall patterns between richness, evenness, and sample size in the four landscapes through Rényi diversity surfaces. Some of the statistics that are provided below were calculated directly from the data used to create Figure 25.1 – the resolution of the figure does not allow for calculations that have the same precision. Figure 25.1 indicates that overall species richness (=exp (H_0)) is relatively high in each landscape, and has the lowest value in Cameroon with 119 and the highest value in Meru with 294 species. When comparing for the same number of farms (n=35, which is the sample size for Meru), however, western Kenya becomes the landscape with the lowest accumulated richness of 96.5 species.

Figure 25.1 indicates that landscapes mainly differ in alpha diversity (the average number of species of one farm), whereas the shapes of the species accumulation curves are relatively similar in the four sites. Average richness of a farm ranges from 16.6 in western Kenya to 53.2 in Meru. The differences of the profile values at scale 0 and at scale ∞ indicate that each landscape contains a dominant species. The dominant species has the largest frequency (indicated by the smallest value of H_∞) in Meru and the lowest value in Mabira. The respective percentage of total abundance for the dominant species is 12.6% in Mabira (for *Markhamia lutea*) and 32.0% in Meru (for *Coffea arabica*). The dominant species *Eucalyptus saligna* and *Persea americana* have frequencies of 17% in western Kenya

and 14% in Cameroon respectively. Figure 25.1 shows that an increasing α corresponds to decreased accumulation of H_α with sample size. This pattern results in diversity profiles that become steeper (an increasing H_0-H_∞) with sample size. Especially for Meru, where accumulation of H_∞ is minimal, this indicates that the dominant species maintains approximately the same percentage of abundance. With increasing species richness with increased sample size, this indicates decreasing evenness in the distribution of the dominant species.

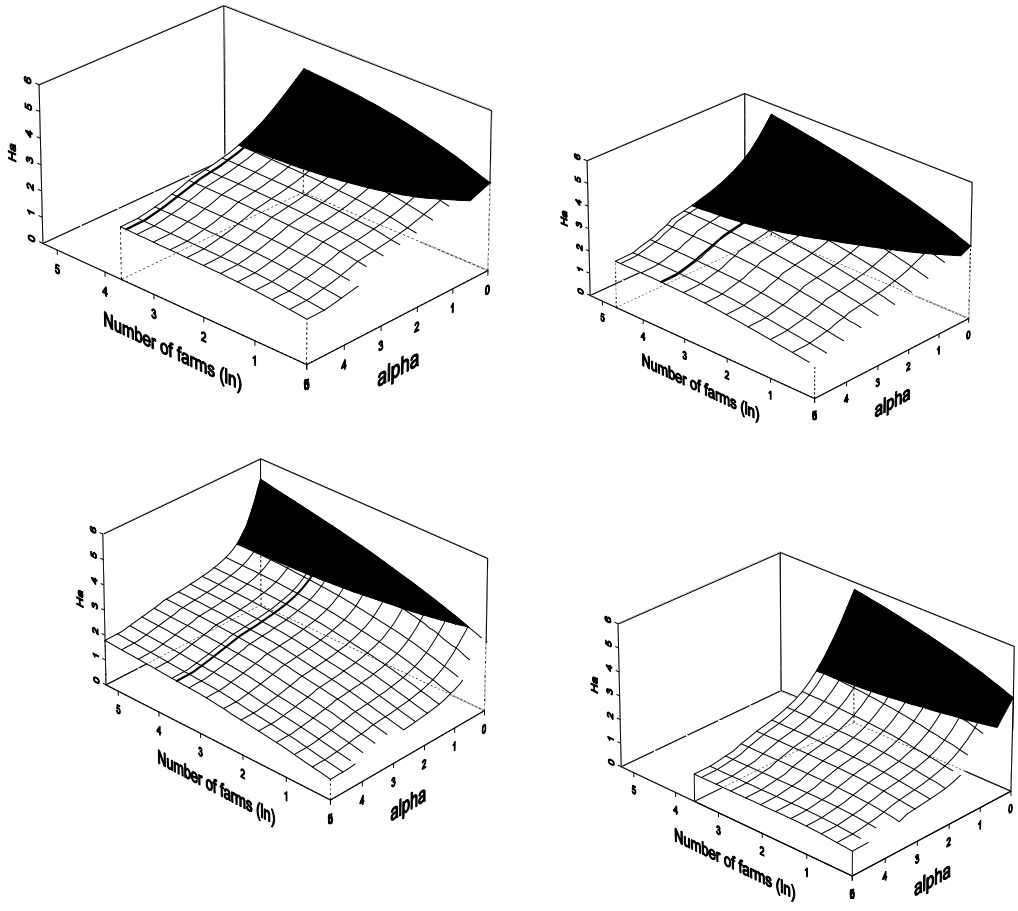

Figure 25.1: Accumulation patterns for the Rényi diversity profile for all species. Horizontal axes represent the Rényi scale parameter α and the randomly accumulated number of farms, the vertical axis the Rényi diversity profile Hα. The bold line corresponds to the average diversity profile corresponding to 35 farms, which is the smallest sample size of the four surveys (Meru). Alpha values of 4, 4.5 and 5 in the figure correspond to scale parameter α values of 10, 100 and ∞. Upper left: Cameroon, upper right: Mabira, lower left: western Kenya , lower right: Meru.

Figures 25.2 and 25.3 repeat some features of Figure 25.1. Figure 25.2 also shows the accumulation pattern of overall species richness, while Figure 25.3 shows the Rényi diversity profile for all farms and all trees. Table 25.1 shows the large number of botanical families to which the encountered species belong, ranging from 42 in Cameroon to 64 in Meru. Total species richness is mainly formed by indigenous species since only 13% (Cameroon) to 28% (Meru) of species are exotic (Table 25.1). Exotic species, however, constitute a proportionally larger percentage of the total abundance, ranging from 30% (Cameroon) to 62% (Meru). Both Kenyan sites differ from the others in the larger percentage of planted trees (71% and 80% versus 48% and 37%). Most of the exotic trees are planted, but also some indigenous trees are planted (*e.g.* in Cameroon, 60% of planted trees are exotic).

25.3.2 Species diversity distributed over uses

The total number of use-groups distinguished were 17 in Cameroon, 51 in Mabira, 60 in western Kenya, and 62 in Meru. In Cameroon, use-groups were pre-classified. In the other surveys, use-groups that occurred only on one farm were the most frequent with respectively 17, 19, and 18 use-groups. Many species have several uses, therefore the sum of total richness of individual use-groups exceeds overall richness. Figure 25.2 shows that although in general the use-groups with larger alpha diversity also had higher total richness, several intersections among accumulation curves can be observed. This is an indication of strong differences among farms in species composition. Fruit had large alpha diversity and low beta diversity (*i.e.* a less steep species accumulation curve) in the four landscapes.

Within the four landscapes, firewood was the group with largest alpha diversity and total richness, which indicates that many species have firewood as a primary or secondary function. Products with more specific requirements, such as species that have hairy leaves that are used to clean utensils (Mabira), species with leaves that can be eaten as vegetables (Cameroon), or species used as beverage (western Kenya) had low total richness. For the more general service functions shade, ornamental, boundary demarcation and soil fertility improvement, total richness was never below 10 species.

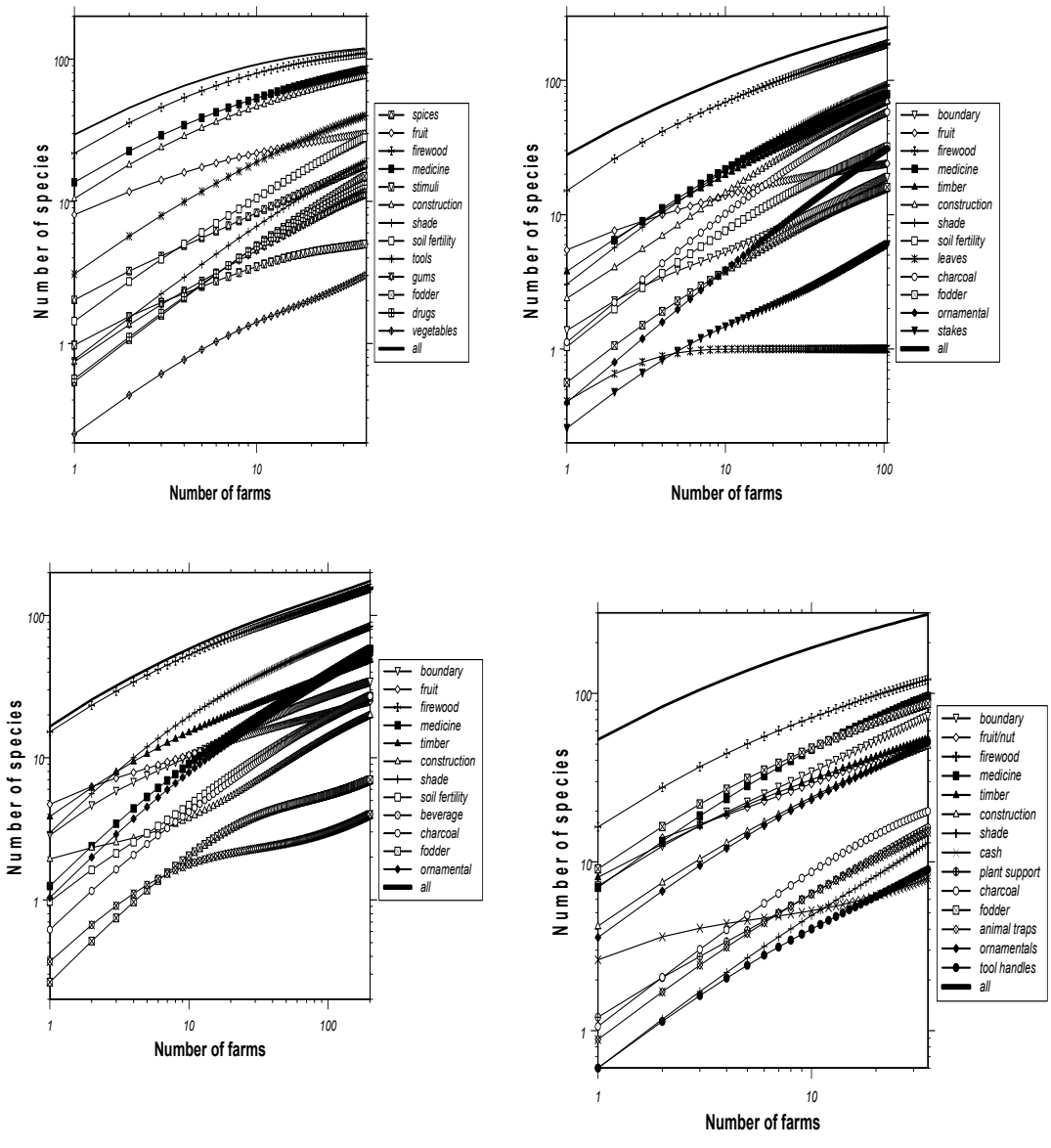

Figure 25.2: Species accumulation curves for trees in various use-groups. Upper left: Cameroon, upper right: Mabira, lower left: western Kenya , lower right: Meru.

Figure 25.3 shows the diversity profiles of the different use-groups at the complete survey scale. The many intersections show the complex pattern where many use-groups that are richer also have a less even species distribution. It is therefore impossible to rank most use-groups in terms of

diversity. Some use-groups can however be distinguished clearly with lower diversity: these groups are especially vegetables in Cameroon, beverage in western Kenya and cash in Meru.

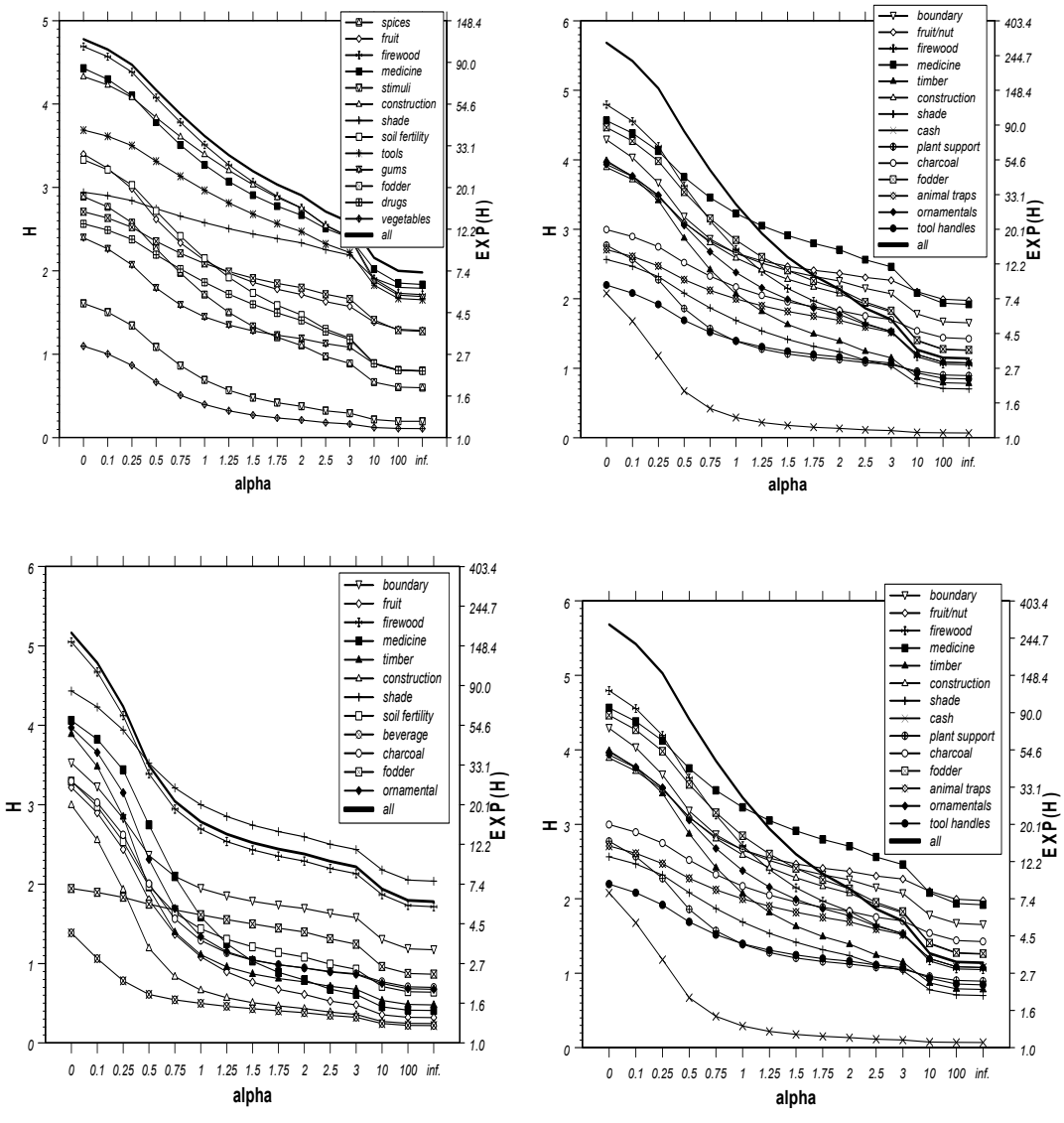

Figure 25.3: Rényi diversity profiles for trees in various use-groups for the complete sample. Upper left: Cameroon, upper right: Mabira, lower left: western Kenya , lower right: Meru

Table 25.1 shows that use-groups of larger total richness were rarely dominated by few botanical families, except for animal traps (15 species) in Meru composed of 2 families only. In some use-groups, nearly or more

than half of the species are exotic. These groups are fruit and ornamental in Mabira, cash, fruit (or nut), and ornamental in Meru, and fruit, construction, and beverage in western Kenya. When considering the abundance of trees, more use-groups become dominated by exotic species. In many use-groups, more than half of the trees were planted. The general pattern that can be observed again is that groups with more planted trees contain more exotic species. However, exceptions exist, such as stimuli in Cameroon that contains no exotic species, but where 90% of trees are planted. Other examples are fodder in Mabira, and plant support in Meru.

25.4 DISCUSSION

Our results indicate that a substantial number of tree species can be found on farms, of which most are indigenous. When species' abundance is taken into consideration, many trees turn out to be exotic. In both Kenyan landscapes, although the percentage of indigenous *species* is larger, a larger percentage of *trees* are exotic. This pattern indicates that, although farmers are protecting and actively planting some indigenous trees on their farms, a larger proportion of exotic species are planted. Further research is required to determine if these differences reflect (*a*) differences in value derived from exotic and indigenous species; and/or (*b*) higher levels of natural regeneration of indigenous species.

Farmers do not manage species – they manage individual trees or populations of trees. The fact that the census number of many indigenous species was rather low as shown by the Rényi diversity patterns. In Cameroon, Mabira, western Kenya and Meru, respectively 39%, 53%, 63% and 47% of indigenous species had fewer than 10 tree individuals in the survey. This pattern stresses the importance of evaluating effective population sizes of tree species. If farmers plan to manage trees for sustainable production, then the effective population size should be maintained at least at 50 trees to ensure that most genetic diversity is maintained over time (O' Neill *et al*., 2001).

Most species were aggregated within farms and within villages. Whether current abundance and distribution of indigenous tree species within a matrix of farmland and natural ecosystems leads to effective population sizes of more or fewer than 50 trees is difficult to assess, however. Information on the reproductive ecology of many tropical tree species is very scant (Alvarez-Buylla *et al*., 1996; Boshier 2000). Species that are grown in densities of lower than 1 tree ha^{-1} (as recorded in our surveys for

most species) do not necessarily have high risk of genetic erosion – most canopy trees of tropical rain forests have densities lower than 1 tree ha^{-1} (Chase *et al*., 1996). Young and Boyle (2000) indicate that pollen flow can be high in fragmented populations, provided vectors can pass non-forest habitat. Young and Merriam (1994) and White *et al*., (2002) actually showed that fragmentation could lead to an increase in pollination distances. Chase *et al*., (1996) found that isolated trees could act as stepping stones for geneflow among populations. Whether current pollen and seed dispersal limitations exist and whether they lead to genetic erosion therefore need to be evaluated for specific species and landscapes. In case substantial genetic erosion is recorded or expected under current tree management practices, farmers could co-ordinate germplasm exchange within and among farming communities, or obtain more diverse germplasm if available from forests, plantations or germplasm production stands (Kindt and Lengkeek, 1999; O' Neill *et al*., 2001).

