

The global need for food, fibre and fuel



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The global need for food, fibre and fuel

Land use perspectives on constraints
and opportunities in meeting future demand

Report from two seminars
at the Royal Swedish Academy of Agriculture and Forestry
27 September and 22 November 2011



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Foreword

In the last ten years or so, the global interest in, and concerns about, the issue of how the world shall provide a growing population with sufficient food, bioenergy and wood raw material has attracted increasing attention. Will land and water resources be enough, how shall they be best managed to achieve increased production and productivity without causing far-reaching negative environmental and social side-effects, will climate change make solutions more difficult, will there be financial means and know-how available to address all challenges and opportunities? These and other questions occupy governments, institutions and individuals around the world today. At the same time, the sense of urgency to address the situation, both locally and globally, has increased in the recent past with the surges in global food prices, the alarming apparent increase in climatic events with disastrous impact on crops and forests, the many controversial deals related to transfer of land tenure rights witnessed in Africa, etc. And, as a timely reminder of what it all boils down to, viz. the increase in number of people concerned, the global population passed the 7 billion mark just in between the two seminars reported in this publication.

Several members of the Royal Swedish Academy of Agriculture and Forestry (KSLA) are directly or indirectly involved in work related to the global supply of food, wood and bioenergy – as policymakers and experts at Swedish or international level, as private company and institutional leaders, and/or as scientists. Several seminars, study tours and meetings organized by various KSLA committees, and publications emanating from such events, have touched upon various aspects of the issue. However, to date, the issues have normally been approached with a sectoral perspective, i.e. they have concentrated on either the food production aspect, or the wood fibre needs, or the potential and problems of increasing the global supply of bioenergy, or the critical water situation in many parts of the world.

The Academy's mandate and the expertise of its members cover the whole range of issues involved, i.e. agriculture, forestry, energy, environment, water, economy and sustainability of natural resources management, etc., and it was felt in early 2011 that the time was ripe to take a more holistic and integrated approach to analyzing and highlighting the “3F-question” as it has become known, i.e. “food, fibre and fuel”. Four of the Academy's committees, viz. the committees on International Forestry Issues, International Agricultural Issues, Energy Issues and Sustainable Development set up a planning group that designed the two seminars that were then held in the fall of 2011. Through the very extensive contact networks of institutions and individual experts that the four committees, and the KSLA Secretariat, have, it was possible to secure presentations at the seminars of some of the world's foremost experts in the various fields.

The two seminars attracted a very large interest and we hope that this publication will serve as a valuable summary of the many highly interesting and thought-provoking presentations and comments that were made during the seminars. However, it has been impossible to reproduce all the fact- and idea-rich figures that were shown in the various presentations, or the many pertinent

opinions and supplementary ideas and facts that came out in the panel and general discussions. Most of these presentations are available at the websites of KSLA (www.ksla.se) and the Secretariat for International Forestry Issues (www.sifi.se).

Finally, KSLA and the organizing committees would like to thank all the people involved in making the seminars such a success and this publication a valuable record of them: the speakers first of all, who are presented in the report; the very active and knowledgeable audiences at the two seminars contributed immensely to the final success; the individuals in the planning group; the staff at KSLA and SIFI that contributed to the organization, particularly Dr. Fredrik Ingemarson, who coordinated all the arrangements and edited the report; and Dr. Lisa Holmgren who kept records and put together this report.

Very special thanks go to Mr. Lennart Båge, former President of the International Fund for Agricultural Development (IFAD), who acted as a highly appreciated and effective moderator of the two seminars. In addition, he made a very good summary of the seminars which, together with the individual presentations and comments made during the seminars, constitute the basis for this report.

Stockholm 2012-01-22

A handwritten signature in dark ink, appearing to read 'Björn Lundgren', with a long horizontal stroke extending to the right.

Dr. Björn Lundgren
Chairman
KSLA Committee for International Forestry Issues

Speakers' profiles

Dr. Dominique van der Mensbrugghe is Senior Economist and Team Leader of the Global Perspectives Studies Team at the Food and Agriculture Organization of the UN (FAO). Before, he held a position at the World Bank as Lead Economist in the Development Prospects Group. His focus has been on long-term structural change of the global economy and the analysis of global economic policy issues. He has a PhD in economics from the University of California, Berkeley, and his work has appeared frequently in various economic journals and the World Bank's annual flagship reports.

Dr. Stefan Wirsenius is Associate professor at the Division of Physical Resource Theory, Chalmers University of Technology, Gothenburg. He has a PhD in environmental science from Chalmers, and his research areas include land use and greenhouse gas emissions of food systems.

Harald Svensson is an economist by training and has a long career in the Swedish public agricultural administration. He has held different chief positions, among others as Director of the departments for supervision and for crops. Since some years, he holds a position as Chief Economist in the central management of the Swedish Board of Agriculture.

Jan Wintzell is a Director at Pöry Management Consulting in Sweden. He holds an MSc in Forestry from the Swedish University of Agricultural Sciences and has more than 25 years of consulting experience within the forest and forest industry sectors worldwide, the past 20 years of which with Pöry. Mr. Wintzell has specialized in subjects related to forest resource and industrial development matters, serving both corporate and institutional clients around the world.

Dr. Stefan Bringezu is Director at the Wuppertal Institute, heading the Research Group on Material Flows and Resource Management. He is a biologist by training and has a PhD in ecosystems analysis. He has worked on chemicals assessment, supply systems and environmental planning, among other things, and is a member of various advisory boards. His main subject is the analysis of the socio-industrial metabolism and related land use and the instruments to sustain resource supply, use and waste management.

Anders Dahlberg has a Master in science and engineering from Uppsala University. Currently, he holds a position as programme manager at the Swedish Energy Agency, Analysis department, Energy markets and energy use, working with biofuel markets, trade and pricing. He participates in the EU-project EUBIONET on international wood-fuel trade.

Professor Sten Nilsson joined IIASA in January 1986, becoming Leader of the Forestry Program in 1990, and was appointed Deputy Director from July 2002 to May 2008. He currently holds a visiting affiliation with IIASA. A native of Sweden, Professor Nilsson has had a distinguished academic career in forest sector analysis with emphasis on policy analysis. He is a working member of, among others, the Royal Swedish Academy of Agriculture and Forestry (KSLA), and has held a number of consultancies in organizations such as the World Bank, FAO, GECD, European Commission and SIDA.

Dr. James Stevenson is an agricultural economist, based at FAO in Rome, supporting a group of global experts that assesses the impact of the Consultative Group on International Agricultural Research (CGIAR). Previously, he worked for Oxfam GB, on impact evaluation of development programmes in West Africa and South Asia, and at the University of Reading, researching farm-level trade-offs between economic and environmental indicators in aquaculture systems in the Philippines.

Professor Mats Olsson has a MSc in Forestry and a PhD in Soil Science and is Professor in Soil Science since 1989. He is currently head of the research group on Biogeochemistry and Environmental Assessment at the Department of Soil and Environment at the Swedish University of Agricultural Sciences in Uppsala. He is also adjunct professor at North Carolina State University in USA. He has during many years carried out research and supervised MSc and PhD students in e.g. Ethiopia, Mexico, Laos and Vietnam.

Dr. Johan Kuylenstierna is Centre Director for SEI Stockholm and SEI Deputy Director Operations. He holds an adjunct professorship in international water resources issues at the Department of Physical Geography and Quaternary Sciences at the Stockholm University. He has experience from international policy work through professional positions at the World Meteorological Organization in Geneva and the Division on Sustainable Development (CSD) at the United Nations Headquarters in New York. His academic background is in Palaeoclimatology.

Gabriella Cahlin has a Master in Agricultural Sciences, and has worked for the last 23 years at the Swedish Board of Agriculture in different positions and areas. The last six years, she has held a position as head of the Market department, which is responsible for giving expert advice to, and in other ways assist, the Ministry for Rural Affairs concerning agricultural market and trade issues. The Market department also produces the Swedish official agricultural statistics.

Hanna Wetterstrand is an agronomist with a main focus on environmental economics. She has focused most of her professional life on the interactions between agriculture, environmental sustainability and climate change and poverty reduction. She has been working as a programme officer for Vi Agroforestry since 2005 with environmental sustainability and climate change adaptation.

Jeremy Woods is a Lecturer in bioenergy at Imperial College London working on the interplay between development, land-use and the sustainable use of natural resources. Recently he became co-director of the Porter Institute, dedicated to the development of advanced bio-renewables. His research focuses on accessing the development opportunities that arise from advanced bioenergy and bio-renewables including African development and food security linkages with bioenergy production.

Heikki Rissanen is Senior Vice President for Business Planning in Stora Enso's Group Forest Operations. He has worked with Stora Enso since 1993. For the past ten years, he has worked in various strategic positions, amongst others with identifying new plantation-based business opportunities. He was earlier employed by the Food and Agriculture Organization of the UN and the Ministry for Foreign Affairs of Finland.

Jörgen Sandström is Deputy Managing Director of Addax Bioenergy. He is a Swedish national and former Swedish career diplomat with 20 years of experience from development and humanitarian assistance work in Africa and the former Soviet Union and with several international organizations. Jörgen Sandström started Addax Bioenergy four years ago.

Dr. Jörgen Levin is a Senior Lecturer and Researcher at the School of Economics, Örebro University. He received his PhD in development economics at Göteborg University and has more than 20 years of experience of economic reform programmes in African countries. He has worked on growth, inequality, poverty, public finance and MDGs with several international organizations.

Professor Johan Schnürer is Assistant Vice-chancellor (Vice President) and responsible for external research cooperation at the Swedish University of Agricultural Sciences. He is a specialist on the biology of food- and feed borne micro fungi. Professor Schnürer has initiated and coordinated several large research programs on microbial biotechnology.

Mafa E. Chipeta has recently retired from positions as coordinator of a new FAO sub-regional office for Eastern Africa, which he set up in 2007, and as representative to the African Union, the UN Economic Commission for Africa and to Ethiopia. Currently he does sundry work on policy for the Southern Africa Development Community, the Union of Farmers organization of Southern Africa, and (on land matters) for the consortium of the African Union, African Development Bank and the UN Economic Commission for Africa. During his career, he has, among other positions, served in various positions at the Food and Agriculture Organization of the UN and as Deputy Director-General of the Centre for International Forestry Research (CIFOR) in Indonesia.

Summary

Producing enough food, fibre and fuel – a challenge for the 21st century

The past few years have witnessed a sharply increased focus on the need to produce more food, wood fibre and bioenergy to supply the demand of a growing world population. The global demand for “food, fibre and fuel”, or “the three F’s”, has become a matter of high political concern. There seems to be wide agreement that beyond 2030, food, fibre and fuel production will compete intensively for limited land and water resources. This in turn imposes both threats and opportunities of a complex nature, not least in the face of accelerating climate change.

One starting point in addressing the challenge of managing a finite land resource is to look at what a growing world population is expected to need and demand in terms of food, fibre and fuel, and what this might imply for land use at a global scale. Increasing global demand is expected for food, fibre, and fuel. Demand for cereals, for both food and feed, is projected to grow with some 50 percent by 2050 compared to today. Demand for other food products that are more responsive to rising incomes in developing countries (meat and dairy products, fish and aquaculture products, and vegetable oils) is projected to grow much faster than that for cereals for food use.

However, land use and greenhouse gas (GHG) emissions must be considered of critical importance in any long-term assessment of the global food system. Since land is becoming increasingly scarce globally, and GHG emissions need to go down to reduce risks of climatic change, costs for land and for GHG

emissions are likely to rise and influence food demand structure. Mainstream forecasts and projections of global food demand might need to be revised with factors such as more stringent climate mitigation policies and even higher oil prices being taken into account.

Global industrial demand for wood fibre is expected to increase for all traditional forest products and this will impact future land use and increase pressure on land. In addition, wood fibre is also increasingly demanded for other uses than traditional forest products like, for example, wood pellets for heating and power. Fast growing forest plantations will have to play a greater role in meeting increasing demand. Further, combined land utilization is increasingly valuable to meet different and growing demands for wood fibre.

Although future supply and demand for bioenergy is harder to predict than that for food and fibre, there seems to be general agreement that developments in bioenergy will have major implications for land use, and will result in increased competition for land, particularly between the biofuel and the food sector.

Food, fibre and fuel production will compete for limited land resources

The sectoral responses to a growing world demand lie to a large extent in increasing productivity on land already under cultivation and in expansion of land under cultivation. However, apart from the adverse ecological, economic and social consequences that this might imply, there is also limited scope for such expansion

during the coming decades. Figures vary, and there are great uncertainties in available data sets, but analyses show that we might expect a significant deficit of productive land already by 2030.

One effect of land resources becoming relatively scarcer as global demand for food, fibre and fuel is growing is a new wave of transnational farmland investment and what has been referred to as a “rediscovery” of the agricultural sector by different types of investors. The phenomenon has attracted much international media attention and spurred a number of reports on its negative consequences as well as on its potential opportunities. It is here argued that large-scale land acquisitions cannot be judged in black and white while there is no simple way to say they are always good or always bad. Therefore, the international community should not condemn such investments out of hand but instead assist countries concerned in making such investments less damaging where bad deals have been concluded and help build institutional capacity to negotiate deals with investors using the guidelines now being developed by FAO.

Need for improved management of land and water

The overarching challenge can be described as a question of how to manage land and water to supply the demands of a growing world population for food, fibre and fuel, while at the same time protecting the natural ecosystems that sustain life on the planet. Prospects for increasing food availability lie mainly in intensification of production from land already under agriculture and in expansion of agricultural areas. However, much attention has been paid to how expansion should be minimized, to avoid further adverse effects. There is considerable agreement that

increasing yields on existing agricultural land, and especially on cropland, is a key component for minimizing further expansion. Improved soil management indeed holds significant potential, and agricultural yields on many soils in developing countries may get doubled or tripled production rates provided that soil management is improved, for example by the use of adequate fertilization. Regarding supply of wood fibre, industrial forest plantations hold a great production potential. For these potentials to be realized, one prerequisite is that governance of global water resources is improved substantially, and that water is seen and planned for as an integral part of land and soil systems.

Need for cross-sectoral policies and adapted institutions

There is a need to stop thinking and acting in sectoral trajectories and move to cross-sectoral analyses and integrated land-use policies in order to address competing demands for food, fibre and fuel. The need to integrate water issues in land management planning is one of these cross-sectoral challenges. Another concerns the production and use of biofuels, which should be fit into an overall resource strategy, covering energy, climate, land-use, water and agricultural issues, if their deployment is to benefit society, the economy and the environment as a whole.

Land tenure issues have also come to be of particular concern in the context of global demand for production of food, fibre and fuel since increased competition for land has placed further stresses on land tenure systems. One issue that has been widely discussed as a consequence of past years’ large-scale transnational land acquisitions is how to secure land tenure rights for local and forest-dependent people in negotiations on land deals. In this context, water tenure must not be forgotten.

Challenges are also related to distributive aspects of, and market infrastructure for, agricultural commodities. Open and well-functioning markets and trade from the local level to the global level are important in order to increase availability of food and, above all, it is important that markets are accessible for those who need them. As for the local farmer level, it has been said that failure to help small-scale farmers to access markets is a key cause to hunger and, in this respect, there is a need for well-functioning farmers' organizations.

As for the global food market, world trade in agricultural commodities will continue to increase. There are several factors that may distort global trade, such as export restrictions and subsidies. Increased trade also carries risks for increased spread of animal diseases and plant pests. Different preventive regulations may be a limiting factor in world agricultural trade, as might also be, for some areas, insufficient infrastructure for handling increased amounts produced. Several of these factors can potentially be dealt with in trade agreements, preferably at a global level as the WTO-agreements.

Need for more efficient use of existing resources

As a parallel route to increasing availability of food, fibre and fuel through increased production rates, we have to use existing resources more efficiently. There is a need to be more cautious of what is today regarded as waste products in the chain of production and consumption for food, fibre and fuel, in order to increase food

availability. More food can also potentially be delivered by changing our agricultural and dietary preferences. Especially demand for animal protein is a crucial concern since livestock production is by far the most resource consuming agricultural activity. Certification and different kinds of sustainability standards are two means to move consumptive trends towards taking account of environmental and social issues to a greater extent, and so help in guaranteeing food safety.

Need for enhanced knowledge and capacity building

There is a need for enhanced knowledge and capacity building for many areas related to the themes addressed here. Available tools to study land use change are limited in their abilities and there are great uncertainties in available data sets. The challenge to put the whole "food-fibre-fuel-feed-forest ecosystems-fresh water nexus" to analysis from a land use perspective is, to a large extent, still ahead of us.

It is clear from the seminars and from literature that there is a lot of thinking done on what strategies to pursue to meet a growing global demand for food, fibre and fuel in a sustainable manner. However, as also pointed out by many, the question of *how* to translate strategies into action remains to a large extent to be answered. It should be kept in mind that increasing the supply of food, fibre and fuel is a means to an end. There are still one billion people in the world that are poor and hungry, and this should be our first priority.

Introduction

Producing enough food, fibre and fuel – a challenge for the 21st century

The past few years have witnessed a sharply increased focus on the need to produce more food, wood fibre and bioenergy to supply the demand of a growing world population. The global demand for “food, fibre and fuel”, or “the three F’s”, (sometimes added with a fourth F for “feed”, alternatively “fresh water” when water scarcity is in focus) has become a matter of high political concern. Nilsson (2007) has summarized the drivers behind this political interest as concerns for food security, energy security, national security, environmental security and political security. As a consequence, issues related to these concerns are found on the agenda of virtually every UN-body, development bank, policy and research institute, NGO and others with mandates and programmes related to agriculture, forestry, energy, and the environment.

There seems to be wide agreement that beyond 2030, food, fibre and fuel production will compete intensively for limited land and water resources. Naturally, competition for land and water to secure different interests is not a new phenomenon in history. What may be new to our time, however, and what was perhaps made even clearer by the food price crises of 2008/09, are the global dimensions of land use issues in the face of scarcer resources, and the need to apply a global perspective on land management. Recent projections by internationally recognized organizations speak in favour of this:

- The global population will surpass 9 billion by 2050 and has to be fed;
- Renewable energy sources will have to play a central role in moving the world on to a more secure and sustainable energy path;
- Demand for wood and fibre products will continue to increase at a global level;
- Climate change will reduce crop yields in many countries;
- Agricultural demand for water is expected to increase drastically and global water scarcity will thus worsen.

This in turn imposes both threats and opportunities of a complex nature, of which all can probably not be foreseen at present. What many foresee, however, is that handling increasing global competition for cultivable land will be a huge challenge for the 21st century. The overall question posed, in a global natural resource use governance perspective, is how to manage land and water to meet the demands for food, fibre and fuel of an expected world population of 9 billion people in the year 2050, and at the same time protecting the natural ecosystems that sustain life on the planet.

Practices and policies needed to address this challenge have been discussed for many years, and there is now quite an extensive literature on what would need to be done. However, as also noted by many, the question is still to a large extent *how* to implement proposed strategies to cope with this challenge. Intrinsic to this ques-

tion is also the uncertainty on how pressures like climatic change, reduced freshwater availability, and land degradation will impact natural resource management. Despite extensive research, we cannot know for sure yet how the eco-systems, that make production of biomass for human purposes possible, will react to such future changes.

It is against the above backdrop that the Royal Swedish Academy of Agriculture and Forestry organized two related seminars during the autumn of 2011 on the global need for food, fibre and fuel, and how to address constraints and opportunities to meet increasing demands, from a land use perspective. This report summarizes the two seminars.

About the report

The report includes speakers' notes on presentations made at the two seminars as well as an attempt at synthesis. The structure of the report largely follows the seminars' disposition. The first seminar covered global demand and supply of food, fibre and fuel for the next 20 years and addressed the question of available land resources to meet the demand. Chapter 1 includes speakers' notes from presentations made at this seminar.

The second seminar dealt with the question of how to address constraints and opportunities to meet the demands. Presentations stretched

from requirements for improved management of the resource base to requirements for policy and institutional development, and Chapter 2 includes speakers' notes from this seminar.