The fact that farmers prefer certain species and only maintain other species in low abundance does not mean that they are unwilling to foster diversity. In western Kenya, in a follow-up survey to the tree inventories, farmers were requested to rank species by preference, and also asked which species they desired on their farms, using participatory methods including drawings of "ideal farms". In the follow-up survey, although exotic species often were preferred for particular use-groups (*e.g. Eucalyptus saligna* for construction and firewood, *Persea americana* for fruit), farmers expressed the desire to maintain a variety of indigenous species on their farms for these uses. However, some indigenous species were the first priority within some use-groups. Therefore, although many indigenous species regenerated naturally and were not highly preferred in western Kenya, farmers desired their presence.

The various explanations that farmers provided for preferring diversity within a use-group included statements of the advantage of complementary characteristics that were not easily provided by a single species. Examples were the need for strong poles and flexible branches for construction, higher efficacy of medicines when used in mixtures, fast versus more robust growth for boundary marking or timber, and year-round supply of fruit, firewood, and charcoal. Most importantly maybe, our results did not indicate a saturation point for desired diversity, as farmers with high richness on their farms also desired high richness. In addition, farmers preferred to obtain several tree products and services from their own farm, rather than concentrating on one species. We

identified limitations in local knowledge on alternative species to use as an important factor that limited diversity on farms – although many farmers were experimenting with new species on their farms, wider distribution of information could result in more rapid diversification.

Our results indicated spatial patterns in the distribution of diversity of many use-groups. Species accumulation curves provide information on the possibility of enhancing diversity by modifying the distribution of species that are already present in the landscape. Especially where alpha diversity is low and beta diversity high, wider distribution of species that currently have lower frequencies would substantially increase the alpha diversity. In contrast, systems with high alpha and low beta diversity have a more limited scope for diversification with species that are already present.

What needs to be investigated together with farmers is the reason why some species occur in lower frequencies in a landscape now. Maybe they have limited fitness for a particular use, maybe few farmers need their specific products, maybe few trees produce enough for several households, maybe few farmers know how to use the species, or maybe farmers do not have access to germplasm of the particular species – and other reasons could exist. It is obvious that efforts to increase the frequency of species should consider farmers' perceptions and limitations. In addition, space limitations on individual farms and within villages could prevent that effective populations are established of each species, which poses limits on the species richness that can be managed sustainably within these spatial contexts. Possibly, neighbouring farmers should agree on common species on their farms to allow large enough effective population sizes (O' Neill *et al*., 2001).

In general, our results demonstrate that farmers cultivate substantial diversity of trees on farms, especially when scaled-up from the individual farm to the village and larger spatial areas. Although we do not expect that farmers will conserve all indigenous species that were historically present in the landscapes that we investigated, we are hopeful that ongoing research conducted together with farmers will demonstrate that a substantial percentage of tree species can be conserved-through-use while also contributing through diversity to the wellbeing of those local farmers that manage these systems. Especially in areas where forests are under threat of fragmentation and extinction, conservation-through-use may offer the most realistic conservation approach for many tree species.

We do not want to undervalue the need to protect remaining forest ecosystems in the landscapes that we investigated, however. Although only three species were included in the World Conservation Union (IUCN) Red List, more species could be threatened as deforestation progresses. Some of these species could not be useful to farmers or suited to ecological conditions of agroecosystems and could therefore only be conserved in forests. Evolutionary forces may be different in agroecosystems and conservation-through-use may therefore not be equivalent to *in situ* conservation (nor as *ex situ* conservation for that matter). In fragmented landscapes, farms may provide corridors that provide a necessary link for conservation of tree species in otherwise isolated forest fragments – trees may be needed both in agroecosystems and in remaining forest ecosystems to enable survival of the species.

Where forests are fragmented or gone entirely in a landscape, trees in agroforestry systems may offer suitable habitats for other organisms. Safford and Jones (1998) for example reported that restoration of native vegetation is not always the most effective conservation method of animal species, but that certain exotic species can be essential. On the other hand, some agric-environmental schemes may not be effective in conserving plant and animal species (Klein *et al*., 2001). The results of the Biodiversity Conservation Network that studied the hypothesis that people will conserve natural habitats if they can benefit financially from community-based enterprises that depended on them showed that they only lead to conservation under a limited set of conditions (Salads *et al*., 2001). There was a weak association between enterprise success and conservation success, but a strong association between local involvement in the enterprise and conservation success. Enterprises that are not linked to biodiversity that are easier to be implemented and more profitable may actually be more effective. This study indicates that conflicts may exist between conservation of local biodiversity and livelihood strategies of local people.

Balmford *et al*., (2001) and Huston *et al*., (2001) indicate that in sub-Saharan Africa, biodiversity conservation and human needs may indeed result in conflicts since biodiversity and human population density are positively correlated. McNeely & Scherr (2001) describe that, since 1.1 billion people live in the 25 global biodiversity hotspots identified by Myers *et al*., (2001), a new type of agriculture is needed that leads to increased food security and conservation gains. Their report provides examples of innovative landscape management strategies that successfully combined both objectives by applying ecoagriculture strategies. These six

strategies include enhancing wildlife habitat on farms and corridors that link uncultivated spaces in the landscape (Strategy 2); establishing protected areas near farming areas (Strategy 3) and mimicking natural habitats by integrating productive perennial plants (Strategy 4). Although we did not collect data that enable us at this point to establish that management of tree species in the four landscapes could be described as effective ecoagriculture, we did document here that farmers managed their ecosystems in ways similar to some ecoagriculture examples, especially for Strategy 4. We can therefore be carefully optimistic that some biodiversity can be conserved, although this hypothesis needs to be effectively tested through whole-landscape research, especially on metapopulation dynamics of flora and fauna in the landscape matrices.

It should be obvious that any diversification strategy should involve farmers and other stakeholders, and not be merely a desktop study of comparisons between species compositions of original and current vegetation types (Kindt *et al*., 2006c). Also, if biodiversity conservation is one of the objectives of diversification efforts, landscape-level planning of how biodiversity within remaining natural fragments can be better protected should remain a priority as habitat loss remains the biggest threat to biodiversity conservation.

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26 The Role of Forestry Education in Rural Strategies to Cope With HIV/AIDS in SSA

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ABSTRACT

The HIV pandemic is deeply entrenched in many countries and has had dramatic effects on rural livelihoods. In poor rural communities only a few people have access to treatment due to high prices of conventional medicine, poor health infrastructure and long distance to the health centres. The combination of the high incidence of HIV-related illnesses, high cost of treatment and the scarcity of health services in the rural areas have led to a greater dependence on the natural resources. Forest products are easily accessible to most people and their use has increased over the years. The higher mortality rate of adults has increased the demand for wood, in part to prepare food for increasingly frequent funerals, among others. The impact of HIV and AIDS on household labour has intensified the dependence on forest food products. This paper examines the role of forest education in response to HIV and AIDS, particularly in terms of food, herbal medicines and energy. It is based on the findings of different case studies that have been carried out in different parts of the world over the years. The paper shows that HIV and AIDS epidemic has increased the dependence of communities on forest resources and that the pandemic has environmental and natural resource management implications. Some forest policies and programme interventions that might help lessen the impact of the pandemic on natural resources and the role forestry education can play in the multi-sectoral response to HIV and AIDS have been highlighted.

26.1 INTRODUCTION

Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) is currently one of the greatest threats to global development and stability. Since the emergence of the epidemic in the early 1980s, more than 60 million people worldwide have been infected HIV and over 20 million have died from AIDS. In 2004 alone, the global HIV/AIDS epidemic killed more than 3.1 million people, and an estimated 4.9 million acquired the HIV bringing to 40 million the number of people living with the virus around the world (UNAIDS, 2005). Sub-Saharan Africa (SSA) is the hardest hit region of the world (UNAIDS, 2003). The AIDS-related excess mortality has had a profound impact on the demographic composition of communities and households. By 2010, AIDS is projected to leave 20 million African children under 15 years of age without one or both parents (UNAIDS and WHO, 2002).

For a long time, HIV/AIDS was viewed purely as a health issue, yet HIV/AIDS has implications that reach far beyond health - including great impacts on natural resources, agriculture and food production systems. In its earlier stages, the HIV/AIDS epidemic was predominantly an urban problem, affecting more men than women, and those with relatively higher incomes. Now the epidemic has rapidly moved into the rural areas, hitting those who are least equipped to deal with its consequences. In SSA, most infected people live in the rural areas and HIV/AIDS has become mostly a rural problem (UNDP, 2002). With its largely rural-based economies, it is unlikely that the epidemic can be controlled without the effective support to natural resources and agricultural sector (du Guerny 1999). This sector is in a strong position to assist in both the prevention and mitigation of HIV/AIDS (Gari and Villareal, 2002).

There is therefore, need to recognize natural resources household based activities which are vital to food security in any developing country and which cannot be sustained if HIV/AIDS continues unchecked. Where availability or affordable access to food is lacking, the prevalence of HIV is also alarmingly high. This unfolding tragedy underlines the need to tackle rural development, food security and agriculture policies in concert with fighting the AIDS epidemic. The role of forestry education becomes therefore very relevant in helping the communities in rural areas to cope with HIV/AIDS in SSA

26.2 THE CHALLENGE OF HIV/AIDS TO SUSTAINABLE DEVELOPMENT IN AFRICA

In Africa, HIV/AIDS is undermining progress towards sustainable development, leading to environmental exploitation and reversing many of the development gains of recent decades. By the end of 2006 there were an estimated 39.5 million adults and children living with HIV/AIDS, 24.7 million (63%) of whom are in SSA. Of the estimated 4.3 million new infections and the 2.9 million deaths from HIV/AIDS in 2005, 2.8 million (65%) and 2.1 million (72%) respectively were adults and children living in SSA (UNAIDS, 2006). One of the major causes is the desperate poverty and inequality experienced in the worst affected communities and countries. Poverty is a driver of HIV/AIDS and HIV/AIDS is a driver of poverty. It is a vicious circle. Where people are deprived of adequate health services, access to information about HIV prevention, and adequate nutrition and food security, conditions are set for HIV/AIDS to spread very rapidly (Oglethorpe and Gellman, 2004).

HIV/AIDS is devastating people's lives and livelihoods, resulting in damaging environmental impacts. Desperate people are more concerned with meeting immediate needs through short-term environmental exploitation than with long-term sustainability. The environmental impacts are diverse and a cause for concern because surviving children, grandparents and spouses still have food and livelihood needs but must satisfy them from an increasingly impoverished resource base. A major environmental impact is that HIV/AIDS-affected families and communities tend to increase exploitation of local environmental resources. The need for alternative incomes in response to the loss of family breadwinners is leading to unsustainable levels of hunting, fishing, fuel wood gathering and charcoal production for income generation.

HIV/AIDS have serious impact on national economies and it is estimated that labour in the ten worst affected African countries will decrease by 26% over the next 20 years (FAO, 2001). Impacts on the agricultural sector are also grave, with dire implications for future local and national food security. It is estimated that around 7 million agricultural workers have died from AIDS since 1985 in the 25 most severely affected African countries, and that a further 16 million more could die from the disease in SSA within the next 20 years (UNAIDS, 2002). This will have devastating impacts on developing country economies and food security, especially the lives, livelihoods and food security of rural families and farming communities. Some countries in Sub-Saharan Africa like Botswana, Namibia and Zimbabwe are expected to have a deficit of more than 20% in their agriculture labour force by year 2020

(Table 26.1). This will have a big impact on national economies taking into consideration that most of SSA are agricultural based.

Table 26.1: Projected Loss in Total Population and Agricultural Labour Force Due to AIDS, 1985-2020 in Some SSA Countries (FAO, 2001)

Country	Total Population	Agricultural labour force
Namibia	-17%	-26%
Botswana	-30%	-23%
Zimbabwe	-23%	-23%
Mozambique	-16%	-20%
South Africa	-27%	-20%
Kenya	-16%	-17%
Malawi	-17%	-14%
Uganda	-8%	-14%
Tanzania	-7%	-13%

The epidemic is also undoing the progress made in life expectancy in SSA which would have been 62 years without HIV/AIDS but has now dropped to just 47 years (DFID, 2004). It is predicted that it may fall below 30 years by 2010 if current AIDS trends continue in Africa (DFID, 2004). HIV/AIDS is also undermining sustainable resource use and environmental conservation. Desperate people have few choices: they have neither the reason nor the ability to fulfil long-term objectives and are instead concerned with meeting immediate short-term needs for food, energy, water, medicine and incomes. The result: excessive exploitation of resources as a survival mechanism; breakdown of community sustainability activities; lack of maintenance of conservation infrastructure such as for soil and water; lack of time and resources to implement long term projects such as establishing woodlots. This exacerbates resource scarcity and food insecurity.

One of the most critical characteristics that makes HIV/AIDS unique from other illnesses is that it disproportionately affects the most productive people in society, the very people on whom so many others depend. The most affected age group is 15-49 years; the breadwinners in society and the people who have children depending on them and, in the extended family systems.

In the worst affected countries, it is killing a whole generation of the most economically active, leaving grandparents to care for grandchildren, or orphans to care for themselves. Households headed by grandparents, women and children are becoming increasingly common (Figure 26.1). The impacts are undermining food, nutrition and income security, thereby pushing

surviving people into livelihood strategies that may make them more vulnerable to contracting HIV themselves. In understanding how HIV/AIDS is affecting people and their livelihoods, it is important to know about the social, economic and environmental impacts of the epidemic so that projects and programmes addressing HIV/AIDS can take a broad, multifaceted and multi-sectoral approach to increase their effectiveness and sustainability.

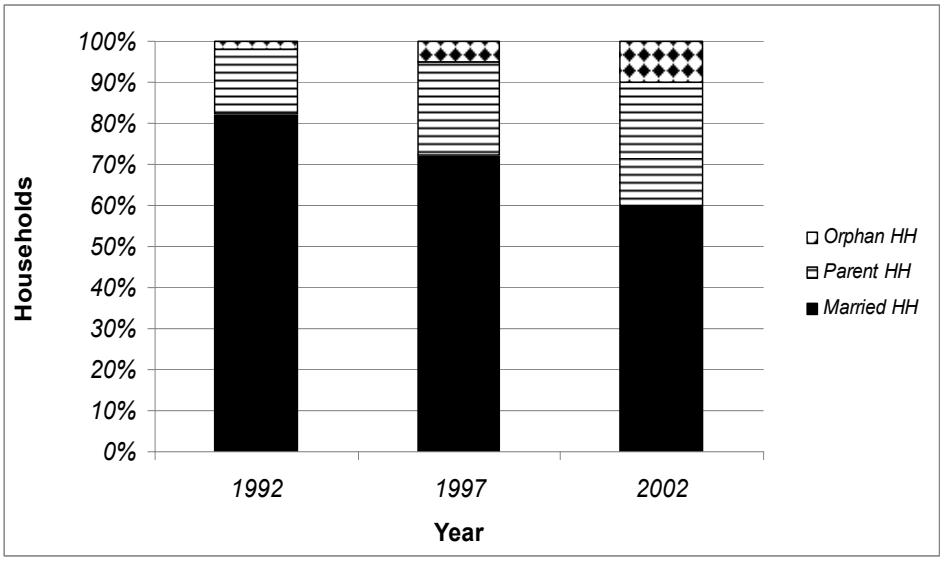

Figure 26.1: Changing Composition of Households in Bondo District, Kenya, 1992 to 2002 (Crare, 2003)

26.3 ROLE OF FORESTRY IN MITIGATING HIV/AIDS

Most people are not aware of the extent of relations between the forest sector and the HIV/AIDS pandemic. There is need for people to be aware of the role of forests in contributing to livelihood responses to HIV/AIDS affected households. Education can play a significant role in creating this important awareness. The impact on the demand and supply of forest products at local, national and regional levels and the transfer of local knowledge on sustainable use of forests and non-wood forest products to the next generation is very important for sustainable forest management.

There is need to understand that one of the few coping mechanisms that poor households with limited options can employ when subjected to shocks and pressures of HIV/AIDS is turning to 'freely' available forest resources and other natural capital for subsistence and income. This may include adapting to

existing use patterns, intensifying use, adding new products to the portfolio, or engaging in the trade of products previously used primarily for subsistence or cultural purposes.

Forest ecosystems contribute to the diets and subsistence of forest dwellers. In increasingly market-oriented economies, they provide a significant portion of the food and medicines consumed by urban populations. Recognition that the sustainable use of forest resources is essential for local livelihoods and the well-being of national population provides a foundation for investment in conservation of forest biodiversity and its integration with objectives of poverty reduction, food security and disease reduction in development policies. It becomes very necessary to demonstrate more fully that forest biodiversity is indispensable for combating malnutrition and diseases of vulnerable populations.

Farming households affected by HIV/AIDS have labour shortages and are using various coping strategies (Engh *et al*., 2000; Egal and Vastar, 1999). The household health care represents 25 to 50 percent of the net annual income of most small farms in developing countries (UNAIDS, 2004). High prices of drugs and recent market orientation of health care systems limit access to medical treatment (Nnko *et al*., 2000; Farah, 2001). Individuals infected with HIV are recommended to eat more food as their bodies require more nutrients (FAO, 2001). Low-income and HIV/AIDS-affected households often rely upon tree and forest products to complement their diets (i.e. wild food plants, bush meat, nuts, leaves and roots). Forest foods are often good sources of micronutrients (vitamins and minerals which are essential for good nutrition and health) and are essential to HIV/AIDS affected households. As Table 26.2 shows that some fruits in the forest contain high amounts of vitamins and nutrients.

Table 26.2: Some Neotropical Fruits in Brazil that are Excellent Sources of Provitamin (Rodriguez-Amaya, 1996).