One hotly debated matter in the context of growing demand for food, fibre, and fuel is the phenomenon of large-scale transnational land acquisitions, or what has sometimes been referred to as "land-grabs" in, for example, Africa. The phenomenon has attracted much international media attention in recent years, and spurred a number of reports on its negative consequences as well as on its potential opportunities. However, the debate and reports on the issue tend to be dominated by industrialized country perspectives. In Chapter 3, Mafa E. Chipeta provides a view on the matter from African countries with perceived land resources.

Chapter 4, finally, is an attempt at synthesis of what has been learnt from the speakers' presentations and notes, as well as from the seminars' panel discussions.

Any referenced literature is found in connection to each speakers note, and references are also found compiled at the end of the report in the list of references. As mentioned above, there is quite an extensive literature on different aspects of "the three F's", and the reference list also includes some other selected recent reports and research articles of relevance to the subject matter of the seminars.

Chapter 1

THE GLOBAL NEED FOR FOOD, FIBRE AND FUEL – IS THERE ENOUGH LAND TO SATISFY THE DEMANDS?

One starting point in addressing the challenge of managing a finite land resource is to look at what a growing world population is expected to need and demand in terms of food, fibre and fuel, and what this might imply for land use at a global scale. After a short introductory note, this chapter includes speakers' notes related to expected demand for the coming 20 years, and also addresses the question of how much land that might potentially be available for cultivation globally within this timespan.

Global biomass demand and land resources available for cultivation: an introductory note

Projections on future global demand in food, wood fibre and biofuels are made by several international organizations. The most widely used agricultural projections are those of the UN Food and Agriculture Organization (FAO) and the International Food Policy Research Institute (IFPRI) (Smith *et al.*, 2010). For projections of global demand in wood products and energy needs, the FAO and the International Energy Agency (IEA), respectively, are widely considered as authoritative sources.

Expectations on long term food demand and supply

According to UN projections, world population is expected to reach 9.3 billion people by 2050, and nearly all of the population growth is forecast to take place in developing countries.

FAO projections show that feeding a global population of 9.3 billion people would require raising overall agricultural production by 70 percent from now up to 2050 (FAO, 2009). In this chapter, Dominique van der Mensbrugghe, FAO, addresses the main drivers behind food demand and presents a FAO long term global perspective on demand for food and agricultural goods.

Climate change is already a factor that affects natural and managed systems (forests, agriculture, fisheries, wetlands, coral reefs) that societies depend on for the production of food, fibre and fuel. There seems to be wide agreement that climate change will mainly affect future crop yields negatively and thus impose a real constraint on the production of food for a growing world population. In this chapter, Stefan Wirsenius, Chalmers University, argues

that land use and greenhouse gas emissions must be considered of critical importance in any long-term assessment of the global food system, and that current mainstream forecasts on global food demand might need to be revised with upcoming factors related to this being taken into account.

Moving from aggregate global food demand to food supply at the national level, Harald Svensson, Swedish Board of Agriculture, takes a Swedish perspective on food supply in the next 20 years. He accounts for Swedish agricultural production of the last 15 years, and addresses the potential for Swedish agriculture.

Expectations on long term wood fibre demand and supply

As for future demand of wood fibre, there is general consensus that industrial demand for wood fibre will continue to increase. FAO estimates from 2009 show that, up to 2030, a further increase is necessary by 1.4 percent per year for sawnwood, and 3 percent for paper and wood-based panels to meet growing demand. Below, Jan Wintzell, Pöry Sweden AB, presents Pöry's estimates of global industrial demand for wood fibre within the coming 20 years, and points at the increased role of industrial forest plantations in meeting future demand.

Expectations on long term biofuel demand and supply

In its World Energy Outlook 2010, IEA concludes that the energy world at large faces unprecedented uncertainty. This holds especially true for the bioenergy sector, which, to a large extent, depends on what future government policy responses will look like to tackle the twin problem of energy security and climate change.

Regarding bioenergy, it can first be noted that there are some differing usages of terms in the discussions of, and reports on, different types of bioenergy. FAO defines bioenergy as all energy derived from biofuels, which are fuels derived from biomass (that is, matter of biological origin). This is further subdivided into type (solid, liquid, and gas) and by origin (forest, agriculture, and municipal waste). FAO thus notes that biofuels from forests and agriculture (woodfuel and agrofuel) can come from a wide range of sources, including forests, farms, specially grown energy crops, and waste after harvesting or processing of wood or food crops.

In this chapter, Stefan Bringezu, Wuppertal Institute, takes a look at global demand for biofuels in a land use perspective, and argues that the use of crops for biofuels must be assessed in an overall land use perspective in order to be sustainable.

Anders Dahlberg, the Swedish Energy Agency, focuses on biofuel use in Sweden, particularly developments of the market for biofuels for the Swedish transport sector, which is expected to double from now to 2030.

Potentially available land for cultivation

Increasing global demand is expected for food, fibre and fuel, and the sectoral responses lie to a large extent in increasing production and in expansion of land under cultivation. Many are asking where the land to serve this increased production will come from and what the consequences will be of further land expansion. Sten Nilsson's presentation addressed the question of how much land that is potentially available globally for cultivation and showed that we can expect a land deficit by 2030. It is argued that we are facing a huge problem and that the issue must be lifted to highest political level.

A long term global perspective on the demand for food and agricultural goods: a view from the Food and Agriculture Organization

DOMINIQUE VAN DER MENSBRUGGHE AND PIERO CONFORTI, UN FOOD AND AGRICULTURE ORGANIZATION

Long term developments in food and agricultural markets are fundamentally driven by a few key variables. Income levels and population growth are the two most important on the demand side. In the coming decades, changes in global food consumption will above all reflect the rising consumption of developing countries. However, despite general progress in world average food intake during the last decades, some regions of the world are still lagging behind, and projections show that there will still be pockets of undernourishment by 2050.

Income and population drive world food consumption

Let us consider income first. According to the World Bank, global economic growth is expected to average 2.9 percent per year between 2005 and 2050, corresponding to 1.6 percent per year in high income countries and 5.2 percent per year in developing countries. GDP will therefore grow more rapidly in developing countries than in high-income countries. In per-capita terms, incomes are expected to rise at 2.2 percent per year to 2050 on average. Absolute poverty, based on a poverty line of USD 1.25 per person per day, would be reduced from 21.9 percent in 2005 to 0.4 percent in 2050, according to the World Bank; and in Sub-Saharan Africa, from 51.7 percent to 2.8 percent.

The second major long term driver for food and agricultural demand is population growth. According to the latest assessment published by the United Nations Department of Economic and Social Affairs in 2011, under a medium fertility assumption world population is expected to reach 9.3 billion in 2050, and then start stabilizing. Virtually all the increase is expected to take place in developing countries. Developed countries will start declining in the late 2040s. East Asia will have shifted to negative demographic growth in the early 2040s, Latin America in the early 2060s, South Asia in the mid-2060s, while the Near East/North Africa region will be shifting in the mid-2080s. By the end of the century, the only region where population will still be growing is sub-Saharan Africa. Projections for certain countries in that region show that populations may be up to 3.5 to 7 times the current levels around year 2080; this is the case, for instance, of Niger, Uganda, Nigeria, or Yemen in the Middle East.

Urbanization will impact food consumption patterns

Urbanization is also expected to impact food consumption patterns significantly. Projections for the coming decades indicate that about 67 percent of the world's population is expected to

be concentrated in urban areas by 2050. Urban dwellers, especially as their income improves, tend to buy more processing services compared to households in rural areas. Also, they usually tend to shift away from more traditional foods such as roots and tubers, as well as to shift towards protein-rich diets. Goods produced in rural areas need to physically reach urban consumers. This requires that more services be incorporated into foods in terms of packaging, storage, grading and transportation. Usually, urbanization is also associated with a reduction in the processing of food and fibres which is undertaken within households. Such changes call for farmers in rural areas to work with longer production chains. In turn, the functioning of longer production chains calls for more services, from logistics and information on market and prices, to credit, finance and insurance. Most of these services need to be produced and made available in rural areas.

World average food intake has increased

Given the above outlook for income and population, what can we forecast about food consumption? Food consumption per capita is perhaps the most stable component of demand, hence the more predictable. The world has made significant progress over the last four decades, at least in terms of average food intake (Figure 1.1). Consumption per person and day has reached 2770 kcal/person/day in 2005/07, while it was only of 2370 kcal/person/day at the beginning of the 1970s. Steady increases were recorded in East Asia, as well as in Latin America and the Caribbean and the Near East/North Africa region. In our most recent (provisional) projections, the world average consumption is expected to be little more than 3000 kcal/person/day in 2050.

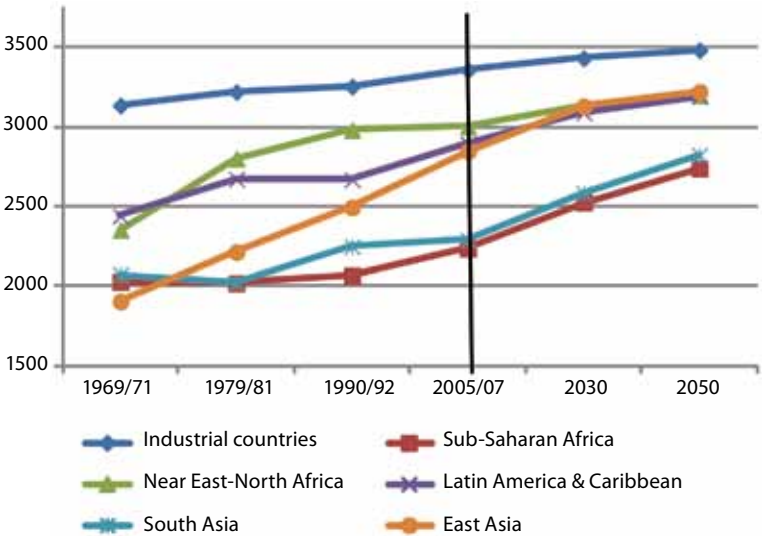


Figure 1.1 World food consumption (kcal/person/day). Source: FAO (2011).

These changes imply that a growing share of the world population will be close to a condition of saturation, in which food consumption will not grow substantially in per capita terms (Figure 1.2). More people around the world, in other words, will get close to the flat part of the Engel curve, and food demand will likely become less price-elastic. This means that prices may absorb a larger share of supply shocks, possibly resulting in more volatility.

In the coming decades, changes in food consumption will reflect above all the rising consumption of developing countries. As a group, developing countries may pass from 2619 kcal in 2005/07 to almost 3000 kcal in 2050. These changes will imply a switch towards energy-dense diets, high in saturated fat, sugar and salt, and low in unrefined carbohydrates. Combined with lifestyle changes driven by urbanization, such transitions are likely to be accompanied by an increase in diet-related chronic Non-

Communicable Diseases. A relevant policy challenge, in this area, will be that of orienting consumers toward healthy diets and lifestyles, allowing a reduction in the social and economic burden of food-related diseases.

Some regions still lagging behind

However, despite general progress, some regions are lagging behind. Sub-Saharan Africa and South Asia, in particular, are reported to still be below 2500 kcal/person/day in 2005/07. South Asia, among developing countries, is deeply affected by what will happen and is happening in India. This country accounts today for about 1.1 billion people out of a total of 2.4 billion in South Asia and Sub-Saharan Africa, that is, nearly half of the total of the two regions in which consumption per capita is still under 2500 kcal/person/day. The evolution of food consumption in India shows a stagnant

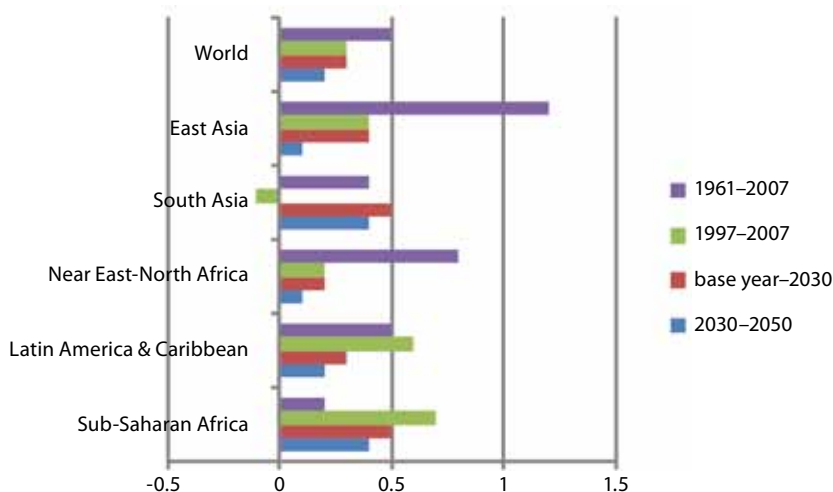


Figure 1.2 Growth rates – food consumption per capita is slowing down. Source: FAO (2011).

response to income growth and poverty reduction. The amount of average kcal/person/day in 2005/07 – around 2300 – is virtually unchanged from 25 years earlier.

The reason for this stagnation is not clear, and somewhat controversial. Broadly speaking, some analysts argue that it should be imputed to changes in relative prices, household age composition, food habits, and reduced dietary requirements, following the reduced physical activity of the population. In turn, this would be the consequence of the increase of secondary and service activities in the economy. Others, instead, argue that there may be problems in the recording of food consumed away from home, so that the incidence of prepared/processed foods would not be adequately measured. To date, however, the apparent paradox of decreasing food consumption has not yet been fully resolved. This casts uncertainty over the expected development of consumption in a country that accounts for a large share of developing countries' total population.

Prevailing pockets of undernourishment

Notwithstanding the expected increases in average food intake in developing countries, projections for the coming decades show that there will still be several countries in which the per capita food consumption will not increase to levels allowing significant reductions in the numbers of undernourished. Overall world prevalence of undernourishment is expected to pass from 16 percent in 2005/07 to 4 percent in 2050. Such percentage could be further reduced by year 2080 to 1.6 percent. Sub-Saharan Africa would still be the area with highest prevalence, as it is today, with about 7 percent of undernourished. The highest *absolute* number of undernourished persons, instead, is expected to still be in Southern and Eastern Asia, as observed currently. This would pass from 544 million in 2005/07, to about 155 million in 2050.

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Global demand for food in 2030: how climate policy and bioenergy might change demand structure

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Land use and greenhouse gas emissions must be considered of critical importance in any long-term assessment of the global food system. There are upcoming factors related to this which are likely to contribute to long-run changes in the structure of global food demand in relation to the current mainstream forecasts. It is here argued that the projections of food demand might need to be revised with these factors being taken into account.

This paper discusses some of the upcoming factors that are likely to contribute to long-run changes in the structure of global food demand. “Changes” in this context means changes in relation to the current mainstream forecasts and projections of global food demand. Thus, it is here argued that the projections of food demand might need to be revised, with these factors being taken into account.

Land use and GHG emissions critical in assessing the global food system

Land use and greenhouse gas (GHG) emissions must be considered of critical importance in any long-term assessment of the global food system. Land is becoming increasingly scarce globally, and GHG emissions need to go down if we are to reduce the risks of climatic change. This means that the costs for land and GHG emissions are likely to rise, which will influence food demand structures, as will be elaborated below. Therefore, as a background, let us take a look at

some basic data on land use and GHG for some major food types:

1) In the EU27, beef requires almost 20 times more land than pork and chicken meat, and about 80 times more than cereal products (per amount of calories). Beef production relies mainly on permanent pastures, but also uses significant amounts of cropland: per unit of calories, beef uses about 4–5 times more cropland than dairy products, pork and chicken, and around 15 times more than cereal products. (Figure 1.3)

2) Beef also emits much more greenhouse gases than most other food types: per unit of calories, GHG emissions from beef produced in the EU27 are about 10 times larger than for pork and chicken, and about 100 times larger compared to beans. It is important to note that most of the emissions from beef productions consist of methane (CH_4) from feed digestion and nitrous oxide (N_2O) from land, and that for both of these emission sources, the prospects for reducing them by agronomic and (bio)technological means are relatively limited. Even in a longer term perspective, therefore, the only way to obtain deep cuts in these emissions is likely to be through reduced production levels.

Three factors that might change future demand structure

After these background data, we now move on to introduce some of the upcoming factors that might contribute to long-run changes in the

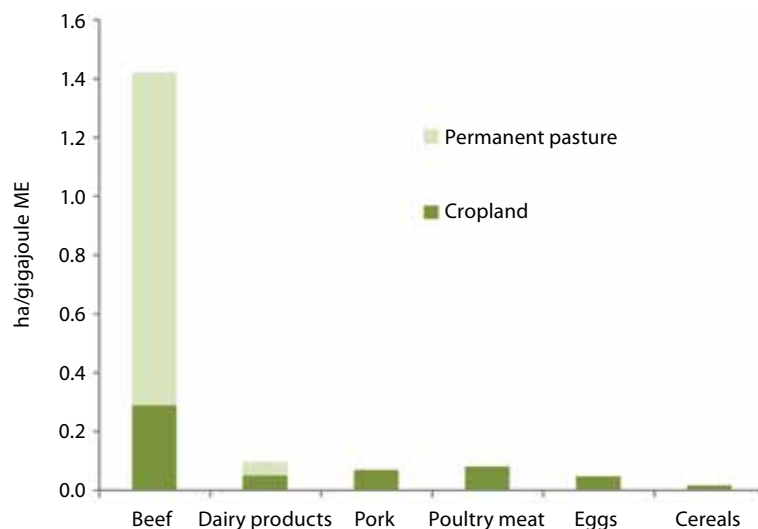


Figure 1.3 Land requirements per unit of food (average for EU27 in the year 2005).
Source: Wirsenius, Hedenus & Mohlin (2011).

structure of global food demand. Focus here is on factors that may increase supply costs and thereby moderating demand (thus, possible changes in preferences, such as trends towards low-carb diets, or vegan/vegetarian food, are not included):

1) Stringent climate mitigation policies

a) If stringent climate policies are introduced at a larger scale, the cost for carbon dioxide (CO₂) emissions from fossil fuels will rise. These higher costs for emitting CO₂ would give strong incentives to expand bioenergy plantations, which would lead to an increased competition for agricultural land between food and bioenergy crops. This competition would lead to significant increases in land opportunity costs and land rents, and therefore also generally higher farm gate prices of crops and animal products. In addition, the higher opportunity cost of

prime cropland might make it cost-effective to establish large-scale bioenergy plantations mainly on permanent grassland. This would push ruminant production towards higher feed-to-food efficiency and a larger reliance on cultivated feeds than pasture, which in turn would add to higher relative prices of beef.

b) Agricultural GHG emissions have so far largely been exempted from climate policy. If agriculture was to pay for their CH₄ and N₂O emissions to an extent similar to that of CO₂ in the energy and transport sectors, food prices would rise significantly. In a recent study of food demand in the EU27 (Wirsenius *et al.*, 2011), it was found that beef demand would be reduced by about 15 percent if production were to take emission costs for CH₄ and N₂O corresponding to EUR 60 per ton of CO₂-equivalent. It could be noted that this 15 percent reduction is more than the expected global increase of 10

percent in beef per-capita demand from now to 2030. However, it should also be noted that EUR 60 per ton of CO₂-equivalent probably is at the lower end of the emission costs that will be needed to bring down emissions enough to meet the 2 degree target. If society aims at meeting the 2 degree target with a high probability, global emissions have to be cut by about 80 percent by the year 2050 (red line in Figure 1.4). For this emission target, only the emissions from agriculture might take almost all of the emission allowance by 2050 (Figure 1.4, green bar), unless there are changes in demand or substantially improved production technology. Therefore, the long-run marginal GHG emission costs might be much higher than EUR 60 per ton of CO₂-equivalent.

c) Reducing deforestation is an essential component for mitigating global CO₂ emis-

sions. Since deforestation mainly is linked to agricultural expansion (roughly 90 percent of deforested land is converted to agricultural use) a substantial reduction, or a complete halt, in deforestation would have a significant impact on the global food supply system. Assuming that the marginal supply costs through expansion are lower than those of intensification (i.e. higher yields), halting global agricultural expansion would lead to an upward push of land rents, and therefore also food prices – particularly of those commodities that are land-demanding and that are predominant at the expansion frontier, most notably beef.

2) Even higher oil prices

Recent forecasts by US Energy Information Administration (EIA) for global oil prices in 2030 range from USD 50 to USD 200. If oil

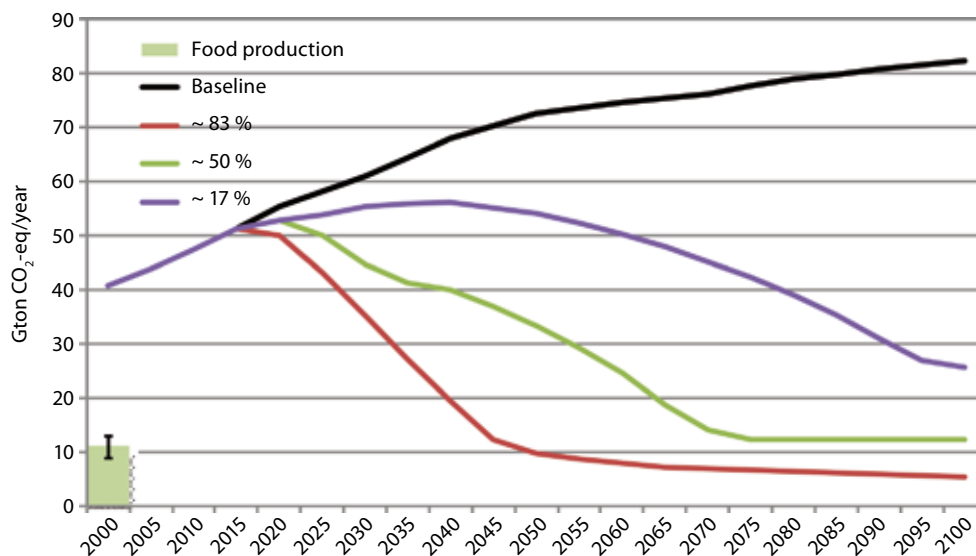


Figure 1.4 Emissions from agriculture (green bar) might be critical for meeting a 2 degree target. Source: Hedenus, Wirsenius & Johansson (2010).

prices reach the high end of this forecast, the incentives for expanding bioenergy production are likely to be strong. In the same way as in the case of increased CO₂ emission costs above, an expanding bioenergy production will contribute to higher land rents and food prices. Higher oil prices will also entail production cost increases through higher fuel and fertilizer costs.

3) Faster development and dispersion of high-productivity and low-emitting livestock systems

Development and dissemination of higher-productivity (with respect to land and feed) and low-emission technologies would most certainly take place in livestock production in response to the cost increases outlined above.

This would cancel out these cost increases, to a varying degree depending on product and forms of production.

Extent of changes depends on supply system's ability to respond

In conclusion, higher oil prices and the implementation of stringent climate policies are likely to lead to higher food production costs, especially for meat and dairy products, and will therefore entail changes in the demand for these products. The extent of these demand changes will depend on the supply system's ability to respond to higher land rents and emissions costs by raising productivity and developing and adopting new technology.

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Global demand for food in the next 20 years: the Swedish perspective

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Agricultural production in Sweden has decreased during the last decade while Swedish trade in agricultural products has increased. This is one of the reasons behind the current surplus of cultivable land in Sweden. The probability for any considerable increase in Swedish crop production in the next decade is low while conditions might be reasonable for increasing production of animal products.

Swedish agricultural production has declined

Sweden is a member of the European Union (EU) since 1995. The first years after the accession, the agricultural production was stable or slightly increasing. However, from approximately the year 2000, the production has declined for almost all important products. Cereals, beef, pork and milk have each declined by about 10 percent. Exceptions are chicken and, from 2001, also oilseeds. Production of chicken has increased by 50 percent (from 1995) and production of oilseeds by more than 100 percent (from 2001).

Agricultural land surplus in Sweden

Because of higher crop yields over time and decreasing production of meat and milk, there is a land surplus in Sweden. An important driving factor is of course also the support-schemes in the Common Agricultural Policy (CAP). In

2005, the coupled support schemes for crops, beef and milk were decoupled to an income support based on agricultural land. Support is given also for agricultural land without any agricultural production, but the land should be managed in a proper way to become eligible for support.

The total surplus of agricultural land in Sweden is estimated at approximately 800,000 hectares (see note below). The total agricultural area is just over 3 million hectares, of which 2.6 million hectares is arable land.

Swedish trade in agricultural products has increased

Foreign trade (with all countries in the world) in food, drinks and tobacco for Sweden has increased a lot during the last decade. The increase is about 100 percent for the period 2000 to 2010, the export over 100 percent and the import slightly under 100 percent. The development of Swedish trade compared with Denmark or EU27 (trade with extra-EU countries) shows that Denmark and the EU has increased its foreign trade less than Sweden, about 25–50 percent.

In 2010, the import of agricultural food-stuffs, feed and beverages to Sweden is calculated to SEK 95 billion (about EUR 10 billion, exchange rate in September 2011). The export for the same year is calculated to SEK 54 billion (slightly under EUR 6 billion). The import consists mainly of fish (25 percent), fruit and veg-

etables (18 percent), meat and meat products (10 percent) and beverages (8 percent). The main countries are Norway (22 percent), Denmark (15 percent), the Netherlands (10 percent) and Germany (10 percent). The export, on the other hand, consists mainly of fish (35 percent), beverages (12 percent), cereals and products thereof (11 percent) and other (11 percent). The main countries are Denmark (11 percent), Norway (10 percent), Finland (10 percent) and France (9 percent).

From the figures we can conclude that the trade in fish is important. It consists mainly of import of fresh fish from Norway which is processed in Sweden and then a high percentage is re-exported to other countries. Another conclusion is that Sweden is a net import country for meat (mainly beef) and meat products and a net exporter of cereals and products thereof.

There is no doubt that Sweden's share of the total global production of important agricultural products has declined in recent years. However, if comparison is made with the EU27, Sweden's share is fairly constant.

As mentioned above, the surplus agricultural area is big in Sweden, about 800,000 hectares. The question is what changes are

probable in the next decade. Based on information from OECD/FAO Agricultural Outlook 2011–2020, the Swedish Board of Agriculture has concluded that we are likely to see the following changes:

- increasing prices for crops,
- slightly increasing prices for milk, and,
- about the same prices for meat.

Increased Swedish production of grain not very likely

Higher profitability for crops may increase crop production in Sweden but, on the other hand, the decrease in crop production during the last decades has mainly occurred on smaller farms in the predominantly forested areas of the country. Therefore, it is not so very likely that we will see a considerable increase in grain production in the next decade. The profitability in milk and meat production is low for many farmers. On the other hand, we can now see a deficit for beef and pork meat in Sweden. If the preferences for Swedish products will be higher than today, the conditions will be reasonable for increased production of animal products in Sweden.

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Note: The surplus area is estimated in two different reports from the Swedish Board of Agriculture. According to one of the reports (Swedish Board of Agriculture: *Kartläggning av mark som tagits ur produktion*, Report 2008:7, page 5), 500,000 hectares are no longer cultivated and the area of cultivated grass-land is between 200,000 and 300,000 hectares bigger than needed in relation to the number of cattle and other animals. In the other report (Swedish Board of Agriculture: *Jordbrukets miljöeffekter 2020*, Report 2007:7, page 30), a forecast for 2020 is made about the cultivation of different crops which can be compared with the total area of arable land in 2010. The difference is about 1 million hectares. The reports are available at www.jordbruksverket.se.

Global demand for wood and fibre in the next 20 years

JAN WINTZELL, PÖYRY SWEDEN AB

Global industrial demand for wood fibre is expected to increase for all traditional forest products and this will impact future land use and increase pressure on land. Fast growing forest plantations will have to play a greater role in meeting increasing demand. Further, combined land utilization is increasingly valuable to meet different and growing demands for wood fibre.

When talking about global demand for wood fibre in a land use perspective, it should first of all be kept in mind that the largest share of wood harvested globally, some 57 percent, is still used for non-industrial purposes, as fuelwood. This picture is likely to prevail for the coming decades. Further, it should be noted that there are significant variations in demand and supply of wood fibre, due to, for example, business cycles. Therefore, in this context, it is the big picture that is of interest.

Industrial demand for wood fibre is sizeable and increasing

Looking at the big picture, global forest industry demand for wood and fibre is sizeable and all projections show increased growth in demand for forest products within the coming 20 years (Figure 1.5). The major use of industrial roundwood is found in sawnwood production, accounting for some 55 percent of the total. Growth in sawnwood demand is expected to continue, mainly for softwood. Historically, demand in sawnwood has been following popula-

tion growth. However, demand experienced a dramatic decline in 2010 and recovery of demand to pre-2009 levels is not expected until after 2020. In a longer-term perspective, by 2040, we will probably see a growth rate of around 1 percent per annum.

Regarding wood-based panels, the picture is different than that for sawnwood. Growth in demand increases faster than population growth, more in line with economic growth, and this is expected to continue, particularly for Asia and China. In a longer term perspective, however, we should probably expect a slight decline in demand growth rate for wood-based panels as demand matures.

As for paper and paperboard, the current demand growth rate is 1.7 percent per annum which equals a growth in volume consumed by some 25 percent between 2010 and 2025. The biggest growth takes place in emerging markets like China, while traditional markets are in a state of decline. The majority of fibre for this use comes from "urban forests", that is, recycled fibre. Thus, the growth in demand for virgin fibre from forests is expected to remain rather modest and mainly include plantation based hardwood fibre. It should also be noted that the Chinese market, which is the locomotive for demand of these products, now experience the introduction of technologies like the internet, e-mail, electronic invoicing and e-book readers, and it is at present hard to predict what this does to demand for paper products.

Product Area	RWE Increase 2010–2030 ^A
Pulp & Paper ^B	150 million m ³ sub
Sawnwood ^C	250 million m ³ sub
Wood-based panels	400 million m ³ sub
TOTAL (gross)	800 million m ³ sub
TOTAL (net) ^D	700 million m ³ sub

- A) Increase according to Pöyry scenario in KSLA presentation.
 B) Virgin pulp based demand increase.
 C) Softwood & hardwood sawnwood including demand recovery 2020.
 D) Including utilization of sawnwood residues in pulp and panels.

Figure 1.5 Industrial wood demand increase to 2030 is sizeable.
 Source: Pöyry AB.

Translating the increase in demand for wood-based products into round-wood equivalents, there could be a total increase in demand for wood of 700 million solid m³ from 2010 to 2030. The question in a land use perspective is naturally where the wood fibre to supply this increase will come from. In theory, there are plenty of resources. However, in practice the resources are not so plentiful. We also have the problem with continuing deforestation that adds further pressures to forest resources.

Fast growing forest plantations will have to play a greater role

The challenges to future wood supply are many. As global demand for wood-based products increases, pressure on natural forest resources is growing. Therefore, industrial plantations are becoming ever more important for securing future wood supplies in a sustainable and ethical manner (Figure 1.6).

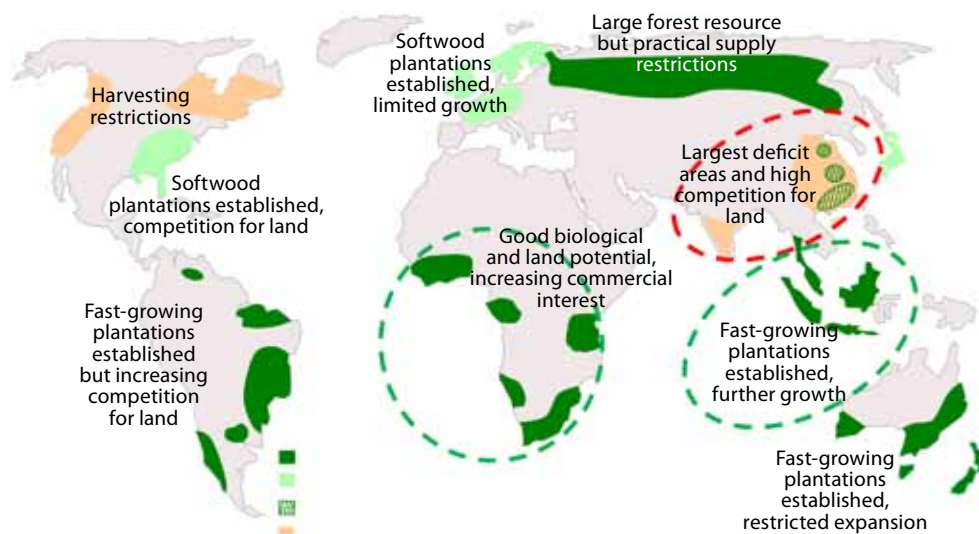


Figure 1.6 Growing challenges to future wood supply. Source: Pöyry AB.

Fast growing plantations hold a great production potential and may give the opportunity not only to increase supply of wood fibre, but also to enhance the economy of the forest sector. This, in turn, may improve prerequisites for forest conservation and also provide opportunities for combined land utilization, for example in the form of agro-forestry, to meet different and growing demands. However, prospects for increasing the area of planted forests vary widely worldwide. As an example, Africa is standing out as having great prospects with good biological and land potential and is now consequently attaining increasing commercial interest.

Can wood fibre be used more efficiently?

Another route to pursue in order to help in meeting a growing demand for wood fibre might be to use existing fibre resources more efficiently. For example, given the large volumes of wood fibre used for fuelwood purposes worldwide, one can pose the question whether fuelwood can be put to “better use” and “industrialized”?

That is, can it be used in a more efficient way in order to secure local people’s energy needs and help in securing future wood supply? In the same way, one can ask whether forest residues can be put to better use than today.

Forest products demand growth impacts future land use

To conclude, it is clear that growing demand for wood fibre will impact future land use. It is also clear that this means increasing pressure on land since growing demand is mainly seen in Asia, particularly China, and the developing world, where land is, or is becoming, a scarce resource. However, industrial fast growing plantations hold significant and growing supply potential, and can be a means to reduce pressure on natural forests. Also, combined land utilization, for example agro-forestry, is increasingly valuable to meet different and growing demands for land and wood use, including fuelwood. In sum, we definitely see forest products as part of providing sustainable solutions for a complex world.

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Is there enough land? The overall use of land for biomass is key for assessing biofuels

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Global cropland will most probably expand only to feed a growing population and additional demand for non-food biomass adds to the pressure of land conversion. Four key strategies for sustaining the future physical basis of economies and societies are here outlined. The use of crops for biofuels must be assessed in an overall land use perspective in order to be sustainable.

Demand for non-food biomass adds to pressure on land

Global land use is characterized by two main trends: first, the expansion of built-up area, and secondly, the expansion of agricultural land, both at the order of magnitude of several hundred million hectares until 2050. This goes at the expense of shrinking natural grasslands, savannahs and forests, mainly in the tropics.

Global cropland will most probably expand only to feed a growing world population with an increasing demand for more protein rich food from animals. Any additional demand for non-food biomass crops will add to the pressure of converting natural land. As an example, the EU is already a net importer of cropland for its domestic consumption of agricultural goods, with a per capita use exceeding the global average (Bringezu *et al.*, 2012). This imposes a high risk of more greenhouse gas emissions for the coming decades due to energy crop-based biofuels (Bringezu *et al.*, 2009).

There is also an increasing demand for ligno-cellulosic biomass from forest. Traditional

use for timber products is competing with use for energy, and stationary uses for heat and power compete with conversion to liquid bio-fuels. As a consequence, traded volumes of liquid biofuels and wood pellets are increasing rapidly. Figure 1.7 shows the main trade flows of ethanol, wood pellets and biodiesel.

Land-use change for biofuel crops cannot be avoided by product standards and certification alone, as long as global demand for biomass is growing. Certified production would drive non-certified production, particularly for food, to other areas.

Bio-economy and “bioniconomy” – visions for sustainable societies

Sustaining the physical basis of economies and societies will require the pursuit of four key strategies: resource efficient and recycling based industries; steady stocks society; solarization of infrastructures, and; balanced bio-economy and “bioniconomy” (Bringezu and Bleischwitz, 2009). Regarding the latter strategy, a bio-economy may be characterized as an economy largely based on biomass, interwoven with and nested in natural eco-systems, resulting from a relative decrease of mineral resource use. It should be balanced with regard to both production and consumption. As for production, this should be consistent with local environmental conditions and, regarding food versus non-food, build on a food first principle. In order to arrive at sustainable consumption, consumption

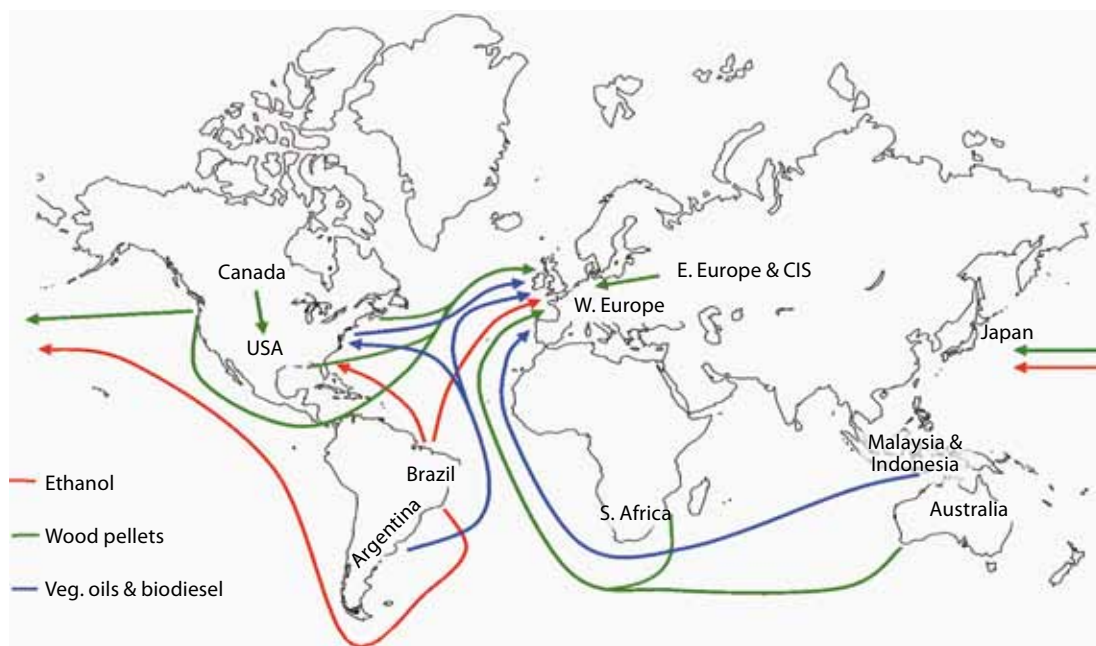


Figure 1.7 Trade flows of ethanol, biodiesel and wood pellets. Source: Taken from Schouwenberg et al. (2009), IEA Task Force 40.

levels, as well as domestic and foreign supply, must not exceed local, regional and global capacities.

While the introduction of bio-economies is a medium-term vision, the long-term vision is arriving at “bioniconomies”. A “bioniconomy” may be characterized as an economy that makes use of biological principles (“bionic”), carbon recycling and industrial photosynthesis.

Biofuel use needs to be assessed in overall land use perspective

The review of available knowledge and recent findings lead to the following conclusions:

- 1st generation biofuels from energy crops impose a growing risk for world food supply and natural ecosystems,

- biofuels for transport increasingly compete with more efficient heat and power,
- use of 2nd generation biofuels from waste and residues has a certain sustainable potential, and may be an interim step towards carbon recycling regenerating base materials,
- Syndiesel and Syngas from wood have a certain, limited potential for transport, and
- the level of sustainable use of forest biomass in the world regions needs to be determined.

Governments should fit biofuels into an overall resource strategy, covering energy, climate, land-use, water and agricultural issues, if their deployment is to benefit society, the economy and the environment as a whole.



Industrial residues (eucalyptus) processed into chips for use in pulp and paper production. Photo: Jim Carle, FAO (FO-6953).

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Past, present and future biofuel use in Sweden

ANDERS DAHLBERG, SWEDISH ENERGY AGENCY

Swedish demand for biofuels is politically driven through policy measures. Even though Swedish production capacity would be enough to satisfy the demand, large quantities are imported. The use of biofuels in the Swedish transport sector is expected to double from now to 2030. However, partly because of the high percentage of imported biofuels, the increased use of biofuels does not imply any notable land use change for Sweden's part.