Fruit	Portion analyzed	α-carotene ***(µg/g)***	β-carotene ***(µg/g)***	β-cryptoxanthin ***(µg/g)***	Other carotenoid ***(µg/g)***	Vitamin A activity in mixed foods ***(Retinol activity equivalents/100 g)***
Mauritia vinifera	Pulp	80.5	360		γ-carotene, 37	3050
Astrocaryum vulgare	Pulp		107	3.6	b-zeacarotene, 5.9	930
Eugenia uniflora	Pulp		9.5			830
Acrocomia makayayba	Pulp		55			490
Bactris gasipaes	Boiled pulp	3.2	22		γ-carotene, 18	270
Malpighia glabra	Pulp		26	3.6		230
Mammea americana	Pulp		14		β-apo-10'-carotenal, 5 β-apo-8'-carotenol,11	195
Spondias lutea	Pulp and peel		1.4	17.0		93
Cariocar villosum	Pulp		1.2	4.4		30

Note: By comparison, mango (***Mangifera*** spp.) and papaya (***Carica papaya***) provide 38–257 and 25–150 retinol activity equivalents per 100 g, respectively (USDA-ARS, 2004).

Wild supplies of food comprise much more of the diet of subsistence populations than is often realized (Hoskins, 1990). HIV/AIDS affected households tend to attach more importance to forest product collection than non-affected households (Barany *et al.,* 2005). Approximately 1,500 species of wild plants have been reported as being collected for consumption in central and West Africa (Chege, 1994). In some parts of Africa, diets based on staple grains depend largely on tree products to provide essential vitamins.

There are many trees that produce oil seeds, edible leaves and fruits that are rich in important vitamins and nutritional elements (Hoskins, 1990; Ogden, 1990). After the oil palm, the shea-butter tree (*Butryospermum paradoxm*) has been reported as the second most important source of fat in African diets (FAO, 1995). In some areas, wild game from forests provides most of the protein eaten by rural populations (Bennett and Robinson, 2000). Dietary supplementation with forest and tree products can play an important role in community nutrition given growing evidence that malnutrition is a major underlying cause for the rapid expression of AIDS in Africa's HIV-infected individuals (Enwonwu and Warren, 2001). There is evidence that agricultural labour and cash shortages amongst HIV/AIDS affected households have led to the reversion and increased consumption of wild foods, including fruits, nuts, leafy vegetables, fungi and protein sources such as bush meat and insects, (Kengni *et al.,* 2004).

Wild plants are a principal source of traditional medicines (leaves, roots, etc.) that may help to treat many of the symptoms of opportunistic infections that are associated with AIDS. Indigenous medicinal plants (including cultivated tree nuts and wild fruits) may also boost the immune system of HIV/AIDS patients. In SSA, health care is largely a forest-based service (Chege, 1994). Forests and trees are valued by agrarian communities for their supply of medicinal products (Hoskins, 1990), and plant-based remedies are used increasingly in the region to treat HIV/AIDS-related illnesses (Bodeker *et al.,* 2000).

Many households turn to traditional remedies to help ease some of the suffering of ailing household members, particularly from HIV/AIDS related opportunistic infections. These medicines may be collected by household members or purchased from traditional healers and medicinal plant vendors. Traditional remedies are often more affordable than conventional, western medicines, and consequently favoured (Kungu *et al.,* 2006). In Tanzania, the Tanga AIDS working Group is reported to treat AIDS patients with herbs prescribed by traditional healers (Hayman, 2001). At the Mefopla Centre in Cameroon, efforts to boost the immune system of AIDS patients involve indigenous medicinal plants with enzyme-rich food, including cultivated tree nuts and wild fruits (Kinyuy, 2001). Not only do forest and tree products directly contribute to nutrition and health, but they also contribute to the accessibility of food and health care by increasing household purchasing power. The growing demand for traditional medicines created by HIV/AIDS pandemic is likely to increase pressures on existing stocks possibly leading to scarcity in the future (Barany *et al.,* 2005).

26.4 TIMBER AND NON-TIMBER FOREST PRODUCTS AND HIV/AIDS

Trees, forests and woodlands provide materials for housing, roofing, and lighting. They also provide fuel wood which is essential for cooking, as well as drying and heating. Forests and trees also provide fibre, timber, fodder and mushrooms which can reduce expenditure and generate income. Timber and non-timber products may be used as a source of livelihood through value adding (i.e. handicrafts, furniture-making, and beekeeping). Perhaps one of the most important non timber forest products to household nutrition and health is fuel wood. In some regions of Africa, fuel wood comprises 61 – 86% of the primary energy consumption, with 74 – 97% of this consumed by households (Amous, 2000).

The availability of fuel often determines the nutritional values of meals (Egal *et al.,* 2000), as cooking releases nutrients in grains and fibrous foods. HIV/AIDS affected households often increase their consumption of fuel wood, since they can no longer afford to purchase alternatives. A study carried out in Malawi revealed that households that had experienced the loss of a working aged adult were five times more likely to have increased fuel wood collection than non-affected households (Barany *et al.,* 2005). The increased frequency of funerals also results in escalated demands for fuel wood and other traditional products associated with burials such as reed mats. In the long-term, this expanded use may have negative impact on the forest resources.

Home-based production and trading activities, often using traditional skills such as weaving, are frequently a 'last resort' option for income for widows, grandmothers left with AIDS orphans to care for, or even for orphans themselves. Shackleton (2005) reports that in Bushbuckridge, South Africa, at least 10% of mat weavers and traditional hand broom producers were elderly women with sole responsibility for their grandchildren. They had entered the trade for much needed extra income to pay school fees and purchase food. Case studies from across South Africa indicate that a significant proportion of female crafters head their own households (50-70%), with many of these women having been recently widowed. Similarly, selling woven products has been found to constitute an important coping strategy following illness and death in households in Mozambique, Malawi (Barany *et al.,* 2005) and Uganda (Barnett & Haslwimmer, 1995).

26.5 CONCLUSION

With most people in African countries living in the rural areas, it is unlikely that the HIV/AIDS epidemic can be controlled without the effective support of forestry sector. Training in forest biodiversity and awareness creation on local knowledge can be one way to mitigate the effects of HIV/AIDS. A greater focus on timber and non timber products can help to promote food security and nutrition, medicinal relief, and income generation. Successful interventions to support the use of forest biodiversity for health objectives are likely to be multi-sectoral, multidisciplinary and problem focused. Diversity-based approaches to improving nutrition and health depend on the conservation and sustainable use of forest and other wild species and biodiversity.

There is need to formulate and implement effective training strategies by involving the participation and integration of the different stakeholders. At the national level, ministries responsible for environment, health and nutrition, agriculture, forestry, economic development, culture and education could create awareness of forest products within collaborative initiatives for fighting and controlling HIV/AIDS epidemics.

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27 Environmental Perceptions and Attitudes of Local Communities towards Sustainable Harvesting of Baobab in Zimbabwe

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ABSTRACT

A survey to assess local communities' environmental perceptions and attitudes towards sustainable harvest of *Adansonia digitata* (baobab) was conducted in October 2005 in Nyanyadzi and Gudyanga wards in eastern Zimbabwe. The study area constitutes part of Zimbabwe's low veld with large population of the baobabs. However, the baobab population has been on rapid decline due to droughts, diseases, climate change and exploitation. Information on baobab product harvesting and utilization, markets and marketing of the baobab products, was gathered using questionnaires that were distributed among randomly selected baobab dependent enterprises, rural households, students, and retailers. The results revealed that the local people valued baobab greatly. More than 90% of the households derived food, fodder, and income from the tree. The intensity of baobab harvest is alarming with most trees being debarked. Regeneration of the trees in the area is on the decline with young trees being scarce. More than 80% of the respondents indicated that the population of baobab trees in the two wards was on the decline and its products were rare. Thus, the distance travelled by the locals in search of the rare products of baobab has increased. Increasing competition for the scarce baobab commodity is likely to result in social conflicts. Also, the results show that local knowledge systems and structures can be very

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useful in channelling forestry education. However, education on its own is inadequate. Communities need alternatives and incentives in order to ease the pressure on baobab products.

27.1 INTRODUCTION

Forest products are a common resource in most arid and semi-arid communal areas of Sub-Saharan Africa (SSA) that require minimum capital and skills to bring them to production. They provide a source of sustenance to the households when faced with risk, therefore they are used to raise money for the family in times of crisis. Among the trees that have gained favour with many communities of SSA because of the value attached to their products is the African baobab, *Adansonia digitata.* Found throughout the tropical and subtropical parts of Africa, from Senegal to Botswana it is abundant in arid to semi-arid regions (Wickens, 1982). Because of its drought tolerant nature, it has managed to sustain the lives of many people in these areas where agriculture cannot solely be relied on to provide food to the people (FAO, 1993, 1998; Campbell and Luckert, 2001).

The baobab tree in several countries is threatened with disappearance because of overexploitation (FAO, 1998). In recent years, there has been an increase in the commercial harvests of baobab products. Most of Zimbabwe's baobab trees are found in the communal areas where the land tenure system makes them a common property resource. In this regard the conservation of the baobab requires the participation of the whole community. For centuries, the rural communities of the low veld relied on the baobab in years of drought and harvested it sustainably. Because of many factors, which include population growth, the perceived commercial value of the baobab products, droughts and increasing poverty, the baobab is being harvested unsustainably. It is now generally believed that in the absence of intervention, the baobab will be overexploited to levels of depletion in the next few years. It therefore must be protected and its population should be allowed to increase because of its role as a buffer against poverty and as a source of raw material for the cottage industry in the country (Campbell and Luckert, 2001).

For any forest conservation strategy to work there is need to involve the community in which this resource is found and people who utilise it on a day-to-day basis. This study was initiated as part of an effort to come-up with a participative conservation strategy for the baobab tree in the Zimbabwe's lowveld because the population of the species is on the decline and the species

is considered as indicator of the state of the low veld and its conservation will support the adequate management of the arid and semi-arid ecosystem.

Understanding local people's attitude and perception towards management interventions is critical so as to win the support of local community towards management interventions. This study was set up to highlight the extent of household-use and small enterprises dependent on baobab related income-generating enterprises, indigenous knowledge on threats and management of baobab resources, and attitudes towards possible intervention strategies. This information is important to come-up with ways of engaging local communities in conservation of arid and semi-arid forest and woodland resources, motivating and assisting community based institutions to improve management of baobab harvest. The study helps in identifying gaps in the management one of the world's useful non-timber forest resources in the arid and semi-arid regions.

27.2 FORESTRY EDUCATION, LOCAL COMMUNITIES' ATTITUDES AND ENVIRONMENTAL PERCEPTIONS

Forest conservation education consists primarily of helping people develop their appreciation of forest-resource values. People cannot support forest conservation programmes to produce or maintain the values they do not perceive. The first step is to foster recognition then comes perception. Once perception begins, participation may follow. Forest conservation is a dynamic social process that defines and seeks to attain wise use of forest resources, while maintaining the productivities of forest habitats. This process is strongly influenced by practices, and attitudes of the past.

Forest conservation knowledge determines local communities' ability to use resources – more specifically, to discover them, harvest or use them at minimum expense, to make and provide a variety of material and spiritual forms of wealth from them, and to distribute this wealth among our people. Knowledge results from experience, scientific research and education. The manner in which knowledge is used may be more important than the mere availability of knowledge. Efficient use of knowledge is determined by public attitude – a product of the constantly changing philosophies and apathies of our people. Local communities' attitudes either stimulate or permit activities that may increase or decrease our quality of life.

27.3 METHODS

27.3.1 Study area description

Nyanyadzi and Gudyanga wards lie in the natural region V where average annual rainfall ranges from 300-500 mm. The rainfall pattern is erratic and during drought periods the area receives very little or no rainfall. The temperatures are very high, reaching a maximum of about 39 °C during summer. The study area constitutes part of Zimbabwe's low veld area with the largest population of the baobab tree. The harvest and sale of baobab products has also become a lucrative market for this community. Local businesses that are involved in the harvest and processing of baobab bark are on the increase. Baobab fruits are packed in sacks and can be seen on the roadside ready for transportation to markets in the larger town and regional locations. Processed items from the bark are also sold along the roadside, Birchneough–Mutare road, to tourists who have proved to be a large market for these products.

27.3.2 Data collection and analysis

Primary data was collected by means of questionnaires. The questionnaires were distributed to two categories of people found in the community: those who benefit directly from baobab exploitation (retailers, households and small enterprises) and those who are indirect beneficiaries (students and government officials). The questionnaires were administered with the help of the local agricultural extension officer. Over 100 respondents were interviewed during the study.

27.4 RESULTS AND DISCUSSION

27.4.1 Environmental and socio-economic problems in Nyanyadzi and Gudyanga Wards with implications on baobab conservation

Loss of vegetation, soil erosion and river siltation were viewed as serious problems in the area (Table 27.1). In Zimbabwe, the highest rate of forest degradation is found within communal areas, where the community largely relies on the forest for their energy requirements and population pressure has resulted in the removal of forestland to create room for settlement and agricultural practices. Like any other communal area, Nyanyadzi and Gudyanga wards also suffer from the forestland degradation as a consequence of population pressure and fuel energy requirements.

The overall mean ranking of the problems being faced in the area showed that there are some problems that were inter-related e.g. the increased erosion rate would result in a more serious siltation problem in the rivers within that area. The loss of vegetation results in soil erosion, siltation of rivers, extinction of plant and animal species and loss of soil nutrients. The people themselves usually conserve trees that are known to have great value within a community. There is also the concept of sacred trees that should not be harvested for firewood or any other uses e.g. the tree locally named *mukwirashoko* in shona. It is traditionally not harvested in districts to the south of Mutare. They are usually left when clearing of agricultural land is done. However, with the continual population pressure, deforestation is likely to cause a decline in baobab population regardless of the traditional conservation measures put in place.

Table 27.1: Prevalent Environmental and Socio-Economic Problems in Nyanyadzi and Gudyanga Wards, Zimbabwe

Problem	Mean Ranking
Loss of vegetation cover	3.65
Soil erosion	3.22
River siltation	3.19
Over population	3.04
Land shortage	2.92
HIV/AIDS	2.85
Declining crop yields	2.81
Wood shortage	2.69
Careless land practices	2.36
Water shortage	1.38

Scale: 1= Not serious 4= Very serious

Though the death and decline of *A. digitata* has been speculated to be caused by prolonged dry periods, the people in Nyanyadzi and Gudyanga did not perceive water shortage as a major problem. This may be as a result of the presence of several deep wells established within the areas and the existence of irrigation schemes where crops are established all year round. However, the semi arid nature of the region may affect the natural regeneration of the baobab tree. The germination and growth of baobab seedlings is restricted to the short rainy season that the area experiences. Most of the time, the amount of rainfall available is inadequate to ensure the successful establishment of the tree seedlings, therefore it is rare to find young baobab seedlings in the area.

The decline in baobab population, increasing distance and time to collect baobab products gives an indication of baobab resource depletion. Not all villages within the two wards were actively involved in the harvest of baobab products. Over use of the trees within their villages results in expansion into neighbouring villages. In addition, the time taken to acquire the resource continues to increase as the resource is depleted. The rare occurrences of baobab that have never been debarked also indicate an overexploitation of the tree. Some trees have been completely debarked, and steps have been constructed around the trunk so that the harvesters can reach up to heights above 2 m.

Increasing number of competitors in the business threatens also the existence of baobab trees in the Nyanyadzi and Gudyanga wards. Everyone wants to obtain maximum harvest from the trees and as the resources start depleting, the amount of time that the trees are given to regenerate is also reduced and extent of harvest is much greater than the regeneration rate. This will cause the death of trees through disease infestation or other stress related factors. Also, studies by Guy (1969) showed an increase in the number of dying baobab trees. This was attributed to the outbreak of the disease that causes a sooty blackened appearance on the trees and later results in their death affecting a large number of trees in Zimbabwe.

27.4.1 Importance of baobab in Nyanyadzi and Gudyanga wards

Survey results revealed that baobab was regarded as an important tree in the two wards and 95% of the local community derived benefits from the tree, which ranged from food, income to soil conservation. Generally, importance of baobab as a source of food, income, employment and soil conservation were ranked highly within the community. Respondents that were involved in baobab enterprises said that baobab were an important source of income and employment. It is interesting to note that students and general enterprises also view baobab as an important source of income. Households ranked baobab as a very important source of food higher than the other socio-economic categories found in the area.

According to Food and Agriculture Organization (FAO, 1998), the baobab is one of the most important trees in Africa, with each part yielding some product that is of economic importance. However, the baobab is not only important in economic terms but also as a source of food security in most rural households and as fodder for their livestock. The multiple uses of the baobab

makes the tree vulnerable to overexploitation especially in arid and semi-arid regions vulnerable to droughts, scarce economic activities and prevalent crop failures.

As a source of food, its leaves are commonly eaten as a relish to substitute commercially grown leafy vegetables like cabbages and lettuce, especially in times of drought. They are a major source of iron as well as other minerals required and supplied in the diet of the family. Baobab fruits are a favourite of cattle-herders and children across Africa. When dissolved in milk or water, the resultant liquid is taken straight, as a drink, or as a sauce for food, a substitute for cream of tartar in baking, and a fermenting agent in traditional brews. When dried, the fruit pulp can also be added to gruels on cooling after cooking. Research on the processing techniques have revealed that the pulp can be stored for long periods of time for use in soft drink production but requires to be kept in air tight containers. Although the seed is used in many parts of Africa as a continent, its potential has not been fully exploited. Baobab seed has been shown to contain about 30% protein. Studies by Igoboeli *et al*. (1997) showed that by processing the seed, the nutritive quality was enhanced by reducing and destroying the anti-nutrients present depending on the method used. Studies have further revealed that exposing the seed to hot alkali resulted in the highest removal of tannins, whilst dehulling and cold water treatment reduced the activity of the amylase inhibitors (Igboelli *et al.,* 1997).

The seeds, which may be eaten raw or roasted, produce oil that is edible, which is a useful substitute for vegetable oil, and are sometimes ground up to produce a coffee-like hot beverage. They are used generally as a thickening agent in soups, but can also be fermented and used as a flavouring agent. The young shoots are also an alternative source of relish and are eaten as asparagus (Saka and Msonthi, 1994). In Zimbabwe, Southern Alliance for Indigenous Resources (SAFIRE) has been promoting the extraction and use of baobab seed oil by the local community both for local use and as income generating project for the regional market. Although trees are a major source of fuel wood in the area, baobab was viewed as a very poor source of firewood and was ranked as not an important source of firewood by respondents in the Nyanyadzi and Gudyanga wards (Table 27.2). The survey also revealed that the community does not regard highly the importance of baobab as a source of medicine.