Mature market for biofuels in Sweden

In most areas, Sweden is a small player in comparison with the rest of the world and this is also true regarding biofuels. Even though it is small, the market of biofuels in Sweden can be considered mature compared to most countries in the world. The demand for both ethanol and biodiesel (RME) is driven politically through policy measures. Biofuels cannot compete with fossil fuels without some kind of support. This is the case for most biofuel markets in the world, except Brazil where ethanol made from sugar cane can be competitive with gasoline.

Sweden is dependent on import

The capacity of the Swedish producers is theoretically enough for the Swedish demand, but the production is less than half of the consumption. During 2010, large quantities of biodiesel and ethanol were imported to satisfy the market. In 2010, 73 percent of the ethanol consumption and 47 percent of the biodiesel consump-

tion was imported. Grains and seeds are also imported in rather large quantities for biofuel production in Sweden, especially for RME-production (Energimyndigheten, 2011a).

Besides ethanol and RME, biogas from waste is upgraded and used in the transport sector. The most common use is a mixture of approximately 65 percent biogas with natural gas. There are around 120 public fuelling stations, mainly in the south of Sweden (Energimyndigheten, 2010).

Biofuel use does not imply notable land use change in Sweden

Sweden has decreased its land area used for crop production, as have many other countries in the EU27, during the last decades. In combination with a high percentage of imported biofuels and commodities for biofuel production, the increased use of biofuels does not have any notable effects on land use changes in Sweden. Today, 0.1 million hectares, out of a total of 2.6 million hectares arable land, is used for biofuels in Sweden.

Energy end use in the transport sector

Since 1970, the end use of energy in the Swedish industry and housing sectors has been constant due to efficiency improvements and changes in energy carriers. This is not the case for the transport sector, which has nearly doubled since 1970. Today, the energy end use in the transport sector accounts for 25 percent of the total use in Sweden (Energimyndigheten, 2011b).

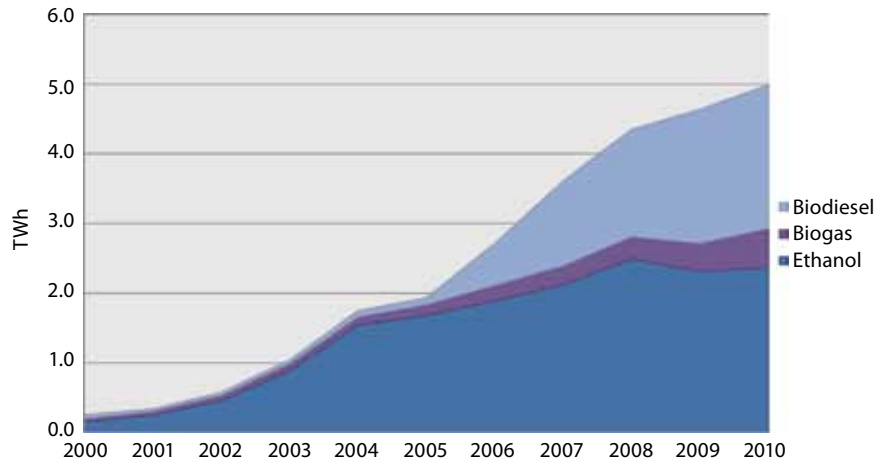


Figure 1.8 Biofuel use in Sweden 2000–2010. Source: Energimyndigheten.

Since 2000, there have been two trends in the transport sector. The first is the decrease of petrol use by 15 percent, and the increase in diesel use by 50 percent. The second is the increase of biofuel use with the current trend of biodiesel and biogas increasing while ethanol levels off (Energimyndigheten, 2011c; Figure 1.8).

Policy requirements

In the EU directive on renewables (2009/28/EC), a binding target is set to 10 percent renewable energy in transport to 2020 for all EU27 member states. Renewable biofuels are also required to fulfill sustainability criteria. At first, a 35 percent reduction of CO₂ emissions compared to fossil fuels is required and the requirement will grow to 50 percent until 2017. The fuel quality directive (2009/30/EC) specifies permitted levels of low-admixture additives in motor fuels, 10 percent ethanol or 3 percent methanol in petrol and 7 percent biodiesel in diesel. In Sweden, only up to 6.5 percent blending in petrol and 5 percent in diesel is

exempted from tax. Additional low-admixture is subject to full tax which means the same tax as for petrol and diesel. Sweden also has incentives for the use of renewable fuels. One example is a law which requires larger petrol stations to sell at least one renewable fuel since April 2006. The fuel most commonly chosen is ethanol (Energimyndigheten, 2011b).

Outlook to 2030

The latest long term forecast from the Swedish Energy Agency extends to 2030. The use of biofuels in the transport sector is expected to increase from 3.5 TWh in 2007 to 7 TWh in 2030. The forecast is strongly dependent on today's tax-rules for low-admixture of ethanol and biodiesel into petrol and diesel. The percentage of blending with tax-exemption is assumed to be used and the increase over this is moderate. If Sweden is going to reach more than 10 percent renewables in 2020, new measures are likely to be needed (Energimyndigheten, 2011d).



Food. Photo: John Foxx/IBL.

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Availability of cultivable land to meet expected demand in food, fibre and fuel

STEN NILSSON, FOREST SECTOR INSIGHT AB

Studies have been made of potential global availability of land for expanded cultivation. With the question of land availability starting from the hypothesis that, in the future, there will be land use conflicts due to a shortage of land and the impossibility of meeting all the demands. In conclusion there are three possible interpretations of the current analyses of the future land use: a) available land use data are so uncertain that not much can be said about the future land use; b) a number of the analyses carried out conclude that the foreseen land use conflicts can be avoided if appropriate policies in a number of fields are implemented; and c) the global society will not be able to implement needed policy changes and transformations and in this case a minimum land deficit of 300 million ha is foreseen by 2030. The latter option has been advocated for, based on the fact that the global society has not been able to take needed actions on earlier complex, multi-sector problems like deforestation, climate change, poverty, etc.

Different approaches to the study of land availability

Regarding current global distribution of agricultural and forested land, some 4 billion hectares (or around 30 percent of total land area) is considered forested land (of which 7 percent is planted forests), around 1.5 billion hectares (or 12 percent of total land area) is currently under

crop cultivation, and 3.4 billion hectares (26 percent of total land area) are used for pasture.

Studies have been made on global availability of potentially cultivable land. For example, FAO, in collaboration with the International Institute for Applied Systems Analysis (IIASA), has developed the Agro-Ecological Zones (AEZ) methodology and a worldwide spatial land resources database, which enables us to make an evaluation of biophysical limitations and production potential of major food and fibre crops under various levels of inputs and management conditions.

Previous Agro-Ecological Zones results indicate that, at the global aggregate level, Earth's land, climate and biological resources are ample to meet future food and fibre needs, also for a projected world population of over 9 billion people. The calculated total extent of land suitable for at least one crop amounts to some 3.3 billion ha (or 26 percent of total land area as compared to today's 12 percent), of which 23 percent are in land classified as forest ecosystems. It is, however, concluded that despite this positive aggregate global picture (the figure is lower, though, if only counting the most suitable land), there are reasons for profound concern in several regions and countries with limited land and water resources.

A different approach to address the question of potentially available cultivable land has been made by Rockström *et al.* (2009) in exploring the planetary boundaries within which it

is expected that humanity can operate safely, without jeopardizing ecosystems' functioning. Regarding a planetary boundary for land-system change, it is proposed that no more than 15 percent of the global ice-free land surface should be converted to cropland in order to keep within limits.

Great uncertainties in data on land use change

Some different approaches to undertake analysis of future land use are geographic approaches, economic approaches, and integrated approaches. Available tools to study land use change are limited in their abilities and there are great uncertainties in available data sets.

Current availability of cultivable land

Data produced with the Agro-Ecological Zones methodology, show that when land already in use or not suitable for cultivation is subtracted from total land, and when grasslands used

for grazing of ruminant livestock have been withdrawn, some 700 million hectares remain potentially available for further expansion of cultivable land at present (Figure 1.10).

However, it was noted that this figure looks more positive than it is in practice. Much of the suitable land not yet in use is concentrated in a few countries in Latin America and Sub-Saharan Africa while many countries with growing populations in these regions are extremely short of land. Further, much of the land not yet in use is suitable for growing only a few crops, which might not be the most demanded ones, or suffers from varying constraints (chemical, physical, endemic diseases, lack of infrastructure) that are difficult to overcome or has important environmental characteristics (FAO, 2009).

Minimum land deficit of 300 million hectares by 2030

The conclusion is that analyses made point at a minimum deficit of some 300 million hectares of productive land by 2030 and with continued transformation of natural forests. Contrary to a common misconception, there is practically no completely unused land reserve in the developing countries – virtually all land is used for some kind of activity-purpose, although some uses are very extensive and/or intermittent (Figure 1.9).

Estimates thus differ but, taken together, the picture that emerges is that although there might in theory be enough suitable land available, in reality increasing global competition for land seems to be a fact. The question thus remains as to what must and can be done to tackle such a future.

Figure 1.9 Projected land use for 2030 – estimates of additional land needed in Mha. Source: Lambin & Meyfroidt (2011).

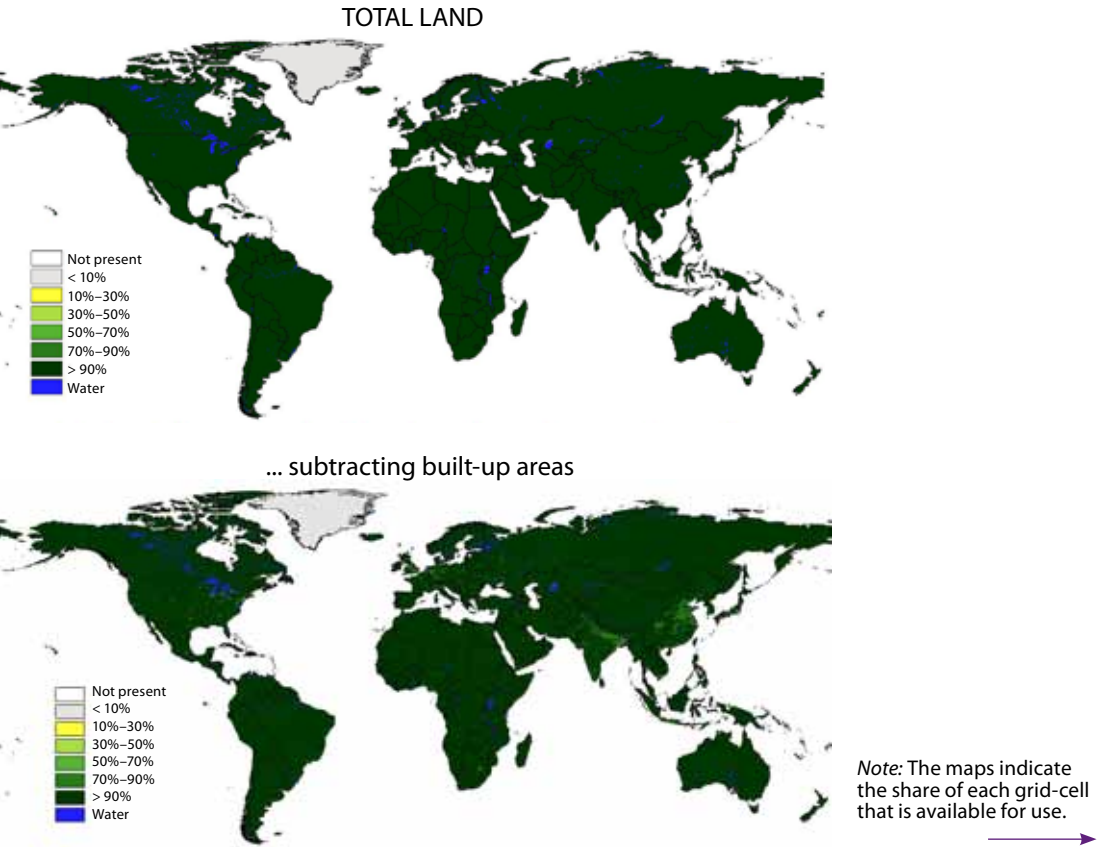
Categories	Estimates	LOW	HIGH
Additional croplands		81	147
Additional biofuel crops		44	118
Additional grassing land		0	151
Urban expansion		48	100
Industrial forestry expansion		56	109
Expansion of protected areas		26	80
Land lost to land degradation		30	87
TOTAL		285	792

Political will and integrated land-use policies needed to solve the problem

We are facing a huge land use problem and there is a need to lift the issue of land use and future availability of cultivable land to highest political level – particularly at the coming (in June, 2012) UN Conference on Sustainable Development, Rio +20 – as a green economy issue, demanding cross-sectoral and integrated land-use policies. Further, the work of broad-based economic development for diminishing poverty and enhancing well-being will contrib-

ute to more sustainable land use, and needs to be intensified. It was also proposed that a new global Remote-Sensing Program (high resolution) and platform for analyses of land use and land availability be established, as well as a process of integrated assessments of future land use and land availability, in line with the Intergovernmental Panel on Climate Change (IPCC), the Global Energy Assessment, the International Assessment for Agricultural Knowledge, Science and Technology for Development (IAASTD), and others.

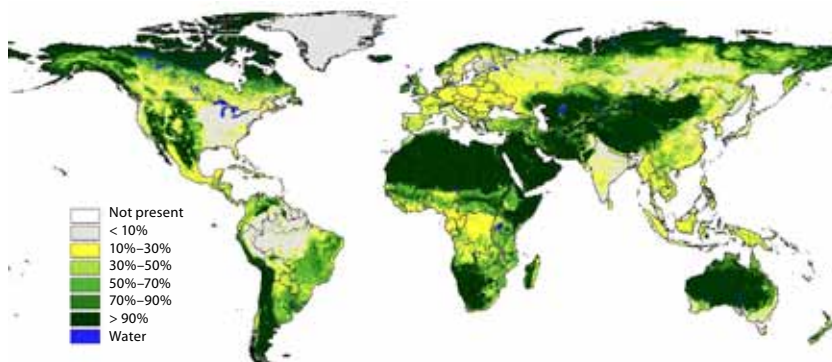
Figure 1.10 Series of maps indicating land area currently available for expansion of cultivable land after subtraction of land already in use or unsuitable for cultivation. Source: GAEZ 2007, IIASA – LUC/FAO.



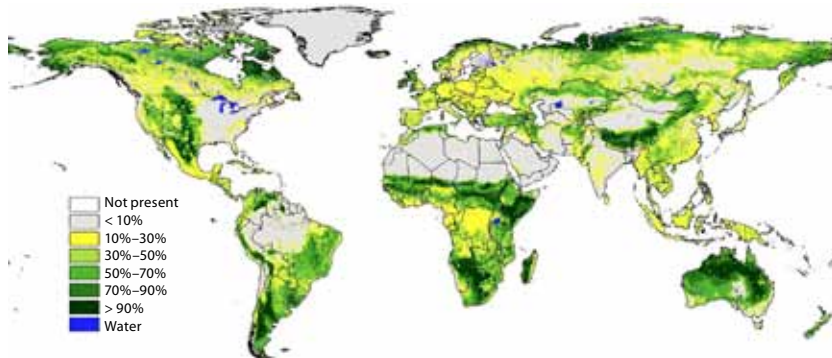
... subtracting cultivated land



... subtracting forest areas



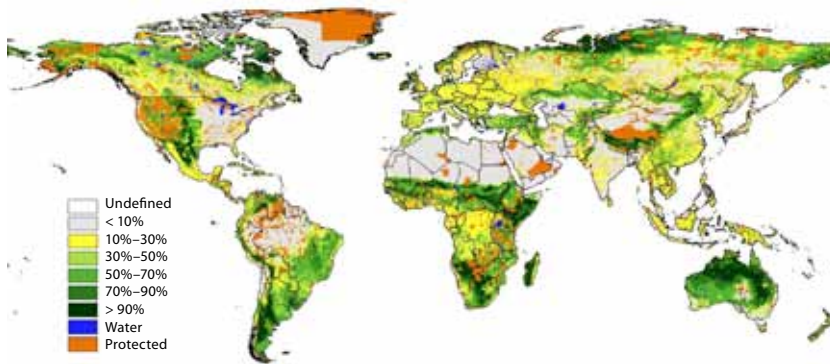
... excluding non-vegetated areas



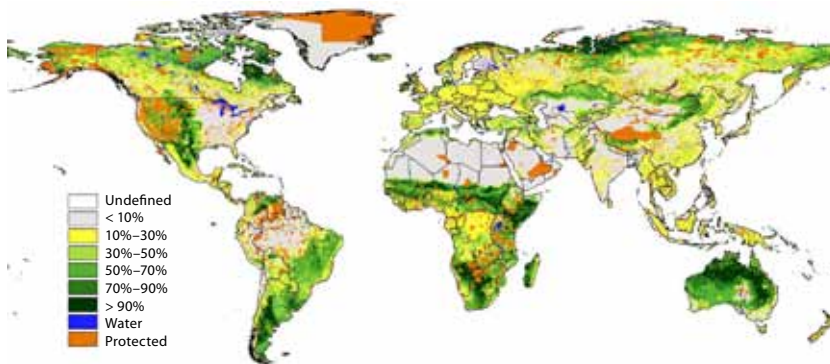
Note: The maps indicate the share of each grid-cell that is available for use.



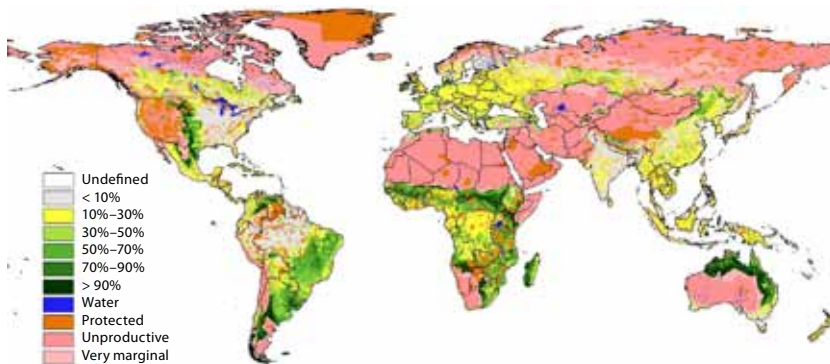
... excluding protected areas



... subtracting land with steep slopes



... excluding climatically unsuitable or very marginal areas



Note: The maps indicate the share of each grid-cell that is available for use.

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Chapter 2

HOW DO WE ADDRESS CONSTRAINTS AND OPPORTUNITIES TO MEET THE DEMANDS?

The overarching challenge can be described as a question of how to manage land and water to supply the demands of a growing world population for food, fibre and fuel, while at the same time protecting the natural ecosystems that sustain life on the planet. After a short introductory note, this chapter includes speakers' notes on different aspects of challenges and threats related to management of scarcer resources of land and water, as well as to institutional development, which would have to be dealt with in order to address this challenge.

Constraints and opportunities in future global biomass production: an introductory note

Facing a future of growing demand and scarce resources of cultivable land naturally means challenges and constraints of economic, ecological and social character. This is true both when it comes to managing the actual natural resource base in a sustainable manner as well as for managing a political and institutional environment that is conducive to this end.

Managing land and water for higher yields and improved conservation

Prospects for increasing availability of food and non-food crops lie to a large extent in expansion (extending croplands and pastures into new areas, replacing natural ecosystems) and intensification (managing existing agricultural areas more intensely, for example through mechanization and use of irrigation, fertilizers,

and biocides) of agricultural areas. However, it is also well established that both expansion and intensification may have adverse environmental effects in the form of, for example, destroyed habitats, deforestation and decreased biodiversity, worsened soil conditions and carbon storage possibilities, water degradation, increased energy use, and pollution (see e.g. Foley *et al.*, 2011). A question in a land use perspective is thus what strategies to use to strike a balance between increased productivity and adverse effects. In this chapter, James Stevenson, CGIAR, considers the effects of two broader land-use strategies – land-sparing and land-sharing respectively – for meeting agricultural productivity and environmental goals in the face of rising demand for food, fibre and fuel.

Moving from broader land use strategies to soil management level, Mats Olsson, Swedish

University of Agricultural Sciences, addresses requirements for improved soil management and shows that improved soil management can increase agricultural yields substantially. He stresses, however, that soil is an extremely diverse concept and that a system analyses perspective is required when different soil management options are considered, in order for long term sustainability to be achieved.