However, baobab has many medicinal applications. The pulp is consumed to treat fever, diarrhoea, malaria, haemoptysis and scorbutic complaints (vitamin

C deficiency). The bark and leaves are also useful in the treatment of fever, and are reported to have anti-inflammatory and diaphoretic properties. The seed is either pulped or applied externally, or drank in water, to cure gastric, kidney and joint diseases. In the Kalahari, San Bushmen use the seeds as an antidote to Strophanthin, a common plant-derived arrow poison. The baobab products are also a component of Indian medicine, with the bark being used internally as a refrigerant, antipyretic and anti periodic. The powdered leaves are similarly used to check excessive perspiration. Externally, the young leaves are crushed into a poultice and used for painful swelling. In Zimbabwe an infusion of roots is used to bathe babies to promote smooth skins and growth of the babies.

Table 27.2: Attitudes and Perceptions of Local People in Nyanyadzi and Gudyanga Wards in Zimbabwe on the Importance of the Baobab Tree

Uses	Mean importance
Control of soil erosion	3.58
Source of food	3.53
Income source	3.42
Employment source	3.31
Source scenic environmental aesthetic beauty	3.03
Source of forage for livestock	2.49
Cultural, traditional and religious inspiration	2.49
Medicine	1.59
Firewood	1.05

1= Not important 4= Very important

Soil conservation was ranked to be one of the most important benefits that baobab offers to the community of Muwusha, whilst food and income were ranked second and third respectively. The baobab tree was not perceived as a very important firewood source within the area (Table 27.2). There is significant difference in the way the different socio-economic categories found in the area perceive the importance of baobab as a source of forage.

Baobab products are a major part of people's livelihoods. They are a source of raw materials for their business ventures as well as in their households. Ranking the overall means of the benefits derived from the tree in terms of importance shows that the community is largely dependent on the baobab tree as a source of food. However it was rather surprising that most of the respondents ranked soil conservation as the most important benefit derived from the tree. This could be because of the tree's shallow root system that

holds together the top soil and prevents it from being washed away. Also, the trees' large canopy reduces the impact of raindrops onto the ground thus reducing the amount of soil washed away. Most households were more concerned about food security and whether the family had enough food to eat, therefore the results showed an expected trend in that the majority of household members interviewed viewed baobab as a very important food source for their families.

The lack of differences in perception of the importance of baobab between the different age groups indicates a strong indigenous knowledge base within this society. This is in contradiction with the perceived theory that with the coming of formal education, local knowledge systems have been displaced and knowledge of the traditional uses of indigenous resources is minimised within the young age groups.

The lack of differences in perception can also be explained by the fact that baobabs have been used within the society for a very long time that everyone has come to realise and accept their importance within the society in which they live. As a forage source, households and students could have put more emphasis on that because they tend to spend a lot of time out in the pastures with the animals and have observed their feeding behaviours. It is also interesting to note that not only is baobab forage of domestic animals, but elephants have been seen tearing off the trunk and eating it. Because baobab bark has high moisture content of about 40%, it is not a popular source of firewood in this area. This also explains why it is not frequently cut down for use as firewood.

27.4.2 Baobab related enterprises in Nyanyadzi and Gudyanga wards

In many countries both commercial and indigenous forests support the bulk of small to medium income generating enterprises. Although the extremely high moisture content of the wood (40% or above) renders it unusable as a timber, the baobab bark makes excellent fibre, employed in basket, rug and rope making, and has been used variously to make fishing nets, animal snares, sacking and even strings for musical instruments. Selling of these products provides extra income for the household. Harvesting and marketing of these products is not a primary function for most people. However, a peak in these activities occurs during the dry seasons when other field crops production is low. An almost equal distribution of males to female was found within the baobab enterprise dealings.

The majority of entrepreneurs (36%) were within the 21-31 age group, which comprises the young people who had just left school (Table 27.3). At least 89% of the people involved in baobab enterprises had some level of education. When asked about the source of motivation that made them get involved in the business, 73% of the respondents claimed that it was because of their knowledge on how the business operates. Eighteen percent were involved in the business because their families were operating the enterprises. Other factors that were noted include unemployment and poverty.

Table 27.3: Socio-Economic Characteristics of Entrepreneurs Involved in Baobab Enterprises, Nyanyadzi and Gudyanga Wards, Zimbabwe

	Sex		Age group				
	Female	Male	15-20	21-30	31-40	41-50	>50
Percentage	55	45	9	36	27	18	9

The respondents were asked about the line of business in which they were involved. The majority of the entrepreneurs were involved in the weaving of mats and the collection and sale of baobab fruit (Figure 27.1). None of the respondents interviewed were involved in the business of processing of the bark into fibre.

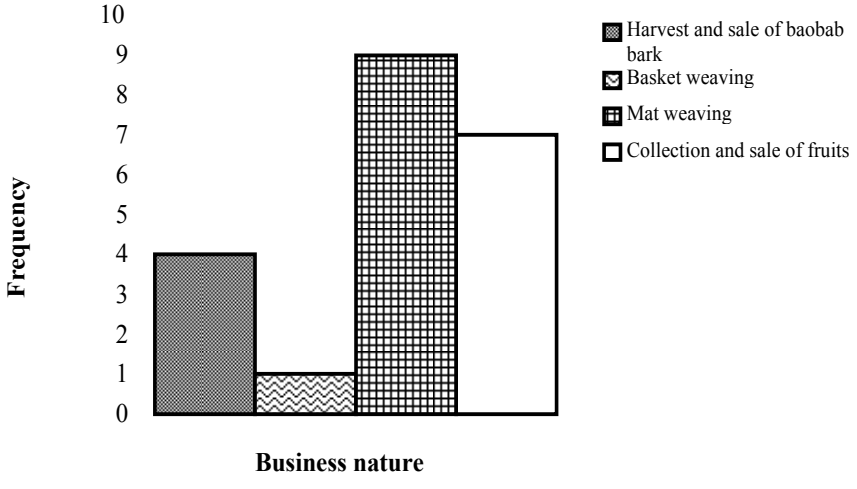

Figure 27.1: Baobab Related Enterprises in Nyanyadzi and Gudyanga Wards, Zimbabwe

27.4.3 Baobab products: Markets and marketing

The survey revealed that most of the products that were made from baobab were sold to several markets both local and international. These products included mats, hats, bags and fruits. The export market was seen as the major one for these products with tourists and neighbouring countries constituting 59% (Figure 27.2). Stalls could be seen set up along the road with these products for sale to the local people as well as tourists travelling along the road. The survey also revealed that there were no stable prices for the baobab products. Prices were determined by either the current market price, negotiation with the buyer, size and decorations of the products.

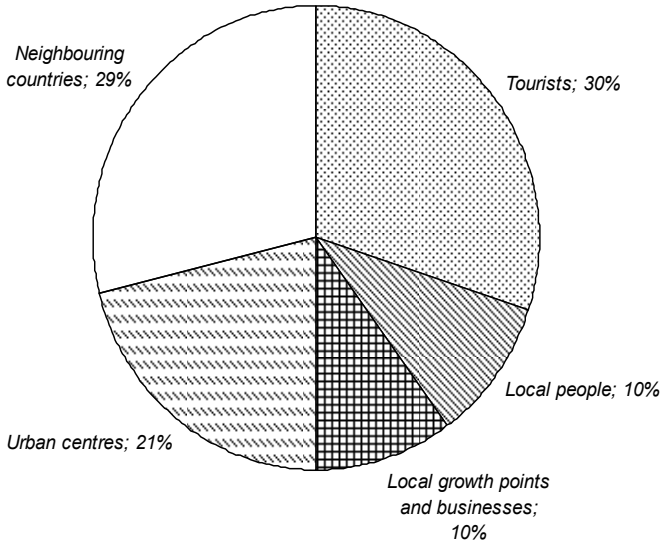

Figure 27.2: Market Segmentation for Baobab Products in Nyanyadzi and Gudyanga Wards, Zimbabwe

27.4.4 Trade in baobab products: implications on drylands woodland biodiversity conservation

The baobab industry is neither sensitive to age nor gender as both the old and the young, female and male are found actively involved in the business. Young men can be found harvesting the bark (which requires physically strong people) whilst the women harvest fruit. Both men and women are also involved in the processing of the fibre and making of the crafts. The dominance by young people between the 21-30 years category, the country's major labour force, could be a result of the high poverty and high

unemployment levels in the country. They venture into the crafts business as a way of trying to survive while others may be involved in the trade because this is what they know how to do best and their families are involved in the trade.

The survey showed that there exists a large market for baobab products, which seems to be enticing an increasing number of people to harvest the product. Existence of such a market, especially a foreign market compounded by the increasing level of unemployment has potential adverse repercussions to the conservation of the baobab tree in Nyanyadzi and Gudyanga wards. The market of local businesses is probably an indication of middlemen who buy the product for resell at higher prices to other markets. The expansion of the market of baobab products to cater for both the local and regional destinations implies that there is need for a stable resource base for the commodity to achieve sustainability. The maintenance of a stable or increasing resource base may be greatly affected by the loss of vegetation that the area is faced with. Deforestation in the area, may contribute to the reduction in numbers of the baobab tree. This problem may be made worse by the rarity of finding young baobabs in the area; therefore the tree may be faced with extinction sometime soon if nothing is done to protect the trees that are still in existence.

27.4.5 Attitudes and perceptions towards baobab conservation

The loss of vegetation was a major problem in the area. This could have given rise to the high level of concern towards the loss and death of baobab trees. This decline in trees would mean a reduction of the baobab industry because of a decline in raw material, overexploitation of the current resource base and a reduction in the period trees are left to recover. The loss of vegetation was a major problem in the area. This could have given rise to the high level of concern towards the loss and death of baobab trees. This decline in trees would mean a reduction of baobab industry because of a decline in raw material, overexploitation of the current resource base and a reduction in the period trees are left to recover.

The local communities were greatly concerned with the fate of the baobab trees, and were willing to do something to prevent their extinction. This is unlike the conventional theory that rural communities are not concerned about their resources. Those involved directly with the use of baobab products will however be reluctant to favour those conservation measures that affect their access to the raw materials that they have, for example regulating the amount of bark harvested or the number of people harvesting. These people will tend

to prefer conservation measures that reduce the impact of harvest on the tree e.g. alternative sources of raw materials. This detachment from some forms of conservation may be because of the lack of adequate knowledge about what and how that conservation strategy will be conducted and what its impact on their businesses will be in the long term.
Based on the responses given, any conservation strategy that has its basis on allowing the recovery of baobab is likely to succeed as it has the full support of the community. The total ban of harvest would take the 'management for the people' approach of conservation and this would result in the defranchisation of the resource of the people promoting illegal harvesting to higher levels.

27.4.6 Threats to the conservation of *Adansonia digitata* in Nyanyadzi and Guydanga wards

The survey revealed that, 81% of the respondents interviewed showed that they were aware of the decline in the population of baobab trees in the recent years. Of the above 49% was constituted by women and 51% were men. It was also apparent from the study that the rural communities had already started suffering the consequences of over utilization and decline of baobab resources in the area. The respondents cited the problems of increasing distance to harvest and collect baobab products, increased efforts (time and money), declining fruits yields and the increase in competition by other craft businesses as the major problems experienced (Figure 27.3). In addition, unregulated harvests and the decline and death of trees were problems that would likely affect the sustainability of their businesses. Also, 87% of the respondents confessed that it was rare to come across a baobab tree that has never been debarked.

Baobab tree regeneration rate in the community is generally low threatening the continual survival of the tree in this area. 80% of the respondents revealed that coming across a young baobab tree was a rare occurrence. It also revealed that of the few young trees available, these trees were a favourite to animals that would browse on them, thus reducing their numbers. The amount of knowledge the people had about the current status of baobab in the area could also be a threat to the conservation of the tree. The survey showed that 20% of the respondents felt that baobab was still plentiful and people should be allowed to harvest as much as they wanted. Twenty nine percent felt that debarking did not inflict any damage to the tree as it recovered within a few years. Twenty percent of the respondents felt that baobabs were many and there should be no worry about their conservation.

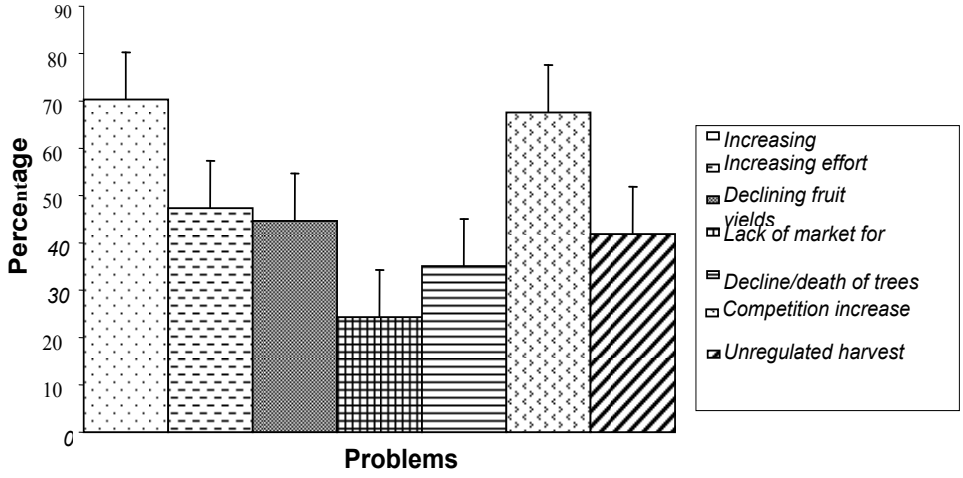

Figure 27.3: Problems Being Encountered as a Consequence of the Declining Baobab Resources in Nyanyadzi Gudyanga Wards, Zimbabwe.

27.4.7 Attitudes and perceptions towards baobab conservation and management

More than 50% of the respondents interviewed were concerned with the fate of the baobab tree in the Nyanyadzi and Gudyanga wards if present conditions continued to prevail. It was evident that the death and loss of baobab trees and the number of debarked trees were a major concern in the community.

Generally the respondents were concerned about the over exploitation and fate of the baobab trees within their areas (Table 27.4). The major concern was that of the decline of baobab populations in the area whist the least concern was the effect that the lack of regulations to control amount of bark harvested had on the tree. According to the survey done by Matose and Clarke (1991), there is no form of tree tenure in communal grazing areas that governs the use of the trees. As long as the situation remains like this and people continue to utilise these trees without any control, then tragedy is bound to fall on them. A Study by Guy, (1969) showed an increase in the number of dying baobab trees. This was attributed to the outbreak of the disease that causes a sooty blackened appearance on the trees and later results in their death and has affected a large number of trees in Zimbabwe. This disease which is spread through fungal infestation was said to have been around but was only observed on old trees and was part of the decaying process. However, this phenomenon has recently been observed

on both the old and young trees. It has become more serious as a result of the prolonged drought periods.

Changes in rainfall patterns, rainfall reliability, climate change and lowering of the water table are some of factors cited to contribute the increasing occurrence of the fungal infection (Guy, 1969). Most of the trees do not recover from the disease when normal rainfall conditions continue and therefore not only are the old trees dying because of this disease but the young ones as well. The survey by Matose and Clarke (1991) further revealed that the bark had a sooty appearance was not suitable for use as fibre. Not only is the sooty baobab a threat to the tree, but also to the businesses that rely mainly on the fibre as a raw material. This also implies that the resource base for the industry is reduced and as a result overexploitation is likely to occur on the trees that are free of the disease and thus the need for the sustainable use of the trees.

A survey by Matose and Clarke (1991) about the rural communities' attitude towards increased death of the baobab as a result of the fungal attack revealed mixed reaction. For example an old woman after being asked whether she was concerned about the dying of these trees, replied, 'Yes it is a problem, but it's not only the trees which are dying; people are dying of starvation and so are our livestock' (Matose and Clarke, 1991).

Table 27.4: Concern towards Baobab Exploitation by Communities in Nyanyadzi and Gudyanga Wards, Zimbabwe

Management concern	Degree of concern
The death and loss of baobab trees	1.97
The number of debarked trees in the area	1.93
Lack of regulations to control number of harvesters	1.82
Lack of regulations to control the amount of harvested bark	1.67

3 = Very concerned 2= Concerned 1 = Not concerned

Results of the survey on the people's acceptance suggested options to reverse the decline of the baobab are summarized in Table 27.5. The overall mean response for the approved strategies has revealed that allowing baobab recovery is a method that the communities themselves are fully in favour of whilst the respondents were against the total ban of harvest by government. This is understandable given the apparent lack of alternative economic opportunities in the area at the moment. Currently, no study has been carried out to investigate the period taken for the trees to recover fully from the

different levels of debarking. However, given the problem of fungal infection and prevalence of droughts, the recovery period should be considerably getting longer and longer. Also, this management intervention can be difficult to enforce, without a donor or government agency providing alternative income generating options during the period the baobabs are allowed to recover from debarking.

Regulating the number of people harvesting the bark as well as regulating the amount of bark harvested are measures the local community can enforce and police with ease especially if the local institutions are developed and capacitated. If the rural communities could be empowered to implement the measures described above, they could easily deter poachers and non-residents perceived to be exploiting the open access window to exploit the baobabs at the expense of adverse socio-economic repercussions on the local people. The local people were opposed to a local authority such as the Rural District Council (RDC) charging a fee to minimize the level of debarking. However, it might seem more feasible to develop local institutions to manage the resources and charge fees where the money generated goes to development projects that benefit the area, such as drilling boreholes.

Table 27.5: Attitudes towards Proposed Measures to Curb Overexploitation of Baobab Resources in Nyanyadzi and Gudyanga Wards, Zimbabwe

Conservation measure	Level of approval
Allow debarked trees to recover	2.66
Regulate number of people	1.97
Regulate amount of bark harvested	1.88
RDC to charge a harvesting fee	1.58
Total ban of harvest by government	1.40

3 = Agree 2 = Indifferent 1 = Disagree

27.4.8 What are the implications of this study on teaching of forestry?

Forest conservation including regulating the harvest of non-timber resources such as the baobab as discussed here, and as presented in many forestry discussions includes the term wise use, which cannot be clarified without resorting to personal philosophies. Although forestry managers need to know how to manage forests, they must also know why. If they are to succeed, they must be convinced that the job is worthwhile. Such a conviction arises from personal philosophy. The philosophy is a system of personal ideals, principles, and morals. There is need for forestry training to include important topics like local knowledge systems in forest resource management.