Closely linked to the issue of improved land management is the issue of improved water management. Global water scarcity is a problem that has been present on international policy and research agendas for a long time, particularly in connection with production of food since this is a highly water-consuming activity, but increasingly also in connection with bio-energy production. Below, Johan Kuylenstierna, Stockholm Environment Institute, presents a picture of the challenges associated with the water-food-energy security nexus and concludes that, although challenges are significant, on the positive side is that awareness and recognition of the importance of improved water management is on the increase.

Policy- and institutional development aspects

Meeting a growing demand for food does not only imply challenges associated with increasing production of food, but also challenges associated with enhancing accessibility to adequate and affordable food for those who need it. The functioning of the global trade system in relation to agricultural products is one aspect of this. In this chapter, Gabriella Cahlin, the Swedish Board of Agriculture, gives a picture

of world agricultural trade and points at some of the barriers and challenges associated with the expected increase in global trade in major agricultural products, as well as at some available policy means for dealing with these.

Moving from distribution of agricultural products at the global level to distribution at the household level, Hanna Wetterstrand, the Vi Agroforestry Programme, underlines the importance of market access. Accounting for agroforestry as an agricultural system with significant potential to increase the production of food and biomass at the household level, she recognizes farmers' lack of access to local markets as one crucial constraint to improved farming at the household level. She also points at other policy and institutional factors, such as appropriate tenure rights and strong farmers' organizations, which have to be in place in order for agroforestry to be introduced successfully.

Learning from experiences of Swedish involvement

Learning from experiences of companies and organizations that are involved in production of food, fibre and fuel is one way of gaining knowledge on how to address constraints and opportunities. There are several examples where Swedish commercial and public companies, managers and research institutions are involved in larger food, wood and bioenergy production programmes outside Sweden. Four such cases, related to production of wood fibre and production of biofuels, as well as to research on sustainable production of food, fibre and fuel, were presented during the seminars and are briefly summarized in this chapter.

Agricultural intensification and the environment

JAMES STEVENSON, CGIAR INDEPENDENT SCIENCE AND PARTNERSHIP COUNCIL
SECRETARIAT

An overarching challenge in sustainable food and fuel crop production is to find the means to strike a balance between increasing agricultural yields to meet demand from a growing world population and minimizing negative impacts from agriculture on the environment. Here, the effects of two broader land-use strategies – land-sparing and land-sharing respectively – for meeting agricultural productivity and environmental goals in the face of rising demand are considered.

The Consultative Group on International Agricultural Research (CGIAR) is a consortium of 15 research centres carrying out applied research on technologies, policies and institutions, on specific themes within agriculture, fisheries, forestry, water, climate change and nutrition. This pluralism in research is reflected in a range of perspectives on the relationship between agriculture and the environment. There is a degree of consensus around two policy goals: raise agricultural productivity to meet the projected increases in demand for food, feed and fibre to mid-century; and, minimize the negative impacts that agriculture has on the environment (especially minimizing net greenhouse gas emissions and conserving global biodiversity). Indeed these goals are now enshrined in the CGIAR's new Strategy and Results Framework (Consortium of CGIAR Centers, 2011). However, there is a healthy scientific debate about the means through which these objectives should be met.

Some scientists see no trade-off between agricultural productivity and a more multi-functional agriculture – one in which a wider range of ecosystem services are delivered without a “yield penalty” (e.g. Boelee, Chiramba and Khaka, 2011). Others would argue that de-emphasizing productivity as a main objective of agricultural research risks confusing targets and instruments in the pursuit of social policy goals (e.g. Alston, 2010), and that win-win scenarios between agricultural and environmental policy goals are likely to be the exception rather than the rule (Lee and Barrett, 2000). There remains insufficient empirical evidence on both sides of this debate, and this is an important direction for research over the coming years.

Land-sparing through yield-increasing agricultural technologies: does it work?

Consider two land-use strategies for meeting agricultural productivity and environmental goals in the face of rising demand for agricultural products: land-sparing and land-sharing (Figure 2.1). Land-sparing occurs when productivity on existing agricultural land increases and areas of natural ecosystems are protected. Land-sharing occurs when lower-yielding agricultural land spreads into natural ecosystems, but which (it is assumed) brings a greater range of on-site ecosystem services compared to higher-yielding agricultural land. Some recent papers suggest that a land-sparing strategy is better for net greenhouse gas emissions (Burney

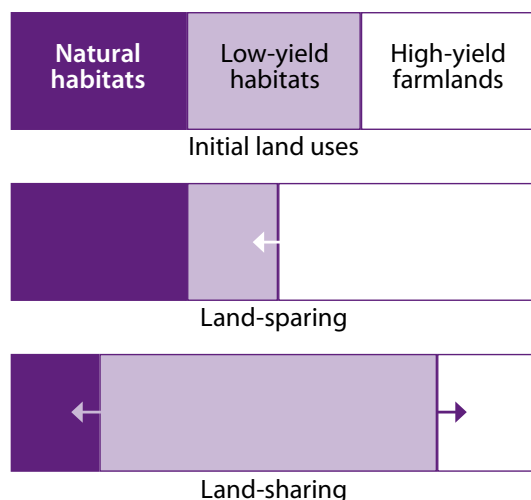


Figure 2.1 Two broad land use policy alternatives.
Source: Phalan, B. et al. (2011).

et al., 2010) and can be better in terms of biodiversity conservation (Green *et al.*, 2005; Phalan *et al.*, 2011).

We present new estimates of the extent of global land-sparing resulting from the adoption of improved varieties in the major staple crops between 1965 and 2004. These estimates are based on simulations carried out using the Global Trade Analysis Project Agro-Ecological Zone model (GTAP-AEZ): a multi-commodity, multi-regional computable general equilibrium model linked to a global spatially-explicit database on land use. This is the first time that several different effects – higher yields, lower prices, higher land rents, and the effects of trade – have been incorporated in a single model of the impact of the Green Revolution on land-cover change. Although the model incorporates the countervailing effects of technology

on land-use changes through prices and land rents, we find that increases in cereal yields as a result of widespread adoption of improved crop germplasm have saved natural ecosystems that would otherwise have been converted to agriculture. However, the results of this study suggest that this effect is of a much smaller magnitude than might be intuitively argued. The GTAP-AEZ estimates suggest that the total crop area in 2004 would have been between 17.9 and 26.7 million hectares larger in a counterfactual world which had not benefited from crop germplasm improvement since 1965. Of these, 12.0 to 17.7 million hectares would have been in developing countries.

Conclusions and implications for future research

A purely technology-led land-sparing strategy delivers some relief to the pressures on forests and other natural ecosystems, but is only a relatively weak counter to the real-world mix of factors that currently drive agricultural expansion (de Fries *et al.*, 2010; Angelsen, 2010). Improved governance mechanisms for effectively managing protected areas are a necessary complement to achieving both agricultural productivity and conservation goals. Further research is required into yield-environment trade-offs in different agro-ecologies, and into the economics of adoption of conservation measures by farmers in developing countries. This research agenda should help our understanding of how multiple policy objectives can be pursued at what cost. This is necessary to help move towards greater consensus in what is currently a fractured scientific literature on the ecological impacts of agricultural intensification.

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Eucalyptus plantation in Brazil: 50–60 ha m³/ha*yr (Acrisols). Photo: Mats Olsson.

Soil management requirements

MATS OLSSON, SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES

Improved soil management can increase agricultural yields substantially. Experiments show that agricultural yields on many soils in developing countries may get doubled or tripled production rates provided that soil management is improved. However, soil is an extremely diverse concept and a system analyses perspective is required when different soil management options are considered.

System perspective needed in soil management

Soil management requirements have to be elucidated from the standpoint that all ecosystem services, including biomass production, have to be secured in a long-term perspective, and that the use and management have to be site adapted. Furthermore, a system analysis perspective is needed when different options are compared or evaluated. Soil is an extremely diverse concept. There are more than 30 major soil units world-wide (International Union of Soil Sciences, 2006). Each one of these provides unique properties with specific prerequisites for biomass production, agricultural crops, energy crops, range land and forestry. The soil properties are determined by the combination of geology, climate, topography, land use and soil age. Thus, each soil type has its own limitations or bottlenecks regarding ability to produce biomass.

Different land use on different soil types

About 11 percent of the globally available 15,300 million hectares of land occur in mountainous landscapes and are characterized by very thin soils (Leptosols) due to strong erosion. These soils are not at all suitable for any intense biomass production and should be preserved by keeping a permanent vegetation cover. Potential land uses are forestry, preferably uneven aged forestry with a continuous tree cover, or extensive grazing. In some cases agroforestry may be a viable option. Another 12 percent land occurs in cold climates with permafrost. Low temperatures and frozen ground make intense biomass production impossible, though extensive grazing is possible.

Not less than 23 percent of the world land area are soil types characterized by limited availability of water, either due to drought, a groundwater level too deep for roots and/or low water retention capacity in the soil. Many of these soils are rich in nutrients but in need of substantial irrigation to sustain high yields. Alternatively, with less irrigation, they may be used for extensive grazing. The potential for irrigation and agricultural production will most likely be even more limited in the future because of less water resources and competing water use due to urbanization. Furthermore, the climate where these soils occur is often expected to get even dryer.

About 11 percent of the world soils have a too high content of water to enable intense bio-

mass production. Some of these soils are very fertile and may after some water regulation provide excellent agricultural conditions. However, some soils have dense subsoil and drainage has to be combined with deep ploughing and even fertilization. Some areas with wet soils ought to be preserved due to high biodiversity values and water quality issues.

About 23 percent of the land area consists of soil types that, due to poor mineralogy and/or intense weathering, have a low nutrient content. Many of these soils occur under tropical conditions and are characterized by excellent structure, but in particular limited phosphorus availability. A number of experiments show that the production of agricultural crops could be doubled or tripled through application of commercial fertilizers or compost and manure, or, best of all, a combination of organic matter and mineral fertilizers. One example of results from such experiments is shown in Figure 2.2.

Alternative land uses are forestry or shifting cultivation.

Finally, almost 20 percent of the land area consists of naturally fertile soils with respect to nutrient levels, texture and climate. These soils are frequently fertilized with nitrogen and phosphorus, which, to a point, will further increase yields, but in many developed countries today, and also in China, the high application rates normally means that the marginal effects of further increases of applications are rather small or negligible.

An allocation of fertilizers from countries with current high application rates to countries with low application rates may be beneficial with respect to yields and effective use of resources. On the other hand, many of the countries with low application rates have limited water availability, and, at the same time, high demand of water per unit produced crop.

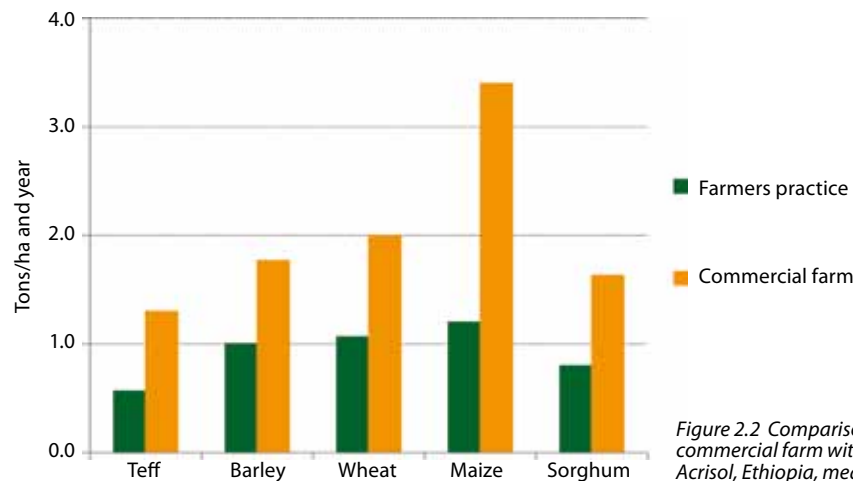


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Water as the hidden resource: the Water-Food-Energy security nexus

JOHAN KUYLENSTIERNA, STOCKHOLM ENVIRONMENT INSTITUTE

Managing global water resources is key to meeting the growing demand for food, fibre and fuel. The agriculture and energy sectors will “drive” the increase in water utilization over the next dec-ades. Already, approximately 3.5 billion people live under moderate to extreme water stress. By 2030, the gap in water availability may be as high as 40 percent. Water must be included as a key component in land use planning and management to accommodate such a future.

Water an integral part of land and soil systems

Water is an integral part of land and soil systems. When approaching and developing land use planning and management options, water must be included as a key component. Water resources are not like any other natural resources; it cannot be substituted, it is at the same time highly valued and terribly wasted, it is renewable but unevenly distributed in time and space, it is moving between users, regions and countries and it is a fundamental resource for all development. Human development and well-being, industrial and economic development, energy production and agriculture all rely on the availability of (often abundant) water resources. However, there are distinct differences between sectors and societies, their relationship to water and the future implications that changes in availability may have.

Globally, the water cycle provides about 40,000 km³ of renewable freshwater annually but differences in rainfall, evaporation and transpiration vary greatly by region and over time. The 20th century witnessed a six-fold increase in human water use, while the population increased three-fold. Although by far most precipitation originates from evaporation from oceans, it may also, in many regions, come from land-based evapotranspiration. This is one example of how land use changes and planning can directly influence precipitation patterns and thus the strong relationship between land and water.

Water essential to tackle development challenges

Water has multiple uses in society. It is involved in almost all forms of energy production, in primary production such as agriculture, in industry production and municipal (personal) uses and as part of environmental services. The human water needs are approximately 3,500 litres/person/day due, in particular, to our food requirements. Household use is normally between 50–200 litres/person/day. Globally, approximately 800 million people lack access to safe drinking water and more than 2.6 billion lack access to sanitation. Almost a billion lack access to enough food and 1.5 billion to electricity. None of these development challenges can be met without abundant access to water.

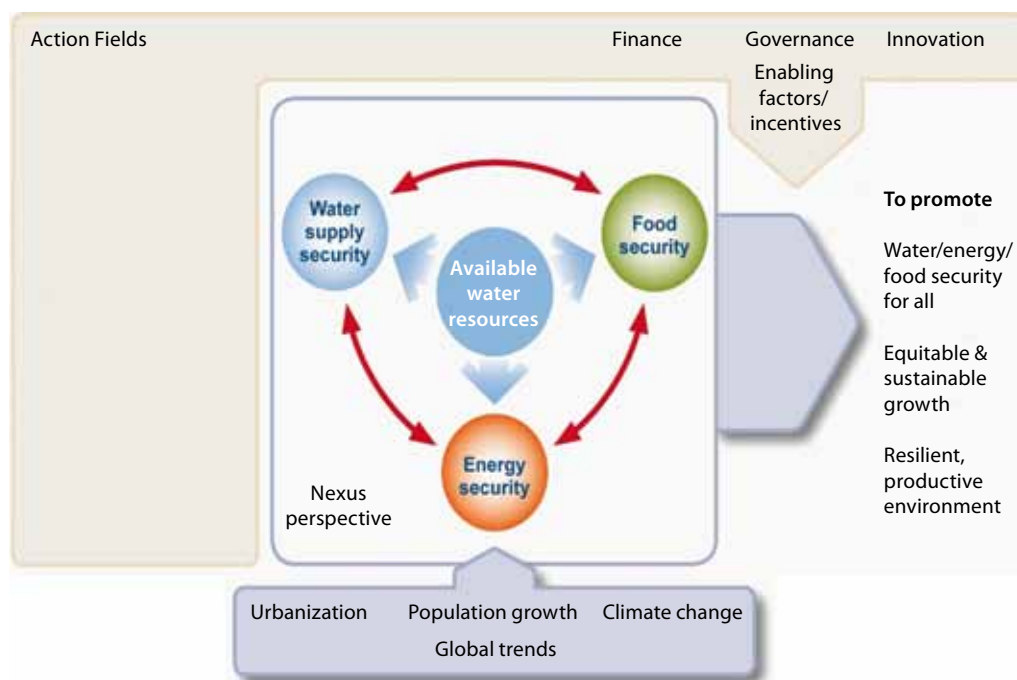


Figure 2.3 The Water-Food-Energy security nexus. Source: Stockholm Environment Institute.

The global thirst for water, in particular for food and energy production purposes, has led to a situation where approximately 3.5 billion people already live under moderate to extreme water stress. At the same time, it is the green revolution, including rapid spread of irrigation, which has secured a food production that has at least kept pace with population growth.

The agriculture and energy sectors drive increase in water utilization

It is clear that a particular challenge is associated with the Water-Food-Energy security nexus. The agriculture and energy sectors will “drive” the increase in water utilization over the next decades.

Food production alone is expected to grow by 70 percent until 2050, almost doubling water use in a “business as usual” scenario. Bio-energy will place further stress on production systems (land and water), where water consumption for 1 Gigajoule could be as high as 10,000–100,000 litres compared to 1–10 litres for the same amount of energy from oil. The key drivers of change remain more or less the same as in the past; population growth, urbanization, changes in consumption patterns, climate change, economic growth, etc. This can, if not well managed, lead to conflicts between different economic sectors but also between regions and countries.

The estimated gap in water availability can be as high as 40 percent by 2030; much of it al-

ready in river basins suffering from deficit. The Water-Food-Energy security nexus is, however, still a simplification of the reality where interconnections between water and other societal changes at global, regional, national and local levels creates a complex web of interactions and feed-backs. Climate change poses an additional level of uncertainty as, for example, projections on changes in rain-fall remain highly uncertain.

Awareness is increasing

There are also positive trends and opportunities. Awareness and recognition of the challenges are on the increase among key stakeholders, ranging from international organizations to governments and the private sector. Technologies and policies are available; it is mainly an imple-

mentation problem. Globalization, foreign direct investments and trade can play fundamental roles to increase investments (in particular in Africa), increase productivity and to stimulate transfer of resources (food, energy) from water rich to water poor regions. However, such processes must be well managed in order not to create further degradation and inequalities (e.g. land grabbing, trade distortions). Sectors still remain key (despite the need to further adopt integrated management approaches), and a stronger focus on efficiency and “creating more with less” must be stimulated. It is also essential to deal with waste issues; up to 40 percent of the food is lost in both developed and developing countries (although the reasons behind the loss vary).

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Trade flows: trends, barriers and challenges in some key agricultural markets

GABRIELLA CAHLIN, SWEDISH BOARD OF AGRICULTURE

A well-functioning and fair trade is essential both for the global distribution of food and for the increase of wealth. World trade in agricultural products will continue to increase over the next ten years, with the greatest increase being seen for oilseeds, mainly soybeans. The increasing consumption of animal protein is a driving force behind this. Increasing trade flows carries a number of challenges. Trade agreements and development of different standards and certification schemes play important roles to address these.

How much and what is traded?

How much food and feed is traded globally in a year? If we just look at mainly unprocessed food it is about 550 million tons per year, or 50 ships full that leave a harbour – every day all year around – that is if all was to be freighted by ship. The major commodities in world trade are coarse grains (maize, barley and other grains mainly used for feed), wheat, oilseeds and oilseed meals. Even if we do not have data on how much of these are used for food and feed respectively, it is reasonable to assume that the major part goes to feed to produce meat and milk. Increased animal consumption is thus a driving force for increased trade. The major animal products in world trade are poultry, beef, pig meat and to a lesser extent milk powder.

Exporting and importing flows

Exports are dominated by rather few countries – somewhat different for different products. For example, over 70 percent of all exports of oilseeds are accounted for by two countries, USA and Brazil. USA still leads “the commodities league” as the major exporter of coarse grains as well as of wheat and oilseeds. OECD countries still dominate in pig meat exports but for poultry and beef, developing countries like Brazil and Argentina are very competitive.

Importing countries are less dominating in trade than exporters are. One exception to this is China that has evolved as a major importer of soybeans, probably mainly for their own animal production.

Trade development over time

If we look at the development of world trade in agricultural products over time, there has been a steady increase ever since the fifties, only slowed down during periods of global recession. Notable, though, is that trade in manufactured goods has developed faster. According to projections by OECD and FAO (OECD/FAO, 2011), world trade in agricultural products will continue to increase over the next ten years and the greatest increase will be for oilseeds (mainly soybeans) for which exports including meals will increase with 22 million tons until 2020. Looking at relative figures, it is the exports of biofuels that increase most, by almost 90 per-

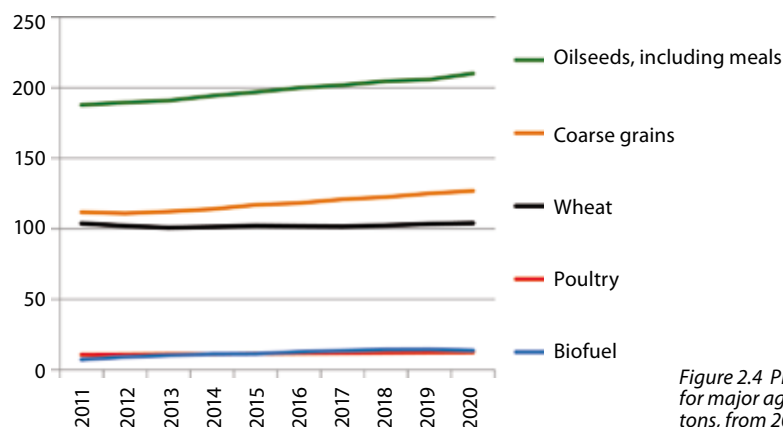


Figure 2.4 Projections on increase in world trade for major agricultural products, in millions of tons, from 2011 to 2020. Source: OECD/FAO (2011).

cent. This is, however, from a rather low level and in absolute terms the increase is 6 million tons. On the other hand, wheat exports are projected to be maintained at today's level during the next ten years (Figure 2.4).

Production and trade development

The global production of agricultural products has increased over a long period of time, as has the trade, although in some areas productivity increase is slowing down. Only a rather small portion of the produce is traded – with the exception of soybeans. The export of soybeans makes up more than a third of the produced amount globally, including the meals. The reason for this is that soybeans are a very important protein source in feed products, and the production of soybeans is more concentrated than the animal production is.

Barriers and challenges for trade

At times with high prices on the world market, some countries have imposed export restric-

tions with the aim to keep national food prices down. Apart from distorting trade, however, this will give the wrong signals to their own farmers, who, at times with high demand and high prices, should be given incentives to increase their production. Other countries may have export tariffs, which partly may have the same effects, but also provide governments with incomes. Export subsidies and subsidies for certain products or uses (for example for biofuels) are also trade distorting.

An important trend in trade is the development of different standards and certification schemes, for example regarding organic production and fair trade. This is one way for retailers and consumers to differentiate products and influence producers and production systems, even far away, as well as to guarantee food safety. Too many different standards may, however, lead to complicated systems for keeping products separate. On the other hand, clear and reasonable international standards could be a useful instrument for trade to be more sustainable as it could take account of environmental and social issues.

Although most countries probably agree that risk assessments should be based on scientific knowledge and experience, there are different views among countries on the acceptance of different risks. Examples of this are the different views on pesticides, GMOs, and the use of hormones in animal production.

With increased trade there are also risks for increased spread of animal diseases and plant pests and different preventive regulations to deal with these risks may also affect trade. With increased production in some areas, the

infrastructure may be insufficient to handle the amounts produced and thus this may be a limiting factor.

Several of these factors can be dealt with in trade agreements, preferably on a global level, such as the WTO-agreements. As a functioning and fair trade is essential both to the global distribution of food and the global distribution and increase of wealth, there is much effort and hope put into the closing of the present Doha round.

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Household constraints: an example from Vi Agroforestry in Eastern Africa

HANNA WETTERSTRAND, VI AGROFORESTRY

Agroforestry as an agricultural system has enormous potential to increase the production of food and biomass at the household level and help farmer families adapt to climatic change. Vi Agroforestry works in Eastern Africa with 200,000 small scale farming households to make agroforestry and enterprise development engines of economic growth and poverty reduction.

Our failure to help small-scale farmers to access markets, and to live decently from farming, is a key cause of hunger, according to Olivier De Schutter, UN special reporter on right to food. I believe he is right. I will share with you some of the experiences that Vi Agroforestry has gained during more than 25 years of working in Eastern Africa. Vi Agroforestry is an organization fighting poverty through the sustainable use of natural resources. Its vision is a sustainable environment that can offer good living conditions for farmer families, and the mission is to make agroforestry an engine of growth.

Vi Agroforestry works in the watershed of Lake Victoria, the source of the Nile, since the ecosystems around the lake are crucial and today under great threat of erosion, deforestation, climate change and a large growing population. The work with supporting farmers and their

organizations with extension services is carried out in four countries, and reaches out to about 200,000 farmers with an average of less than two hectares of land per farm. This means that approximately 1.2 million people in total are reached by the programme (Figure 2.5).



Figure 2.5 The working area of Vi Agroforestry.
Source: Vi Agroforestry.

Picturing constraints for farming at household level

Some of the constraints to improved farming at household level that Vi Agroforestry has been able to identify are weak health and education systems, unsustainable farming techniques, loss of forest cover, climate change, weak institutions, and lack of household savings. These constraints can be illustrated by picturing an average farmer of this region. First of all, you are a woman, since women produce about 80 percent of the food in Africa. You have a husband who has one other wife. You have given birth to six children, of which one died before five years of age. You also care for another two children whose parents have died in HIV/AIDS.

You are able to feed your children one meal a day. The children and you are quite often sick, and the medical care is poor and far away. You walk four kilometres a day to fetch fire wood for cooking. You remember as a child playing in the close-by forest, a forest that no longer exists. The rains, which used to be reliable, today come in heavy showers and create great gullies.

You grow mainly maize, and burn the maize stalks after harvesting. You have also got two goats. In the last couple of years, you have lost several harvests due to lack of rain. Your husband might sell some of the maize at the farm gate to a man from the town, coming in a small pick-up. When he is lucky, he also has a seasonal job at a nearby sugar cane plantation.

You have no savings, and thus no money to invest in your farm and the small existing cash flow is very uneven, and you have little say in what to use the money for. You are unaware of your legal rights as a woman to inherit land. You have seen your sisters having to leave the land when their husbands die.

It is with these constraints at the household level that people organize themselves in small organizations, which Vi Agroforestry works to support.

Working with five integrated areas

Vi Agroforestry has an integrated approach and work with several areas. The basis of all work is agroforestry and sustainable land use management practices. Second, gender equality is a very important topic for Vi Agroforestry since the majority of the target group are women. A third area is work with support to create and develop farmers' organizations. Fourth, Vi Agroforestry work with farming as a business, which implies support to marketing and business development. The fifth area is financial services, in the form of Village Savings and Loans Associations. Working with these areas combined makes people less vulnerable to the impacts of climate change. Further, the resilience of the ecosystems increases, as does the social and economic resilience of the local community.

Agroforestry's enormous potential

The potential of agroforestry is enormous. Agroforestry implies integration of trees in a crop- and/or livestock-based farming system. The farmers we support often turn their farming system from a monoculture to an integrated system with high diversity and crops to harvest throughout the year. Agroforestry has been recognized and highlighted by the UNFCCC Intergovernmental Panel on Climate Change as one of the most efficient agricultural systems in the era of climate change. In this context, agroforestry is a triple win: it can give increased crop yields and farm productivity, at the same time as increasing carbon sequestration, and increasing smallholders' resilience to climate change.

Two agroforestry success stories

Let me share with you two stories of how agroforestry has helped improve the living situation of two women. First, since 1995, Nalongo



Figure 2.6 Agroforestry – climate change adaption and production increase. Source: Vi Agroforestry.

Kakumba in Uganda has planted more than 1,000 trees on her small plot of land by starting up a tree nursery together with the group where she was a member. Before that, she had to walk four kilometres a day to search for wood. Now she instead makes a good profit out of selling wood. Each semester, she sells six lorry-loads of fire wood to a nearby school and has earned an equivalent of SEK 20,000. Through the Village Savings and Loans Group she got support to handle the cash flow. With the incomes, she has been able to buy 13 cows, from which she gets milk to sell on the local market. Now, she has started a new project of raising hens. She has bought 60 hens and started to sell eggs.

Second, the story of Habimana Elias in her own words: *“My name is Habimana Elias and I live in Bushoki, Rwanda. During the many years I have lived here I have always asked myself how I can get a bigger land to increase my production. Indeed, the treasures of my small land were hidden to me until I started working with Agroforestry. Now, I can earn my living, my children can go to school and I can put some cash in the bank for saving, all from the same, small land. The only crops I grow here are cabbages, carrots, beetroots, beans, amaranthus and agroforestry trees, using new techniques that I learnt from Vi Agroforestry.”*

Success factors

In order to introduce agroforestry successfully, there are some factors that have to be in place, in the experience of Vi Agroforestry. First, land tenure rights have to be pretty secure, so that people dare to invest in their land. Further, the political and economic situation has to be relatively stable. A crucial factor is building strong farmer organizations to which farmers' com-

mitment is essential in order to build sustainability and social capital. We can also conclude that support needs to be persistent and long term and that it is the combination of working areas that builds knowledge. With these factors in place, agroforestry has amazing potential. It also has the advantage of giving relatively quick results, which makes the farmers rather willing to adopt the practices.

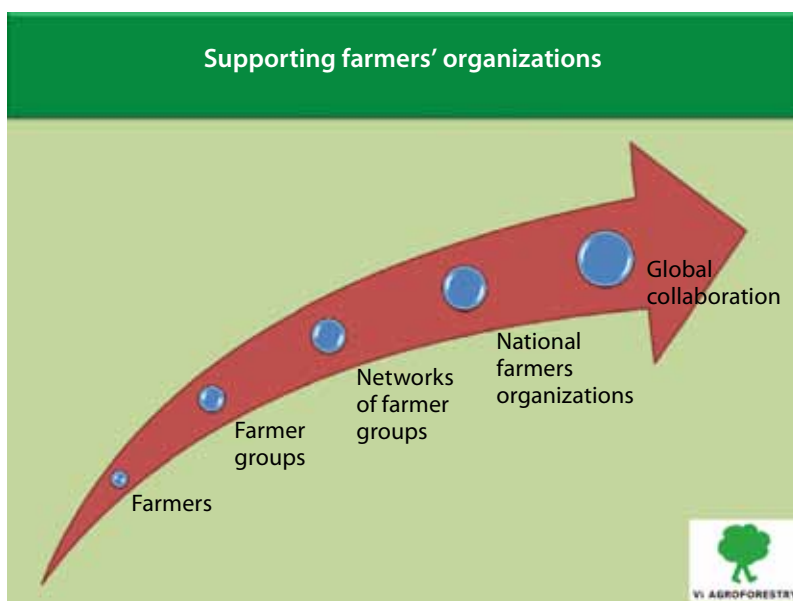


Figure 2.7 Supporting farmers' organizations. Source: Vi Agroforestry.

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Swedish involvement internationally in food, wood and bioenergy production programmes: four different cases

There are several examples where Swedish commercial and public companies, managers, and research institutions are involved in larger food, wood and bioenergy production programmes abroad. Their experience is valuable in learning how to best deal with constraints and how to capture opportunities in food, fibre and fuel production.

The Stora Enso forest company is involved in various forms of wood raw material production in for example Brazil, Uruguay and China. Heikki Rissanen, Stora Enso, presented some lessons learnt from managing large forest plantations and negotiations on land deals.

Stora Enso forest plantations – some lessons learnt

Heikki Rissanen noted to start with that in the context of land investments, principles may be global, but issues are local and therefore solutions must be adapted to the local context. This was made clear by the examples that were presented of experiences from Stora Enso's plantations in South America and in China, which all have faced different challenges in the establishment and management phases. At the Veracel plantation in Brazil focus has come to be very much on social engagement in the form of, for example, support to income generation and tree farmers, with an FSC certification in process. In Montes del Plata in Uruguay, water availability has been a huge problem, and therefore

watershed protection has come to be in focus in the planning of plantation establishment and management, with some plantations designed to mitigate potential negative hydrological impacts. At the Stora Enso plantation in Gaungxi in China, challenges have, to a large extent, been related to land use and problems with land lease contracts, since establishment of the plantation takes place in the midst of China's large land reform. A conclusion drawn was that each country and each area has its specific sets of problems and thus need site-specific solutions, and that this is something that needs to be taken into account by investors to a greater extent than today.

Also on the biofuel side, Swedish companies and managers are, or have been, involved in projects in several countries. For example, the Switzerland-based Addax Bioenergy develops a greenfield sugarcane estate in Sierra Leone and manager and vice-president Jörgen Sandström presented experiences of this work.

Addax Bioenergy – the Makeni ethanol and power project

Addax Bioenergy is part of the Addax & Oryx Group and was established in 2008 in order to develop the Group's work with renewable energy, and biofuels in particular. The Makeni ethanol and power project in Sierra Leone,

developed by Addax Bioenergy, is a greenfield renewable energy and agriculture project. The estate will produce bioethanol from sugarcane for export and domestic use, and green electricity for the national grid as well as by-products as fertilizers. The project aims to become a model for sustainable development, by respecting strict sustainability standards and through the introduction of innovative social solutions, and has consequently been designed to comply with a number of international standards in these respects.

The project philosophy has been to bring local farmers in from day one, and a so called Farmer Development Programme has been set up in order to ensure minimum impact on food crop production areas and to ensure that large areas of land are available for communities within the project area. Addax Bioenergy's experience from community relations in Africa is that these have to be long-term and of a win-win character. Jörgen Sandström concluded that commercial success is naturally the key to the Makeni project, but stressed that this requires that the project is sustainable in economic, ecological and social terms, or otherwise business will not succeed in the long term.

In order to address constraints and opportunities to meet the demand for food, fibre and fuel, many point at the need for more research into different aspects of sustainable production. Swedish research institutions are involved in such knowledge generation. Johan Schnürer, Swedish University of Agricultural Sciences (SLU), gave examples of in what way SLU contributes to knowledge on sustainable biomass production through different research programmes and collaborations. Jörgen Levin, University of Örebro/University of Gothenburg, presented the approach of a specific research project on

implications of biofuel investments in Ethiopia, Kenya and Tanzania.

Research, education and collaboration at the Swedish University of Agricultural Sciences related to the global need for sustainable food, fuel and fibre production

Johan Schnürer stated that SLU undertakes land- and biomass use research projects that are not found at other Swedish universities. There are currently several thematic research programmes running which are of relevance to the issues discussed in this context. For example, the Future Forest programme addresses the economic, ecological, and social trade-offs that have to be made in future production of wood fibre. On the biofuel side, the project MicroDrivE (on microbially derived energy), started from the realization that there are still discoveries to be made in ethanol production and has as its long term goals to maximize the energy yield of ethanol and biogas processes, improve overall process economy through development of novel co-products, and to minimize environmental impacts. Also mentioned were the programme Future Agriculture on livestock, crops and land use, as well as FUSE on future urban sustainable environments.

Apart from research programmes, SLU hosts several competence centres which provide expertise of relevance in this context. Examples include a new SLU competence centre for biological control, and a centre for Global Animal Diseases. Schnürer concluded that SLU contributes, and will continue to contribute, to knowledge on sustainable production of food, fibre and fuel by strong disciplinary research, its tradition of external cooperation, through the research in thematic programmes and its centres of expertise with "global ambitions".

Research project on implications of biofuel investments

Given the expected global increase in the production and use of biofuels, a central question posed is whether this will have a positive or a negative impact on smallholder farmers and people living in rural areas, as more agricultural land will be used for biofuels production. Jörgen Levin, University of Örebro, presented the approach of a research project on impact on the poor of biofuel investments in Ethiopia, Kenya and Tanzania, which involves several partners, with the University of Gothenburg as project leader. The research investigates economic

implications of production of biofuels in the countries mentioned, and particularly its implications on food security, growth and poverty reduction, by means of a computable general equilibrium model. This model allows getting a consistent picture of the impact of biofuel investments at the macro, sectoral and household levels. Results so far from use of the model in the case of Tanzania indicate, for example, that one effect of biofuel expansion was a reduction in the national poverty rate, and that poverty declines the most when feedstock is produced using out-grower schemes.



Industrial plantations in Brazil. Photo: Veracel Company, FAO (FO-5153).

Chapter 3

LARGE-SCALE LAND ACQUISITIONS FOR FOOD AND FUEL: AN AFRICAN VIEW

Large-scale farmland acquisitions in Africa, Latin America, Central Asia and Southeast Asia have become a hotly debated matter in recent years. The phenomenon has attracted much international media attention and spurred a number of reports on its negative consequences as well as on its potential opportunities. However, the debate and reports on the issue tend to be dominated by industrialized country perspectives. After a short introductory note, Mafa E. Chipeta provides in this chapter a view on the matter from African countries with perceived land resources.

Large-scale land acquisitions: an introductory note

One effect of land resources becoming relatively scarcer as global demand for food, fibre and fuel is growing is a new wave of transnational farmland investment and what has been referred to as a “rediscovery” of the agricultural sector by different types of investors (Deininger, 2011a). Food-importing countries with constraints on land and water but rich in capital (such as the Gulf States), and countries with large populations, food security concerns and booming economies (such as China and India) are seeking for land abroad for the purpose of production of food and biofuel crops. These investments are often targeted towards developing countries, where production costs are lower, and which are perceived by many to have an abundance of “empty” or underutilized land. The phenomenon was further triggered by the financial and

food price crises of 2008/09, which reminded many food-importing countries of their vulnerability to food-insecurity and, together with reduced investor attractiveness for other assets due to the financial crises, prompted investments in farmland overseas to secure food supplies (Deininger, 2011a).

There are several aspects to large-scale investments in farmland, and many also point at the lack of empirical data about the magnitude of the phenomenon and of its impacts (e.g. Chipeta in this chapter, Deininger, 2011; Cotula *et al.*, 2009; von Braun & Meinzen-Dick, 2009). In any case, the notion of “land grabbing” has to a large extent become a catch-all phrase to describe and analyze what is seen by many as a current explosion of large scale transnational commercial land transactions.

An African view on large-scale land acquisitions in Africa

Large-scale acquisitions of farmland have attracted much media interest and evoked strong reactions from the international community and civil society groups, not only, but perhaps particularly, in the case of Africa. Some see “land grabs” as a major threat to the lives and livelihoods of the rural poor and so condemn or oppose commercial land deals of this type, while others see economic opportunity for the rural poor and instead call for improvement of land market governance to come to terms with cases of corruption and negative consequences (see e.g. Borras *et al.*, 2011). Regardless of view or position taken on the matter, the international debate and reports on the phenomenon tend to be dominated by industrialized country perspectives. In this chapter, Mafa E. Chipeta, FAO, provides a view from African countries with perceived land resources.

Chipeta here argues that large-scale land acquisitions cannot be judged in black and white while there is no simple way to say they

are always good or always bad. Chipeta argues that Africa needs investment and that “land grabs” are now one form this is taking. Therefore, the international community should not condemn such investments out of hand but instead assist Africa in making such investments less damaging where bad deals have been concluded. Chipeta thus calls for pragmatism on the matter, arguing that strict application of the precautionary principles is unrealistic in development and should not be forced upon developing countries while there is no such thing as a completely harmless development intervention, not even in developed industrial countries. Rather, Chipeta here lays out the role that wealthy countries and the international donor community could play in the matter of the so called “land-grabs”.

The following note, which takes the form of an opinion rather than a research document, is based on four earlier papers that Mafa Chipeta has written on the “land grab” phenomenon. References to these papers are found at the end of this chapter.

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Land acquisition for food and fuel and implications for development, food security and forests: a view from African countries with perceived land resources



MAFA E. CHIPETA, FORMER FAO SUB-REGIONAL COORDINATOR FOR EASTERN AFRICA

Large-scale land acquisitions are not new

The phenomenon of acquiring large pieces of land is not new in the world: colonization prior to and during the 1800s was largely about this and about also seizing other rights to natural resources, such as minerals.¹ In its modern form, large-scale land purchases or leases have come to be known as “land grabs”, an emotive term which reflects the concern the issue has raised; a new euphemism “farmland investment” has been coined to use for more gentle audiences. Presented simply, it involves the surge in land investment by rich countries (a large number of them being developing ones) in poor countries

largely for the purpose of assuring themselves food supplies but sometimes also as a safe haven for speculative capital which can no longer trust financial markets.