Forest production is intimately related to land use and to other land uses and land resources. A multidisciplinary curriculum is required to produce motivated foresters who can address the broad challenges relating to the declining forest resource. Also, forest conservation is a form of morality because it is practiced not for immediate personal and material reward, but mainly for future benefits to communities, states and nation. Future forest curricula must depend heavily on concepts of morality that provide direction and motivation to forest managers.

27.4.9 Forestry education and extension to influence local people's attitude

Forest extension is limited in many rural parts of Africa. There is need to invest in forest education and extension the areas which are otherwise marginalized by development. Educating the rural folks would need to exploit the rural communication media, channels and techniques. The training should seek to empower rural households with basic skills such as forest nursery preparations and management. Incentives could be provided to rural households who demonstrate favourable output in terms of number of well managed tree nurseries, tree care, successfully replanted and rehabilitated areas.

There is need to adopt a participatory approach in future assessment and monitoring on the level of baobab population decline, as well as the socio-economic consequences. Also, there is need to empower rural communities' structures so as to police forest harvesting and deter poaching and overexploitation by foreign markets. If rural communities grasp that they are the beneficiaries of good forest governance, just as they are the victims of poor forest governance, they will take the responsibility to protect and manage the remaining forest resources. As the most discussed in the case of Nyanyadzi and Gudyanga wards, women in the rural areas are the affected category as a result of the declining forest and woodland resources such as baobab. This group is most likely to welcome, appreciate, value and support sustainable forest and woodland management. Deliberate efforts should be made to empower women groups on sound forest or tree management basic skills, and provide them with the necessary support and incentives to spearhead forest and woodland conservation.

27.5 CONCLUSION AND RECOMMENDATIONS

27.5.1 Conclusion

The study reveals eminent overexploitation of baobab resources in the wards with consequent decline over the years. Apart from the cited problems as a result of baobab overexploitation, the observed decline poses potential socio-economic problems relating to issues such as accessibility and affordability of baobab resources given the continuing dwindling of the baobab population. Increasing competition for the scarce baobab commodity is likely to result in social conflicts. Apart from the negative socio-economic repercussions, the phenomenal deterioration of the baobabs has adverse implications on biodiversity and natural resources conservation in this arid and semi-arid area, given that the species is regarded as key-stone species in the region. Overall, the results show that local knowledge systems and structures can be very useful in channelling forestry education. However, education on its own is inadequate. Communities need alternatives and incentives in order to ease the pressure on baobab product harvesting and utilization.

27.5.2 Recommendations

- Explore alternative sources of fibre**:** There is need to explore and introduce alternative sources of fibre to mitigate demand of harvesting the baobab for fibre. The area is prone to droughts and whatever species should be considered should be fairly drought resistant. Given the poverty situation in the area, establishment of drought resistant alternative sources of fibre would require external funding; and

- Introduce alternative forms of economic activities: The study area is prone to droughts, which drive the overdependence and overexploitation of the woodland resources such as the baobab. The government needs to invest in irrigation among other forms of development to diversify alternatives forms of land use.

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28 Trade-Offs and Synergy in Slash-and-Burn Farming: A Case Study From Northern Lao People's Democratic Republic

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ABSTRACT

We have been involved in a research project to devise a land-allocation plan in the northern Laos that may balance agricultural production and forest ecosystem functioning (esp. carbon sequestration) without displacing the present agricultural and other livelihood activities. There appeared to be synergistic relationships among some forest ecosystem functions and trade-offs between forest ecosystem functions and agricultural production in the northern Laos. A minimum optimum fallow period (MOFP) or fallow-period threshold for forest ecosystem functioning may exist. We estimated it at about 5-years in the studied area. The concept of MOFP may be helpful in decision making for balancing forest ecosystem functions and agricultural production. Many factors would be influential to MOFP; e.g. climate, soils, use of cultivars, planting systems and pasturing in fallowed land. Clarifying the factors of MOFP is essential and is a task of agriculture and forestry researchers. Education can play a role in consensus building among the stakeholders on land use and land-allocation plan that is well-balanced.

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28.1 INTRODUCTION

Slash-and-burn agriculture has been widely practiced in Southeast Asia. In the northern part of the Lao People's Democratic Republic (Laos), the fallow period has been drastically reduced from about 20 years in the 1970s to about 5 years in the 1990s as a result of population increases (Roder, 1997). Government policies for forest management were enacted in 1981 (Tan, 1998). Some fallowed slash-and-burn fields were converted to conservation forests, which reduced the area available for slash-and-burn farming. Teak (*Tectona grandis*) plantations established primarily in the 1990s (Roder *et al*., 1995) have also reduced the amount of arable land in the region. As a result of the increased population and the reduced amount of arable land, slash-and-burn agricultural systems with fallow periods of only 1 to 3 years are now common in the region (Inoue *et al*., 2007).

Balancing agriculture and forestry is important in land use planning. From the viewpoint of sustainable land use, through balancing agriculture and forestry, information of ecosystem functions to policy-makers should be required of ecologists. Education can play a role in consensus building among the stakeholders on land use and land-allocation planning. Our aim was to devise a land-use plan that would allow for the recovery and maintenance of the regional ecosystem, improve carbon sequestration by extending the fallow period, and reduce the slash-and-burn areas without displacing present agricultural and other activities. Such a plan requires increased agricultural productivity through the appropriate use of technical innovations (Saito *et al*., 2006a, 2006b) as well as an integrated land-use planning approach in terms of other ecosystem functions (Saito *et al.*, 2006c). For example, Saito *et al*., (2006a) evaluated the use of improved upland rice cultivars in the region.

Using the results of a simulation (Inoue *et al*., 2007) of long-term changes in ecosystem carbon stocks under different patterns of slash-and-burn agriculture, we investigated chronosequential changes in some ecosystem goods and services in fallowed land and then suggested a "minimum fallow period" that avoids overuse of ecosystem carbon stocks. We selected the mean annual increment (MAI) of biomass as a candidate for index of the ecosystem carbon stock function and analyzed MAI values of planted tropical forests.

28.2 METHODOLOGY

The study sites were located in the villages of Houaykhot and Phônsavang in Luang Prabang Province (Figure 28.1), about 200 km north of Vientiane, the capital of Laos. Northern Laos has a tropical monsoon climate, with a pronounced rainy season from April to September and a dry season from October to March. Between 1998 and 2005, the mean annual rainfall was 1312.7 mm and the mean annual temperature was 25.2^0 C at Houaykhot (Northern Agriculture and Forestry Research Centre). Soils of most slash-and-burn fields in northern Laos are classified as Orthic Acrisols, with a reddish-brown colour, clay contents of 30% or more, and a slightly acidic pH. Rain-fed rice farming represents the main livelihood in the region. *Bambusa* sp. and *Cephalostachyum* sp. are the dominant species in the secondary forests at the study sites.

Biomass (above and below the ground), litter, deadwood, and soil organic carbon stocks of fallowed communities were measured or estimated in 6 research plots that had been fallow for between 0.5 and 20.5 years (Kiyono *et al*., 2007a; Asai & Saito, 2006). We interviewed local residents to record the vernacular names of trees in the research plots and the values of each tree species as timber, fuel wood, and non-timber forest products. We also asked about methods of collecting fuel wood; people usually collect deadwood and charcoal from their slash-and-burn fields and deadwood from near the villages for fuel. Nutrients for slash-and-burn cropping are considered to be mainly in the ashes from leaf and branch biomass and litter stocks in the slash-and-burn field. The community's carbon stock (biomass + litter + deadwood carbon stocks, Mg ha^{-1}), timber and fuel wood production index (stem biomass + deadwood stocks, Mg ha^{-1}), and agricultural production index (leaf and branch biomass + litter stocks, Mg ha^{-1}) were regressed against the elapsed time since the last slash-and-burn cropping. We obtained data from the research literature on tropical forests to evaluate the biomass growth of planted trees from dry-land forested areas to wetter tropical zones (Kiyono *et al.,* 2007b).

Figure 28.1: Location of the Study Sites.

We simulated long-term changes in the ecosystem carbon stock under different land-use patterns using semi-empirical equations and the following assumptions (Inoue *et al.,* 2007): Slash-and-burn land use for 1 year caused a loss of about 6 Mg C ha^{-1} in the soil, and it would take a 12-year fallow period to recover the initial level of soil carbon (Asai and Saito, 2006). The community's carbon stock was expressed by a log function of the number of years since the last slash-and-burn cropping, and it increased to about 45 Mg C ha^{-1} after a 10-year fallow period (Kiyono *et al.,* 2007).

28.2.1 Trade-offs and synergy among regional ecosystem functions

The community's carbon stock in slash-and-burn fallowed land markedly increased as the fallow period increased (Figure 28.2). Most of the carbon stocks (75%) exist in the biomass pool. The timber and fuel wood production function (Fig. 28.2, line b), agricultural production function (Fig. 28.2, line c), and species richness of all tree species and non-timber forest product species (Fig. 28.2, line d) also increased with time. If the supply of ecosystem goods and services are sufficient as compared with the demand (use)—as occurs, for example, in thinly populated regions—expanding the fallow period will have

a synergistic effect on other ecosystem functions. If the supplies of ecosystem goods and services are insufficient, however, as is the case of unsustainable use in densely populated regions engaged in slash-and-burn farming, expanding the fallow period will reduce the amount of slash-and-burn cropland available (Fig. 28.2, line e) and result in trade-offs between regional slash-and-burn agricultural crops and other ecosystem functions. In such situations, unsustainable use of ecosystem functions can occur.

(a) The community's carbon stock; biomass + litter + deadwood carbon stocks per land area, (b) The timber and fuel wood production index; stem biomass + deadwood stocks per land area, (c) The agricultural production index; leaf and branch biomass + litter stocks per land area, and (d) The species richness of all tree species or non-timber forest product species; species density per land area. (e) The amount of slash-and-burn cropland available if the arable land is insufficient; land area.

Figure 28.2: Chronosequential Changes in the Value of Ecosystem Goods and Services in Slash-and-Burn Fallowed Land

28.2.2 Minimum optimum fallow period

The long-term average for the ecosystem carbon stock at the research site was estimated to be kept near the initial carbon stock level under a land-use cycle of 1 year of slash-and-burn farming followed by a 5-year fallow period (Inoue *et al*., 2007). When the fallow period was shorter than 5 years, the average value of the ecosystem carbon stock was lower than the initial value (Inoue *et*

al., 2007; Fig. 3). Repetition of a cycle of 1 year of farming followed by a shorter fallow period (<5 years) will decrease the ecosystem carbon stock and cause land degradation. This suggests the existence of minimum optimum fallow periods (MOFP) (or fallow-period thresholds).

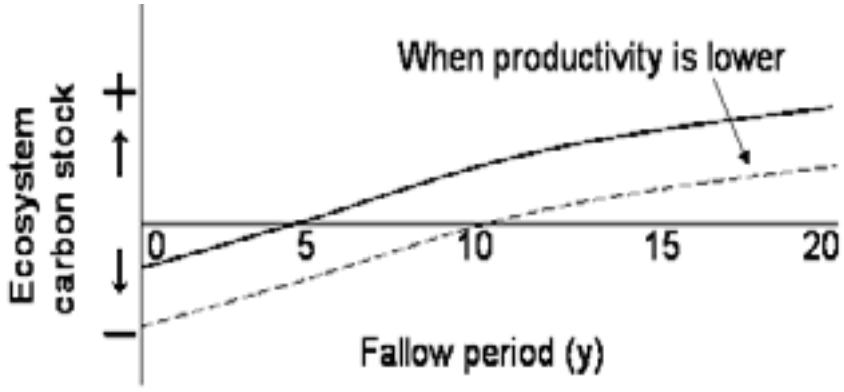

Figure 28.3: Changes in the Ecosystem Carbon Stock Function and Fallow Period of Repeated Slash-and-Burn Use (Inoue et al., 2007).

This fallow-period threshold will be influenced by various natural and social conditions. The biomass MAI is one such factor and may be used as an index of the fallow-period threshold for overuse.

The biomass MAI values of the planted trees varied greatly between 0.5 and 36.1 Mg $ha^{-1}y^{-1}$ (Figure 28.4, Kiyono *et al.*, 2007b). The values differed significantly between fast-growing and non-fast-growing species in the tropical moist and wet climatic zones ($P < 0.0001$), but they did not differ significantly between these two groups of species in the tropical dry climatic zone *($P = 0.999$).* Values of MAI of fast-growing species increased as mean annual precipitation increased ($P < 0.0001$). For non-fast-growing trees, MAI values were significantly smaller in the tropical dry climatic zone than they were in the tropical moist and wet climatic zones ($P = 0.0022$). MAI values for fast-growing tree species in the tropical dry climatic zone were less than one-fifth of the values of those in the tropical moist and wet climatic zones, as compared with about one-third of the corresponding values for slow-growing species.

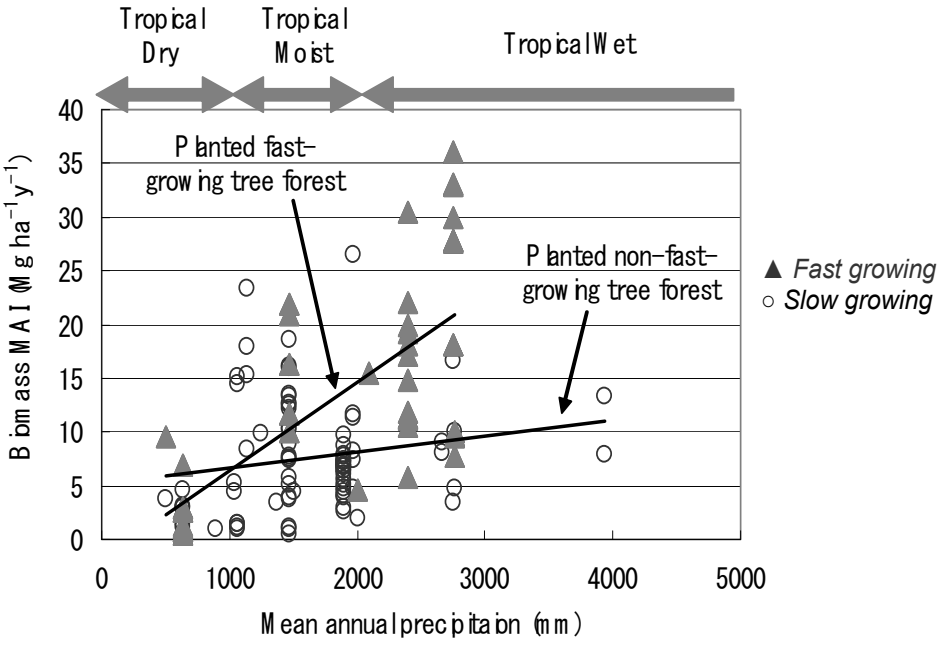

Figure 28.4: Relationship Between Mean Annual Precipitation and Biomass MAI for Forests of Fast-Growing Trees and Slow-Growing Trees (Kiyono *et al*., 2007b)

The land with low values of MAI (e.g., the land in the Tropical Dry climate zones) may have a longer (>5 years) minimum fallow period. However, influence of MAI values on threshold is unknown now. Further studies are required to refine the general relationship between them.

28.3 CONCLUSION

There appeared to be synergistic relationships among some forest ecosystem functions and trade-offs between forest ecosystem functions and agricultural production in the northern Laos. A minimum optimum fallow period (MOFP) (or fallow-period threshold) for forest ecosystem functioning may exist. We estimated it at about 5-years in the studied area. The concept of MOFP may be helpful in decision making for balancing forest ecosystem functions and agricultural production. Education should play a role in consensus building among the stakeholders on land use for land-allocation plan that is well-balanced.

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29 The Place of Women in Tertiary Natural Resource Education for Socio-Economic Development: Perspective on Problems and Trends in Kenya.

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ABSTRACT

The paper provides a comprehensive review of natural resource management (NRM) education in Kenyan universities and highlights the major obstacles that hinder the participation of girls and women. This is on the basis that the low participation in this level of education is a key constraint to the development of the country. The paper outlines the main reasons for the general decline of enrolment in basic science courses and those related to earth sciences and in particular the female students in the government-sponsored programmes, over the last two decades. The paper further analyses the main reasons why fewer and fewer female students are studying natural resource management education and allied courses in Kenya, despite the increasing role of women in environment and the fact that the admission criteria have been lowered to lure female students into courses in natural resource management fields. These issues are discussed through a review of available literature and Kenyan Universities Joint Admission Board (JAB) documents. The paper recommends a review and contextualization of NRM education, the introduction of more social sciences and entrepreneurship in

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school curricula and suggests affirmative action in the award of bursaries for the empowerment of women.

29.1 INTRODUCTION

International concerns about the situation of the world's women have enhanced campaigns for more equitable distribution of the world's resources between men and women. It has been noted, all over the world that women are underrepresented and generally face marginalisation on the basis of their gender (Karim, 1995). According to the World Education Report, there is a long-standing imbalance in participation in formal education by women. One consequence is that literacy rate of the world's women (71.2%) is significantly lower that that of men (83.6%). It is against this background that there is need to widen women's access to education. Various international conventions have been passed concerning women's access to education. These include The Universal Declaration of Human Rights (1948), UNESCO Convention Against Discrimination in Education (1962), and the 1981 UN Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW). However, these conventions have seldom been implemented at national levels.

29.2 ROLE OF UNIVERSITIES IN ENHANCING GENDER EQUALITY

The World Conference on Higher Education (1998) underlined a key function of higher education, the enhancement of participation and role of women in higher education. The major goal of the African universities is to prepare students to play leading roles in enhancing and sustaining economic development of a country. The World Education Forum that was held in Dakar, Senegal in April 2000, reaffirmed this goal and one of the Millennium Development Goals (MDGs) on Education include promoting gender equality and empowering women (Sifuna, 2006).

Women play a major role in managing natural resources such as water, soil, crops, livestock and forests. However, the role of girls and women in natural resources management (NRM) is often underestimated. Girls and women work long hours on both productive and protective roles. Their time is divided between agricultural and non-agricultural work (domestic and community chores). Women have inadequate access and control to production of resources and services. All these factors compounded to limited access to higher education constraints their contribution to socio-economic development of a country. Girls and women can be helped to acquire

knowledge and develop skills that can allow them to make decisions and influence community change in key areas.

For successful implementation and scaling up of activities on and outside the farm, relevant knowledge and skills are fundamental inputs. These skills and knowledge are acquired mainly through formal training in various levels of education. There is, however, asymmetrical access to education with respect to male and female students (gender inequality) in Kenya. Gender equality is to ensure that all people (men and women alike) are treated as equals in dignity and rights. Equality of opportunity in Kenya's education system is implied in various official documents. For example, the National Development Plan (1997-2001) clearly states in the introduction on education that, every Kenyan has the inalienable right, no matter his or her social-economic status to basic education. However, there are no guidelines as to how such statements of principle are to be implemented at various levels of education. There is need to address inequalities at every level of education. In Universities in Kenya, gender inequalities are experienced in relation to access or training.

29.2.1 Admission/access to university education

Access has been identified by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and other United Nations agencies as one way of reducing gender inequality in society. Kenya's education system has been characterized by gender disparities. The widest gender gaps have been at the higher education levels, where in 2004, female students made up of only 36% of those enrolled in universities. As is the case in Sub-Saharan Africa, fewer women than men have access to higher education in Kenya despite its rapid expansion. Their access to higher education is certainly a reflection of factors that limit their education at the lower levels. Although the participation gap narrowed slowly in the 1970s, the 1980s produced no changes. The situation is no better with those studying overseas. Of the 9,000 Kenyans studying abroad in 1980s, data showed that about 11% were females (Maliyamkono *et al*., 1982). The rates are strongly affected by retention of women at lower levels of education. Kinyanjui (1978) indicated that as girls ascend from one level of education to another, their proportion of the total enrolment decreases by 10%. In 1986, women comprised 49% of primary students, 41% of secondary, but only 30% of university students (Republic of Kenya, 1988). Female enrolment has, however, increased over the years. The enrolment increased from 4,740 in 1987/88 to 11,280 in 1990 (Table 29.1), although the proportion remained around 30%. An analysis of the 1990/91

undergraduate students in the national universities revealed that they represented 31 percent of the total enrolment of 10,153 students. In 1997/98, this had the highest number of public university student's enrolment, female students constituted 30.5% of the population.

Table 29.1: Enrolment at Kenyan National Universities by Gender 1987/88 to 1990/91

Academic year	1987/88	1988/89	1989/90	1990/91
Males	11,233	13,817	19, 454	28,443
Females	4,740	5,993	8,118	11, 280
Total	15,973	18,810	27, 572	39, 723

There are considerable variations between different universities, depending on the kind of programmes offered as well as the duration of the study. Maseno University, with largely arts based degree programmes, has the highest female enrolments, with women consistently comprising around 37% of its students population between 1999 and 2004 (Table 29.2). However, female students are much higher in the private universities, where they register well above 50% (Table 29.2). This could largely be attributed to the fact that private universities mostly offer art-based programmes and are relatively more secure than public universities, which offer wide based programmes in art and science courses and whose programmes are frequently interrupted due to student disturbances.

Table 29.2: Percentage of Students Enrolled By Gender in the Kenyan Universities

Academic year	2002/2003		2003/2004	
Public	M	F	M	F
University of Nairobi	69.9	30.1	68.5	31.5
Kenyatta University	69.2	31.8	69.2	31.8
Moi University	70.4	29.6	67.4	32.6
Egerton University	74.5	25.5	63.9	26.1
JKUAT	69.4	30.6	68.8	31.2
Maseno University	62.2	37.8	61.2	38.8
Mean	69.5	30.5	68.4	31.6
Private				
Accredited	45.5	54.5	45.5	54.5
Un-credited	50.2	49.8	50.2	49.8
Mean	47.9	52.2	47.9	52.2

The increased demand for higher education in Kenya has made it difficult for all students who qualify for university education to be admitted and this also has led to variations in the minimum entry grade from year to year. Just a

small fraction of the eligible age cohort is enrolled in Kenyan universities. For example in the year 2002, of the total of 198,356 students who sat for the Kenya certificate of Secondary School Examination (KCSE), the university qualifying examination, 42,721 students attained the minimum university entry requirement. But because of the limited facilities in the public universities, only 10, 872 students (25%) were selected for university courses. And because of high performance, the cut off points were increased from 62 to 64 for male and from 61 to 63 for female students. Admission figures for universities show clearly a difference between the numbers of female and male admitted.

It is also argued that when a choice must be made between educating a daughter or a son, African parents usually pick the son. Although other factors may intervene, the predominant barrier is economic. For the poorest Kenyans, education investment cannot be considered for any children, male or female. At the other extreme, when money is no longer a major constraint, all children are more likely to be educated. But for the majority who may be able to support the schooling of only some of their children, sex of a child plays a significant role in determination of which children will be educated. Not only do sons have the potential of a greater economic pay-off for the family, but also the opportunity costs of removing a daughter from critical child-care and household responsibility can be devastating. Because of these considerations, it is not surprising that there is a greater likelihood that female students come from advantaged families than do their male counterparts (Hughes and Mwiria, 1989).

Differences in the type of courses pursued by boys and girls begin to emerge mainly in secondary and tertiary levels since at the earlier levels there is not much choice in curriculum. Very few girls enrol in science- and technologically-based courses at the secondary and tertiary levels. In the previous education system, the number of girls' schools offering science subjects at the secondary level was much smaller than that of boys (Twoli, 1986). A study of the curriculum options in the former "A" level schools revealed that most of the available places for girls were in the art-based subjects like History, Geography and Religious Studies. Boys have proportional greater access to schools offering courses in sciences and mathematics. It is apparent that, overall, fewer girls gain admission into the science NRM and technology faculties. At Moi University, for example, female representation in the School of Natural Resources Management ranged from 9 to 16% and 84 to 91% for their male counterparts. On the whole,

therefore, most of the female students tend to pursue law, teaching subjects and art subjects over science, engineering and NRM courses.

The fact that women and men follow different courses serves to reinforce inequality in terms of the kinds of occupations women enter, and this impacts their position in society. It is worth noting that most of the subjects that women enrol in, leads to jobs that do not normally have attractive remuneration. This implies that women stand to lose in terms of economic empowerment because they will earn lower salaries than men.

29.2.2 Gender disparities in primary, secondary and university education: explanations for low female enrolment in universities

Gender disparities in performance in national examinations remain a challenge. In Kenya Certificate of Primary Education (KCPE), boys perform better. In Kenya Certificate of Secondary Education female students perform poorly compared to male students especially for Day-Scholars in the rural settings. During school holidays or after school, girls spent most of their time in domestic chores; collecting water, fetching firewood or cooking, at the expense of their study time. In addition there are fewer Girls' Schools in the country than Boys' Schools, a scenario that requires attention. This partly explains also why fewer girls join universities than boys.

A number of issues have been advanced to explain the low enrolment of women in higher education. First, low secondary school enrolment reduces the scope for progress in higher education. Coupled with low secondary school enrolment is the high dropout rate for girls. This rate is estimated to be very high resulting in only a small pool of completers eligible for entry into higher education. Also, poor examination results in the current education system further affect the number of female entrants into higher education. There is also the rigidity of admission requirements for particular degrees or course majors, which also narrows the potential pool of applicants. There are also socio-cultural factors within some communities that confine women to lower levels of the education system. This perception, coupled with economic factors leads some families to terminate girls' education at the lower levels (Onsongo, 2000). These issues require urgent attention to increase women's participation in university education.

29.2.3 Explanations of low enrolment in natural resource management courses

There has been a general decline in student's enrolment in the government-sponsored agricultural institutes, colleges and universities over the last decade. Interest in several traditional agricultural courses has also declined in response to the current lack of employment opportunities in the public sector. At the university level, traditional programmes such as B.Sc. Wood science and Technology and B.Sc. Forestry have continued to have few applicants (Table 29.3). Some of these programmes are being sustained through coercing students into them, through Joint Admission Board (JAB) system. Despite the resource constraints that face the government, a clear policy on optimum enrolment levels in various institutes, colleges and universities has not been developed. NRM education seems to be an ad hoc venture rather than informed by clear policies on what the country needs are and functional roles of trained NRM experts (Legilisho-Kiyiapi, 2004)

The number of students enrolled for BSc. Shown in Table 29.3 reflects the fact that it has declined over the last 2 decades.

29.2.4 Reasons for declining forestry enrolment

- Many bright students see forestry as easy options for less bright students (FAO, 2001). Students who score high grades opt for medicine, law or other more marketable courses;
- The declining employment by government in Kenya since the beginning of 1990;
- Many women students believe that forestry is, by its physical nature, for men only – the grunt image. As shown by the data in Table 29.3, the proportion of female graduates has been below 0.2 since the programme was started at Moi University. However, the trend in the recent past indicates a changing trend. More and more female students are applying for forestry and forestry related programmes; and
- There is a common perception that forestry comprises of nasty men chain saws (FAO, 2001). In Kenya there is a tainted image of foresters being corrupt.

Overall, there has been declining student's intake in forestry programmes and support. Fewer and fewer women are studying forestry, despite the increasing role of women in environment

Table 29.3: Number Of Graduates (B.Sc. Forestry) By Year, Degree Classification and Gender from 1984/85 –2000/2001 at Moi University, Department of Forestry.

Year of graduation	Classification								Sub-total		Total
	1st class		2nd class (Upper Division)		2nd class (Lower Division		Pass				
	M	F	M	F	M	F	M	F	M	F	
1984/1985	-	-	6	-	9	-	5	-	20	-	20
1985/1986	-	-	8	2	10	1	2	1	20	4	24
1986/1987	-	-	15	1	17	2	3	-	35	3	38
1987/1988	1	-	13	3	15	-	2	-	31	3	34
1988/1989	-	-	15	4	14	3	-	1	29	8	37
1989/1990	-	-	17	4	49	7	-	-	66	11	77
1990/1991	-	-	12	4	22	4	1	1	35	8	43
1991/1992	-	-	19	-	36	9	1	-	56	9	65
1992/1993	-	-	16	1	16	3	2	1	34	4	38
1993/1994	-	-	14	2	14	-	-	-	28	2	30
1994/1995	-	-	14	-	16	-	-	-	30	-	30
1995/1996	-	-	13	-	16	-	-	-	29	-	29
1996/1997	-	-	6	2	12	1	-	-	18	3	21
1997/1998	-	-	10	3	5	2	1	-	15	5	20
1998/1999	-	-	6	1	15	1	1	-	22	2	24
1999/2000	1	-	4	3	9	1	-	-	14	4	18
2000/2001	-	-	10	4	7	-	-	-	17	4	21
Total	2	0	198	34	282	34	18	4	499	87	569

Key: M = Male, F= Female

and tree planting activities. Professional training in NRM such as forestry or agriculture has never come close to the professions such as law and medicine either in terms of student admission or employment after graduation. Admission criteria are deliberately lowered to lure students into courses of agriculture, forestry and NRM fields. JAB admission allows female candidates to be admitted a point lower than the male counterparts. However, the number of females admitted *vis-a vis* males is still significantly very low.

In Kenya, public universities in the recent past have introduced privately sponsored programmes (the so-called "parallel degree programmes" or "module II programmes') – becoming a common trend also in many other African countries) in various fields (mainly attractive courses such as medicine, law, commerce, business management, etc.). As a result, it is becoming increasingly difficult to get students admitted to JAB courses of

second or third choices if they can afford to get their first choices under privately sponsored programmes. Basic science courses and those related to earth sciences (agriculture, forestry, wildlife management, botany, zoology and geology) are not attractive because of their "limited" job market.

29.3 CONCLUSION

Natural resources management education has great potential in improving the quality of rural life that will be felt in terms of self-sufficiency in food, wood energy, tree products, quality environment, improved farm productivity, alleviation of rural poverty, through sale of tree products and empowering women improve their household economy and nutrition. However, NRM education has not been exploited to full potential because women in general, are ill equipped in terms of resources, skills and knowledge. Majority of our society are therefore insufficiently empowered to tap the benefits and potentials of natural resources.

29.4 RECOMMENDATIONS

- Governments need to implement the already developed Gender and Education Policy, which provides a comprehensive framework of principles and policies, to achieve equity and equality. This will help gender concerns in education, including disparities in enrolment;
- There is need to link NRM education with national services; and
- There is need to strengthen the quality, relevance and application of NRM education development. There is also, need to re-engineer (e.g. introducing of more social sciences and inclusion of entrepreneurship courses) and repackage programmes so as to be marketable.

A pro-active step should be taken to support girl child education at primary and secondary level, including enhancing capacity in girls' schools (e.g. building more girls' schools and equipping them better) and deliberate empowerment of women. Girls' education capacities should be built right from secondary schools, rather than trying to sort out the gender disparity when it is too late in the university admission stage, in addition to affirmative action in the award of bursaries.

Natural resource management courses should be reviewed and contextualized in the primary and secondary curricula (Temu *et al.,* 2003) and general awareness of the importance of natural resources be made at all policy levels.

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Annex 1: Examples of Forestry Training Projects in Africa

COUNTRY	PROJECT TITLE	YEAR FUNDED	ITTO BUDGET (US$)	STATUS
Cameroon	PD132/91 Rev.1 (F): Training Forestry Workers in Carrying out Certain Tasks Related to Forestry	1991	161,000	Completed
	PD026/02 Rev. 2 (F,I): Development of Methods and Strategies for Sustained Management of Moist Tropical Forests in Cameroon	1993	3,431,090	Completed
	PD047/98 Rev 2 (M): Establishing a Data Collection and Dissemination System on a Sustainable Basis for Timber Marketing Statistics in Cameroon	2000	271,198	Completed
Cote d'Ivoire	PD268/04 Rev. 3 (I): International Workshop on Innovations in Tropical Forestry and Forest Product Industries	2007	147,960	Pending Agreement
Egypt	PD004/97 Rev. (F) I&II: Development and Promotion of Afforestation Activities in Egypt – Phase I & II	1998	246,749 391,873	Completed
	PD040/96 Rev. 5 (M): The Establishment of a National Statistical Information System for Imported Timber and Timber Products	1999	274,300	Ongoing
Gabon	PD029/96 Rev 1 (M): Reinforcement of the National System for the Collection and Processing of Forest Statistics and Support for the Training of Field Units	1996	231,375	Completed
	PD347/05 Rev. (I): Promoting Access to the Forest Sector Activities by Gabonese Nationals through the Development of the SME Forest Partnership	2005	313,200	Ongoing
Ghana	PD044/88 (I): Seminar for the Promotion of Further Processing of Tropical Hardwood Timber in the African Region	1988	154,400	Completed
	PD027/94 Rev. 2 (F): Women and Tropical Forest Development Programme	1994	694,823	Completed
	PD046/96 Rev. 2 (I): Establishment of a Wood Workers and	1997	486,355	Ongoing

	Craftsmanship Village			
	PD012/98 Rev. 2 (I): Manpower Development for the Ghana Wood Industry Training Centre (WITC)	1998	237,375	Completed
	PD393/06 Ref. 1 (F) Village-level Reforestation plus Nutrition Promotion by Self-Motivated Community Women's Groups	2006	165,335	Ongoing
Rep. of Congo	PD004/00 Rev. 1 (F) Biodiversity Management and Conservation in a Forest Concession Adjacent to a Totally Protected Area (Nouabale-Ndoki National Park), Northern Congo	2000	1,002,084	Completed
	PD176/02 Rev. 1 (F): Use of Remote Sensing Technology and Information Systems to Support Forestry Legislation Monitoring in the Republic of Congo	2002	577,676	Ongoing
	PD272/04 Rev. 2 (F): Development of National Principles, Criteria and Indicators for the Sustainable Management of Congo Forest Based on ITTO Criteria and Indicators of SFM	2004	447,702	Ongoing
Togo	PD197/03 Rev. 2 (F): Support for the Implementation of a Sustainable Forest Development Master Plan in Eco-Floristic Area IV, Togo	2003	317,093	Ongoing
	PD217/03 Rev. 2 (F) Establishing a Cooperative Framework between ODEF and the Communities Living in the ETO-Lilicope Forest Complex for the Sustainable Participatory Management of this Complex	2004	139,898	Ongoing
Regional	PD124/01Rv. 2 (M) I: Promotion of Sustainable Management of African Forest Phase 1 & 2	2002 2004	634,983 634,982	Completed Ongoing

30 Global Partnerships for Sharing Forest Education Resources and Information

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ABSTRACT

Global Forest Information Service (GFIS) is an initiative of the Collaborative Partnership on Forests (CPF), an innovative interagency partnership of 14 major forest-related international organizations, institutions and convention secretariats. GFIS, as a CPF initiative is led by IUFRO, together with FAO, CIFOR and the UNFF Secretariat. USGS-BIO also actively contributes to the initiative. GFIS is an internet gateway that allows institutions to share forest-related information through a web portal at www.gfis.net. It offers an information exchange and dissemination tool for partners to share their information resources through the gateway. The development and enhancement of GFIS follows an iterative and incremental approach whereby partners contribute to system and partnership enhancements, as well as capacity building efforts to strengthen developing countries' participation in GFIS. GFIS can be expanded to have forest education resources and information as resource of information exchange and dissemination tool of the GFIS gateway and have forest education resource providers such as International Partnership for Forestry Education (IPFE) act as a key GFIS information provider. It is envisioned that information on individual institutions offering forest education, and forest education teaching and learning resources from Africa and around the world would be accessible to a wide range of users through the GFIS gateway. Attaining this objective of becoming a source of information exchange and dissemination service on forest education information and resources will fulfil many of the objectives of the IPFE.

30.1 INTRODUCTION

Global Forest Information Service (GFIS) is an initiative of the Collaborative Partnership on Forests (CPF), an innovative interagency partnership of 14 major forest-related international organizations, institutions and convention secretariats. The objectives of CPF are to support the work of the United Nations Forum on Forests (UNFF) and its member countries and to enhance cooperation and coordination on forest issues for the promotion of sustainable management of all types of forests. GFIS, as a CPF initiative is led by the International Union of Forestry Research Organisations (IUFRO) together with FAO, Center for International Forestry Research (CIFOR) and the United Nations Forum on Forests (UNFF) Secretariat. Biological Informatics Office of the United States Geological Survey (USGS-BIO) also actively contributes to the initiative.
Global Forest Information Service (GFIS) is an internet gateway that allows institutions to share forest-related information through a web portal at www.gfis.net. Searching among these resources is free and provides direct access to the original information. GFIS offers an information exchange and dissemination tool for partners to share their information resources through the gateway. It provides an open exchange standard for information resources which helps partners to organize their information, generate their inputs, and allows them to manage their contributions to GFIS.