Accident has it that Africa has the last major reserves perceived to be unused or under-used; the world sees Africa as a land-abundant region. Indeed, apart from the likes of Burundi, Gambia, Malawi, Rwanda and a few others, many non-desert African countries have large expanses of lightly settled territory. The fact that their people generally have only informal title to their land and that their resource husbandry has very light impact reinforces the feeling that

1. Estimating the area of land grab has been a challenge and the process has generally lacked transparency, even in the last century. Ilegbune reports that, in the case of Ghana, a 1916 report mentions that “... *the chiefs of the Gold Coast alienated an area which actually exceeded the total area of the territory itself*”. Nor was transparency any better than it appears to be nowadays. The British made legislative proposals in 1894 and 1897 which “... *conflicted with the rights of the people... and precluded the people... from dealing with applicants for concessions. They granted upon the governor the sole right to grant concessions. Proceeds from such grants were to be appropriated by the government.*” Ilegbune, C.U. In: *African Studies Review* Vol 19, No 3, Dec 1976, pp 17–19.

BOX 1: Main areas of interest and origin of large-scale land investments

Tanzania is as good an example as any of a situation where demand for large-scale of land is much higher than actual allocation. The allocation is in turn much higher than the speed at which investors actually develop the land – in that country, of some 4 million hectares requested, only 641,000 ha have been allocated, with land actually developed far less. In Zambia, similar ratios apply but, most worrying, there is, not even for the lands where exploitation has started, no record of registration at the Ministry of Lands.

In both Tanzania and Zambia, the *leading investors* are from America and Europe; from the Tanzania report, the following typology of interest areas emerges:

- Tourism – unclear
- Biofuels – European and American investors;
- Food Security – Asian and Middle Eastern countries;
- Speculation – various.

Sources:

Tanzania – “Scramble for Land in Tanzania” Emmanuel Sule, *Plaas Workshop on Commercialization of Land and Land Grabbing in Southern Africa*. Clara Anna Fontein Reserve, Cape Town, S. Africa 22–25 March 2010;

Zambia – *Case Study on Foreign Direct Investment (FDI) in Zambia*. African Development Bank (Draft) October 2011.

this land is being wasted. Governments have not felt heavy qualms about leasing or selling such land to those who they believe can visibly farm it, produce food, fibre and fuel, and make wealth to prosper Africa. The sections that follow draw attention to some large-scale farmland investment issues in Africa, including those related to food security, forests and fuels. Box 1 gives some investment subsectors of most interest and some of the key investor countries.

The driving forces

The KSLA seminar of September 2011 has, like many other meetings on this topic, synthesized very well the knowledge on drivers and including population driven demand for food, policy-induced pressures and incentives for biomass fuels, income-driven dietary changes leading to greater animal feed requirements, etc. The main spur for the surge however, was the unprecen-

ted surge in food prices in 2008/09 (happening again this year); in 2008/09 many grain surplus countries blocked or restricted exports of basic grains to avoid depletion of nationally-needed food by possible panic buying and hoarding by foreign importing countries.

Importing countries were thus faced with a situation where, even though they had money, there was no grain to buy – they lost faith in the international market because although they had money, they could no longer be guaranteed food security by it. Those which had inadequate domestic arable land started to invest in land-rich poor countries, with the intention of importing food back for their citizens so converting free trade into tied arrangements. Such land purchases took place worldwide but Africa was among the prime destinations, located as it is next to the oil-surplus Middle East. Buying land for financial speculation has been secondary.

How much land is involved?

On June 12, 2011, Paul I. Adujie quoted *The Guardian UK* as having written that “Research by the World Bank and others suggests that nearly 60 million hectares – an area the size of France – has been bought or leased by foreign companies in Africa in the past three years” (in Adujie, 2011). This is quite clearly an emergency and it should be a matter of serious continental and global concerns. Where are the African governments and Public Intellectuals on this all-important existential issue? The International Food Policy Research Institute (IFPRI) also claims to follow acquisitions closely. IFPRI was quoted on 28 December, 2010, by Lord Aikins Adusei as believing that since 2006 between 15 million and 20 million hectares of farmland around the world have been secured for biofuel and grain production with 70 percent of the deals occurring in Africa alone, while between USD 20 billion and USD 30 billion has gone into investment (in Adusei, 2010). So much is the level of guesswork and tendency to quote what the media has reported before that there is not yet one reliable database on how much land has actually been bought or leased so far. As much as two-thirds of the global totals is thought to be in Africa so the pressure there is significant, even if that region’s people still farm only a fraction of their available arable land.

There is even less information on how much of the land is actually already being farmed: indications in many African countries are that of the large areas being quoted from about 4–5 years ago, perhaps 10–15 percent only is actually already being farmed. *The low level of actual progress may well explain the shortage of convincing case study data (see Boxes 2–5) many of which are still followed by vague condemnations of the investments but have little to say whether what has actually happened has been beneficial or has proved*

the doomsayers correct. The limited progress may represent teething problems with mobilization in a continent short of rural infrastructure but if not, it would be a serious problem in that land perceived as being kept idle by the locals is now being kept idle by foreigners who were preferred precisely because they would make profitable use of it.

Why did Africa welcome the new investments?

The surge is driven by strong desire of investor countries to buy themselves assured food security; but there is a corresponding driving force in the investment-recipient countries, many of them in Africa. In that hungry continent, which is increasingly dependent on food aid and commercial imports of food that it can hardly afford, the promise of farm investment inflows is seen as a blessing and they welcomed it when it started. Governments noted that in many cases, their own people were cultivating only a fraction of the arable land with productivity levels that remained too low to meet national and trade demands; the new investors could perhaps accelerate application of yield-enhancing technologies.

The failures of developing country agriculture, especially for Africa, are well described in many places. In summary they relate to: *a)* failure to attract both public and private investment, with consequent stagnation of both productivity and total production; *b)* rapid slide into food deficits – Africa’s annual farm imports having reached some USD 33 billion annually while exports have stagnated at around USD 14–15 billion; *c)* almost annual appeals for charitable food aid from developed countries; and *d)* massive and persistent rural poverty and urban migration by the poor.

International alarm and condemnation and Africa's perception of double and unrealistic standards or unfairness

The spectacle of food-insecure African countries exporting to rich ones when they themselves continued to appeal for food aid raised many moral questions. Soon, a loose coalition of NGOs, international organizations and some developed country governments raised the alarm at the possibility of situations in which poor developing countries could be locked into unfair land deals. They also strongly objected to seeing domestic starvation while food was being exported to feed the rich abroad.

It is in fact quite likely that the deals were not fair but the degree to which they were exploitative could not be easily ascertained. This lack of information led to assumptions of “worst-case scenarios” and so drove further panic. Rumours spread that investment recipient developing country governments were short-changing their own people: they were allowing investors to export every grain back to their homelands while locals starved; they were succumbing to the greater bargaining power of investors in the negotiation of deals; venal governments were pocketing money and failing to defend the rights to land and livelihoods of neighbouring indigenous populations; and they were resisting calls for external oversight over the deals.

The campaigners sought strong land deal guidelines, to be based on severe application of the “precautionary principle” (i.e. do not move forward until you are absolutely sure the deal will cause no harm). This international reaction surprised (and offended) many investment beneficiary governments (including in Africa) which feared frightening off investment that had so far generally eluded them. Investor countries also feared loss of the expected greater assurance of food security for their peoples.

Given strong evidence of severe and persistent want in Africa, some question whether it is fair for international campaigners to protest at the new wave of land investments which could reverse the malaise. They believe international judgements may be too harsh and that they are being made without ground-truthing; that through adoption of extreme “precautionary principles”, the campaigners seek more perfection and higher standards in such land investments than they do for investments into oil and minerals; and that the outsiders wish to “make omelettes without breaking eggs”, so taking all risk out of entrepreneurship.

Being besieged by unceasing condemnation, some poor-country governments appear to now have a siege mentality; it is suspected that they are increasingly more secretive about the land deals. If so, the good intentions of campaigners may be worsening rather than improving the impacts of land deals. Furthermore, the perfection sought may be unnecessarily frightening away even good investment, especially from Africa, because complying with “purist expectations” is too burdensome.

What can be the impacts on food security, forests and fuel?

Before raising some possible “win-win” ways forward for both the investors and recipients (governments as well as local communities), it may be worth quickly linking the large-scale land investments phenomenon to the food security, forests and fuel themes of this forum. Key among the outcomes is that Africa has potential if the deals are run well to make contributions of global importance to food, fibre/forest products, and biofuel security, including through increased availability of produce for international markets. This is no claim that investments must necessarily and only be at the mas-

sive scale of so-called “land grabs” to achieve these outcomes.

The overlap between food, fibre and fuel security investments also needs mentioning. The Box 4 examples for Tanzania reveal, for example, that investors looking for biofuel land but given rich forest resources, they make their first money from selling wood. Their first community conflicts also come from their failure to share timber revenue fairly; in environmental terms, their destruction of biological diversity in favour of a biofuel monoculture is another problem. Cases also arise of rich land being leased for forestry or biofuel when it would have better served the food production objective; similar interfaces occur all the time which regulators and negotiators need to be alert to.

Large-scale farmland investments and African food security

Africa is a real dilemma: it is, relative to its population, a land-abundant region yet it cannot feed itself. As said earlier, Africa is so short of food that it is spending money it cannot afford (over USD 33 billion annually) to import what it could easily produce if it invested well. And it imports food even from land-challenged continents such as Europe yet which have surpluses. Africa's people continue to cultivate small plots of land, often not because there is no more land but due to hand-hoe technology not enabling them to cope with larger expanses.

The real danger to Africa is that failure to cultivate (due to poor technology) leaves much land appearing unused and it is this land that is being leased out or sold in large parcels. The fear, something politicians and campaign organizations are fanning public passions about, is that Africans will one day have capacity to cultivate more of their own land but will wake to find that their land will all have gone to foreign investors. Then the real

problems will start, including possible major conflicts. Some of what follows is well illustrated by Africa and solutions to the constraints and opportunities related to large-scale farmland investments and food security in Africa will need to respond to them:

a. Experience shows that “food security” and “food insecurity” often co-exist. Even now, although the world has at least a modest grain surplus, people are starving in large numbers, especially in Africa and South Asia – they are too far and too poor to access the food. The same situation prevails in individual countries, including some developed ones. Box 2 gives some actual cases in Africa – many are far too early to make definitive conclusions from, and the sources are as much hearsay as anything else; in the prevailing climate, the governments are not releasing official information and a skeptical international community might in any case not believe what they publish.

b. For the investment recipient countries, if they signed away the right to have some of the production channelled to domestic markets, the land grabs could, at the national level, have no effect (i.e., make no improvement) over their earlier food security situation;

c. However, at the local community level, the land presumed to be unsettled by people and therefore leased/sold off to “land grabbers” is no longer accessible to inhabitants. Any foods that local people formerly got from the land would be lost and their food security would be more parlous. Furthermore, it is known that many large land grab farms employ few locals (they lack modern skills) so there is no income effect to compensate for this;

d. The national income of the investment-recipient country from exports to the investor country could allow food imports and, provided the agreed prices are fair, this could be a net benefit; but the reverse could also apply;

BOX 2: Selected cases – large farm investments and food security

Ethiopia: a review looks at an allotment to Karuturi Agro Products (of India) of some 10,700 ha of which some 4,000 ha had been cultivated – prime interest being in maize and palm oil. Small plots of higher-value produce also being tested. Only 4,000 ha were already being cultivated at the time of writing, with production in the first year lower than expected. Some 30 Indians and 50 Ethiopians were employed. Contention relates to blockage of access to roads and to wetlands, etc. Solutions are not yet found and it is too early to judge success and sustainability.

Source: A case study of the Bechera agricultural development project, Ethiopia. Messele Fisseha. CIRAD/International Land Coalition. January 2011.

Mozambique: Government has allocated 60,000 sq km to Brazilian farmers (7.6 % of the country) to grow soya mainly for the Chinese market. Land lease is 50 years renewable for another 50 years. Key motive is to gain from Brazilian technologies for cultivating the savannah. The land clearance will be of rich forests in 4 provinces. It is too early to say how operations are going.

Source: REDD+ in Mozambique: new opportunity for land grabbers? I. Nhlanhlo, Internet: 15 June 2011.

e. From the long-term development perspective, more important possible impacts would include:

- at the very large scale of the farmland deals dominating the headlines, there is no real prospect of technology transfer to the country and local community, both being used to farming at a much smaller scale;
- the scale is large enough to allow vertical integration, so potentially promoting value-addition. Yet there is sparse evidence that this is stressed in many agreements and so multiplier-effect economic growth in processing and trade may be limited; and,
- the literature is unclear on whether products from the new investments will allow the investment-recipient countries to save the foreign exchange that they used to waste on food imports so that they can now invest in development instead (spending local currency instead on food).

It is worth stressing that African (and other developing countries') governments are attracted to foreign large investors because they expect them to have higher productivity than local smallholders. In this they are correct – even in the limited examples of the first years (with some reported exceptions of disastrous jatropha crops) – the investors in fact tend to be more productive: but they cannot help this, given the generous conditions of investment. *The new investors enjoy all the benefits of foreign investors: low land prices, tax breaks, customs duty exemptions for machinery and main inputs, rights to import quality managers and technicians, etc. – who can fail to be productive under such circumstances?*

By contrast, the citizen smallholders are not given nearly the same generosity of treatment: *many cannot afford and access good seeds or fertilizers; have no access to equipment to increase the area possible to farm; they rely on hand-tools and not powered ones; they have no protection from*

price collapse if they have a good harvest. In short, locals are not equally assisted to become productive. This is clearly not a level playing field; the question then is if it is justified to buy food security from foreigners or to effectively subcontract this responsibility to them² at this price while not offering the equivalent opportunity to local producers.

Large-scale farmland investments and forests

Food production generally involves land under natural vegetation being converted to cultivation or to ranch/pasture. *Therefore the lower the productivity of farming, the more land has to be denuded of natural vegetation (such as forest) to produce food.* Many developing countries, especially in Africa, practice low-input/low-output agri-

culture and so cause far more forest degradation per unit food than others. *At present, cereals in Africa yield only 1.0–2.0 tons per hectare while the developing country average is some 3.5 tons/ha; a realistic goal would be 5 tons per hectare. Obviously, with such low productivity of cereals, Africa may currently be deforesting at 3 to 5 times the rate it should be doing if agricultural productivity were raised.*

Box 3 gives some anecdotal information on actual cases. Forest related large scale investments are less common than those for food and fuel crops. What can be said about the large-scale land investments and forests, especially for Africa?:

a. To the extent that the land grabs have higher productivity, their entry into the picture may be benign for forests. The questions are a) *for whose benefit?* and b) *at what cost?*;

BOX 3: Selected cases – large scale land investments and forests

Mozambique: Proposals are being pursued to convert Niassa province into the largest area of pine plantations in the world. One proposal has been defeated by local people in the community of Chimbulila but many more are being pursued.

Source: Mozambique: facing a land scramble. G. Janet. Internet April 21, 2008.

Uganda: New Forests Company, a UK undertaking, has led to eviction of some 25,000 Ugandans from their lands with only nominal compensation to make way for tree plantations. Authorization was given by the National Forest Authority and funding is coming *inter alia* from the International Finance Corporation. The people appear to be getting moved from settled land so planted bananas and cassava will be among assets cleared to make room for trees.

Source: "UK timber firm forces 25,000 Ugandans off their land – Oxfam", *The East African*, October 3–9 2011, page 29.

2. In Africa, stories abound of the welcome extended by governments for settler farmers leaving South Africa for countries to the north, driven by the same perception that foreign farmers can do what indigenous ones cannot. Generous government incentives are given. The expectations of high productivity are generally proved right, but the outcome cannot be otherwise – there is so much support extended to the new arrivals compared to the locals.

b. Regarding “whose benefit”, it is not useful for the local community to know that at national level forests are better conserved due to the large farm now on their doorstep. For them, they may have lost access to firewood, to hunting grounds, to medicinal plants, to water, etc., which are now on privatized land, unless the agreement allows neighbouring communities to practice traditional rights on the privatized land;

c. It is reported that plantations of forests can address the loss of forest products as natural forests are denuded. This is unlikely in many situations – plantations are more likely to be established to meet industrial needs (or export fuelwood chip market needs) than local community requirements; and,

d. Regarding “at what cost”, both the social cost mentioned for the community above and the cost on incentives to the investor must be counted. And they should be compared with what it would have cost to conserve the forest by boosting productivity through the local community.

Large-scale farmland investments and fuels

The land can yield energy whether it remains forest (firewood) or can yield fuel when it is agricultural (bagasse, fuel alcohol, petroleum-substituting vegetable oils). *Agriculture is thus both a user and a producer of fuel and energy.* The sugar and the pulp and paper industries are examples of agricultural industries that produce more fuel than they use – many of them even sell power to national grids.

Firewood is the original “biofuel”; globally, it is used by more people than all the modern fuels put together. But it is a silent fuel – in modern dialogue, no one mentions it when talking of energy shortages – people worry about motor fuels and energy for urban living, electricity for

industry etc. Fuelwood is becoming less silent with the emergence of a wood pellets trade to enable Europe accelerate its achievement of policy thresholds for renewable biomass energy share in total energy mix – even Africa (Congo Brazzaville) is feeding this new export market.

The above said, the question here is what impact could the large-scale farmland investments route have? Answers would probably have to be on a case by case basis, but general principles would include:

a. Given the dependence on modern fuels for running cultivation machinery, etc., large farms create a dependence on fossil fuels, but with potential to substitute at least part by modern liquid biofuels (oils, alcohol);

b. If the large farms choose to grow biofuels at the expense of food crops (or to divert staple food they do grow to biofuels manufacture) in countries where there is clear food shortage, they would be difficult to defend if the food shortage is faced by people too poor to exercise market options for being fed;

c. If the large farms choose to grow crops that can competitively produce liquid biofuels (sugar, biodiesel, etc.) or commercial solid fuels, then they can be a plus for the energy economy of a country (as Brazil has done with firewood-derived charcoal as fossil-coal substitute in the steel industry or with sugar-derived alcohol for motor vehicles);

d. The same questions arise for fuels as they did for forests, i.e. a) *for whose benefit?* and b) *at what cost?*

Which way ahead?

Land acquisition on a large scale cannot be judged in black and white. In general and in the specifics of its links to food and feed, forests/fibre and fuels security, there is no simple way to say it is always good or it is always bad. The

BOX 4: Case profiles – large-scale land investments and biofuels

Mozambique – ProCana sugar estate: Reported as an example of a land and water grab, the project targeted Gaza province and was to grow sugar cane for 300,000 m³ of ethanol annually to blend with fossil petroleum fuels, mainly in the export market of South Africa. Some 30,000 m³ of land was set aside under a 50 year lease for the Central African Mining and Exploration Company (CAMEC), a London-based company; it was only part of what a national biofuels strategy planned to be a 450,000 ha requirement which would give fuel competitive enough as long as international petroleum prices remained above USD 60/barrel. In the end the project failed to take off – the investor lost interest but the protestors highlighted the severe economic distortions and social imbalances the project would cause:

- It would take most of the prime land needed for food production, including that close to irrigation that a new dam would make possible;
- It would potentially use more than the water available from the dam and so close off options for other potential water users; and
- The 50 year control of infrastructure would amount to also controlling the land itself.

It appears that the key investor in the company also had tainted political credentials from a neighbouring country. In any case, the project failed despite the company offering to subsidize small farmers grow 20% food and 80% sugar on their lands in the vicinity. Government is seeking a new investor for the same project.

Source: The politics of agrofuels and mega-land and water deals: insights from the ProCana case, Mozambique. S. M Borras, D. Fig and S. M. Suarez. Review of African Political Economy Vol 34 No 128, June 2011, pp 215–234.

Tanzania

a) Kilwa District Jatropha: At USD 12/acre, a firm called Bioshape has acquired 34,000 ha and started a jatropha pilot with revenue shared 60% to district and 40% to villagers. The company has installed a sawmill and is getting revenue from day 1 from selling timber – some suspect the timber income was a key but hidden motive for the company to seek the land.

b) Rufiji and Bagamoyo Districts: Sekab Company has secured under 99 year lease 22,000 ha towards an eventual 500,000 ha for sugarcane but so far has only established an 80 ha seed cane field. Land has indigenous forest but the agreement is unclear on rights to benefit from the forest products when harvested.