The development and enhancement of GFIS follows an iterative and incremental approach whereby partners contribute to system and partnership enhancements, as well as capacity building efforts to strengthen developing countries' participation in GFIS. Participating in GFIS is voluntary, but it implies a certain commitment in terms of data provision, regional support and promotion of the GFIS service. Continuous system development and maintenance will ensure that GFIS takes advantage of new innovations in web services.

GFIS can be expanded to have forest education resources and information as resource of information exchange and dissemination tool of the GFIS gateway and have forest education resource providers such as IPFE act as a key information provider. It is envisioned that information on individual institutions offering forest education, and forest education teaching and learning resources from Africa and around world would be accessible to a wide range of users through the GFIS gateway.

30.2 GFIS – A BRIEF HISTORY

In 1998, the International Consultation on Research and Information Systems in Forestry (ICRIS) held in Gmunden, Austria, recommended that the Intergovernmental Forum on Forests (IFF) should "endorse and promote the development of GFIS to enhance access to all forest-related information, ensuring that it is accessible to all stakeholders including policy-makers, forest managers, non-governmental organizations (NGOs), community groups and the public at large". As a consequence, the IFF called for promoting the provision and efficient sharing of existing information and the strengthening of networks and specifically "requested IFF member organizations (i.e. a precursor to the current arrangement of the CPF, the Collaborative Partnership on Forests) to work with IUFRO, the International Union of Forest Research Organizations, in exploring possibilities for a global forest information service".

The first version of GFIS was presented at the IUFRO European Conference in Copenhagen (Denmark) in August 2002. The GFIS prototype was subsequently developed and successfully demonstrated at the XII World Forestry Congress in Quebec, Canada, in September 2003. This first operational version included reference data of online and offline information resources from about 60 forestry expert institutions from all regions of the world.

In May 2004, the CPF agreed that GFIS should become a joint CPF Initiative. In response to the request of the CPF, IUFRO, in close collaboration with FAO and CIFOR, prepared a concept paper for the further development of GFIS as a joint CPF Initiative, which was approved at the 13th Meeting of the CPF on 6th September 2004. CPF, which is an innovative interagency partnership of 14 major forest-related international organizations, institutions and convention secretariats, aims at supporting the work of the United Nations Forum on Forests (UNFF) and its member countries through enhancing cooperation and coordination on forest issues for the promotion of sustainable management of all types of forests. GFIS, like other CPF Initiatives, builds on contributions from CPF members under the overall guidance of CPF. The decision to become an initiative of CPF marked the beginning of the second phase of GFIS development; i.e., a new era in terms of partnership and shared responsibilities to ensure that GFIS can successfully be operated over the years to come.

GFIS, as a CPF Initiative is led by IUFRO together with the FAO,, CIFOR, and the UNFF Secretariat. The Biological Informatics Office of the United States Geological Survey (BIO) also actively contributes to the initiative. The GFIS search service was first launched at the XXII IUFRO World Congress in Brisbane, Australia in August 2005, and concentrated on key online information resources, such as news, events, publications and job opportunities. GFIS users are able to search for information within these types of resources. An upgraded version of the GFIS gateway was released in January 2007 providing an improved search tool and view facility for news, events, publications and job opportunities with overall enhanced visibility of GFIS partners.

The development of GFIS has passed through several challenges, partly due to the evolving nature of the technologies and tools for managing metadata-based information services such as GFIS and partly due to the time it takes to build sustainable partnerships. Given these conditions the overall progress in the development of GFIS – since its beginning in 1998 - is satisfactory and can be summarised as follows in Africa:

- Under the umbrella of the Forestry Research Network of Sub-Saharan Africa (FORNESSA) and in partnership with IUFRO-SPDC, FAO, European Tropical Forest Research Network (ETFRN), CAB International, Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD Forêt), and CIFOR, five GFIS Nodes, one each in Gabon, Ghana, Kenya, Senegal and Zimbabwe were established. These nodal institutions (primarily national forestry and agricultural research organizations) serve to facilitate the identification, collection and upload of forest-related information resources in the various sub-regions of Africa;
- Setting-up of the necessary computer hard- and software infrastructure at each nodal institution;
- Implementation of training courses for information managers, system administrators and webmasters. In total, four courses were held focusing on cataloguing of information resources, data entry and indexing as well as metadata editing processes. Particular emphasis in these courses was also given to GFIS information exchange standards and hands-on exercises with GFIS tools and procedures. Overall, about fifty staff members of the nodal institutions including content managers, librarians, and system administrators were trained under the GFIS Africa Project; and

- Organisation of metadata mobilisation campaigns resulting in the collection of approximately 3,000 metadata records about unpublished scientific reports from African forestry research organisations.

30.3 THE CHALLENGES TO ORGANISE AND DISSEMINATE ELECTRONIC INFORMATION OUTPUT

The volume of globally generated information is enormous and continuously growing, as are the sources of this information. It is estimated that to date there are almost 300 million web sites offering information on virtually all aspects of life. A substantial amount of this huge electronic information pool is relevant to forests and thus of value to forest information seekers.

As experience over the past five years has shown it is difficult to locate a significant proportion of the available online information, which, consequently, remains inaccessible to many users. One of the major problems forest information seekers face is the fact that search operations cannot be performed in a domain-specific (i.e. forest-related) manner. Therefore, users turn to general search engines (e.g. Google) that, more often than not, result in lists of several thousands or even millions of references which are largely irrelevant and impossible to screen with reasonable efforts. An alternative approach frequently applied is the search within the web-resources of individual organisations. This method results in fewer references of relevant information resources, but fails to provide a more complete picture on a specific topic available on the Internet. In order to obtain a more comprehensive picture, users would need to go through a lengthy and time-consuming process of searching the websites of a large number of different organisations.

The reasons why users face problems in their search for forest-related data and information are mainly related to the way information providers organise and disseminate their online resources. The majority of information providers fail to create adequate reference data (i.e. metadata) about information resources they have placed on the internet. Because of the above described problems with the organisation and dissemination of electronic forest-related information resources, in general, a search chaos exists and search services have failed to reach their diverse groups of clients. Because of the described problems and challenges with the organisation and dissemination of electronic forest-related information resources, the GFIS gateway and partnership have been developed.

30.4 GFIS APPROACH

30.4.1 Mission statement

According to its vision, GFIS, through enhanced exchange and dissemination of all types of information, contributes to an improved understanding of forest-related issues and better decision-making, and in this way supports the conservation and sustainable management of all types of forest and tree resources worldwide. Based on this vision, GFIS works towards providing the framework to make forest related data and information available through a single online source, and promotes the dissemination and sharing of forest- and tree-related information and knowledge among the global forestry community through developing common information exchange standards, capacity building and enhancing partnerships among forestry institutions and information users.

In the global policy context, the above vision and mission statements are fully in line with the resolutions of the UNFF and the priorities of CPF. The UNFF-6 resolution explicitly mentions the support by the UNFF process for the continuation and development of GFIS as a means to promote the exchange of forest management-related experiences and good practices.

30.4.2 Objectives

In order to achieve its mission, GFIS pursues the following specific objectives:

- To develop and apply common standards for sharing forest-related information resources;
- To develop and maintain a system of web-based tools for information exchange and dissemination;
- To enable participation in GFIS of both information providers and users through appropriate capacity building measures; and
- To promote networking and partnership for sharing forest-related information.

All in all, the role of GFIS is to add sufficient value to currently available information such that GFIS becomes the global gateway of choice for a critical mass of partners providing and using information.

30.4.3 Partnership development

GFIS is built as a global partnership, across sectors and institutions, and aims to maximize the value of all forest information resources and providers worldwide. Through a bottom-up approach partners dictate the amount, coverage and type of information they will share through GFIS. Partnership arrangements will assist in identifying key information resources and in using common formats, means and methods by which the information is made available to GFIS.

The fundamental principle guiding the development of GFIS is that its partners share elements of a common set of needs that can be addressed most effectively through collaboration. Towards this end, GFIS seeks to develop a system of partnership with a variety of organizations and levels of participation that form the GFIS community. Member organisations of the GFIS community are grouped according to the roles they play in GFIS as outlined below.

30.4.4 Information exchange

The GFIS gateway is an open system to which information providers, using GFIS information exchange standards for cataloguing information, may contribute content. GFIS defines elements that are intended to assist contributors in maximizing access to their materials.

The GFIS information exchange standards define parameters that are intended to assist information providers in describing their information resources. GFIS resource discovery is based on a metadata approach that focuses on key elements and provides a description of different types of information resources. The GFIS information exchange standards are based on existing specifications as outlined above. The current GFIS information types like news, various events, recent publications and Job vacancies are based on RSS2.0 specification (RSS, 2007). Library and document collections on AGRIS/GFIS AP are posted in the FAO website (FAO, 2007) while datasets and databases are posted on the USGS website (USGS, 2007). GFIS Information exchange standards help partners to generate their input and allow them to manage their contributions to GFIS.

All in all, GFIS information providers seek to advertise forest-related information types and resources that are currently not covered by general search engines and library services. In this way GFIS fills a niche and assists

information users to locate and retrieve specific forest-related information that they otherwise would not be able to access.

30.4.5 Capacity building

Training is considered a key strategy in promoting GFIS among information providers and users. Depending on the target audience training courses will offer general information about GFIS and its use in information resource discovery and access as well as more in-depth training courses for information providers. These courses will focus on the GFIS information exchange standards and dissemination of forest information resources. In this context, it is important that each information provider maintain its own professional staff trained in GFIS approaches and methods. In this way, information providers are enabled to organise their information resources and create and submit metadata of adequate quality.

Training-related activities will include:

Developing a GFIS annual training plan;

- Compilation of training material for a course on "Use of information and communication technology tools in dissemination of forest information";
- Seeking financial resources for training of potential information providers from developing countries (in close cooperation with IUFRO-SPDC and others); and
- Implementing regular training courses for information providers and users, (e.g. in conjunction with forest-related meetings of IUFRO and other international expert institutions).

30.4.6 GFIS user community

GFIS users are individuals or institutions that seek forest-related information using the GFIS gateway from around the world. Virtually everybody around the world who is seeking forest-related information would be a potential GFIS user. Potential users may include scientists; policy makers, donor organizations (including foundations and aid agencies), non-governmental organizations such as environmental groups or forestry associations, government agencies, researchers, forest owners, financial institutions, news media and public sector, students and educational institutions (all levels), and commercial interests (forest products, transport, etc.), forest managers, and forest land owners. The following scenarios provide some indication how

GFIS helps potential users to access a wide array of forest-related information resources from around the world.

30.5 BENEFITS OF GFIS TO INFORMATION USERS AND PROVIDERS

Organised and efficient systems for the discovery and access to forest-related information on the Internet have many benefits to both information providers and users. GFIS is conceptualized as a global platform for information sharing bringing together expert institutions and individuals who want to disseminate and share forest-related data and information and those seeking to access and use such resources. In an increasingly interconnected world GFIS plays an important role in organising and making available information to all types of stakeholders and thus contributing to the development of a global knowledge society.

Important benefits of GFIS to information users include:

- Scientists will gain access to a diverse array of data and information to help design and direct research;
- Forest planners will be provided with timely, credible data to make knowledgeable determinations about managing natural resources;
- Policy-makers will use GFIS to obtain information resources relevant to policy processes and informed decision-making on policies, laws and regulations at local, national and international levels;
- The private sector will be provided with better information to understand impacts of land use change, product chains and markets;
- Educators will retrieve relevant and stimulating information and training resources for students; and
- Citizens gain unbiased information on natural resources and their use for purposes such as recreation, birding, wildlife watching, hunting etc.

  Information providers investing and participating in GFIS will obtain considerable benefits. Some of these benefits include:

- Better visibility and recognition of information products leading to enhanced reputation and professional standing of an organisation at local, regional and global levels. In this context it should be noted that a high professional standing is indispensable for influencing decision-making in policy and management;

- Higher number of potential users of information that is easily accessible on the Internet. Virtually all people worldwide who are in need of forest-related internet resources are potential users and can be reached;
- Participation in organising information will also help to improve internal information management and build related capacity;
- At the same time an organisation also gains access to other information providers and partners around the world for closer cooperation and networking;
- Users are interested in timely forest-related news items from around the world that are provided by GFIS partners. Such news may include the results of a global policy meeting; changes in forest policy; updates on forest cover information, announcements about investments in the forestry sector such as reforestation, timber processing or eco-tourism development; discovery of new plant or animal species; or any other news item that is relevant to forest scientists and practitioners;
- The GFIS event calendar for international meetings will also attract the attention of all potential GFIS users, particularly policy makers, donor organisations, research and development agencies, educational institutions, and forest managers; and
- Users seeking publications not available on library databases/services can use the GFIS on-line access to "grey literature". These are results of forest research and development activities that have been published as technical reports on websites of GFIS partners.

All in all, GFIS partners, regional support organisations, and information providers benefit from the relationship with GFIS in many ways including:

- Greater recognition within the region and worldwide – serving in the GFIS community gives broad exposure to the forest community and other information networks;
- Increase potential for collaborative work and funding opportunities – Being closely associated with GFIS allows to gain added knowledge of what institutions are seeking partnerships on what projects, and on funding streams for forest research and management; and
- Improved understanding of information management practices – Further enhancement of first-hand knowledge of information management practices through GFIS training and work.

30.6 CONCLUSION

GFIS can be expanded to have forest education resources and information as resource of information exchange and dissemination tool of the GFIS gateway and have forest education resource providers such as IPFE act as a key information provider. It is envisioned that information on individual institutions offering forest education, and forest education teaching and learning resources from Africa and around the world would be accessible to a wide range of users through the GFIS gateway. Attaining this objective of becoming a source of information exchange and dissemination service on forest education information and resources will fulfil many of the objectives of the IPFE and the whole forest education resource community.

Potential contribution of the collaboration with GFIS to forest education resources:

- Information exchange specification developed by GFIS and supported by IPFE could profile institutions involved with forest education, forest education related programmes, and learning resources to enhance the quality of teaching and learning world wide;
- Learning resources could have a mechanism to be widely shared with forest education and training communities globally. It could provide an opportunity for a wide range of educators to search and use case studies, images and learning objects in developing courses and provide a resource to encourage more international content to be utilized in various educational settings;
- IPFE could organize institutions offering forest education resources to use protocols or share and maintain information in a way that can be easily accessed by GFIS users; and
- Training courses for potential information providers on "The use of information and communication technology tools in dissemination of forest education information resources" could be prepared and implemented world wide.

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PART IV

SYNTHESIS AND THE WAY FORWARD

Emerging global issues

The contributors noted that the following global issues will influence future forestry practices:

- Evolution of a paradigm which places greater emphasis on "people and environment" rather than "timber";
- Devolution and decentralization of forest management leading to a surge in the roles and responsibilities of local communities, civil society and private sector;
- The rising importance of carbon-sequestration and bio-energy and associated trade challenges;
- Challenges in establishing suitable mechanisms to account and pay for environmental services;
- Emergence of Agroforestry as a significant tree–based system with potential to deliver complementary solutions to the supply of tree-based goods and services from agricultural landscapes; and
- Recognition of the need to develop products and services from trees outside forests, especially for low-forest cover countries in sub humid conditions.

Various international agreements, protocols and mechanisms have emerged that require better understanding of the role of forests and foresters. It behoves foresters to re-think new forest and tree management science, objectives and practices that can meet all the implied social, economic, ecological and environmental criteria.

The changing image of forestry

In recent years, there has been a broader understanding of the roles of trees and forests, and that is influencing attitudes and choices in the management of forests. Traditional approaches where timber was considered as the main product are under scrutiny and challenges. Foresters have been slow in developing new ways of assessing and managing tree and forest resources in the light of new societal perspectives. These and other developments have not only clouded the forestry profession, but also narrowed the job market for foresters. Paradoxically, the roles and importance of forestry are rising at the same time as the visibility and capacity of forestry institutions are declining. Contributors observed:

- Declining importance of financial profitability and rising influence of public and global goods and services, which do shift the objectives of forest management; and
- Growing public pressure on forest governance to curb illegal logging and other crimes.

The contributors of this book analysed the situation and concluded that future foresters should have a different profile. A new type of forester is needed, with refreshed values, professional ethics, and better coordination with related sectors and between countries. There is a need for new impetus to improve and popularize forestry sciences, technologies and practices. Efforts should be targeted at policy makers, institutional reforms, the youth, women, regional and international organizations and civil societies. Forest management planning must be re-oriented to focus the cardinal issues of food security, poverty alleviation, environmental conservation and mitigation of the effects of climate change. Better forestry accounting is needed to show real direct and indirect contributions of Gross Domestic Product. The link of forestry to other sectors, especially agriculture, livestock and wildlife management should be elaborated to demonstrate the breadth and depth of forestry in economies and in resource conservation.

While retaining the romantic roots of forestry the business aspects should be highlighted. Efforts are needed to expand and deepen the participation of forestry experts at important national, regional and global forums that touch on tree and forest resources.

Scientific and technological frontiers

The contributors noted advances in the application of biotechnology, (especially DNA/gene sequencing), bio-energy, agroforestry, ecotourism and wide range of sociological aspects that are essential inputs into forest science and technology. The application of recent technologies for information and communication should enhance the reach of forestry. Contributors agreed on the need for forestry to deepen links with other land use disciplines. Effective databases are needed to make the case for forestry links with (but not restricted to) water, energy, health, climate change and agriculture (sustainability of productivity). Cutting edge research is needed in all the new link areas.

Forestry education responses

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Forestry education responses

The developments outlined above have thrown forestry education into confusion. Many schools of forestry have either dispersed their forestry programmes into several natural resource areas or added extra courses onto existing programmes. In either case, the outcomes have been less than satisfactory. Absence of global guidance/coordination or mechanisms for maintaining minimum standards has led to highly variable forestry education programmes. Coupled with reduced investment in the area, interest in forestry education has been on the decline, as demonstrated by highly reduced enrolments in most countries. Contributors strongly recommend the following:

- Re-establish a mechanism for coordination of forestry education advisory at global and regional/sub regional levels. The International Partnership for Forestry Education (IPFE) should be supported and financially enabled to advance this effort;
- Review and re-set the objectives of forestry education in the light of current and future developments. For this, thorough assessment of gaps and future needs must first be done;
- Initiate a global mechanism to stimulate stronger investment in forestry education, particularly the re-training of educators, review of curricula, development of relevant learning materials/resources, the use of ICT and graduate research to generate new knowledge. Private sector should be more involved;
- Reinforce courses in forest governance and ethics across all aspects of forestry – management, research and education;
- Some of the universities offering forestry education are corrupt and therefore the university governance should be taken into account when educational systems are revised;
- Forestry Schools should develop and implement strategies to strengthen forestry content in other land use disciplines, and form symbiotic links with such programmes where appropriate;
- Restructure forestry education and practice to address food security, poverty and environmental issues based on business models;
- Strengthen the links between education programmes, research and innovation, industry and local communities;
- Retrain serving foresters in new approaches to forest management;
- Establish inter-institutional and regional collaboration for better use of available expertise and resources to deliver better forestry education;
- Draw strategic forestry education and training programmes relevant to youth and women, effectively diversifying forestry into a well integrated set of programmes reflecting the expanded mandates;

- Serious consideration should be given to re-establish the forestry education programme at FAO to enable linking learning to forestry development projects, and especially support countries emerging from civil conflict and those with low forest cover;
- A global learning resource centre (portal) is needed, possibly based on the Global Forestry Information Systems (GFIS) and with inputs from the Tech-MODE learning and WikiEducator and other web-based learning systems;
- Review national forestry sector development and human and institutional needs on a periodic basis to be reported in 2011 – The International Year of Forests; and
- IPFE and FAO should consider setting up a mechanism for monitoring and evaluating the development of forestry as a science and periodic evaluation of education programmes.

The contributors agreed that for these recommendations to be implemented there is a need to create awareness among policy makers, investors of the urgency to revitalize forestry education. New and predictable funding mechanisms should be created to support forestry education. IPFE should be enabled to present the findings in this book at various global and regional forums to stimulate interest and investment for change. Learning institutions should play their part at the national level. The contributors unanimously endorsed the establishment of IPFE as a platform for future actions.

PART V

VIEWS FROM VARIOUS ORGANISATIONS

Director General, World Agroforestry Centre (ICRAF)

Dr. Dennis Garrity

I first became aware of the dire state of forestry education in Africa through a little booklet written by August Temu and colleagues about improving agriculture and natural resources education published in 2003. Let me quote a few key points from this publication.

"An analysis of 20 technical colleges in forestry shows clearly the consequences of reduced government support to technician training. From 1999, the certificate courses in forestry were almost wiped out while diploma programmes were substantially reduced. This trend clearly reversed previous gains. The female forestry technician graduation seemed to take an upward trend from 1994 but suffered a serious fall from 1998 and has since then not recovered. This is particularly bad news as we move towards greater participation of women in development activities.

The clear conclusion from this analysis is that Africa has entered the 21st century with less technical capacity in forestry in general, and a drastically reduced female capacity, in particular. Yet we are expecting tree planting to be scaled up. The process of such ambitions will be strongly undermined by weaknesses in training policies and low investment in technician training. A cursory examination of trends will reveal a similar picture in agriculture. Therefore, while the number of university graduates is increasing, that of technical college graduates is falling sharply.

In addition to the challenges cited, HIV/AIDS is also affecting tertiary education institutions, causing loss of young as well as senior educators. Unless serious actions are taken to mitigate the impacts of HIV/AIDS, African colleges and universities will fail to produce the future generations of scientists and development workers. Here lies the truly long-term impact of the pandemic on social and economic development. Target 7 of the Millennium Development Goals is aimed at halting and reversing the spread of the disease. This must start with tertiary education institutions where highly

trained experts are directly and indirectly affected, reducing their effectiveness to run quality educational programmes."

Another report by Temu *et al*. (2005) shows that Sub-Saharan Africa (SSA) is graduating just about 300 foresters at first degree level and 60-80 postgraduates per year. These figures are much lower than for individual countries in the developed world, and certainly too low for the needs of SSA. It will take all of us, playing many different roles, to turn the dire situation of African forestry education round. With fresh thinking, creative energy, and sheer hard work, you can turn the ship around. Let your contributions be a milestone in doing that.

Representative of the Embassy of Finland

Mr. Heikki Haili

On the behalf of the Embassy of Finland, I am delighted to have this opportunity to contribute my views for improving forestry education. Some of the commonly known facts that 30% of the earth's land cover is forested, 80% of the world's biodiversity is in forests and 1.2 billion people depend directly on tree and forest resources. However, deforestation is one of the leading causes of global warming where 20% of global emissions are due to land use change and deforestation.

Forest scientists developed the concept of sustained forestry some 200 years ago but the principle has not yet been applied at the global scale. The question I wish to raise is, has the forestry profession failed? Data shows that forestry education has tremendously declined, especially in Africa. This is very worrying indeed. At this historical moment, we would need foresters equipped with new type of skills, and I would stress not only new type of skills, but also new kind of attitudes and behaviour. We do not need new fashionable terms but a real commitment to serve the societies.

At the Millennium Summit of the United Nations in the year 2000, the world leaders agreed on Millennium Declaration and the Millennium Development Goals. One of the practical implications of this event was that the world leaders committed themselves to halving the proportion of the world's people living in extreme poverty by the year 2015, with a view of eventually eradicating it altogether from the world. It was a commitment by countries of the North to support the countries of the South in their efforts to achieve the Millennium Development Goats. It was a commitment made also by the Government of Kenya and other developing countries to their citizens. The fact is that almost half of the Kenyans are living in extreme poverty. This is a clear indication that the combined efforts of the Kenyan Government and development partners have not been effective enough. I sincerely hope that we can promote poverty reduction through improved governance and forest practices here in Kenya and elsewhere in the world.

The Government of Finland is pleased to support initiatives for improving forestry education together with the Government of Kenya and other partners.

Our support is channelled through a bilateral programme titled; *Miti Mingi Maisha Bora; Support to Forest Sector Reform in Kenya.* The meaning behind the expression - *Miti Mingi, Maisha Bora* - is more or less the same as - forests and trees are crucial for a good life - for all of us. I wish that your contributions would serve the target of improving forest education to meet the challenges that face us.

Permanent Secretary, Ministry of Environment and Natural Resources, Kenya

Prof. James Kiyiapi

Forestry is a very robust sector, which touches upon very many other sectors, ranging from water, energy, livestock, environment, education, agriculture (including food security) livestock and wildlife. This clearly implies that trees and forests are central to the improvement of livelihoods and environment. Many developed countries relied on tree and forest resources to generate the wealth which was in turn used to raise their standards of living. Subsequently, they were able to improve their well-being and reinvest in the conservation of forests, biodiversity and the environment. Today the situation has changed in a remarkable manner. Large areas of forest can no longer be cleared – for we now understand the dire consequences of such action.

Our environment and biodiversity conservation efforts would have little meaning if they are not linked to forest management and conservation. Forests remain the single most important source of combined plant, animal and ecological diversity. Recent global conservation efforts have been focussed on forests. We in Kenya strongly believe that conservation can be strengthened through domestication and on-farm production of useful plants and animals. This would enable us to treat conservation as a comprehensive and inter-sectoral effort; as well as weave it together with production of goods and services that enhance livelihoods.

To this end, Kenya is strongly committed to integrated natural resources management (NRM) approaches. We have come to realize that for some parts of our country, more timber is already being harvested from farms than from forests. This reinforces the practices of domestication and cultivation of trees and shrubs on farms. With less than 2% of our country under closed canopy forest, and a rapidly rising demand for tree products Agroforestry is increasingly becoming an attractive option for the future. It is in this context that I see forestry as including the cultivation of trees on farmland.

In Kenya, the majority of our population relies on wood for energy and building their dwellings. Livestock keeping communities need forest areas

especially for dry season fodder. Our tourism industry relies heavily on availability of adequate fodder to feed the wild animals, and trees to provide shade. Recent data regarding climate variation are of major concern for humanity and all living creatures. The potential to mitigate the negative effects through planting trees for carbon sequestration is further reason for employing integrated management approaches. Kenya would also like to benefit more from carbon trade, so efforts in this direction must be encouraged. The bottom-line for all the statements I have made is that forestry is an extremely important area of science, technology and practice. In some parts of Africa, forestry education has declined to a point of being ineffective. The demand for foresters who recognize the multiplicity of production and conservation issues involved as well as the cross-sectoral linkages is extremely important. I wish to express the confidence that your contributions will bear a new fruit for the world – a forestry learning programme that will rebuild an otherwise declining sector. I also hope that policy makers and development partners will see it fit to invest more in forestry education and forests in the future.

Director, United Nations Forum on Forests

Mr. Pekka Patosaari

The issue of forests has been a priority on the international political agenda for the past 15 years. Alarming rates of global deforestation and forest degradation, growing international trade in forest products and services, and the concerns of stakeholders, particularly forest-dependent communities, has led the international community to come together to discuss and to develop coherent, holistic forest policies.

Established seven years ago by the UN Economic and Social Council, the United Nations Forum on Forests (UNFF), as the central body of the International Arrangement on Forests (IAF), aims to promote sustainable forest management of all types of forests worldwide, and to strengthen long-term political commitment to this end. The Forum is the only UN body, aside from the General Assembly, with universal membership of all the Member States. The Forum is also supported by a unique interagency cooperation arrangement, known as the Collaborative Partnership on Forests (CPF), consisting of 14 International organizations, institutions and instrument secretariats, including the UNFF Secretariat.

In my view, 2007 is a *landmark* year for the international forest community. The successful conclusion of the seventh session of the UN Forum on Forests was marked by the long-awaited agreement on the Non-legally Binding Instrument (NLBI) on all types of forests; the adoption of a Multi-Year Programme of Work (MYPOW) for the Forum for 2007 to 2015; and the decision to initiate a process toward the establishment of a forest financing mechanism for all types of forests. Previous sessions of the UN Forum on Forests and previous intergovernmental fora on forests agreed on over 270 proposals for action, and several other resolutions and decisions. The Non-Legally Binding Instrument marks a culmination of these efforts, and seeks to highlight priority issues for action. This Instrument on all types of forests will truly be a key vehicle for translating policies and decisions, developed and adopted by the Forum, into national and international actions for achieving sustainable forest management and the Global Objectives on Forests.

The four Global Objectives on Forests seek to reverse the loss of forest cover worldwide and increase efforts to prevent forest degradation: to enhance forest-based economic, social and environmental benefits; to increase significantly the area of sustainably managed forests, including protected forests, and increase the proportion of forest products derived from sustainably managed forests; and reverse the decline in official development assistance for sustainable forest management and mobilize significantly-increased new and additional financial resources from all sources for the implementation of SFM.

The instrument provides countries with a number of policy proposals intended to guide and assist the implementation of sustainable forest management. In fact, an issue that gained increased prominence for the first time in deliberations at the Forum was the need for public awareness and education on forests. The instrument recognizes that international cooperation in areas of technology transfer, capacity building and education, plays a 'crucial catalytic role in supporting the efforts of all countries, particularly developing countries as well as countries with economies in transition, to achieve sustainable forest management." In particular, it calls for national policies and measures to:

- Promote use of management tools to assess environmental impacts of projects on forests;
- Support the use of traditional forest-related knowledge and practices in SFM;
- Further develop and implement criteria and indicators for SFM;
- Strengthen partnerships to advance the implementation of SFM;
- Promote development and application of scientific and technological innovations, and Incorporate scientific expertise into forest policies and programmes;
- Promote public understanding of the benefits of forests and SFM, through public awareness programmes and education;
- Promote access to formal and informal education, extension and training programmes on the implementation of SFM; and
- Support education, training and extension programmes involving local and indigenous communities, forest workers and forest owners.

The new Multi-year Programme of Work of the Forum focuses on contributing to and reviewing the implementation of the Instrument and the progress toward achieving the Global Objectives on Forests, pressing and emerging issues of sustainable forest management, and has links to several

other sectors and processes, such as climate change, biological diversity, desertification and internationally agreed development goals.

At each session of the Forum, the crosscutting issues on 'Means of implementation", including, among others: technology-transfer of environmentally sound technologies, capacity-building, awareness-raising, education and information-sharing, will be addressed in the context of the discussions of the themes of that session. Both the NLBI and the MYPOW provide a platform for enhanced international and regional cooperation and collaboration. The importance of strengthening forestry research and development, particularly in developing countries and countries with economies in transition, through relevant global, regional and sub-regional organizations and networks, has been highlighted in both the text of the instrument and in discussions at the Forum.

In other developments, last year the General Assembly adopted Resolution A/RES/61/193, declaring 2011 as the "International Year of Forests'. Activities organized to celebrate the International Year will focus on raising awareness and promoting global action to sustainably manage, conserve and develop all types of forests, including trees outside of forests. The International Year provides an opportunity to engage our children and youth, who are a critical element in ensuring that our forests are managed sustainably for current and future generations. The decision by member States to declare an International Year of Forests is a reflection of the recognition that it is only through broad public participation and by harnessing the skills and practical experiences of forestry practitioners worldwide, that we can realize international goals and effect change. The role of education in building awareness, and the need for education curricula that raise awareness of sustainable forest practices, is a vital cornerstone in this endeavour.

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Michel Laverdiere

SETTING THE SCENE

The Millennium Development Goals (MDGs), United Nations Forum on Forests (UNFF), Food and Agricultural Organisation (FAO) and other important conventions and institutions indicate that there is urgent need for focus and investment in Sustainable Forest Management (SFM) in the World. However, SFM in Africa is still wanting.

To a certain degree deforestation, poor watershed management, desertification, loss of biodiversity, inadequate land use plans and inappropriate land tenure systems could all be directly and indirectly linked to poor knowledge base, limited policy awareness and low levels of education and training among some of the stakeholders affecting the forest.

At the strategic level, the New Partnership for Africa's Development (NEPAD) Document's main message is that forestry has enormous potential and priority areas for intervention were identified as policy and legal reforms and improved land use planning, strengthening the institutional framework, investing in SFM, and improving the efficiency of forest industries and other complementary investments. For this to be realized, more resources, well distributed and used, including special care to the provision of adequate human resources properly trained in the vast field of forestry policies and techniques are vital.

FORESTRY EDUCATION ISSUES

The key issues and constraints to forestry education in Africa could be grouped into four categories: (i) Forestry education and training programmes to cater for the specific requirements of rural populations and groups (ii) Limited resources (human, physical infrastructure, financial resources), (iii) Non-optimal communication and collaboration and networking; and (iv) Low political commitment to develop the sector.

It would be interesting during our debates to address also the following issues:

- In the forestry training required today, what is the balance between people oriented, social forestry and more traditional forestry topics such as biometrics, silvics, forest engineering and wood processing?
- What is the status of networking and cooperation among forestry training institutions in Africa?
- How can we act on the well developed diagnoses to position forest education at the forefront of the African institutions of the 21st Century?

FAO's CONTRIBUTION TO FORESTRY EDUCATION IN AFRICA

FAO's interest in the development of forestry education in Africa began immediately following the independence of countries in the early 1960s when priority was given to taking stock of existing forestry education facilities and to the determination of trained human resource requirements. Later efforts were gradually directed to re-appraising forestry training problems and needs in the light of changing situations in forestry and forest industries, and to assisting forestry administrations in assessing their capabilities and improvement needs in the face of their expanding responsibilities.

In Forestry, it is fair to mention that FAO has been at the inception of the creation or upgrading of a majority of University level and Technical Forestry Institutions across Africa. In 2001 FAO organized an expert consultation on forestry education in Rabat leading to recommendations to improve forestry training at all levels and promote regional networks, such as African Network for Agriculture, Agroforestry and natural Resources Education (ANAFE) and Réseau des institutions de Formation Forestière et Environnementale d'Afrique Centrale (RIFFEAC). In Africa FAO actually is still involved in a joint European Project to support Higher Forestry Education in Tunisia and hopefully Algeria and to strengthen the Southern African Development Community (SADC) Forest Training Facility in Zimbabwe.

Over the last years at global level FAO has pushed strongly for the establishment of the recently created International Partnership on Forestry Education and especially the participation of the regional African forestry education networks in this partnership. FAO still supports forestry education activities through the Collaborative Partnership on Forests, National Forestry Programme (NFP) Facility; Technical Cooperation Programme (TCP) and budgets directly managed by the representations in the countries.

FUTURE OF FORESTRY EDUCATION IN AFRICA

The future of forestry education in Africa, we believe, would need to focus sharply on the needs of societies and incorporate the participation of the whole chain of stakeholders, be based on a strong scientific body of knowledge, updated experiences, constant research and first class pedagogy.

However, most importantly, forestry colleges and schools must employ dedicated teachers and this means attractive working conditions, stimulating professional opportunities and possibilities to constantly interact with the forestry sector and civil society. Moreover, it implies that students must be of a high calibre and very motivated by the topics they are to learn and by the promise of a career in that field.

We trust that the following areas are essential for forestry education in Africa:

- Integration of forestry and agriculture training at the technical level with pro-active integration of female technicians;
- Strategize proper training, including curricula revision with existing international institutions, many of which are attending this meeting today;
- Forestry curricula encompassing at all levels, elements dealing with climate change, participatory forestry, biodiversity management and the transversal integration from the energy, water, and agriculture sectors;
- Facilitate the organisation and delivery of solid post graduate studies;
- Support regional cooperation between African countries and other regions through sound networking and efficient use of rare resources; and
- Give more attention to forest education at primary, secondary and adult levels with initiatives such as Forest Management Learning Group experience from RECOFTC. Farmer Field Schools experiences are also examples of including forestry education in adult education.

FAO and ICRAF have both developed activities in forest education in primary and secondary schools, which are worth to be further, developed.

FAO finally recommends the following:

- To develop awareness of universities on the importance of courses on forest policy associated with NFPs;
- The need for a teacher training programme on forest policy such as the one developed by the FAO regional Office for Asia and the Pacific; and
- To support already existing regional networks of forestry education institutions (for Africa RIFFEAC and ANAFE) for designing and developing education modules.

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