Source: "Scramble for Land in Tanzania" Emmanuel Sule, Plaas Workshop on Commercialization of Land and Land Grabbing in Southern Africa. Clara Anna Fontein Reserve, Cape Town, S. Africa 22–25 March 2010.

international community should not condemn them out of hand but assist Africa to make them less damaging where bad deals have been concluded.

The important thing therefore should be that alongside agricultural investments on a smaller scale, both commercial and smallholder, “large-scale farmland investments” should be assessed for whether they may have a significant role in meeting current and future needs for “the three Fs”. Also, that there is *a fundamental need for basing decisions on whether to agree to a “land grab” deal (whether for food security, commercial food to trade, feed, forest products or fuels) on fair comparison of their socio-economic returns/feasibility with alternative approaches, such as investments of a smaller scale.*

It goes without saying that a “land grab approach” should never be treated as the sole way to invest in land for agriculture. Given these perspectives, some thoughts to consider could be:

a. Investment is important, especially for African agriculture, and all parties need to act in such a manner that they communicate a sense of welcoming rather than discouraging it. For this reason, large land deals should be allowed *without prejudgement* among the options for agricultural investment;

b. It is important to focus on the overall investment package and not just on the land deals associated with it – land is only one element in successful agriculture;

c. The impacts of land grab investments on specific resources (forests, fuel) must be assessed not with preconceived bias against the large-scale farmland investment but in fair comparison with alternatives. Among such alternatives (or complements) is always the use of the land by citizen investors at the smaller scale that they can cope with. But fair comparison

would demand that, unlike the current reality, the locals also get at least as good policy support for achieving productivity as the external large-scale farmland investors – make the playing field more level;

d. The land grab quarrel is regrettably never about productive use of the land – it is inevitably about ownership and at times sounds as if mere land possession is everything. *In the end, land is truly a developmental asset when it is made productive:* land that does not produce in some way is pretty useless and may even be a burden. The development-relevant question to ask is therefore “*having achieved ownership, would citizens produce better on that land or would the large-scale farmland investors do a better job?*” – what would develop recipient-country agriculture and their economies faster and so give them economic hope?;

e. The slow mobilization by large-scale land investors to actually use their extensive land is potentially explosive. Although millions of hectares are being publicized in the press, the amount of land actually opened up and in production is relatively small; governments cannot easily explain to their own people why land was taken away from them only to lie idle in foreign hands. Agreements must force the pace of use otherwise protests by local communities accused of not using their own land would be valid when the foreigners also leave the land idle; and,

f. Taken altogether, the real need is for pragmatism: to balance the need for accelerated development (to which well-managed and responsible external land lease/ownership can make an important, even critical, positive contribution), without losing national control over this important resource. Strict application of the precautionary principle (*do not take a step forward until you are absolutely sure no harm*

will result) is unrealistic in development – the industrial countries would not be where they are if they had followed this in their histories – should they be pulling up the ladder after they themselves have climbed up it?

To inform public opinion better and so progress beyond the predominant tendency towards blanket condemnation of large-scale farmland investments, it is necessary to understand the phenomenon better. This may require some of the following elements:

a. Continue reviews of the investments but increase attention to the reality on the ground, reducing reliance upon literature quoting literature;

b. Allow time for claimed large investments to start being implemented and listen adequately to the lessons from them: they should then be assessed fairly, realizing that there is no such thing as a perfect, completely harmless development intervention, even in industrial developed countries;

c. Directly engage the governments of the land-rich African countries and the foreign companies or sovereign-wealth funds that are investing – do not discuss the findings from assessments of performance, environmental and social soundness, fairness, etc., of the land deals behind their backs. In that way the central players in the land deals would be centrally involved in seeking a way forward, including any renegotiation of deals;

d. Make local communities also parties to the dialogue but they should speak for themselves rather than having words put into their mouths by either pro or anti-farmland investment campaigners. This dialogue will be possible and will be useful only if a climate of trust is created, free from *a priori* condemnation or praise even before reality checks are performed; and,

e. Allow and encourage governments in land-abundant countries to encourage other agricultural investments on a smaller scale alongside the super-farms.

The possible role of wealthy countries

This meeting is being held in Sweden, a country which, like the rest of Scandinavia, has a well-earned reputation for seeking balanced, unemotional and fair-minded solutions to social challenges around the world. In the matter of so-called “land grabs”, Scandinavia could play this role again, some areas for intervention and sober opinion being the following:

a. Africa needs investment and “land grabs” are one form this is taking – the situation calls for the voice of reason to intervene and allow sober reflection rather than wholesale condemnation of a potential opportunity to move African agriculture and its development forward. Rich countries of goodwill should understand Africa’s plight and show greater sympathy; just when Africa is being offered investment after long being denied it, it does not seem right that everyone cries “foul”, without offering solutions;

b. The rich countries which currently support the campaigns against “large-scale farmland investments” need to insist on more ground-truthing; more lessons should start coming from land deals where actual farming has started and not from just press stories conveying only alarm and despondency;

c. No doubt some African governments are venal and corrupt. But in many cases, they negotiate bad deals unfair to their own people because they have weak capacities for information, legal knowledge, awareness of international best practice, etc. They also are desperate for investment and the investors can drive a

hard bargain as a result – donors can help to accelerate capacity building for them. There is a strong case for external support to quickly upgrade African capacities to negotiate better and to seek investor compliance;

d. It is taking time for the large deals agreed to transform into actual farming on the ground; it seems essential to discover why and to assist the core parties in the event that genuine capacity hurdles exist. If instead there is the hidden agenda of locking up land and not intending to use it, African governments would need international help to challenge the abuse of good faith, legal transgression and unfair dispossession of local communities for no economic gain to their countries or neighbourhood residents;

e. The industrial country community should also consider launching a process of dialogue whereby campaigners do not just focus on raising alarm among local communities, opportunistic politicians and among sympathetic western and international community audiences; they need to include investors (many are in fact from the west) and investment-recipient governments – for this, donors could launch a fund and programme for neutral assessment and for the dialogue to accompany it;

f. Developed countries should communicate the reality that farms do *not* need to be super-big to be efficient, effective or profitable; they should show by their own example that it is possible to promote successful agriculture at a farm size far lower than the so-called “land-grab” deals;

g. But to do all the above well, the developed industrial countries should promote a tripartite alliance, a true partnership for progress on African agriculture:

- they as one party (*bringing experience, technical assistance and the reality check of their modest scale farming having been successful*)
- the recipient African countries (*bringing land and labour*)
- the investor country governments/their sovereign wealth funds/and their government-backed private investors (*bringing the money, but many with little tradition of agriculture, especially if they are from the Middle East*).

Naturally, the wealthy developed countries should also try to engage in agricultural investment directly in Africa. So far, they have been too timid on this. Instead it is only the adventurers and the unscrupulous from their countries as well as from cash-surplus developing countries that have jumped in fast. Whether from the west or from the more often criticized Asia, Near East or within Africa, these “cowboy” investors have given a bad name to all that have engaged in large land investments. Can wealthy industrial countries do more than just look on? Should they not engage actively to convert bad deals into acceptable ones? Should they not help upgrade the good ones into exemplary models? Should developed countries not help to encourage best behaviour by investors from wherever they come and to minimize the rape of Africa’s lands?



Women carrying fuelwood that they have gathered. Photo: Robert Faidutti, FAO (CFU000352).

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Seminar II, 22 November, 2011. The panel from left to right: Lennart Båge, Jeremy Woods, Heikki Rissanen, Gabriella Cahlin, Johan Kuylensstierna, Mafa E. Chipeta, Jörgen Sandström and Hanna Wetterstrand. Photo: Lisa Holmgren.

Chapter 4

SYNTHESIS

This chapter is an attempt at a synthesis of speakers' notes and presentations, as well as issues brought up during the panel discussions of the two seminars. It first summarizes what has been learnt regarding expectations on increasing demand for food, fibre and fuel, and concludes that land resources to satisfy these demands are limited. It then summarizes speakers' contributions on constraints and opportunities in global food, fibre and fuel production under the headings of need for: improved management of land and water; cross-sectoral policies and adapted institutions; more efficient use of existing resources, as well as enhanced knowledge and capacity-building.

Land resources to satisfy demand are limited

Food demand and implications for land use

Population growth, rising incomes, and urbanization will continue to drive demand for some food products, especially oilseed and animal protein, and related demands for feed and industrial products. Demand for cereals, for both food and feed, is projected to reach some 3 bil-

lion tons by 2050, up from today's nearly 2.1 billion tons. However, developments in the demand for liquid biofuels, depending mainly on energy prices and government policies, has the potential to change these projections and cause world demand to be even higher.

Demand for other food products that are more responsive to rising incomes in developing countries (meat and dairy products, fish and aquaculture products and vegetable oils) is projected to grow much faster than that for ce-

reals for food use. The livestock sector, already constituting 30 percent of agricultural GDP in the developing world, is the fastest growing sub-sector in agriculture (FAO, 2009). However, it has also been argued that land use and greenhouse gas emissions must be considered of critical importance in any long-term assessment of the global food system. Higher oil prices and the implementation of stringent climate policies are likely to lead to higher food production costs, especially for meat and dairy products, and will therefore entail changes in the demand for these products. This means that current mainstream forecasts on global food de-

mand might need to be revised with upcoming factors related to climate policy and bioenergy being taken into account.

In any case, the expansion of the area under agriculture seems unlikely to slow down. The World Bank, in what is referred to as a conservative estimate, projects that, in developing countries, 6 million ha of additional land will be brought into production each year to 2030 (Deininger *et al.*, 2011). Looking further ahead, the maps in Figure 4.1 show projected land use changes by 2050, with regard to expansion of agricultural land.

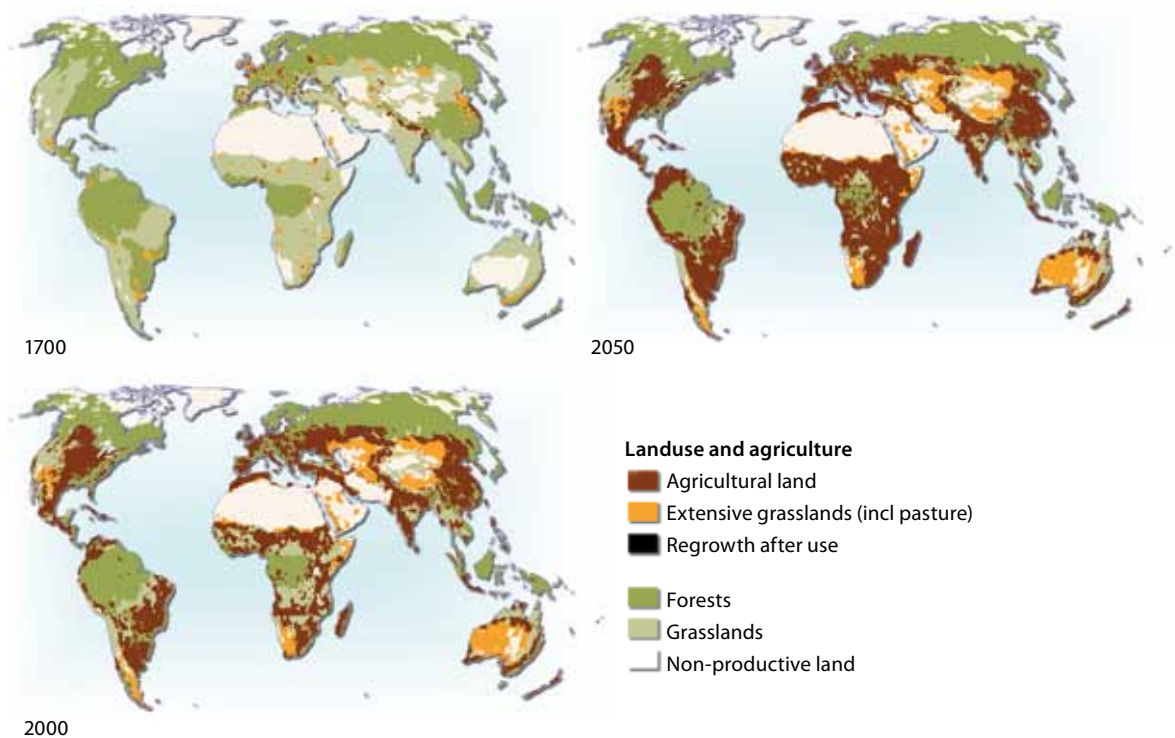


Figure 4.1 Land use by 1700 and 2000 and projected land use changes by 2050. Source: UNEP, 2009.

Industrial wood fibre demand and implications for land use

When talking about wood fibre demand in a land use perspective, it should be kept in mind that still the largest share of wood harvested globally, some 57 percent, is used for non-industrial purposes, mainly fuelwood. Hundreds of millions of people are today completely reliant upon wood for energy, and this picture is likely to prevail for the coming decades since any rapid transition to other energy sources is currently not feasible.

Regarding industrial demand for wood fibre, all projections show increased demand in traditional forest products (sawnwood, wood-based panels, paper and paperboard) in the coming 20 years. According to a scenario made by Pöyry AB, there could be a total increase in demand for wood of 700 million solid cubic metres from 2010 to 2030 for these products.

In addition, wood fibre is also increasingly demanded for other uses than traditional forest products. For example, the past few years have seen a dramatic increase in the global market prospects for wood pellets for heating and power. Large-scale pellet production facilities have been built in North America, and many more are announced to be constructed to meet expected demand. Sweden, Germany, the UK and Denmark are expected to have the fastest growth in consumption in wood pellets the coming 10 years, to a large extent driven by EU renewable energy targets. Development of wood pellet supply depends to a large extent on availability of wood fibre as pellet raw materials.

In the EU area, and according to figures presented by the international consultancy firm PricewaterhouseCoopers, 340–420 million cubic metres (under bark) of woody biomass per year is forecast to be needed solely for energy purposes by 2020, if current government poli-

cies on renewable energy continue. Under those assumptions, that would mean a wood fibre deficit of 200–260 million cubic metres within the EU by 2020. It is further concluded that new uses will make up a larger share of fibre usage, as a consequence of dropping demand for paper products in mature markets and decoupling from GDP growth in emerging ones (PwC, 2011).

It is clear that growing demand for wood fibre will impact future land use and lead to increasing pressure on land. Many see one response lying in increasing the area of planted forests. As an example, the World Business Council for Sustainable Development estimates that the yield and harvest from planted forests will need to increase threefold by 2050, with the area under plantations increasing by 60 percent compared to today (PwC, 2011). Today, the area under forest plantations is some 270 million hectares (PwC, 2011), or around 7 percent of total forested area of 4.1 billion hectares.

Biofuel demand and implications for land use

The strong resurgence in the past decades of interest in bioenergy has been driven by several factors, including biofuel mandates, higher oil prices and instability in oil-producing regions, extreme weather events, etc. (Cushion, 2010). Current and future demand for biofuels show significant variations between countries and regions (Murphy *et al.*, 2011), but projections at aggregate level point at a four-fold increase in the use of biofuels from 2008 to 2035 (IEA, 2010).

Over this time, a transition is expected from the so called first-generation biofuels (cereal and oil crops) to the so called second generation biofuels, based primarily on ligno-cellulosic feedstock. The development of second-generation

technology is moving forward at a rapid pace, and although producing biofuels from non-food crops is not expected to be commercially viable for another 5–10 years, demonstration-scale plants are already operating (Cushion *et al.*, 2010). Advanced biofuels, including those from ligno-cellulosic feedstock, are assumed to enter the market by around 2020, mostly in OECD countries (IEA, 2010).

Although future supply and demand for bioenergy is harder to predict than that for food and fibre, there seems to be general agreement that developments in bioenergy will have major implications for land use. Land requirement projections for biofuels vary widely depending on chosen development trajectory (Murphy *et al.*, 2011), but it seems clear that growing bio-energy consumption will result in increased competition for land, and especially between the biofuel and the food sector.

Food, fibre and fuel production will compete for limited land resources

Increasing global demand is expected for food, fibre and fuel, and the sectoral responses lie to a large extent in increasing productivity on land already under cultivation and in expansion of land under cultivation. However, apart from the adverse ecological, economic and social consequences that further expansion of cultivable land may carry, there is also limited scope for such expansion during the coming decades. Figures vary, but analyses show that we might expect a land deficit of 300 million hectares of productive land already by 2030, which translates into an even stronger emphasis on increasing productivity.

Competing land demands between the food and the biofuel sectors has been the subject of several analyses, and there is a “food versus

fuel” debate going on internationally. Also, the relation between land claimed for agricultural expansion and diminishing forest cover has been much studied. However, when it comes to actual analyses that take competing land demands between the biofuel, food and forest sectors into account, there seems yet to be very few concrete examples. Judging from current rates of deforestation, it does, however, seem that naturally forested land would tend to be the “loser” in future competition around cultivable land, unless some radical change in trends takes place; Roberts *et al.* (2008), for example, state that the converging global demand for land to produce food, fibre and fuel is likely to lead to large-scale land acquisitions, and that forest lands are likely targets for conversion to industrial agricultural use. They question whether natural forest management will be competitive when compared with the fuel and food sectors.

Apart from competing sectoral demands, pressures like climatic change, water scarcity, and land degradation are likely to add to competition for land. Climate change is already a factor that affects natural and managed systems (forests, agriculture, fisheries, wetlands, coral reefs) that societies depend on for the production of food, fibre and fuel. There seems to be wide agreement that climate change will mainly affect future yields negatively and thus impose a real constraint on the production of food for a growing world population. Land and soil degradation, as well as loss of cultivable land due to urban sprawl, are no new problems either. These are, however, factors that intensify the competition for land since they reduce the quantity of land suitable for different types of cultivation. A quite recent global assessment (ISRIC, 2008) identifies 24 percent of global agricultural land as degrading.

The question is thus not primarily how to avoid competition for limited land resources,

since this in any case seems inevitable, but what can be done to make the best possible use of available resources, without jeopardizing ecosystems' functioning. FAO currently takes the position that resources may be sufficient for feeding a world population of 9.3 billion people by 2050, but underlines that this requires substantial improvement in management. Foley *et al.* (2011), in an article referred to during the seminars, argue that tremendous progress could be made by basically pursuing four strategies: halting agricultural expansion, closing "yield gaps" on underperforming lands, increasing cropping efficiency and enhancing food delivery by shifting diets and reducing waste. These routes were all touched upon during the seminars.

Need for improved management of land and water

Prospects for increasing food availability lie mainly in intensification of production on land already under agriculture and in expansion of agricultural areas. However, much attention has been paid to how expansion should be minimized, to avoid further adverse effects. Wirsén *et al.* (2010) conclude that there is considerable agreement that increasing yields on existing agricultural land, and especially on cropland, is a key component for minimizing further expansion. Stevenson, in Chapter 2, also refers to recent literature suggesting that "land-sparing" as a strategy, by means of yield-increasing agricultural technologies, and as compared to "land-sharing", is better for net greenhouse gas emissions and can be better in terms of biodiversity conservation.

Increasing productivity on currently cultivated land sustainably

Recent literature notices land and water "productivity gaps" as an untapped potential to increase availability of food, fibre and fuel, and prospects for productivity increases were discussed during presentations. According to FAO, more than four-fifths of agricultural production growth to 2050 is expected to come from increased productivity on presently cultivated land (FAO, 2011a). At the seminars, it has been shown that improved soil management indeed holds significant potential, and that agricultural yields on many soils in developing countries may get doubled or tripled production rates provided that soil management is improved, for example by the use of adequate fertilization. Figure 4.2, based on estimates made by IIASA from the Global Agro-Ecological Zone (GAEZ) simulations model, indicates the potential for increasing yields in different regions of the world by closing "yield gaps".

Also for meeting growing demand for wood fibre, increasing yields on existing productive forest land by different means is a route pursued (and politically supported, for example, in the whole European region). The Swedish government's expectation on an increased Swedish forest growth by 25–50 percent within the coming 60 years is a case in point, although this is also intended as a climate change mitigation measure. The great production potential of industrial forest plantations as suppliers of demanded wood fibre has also been pointed at.

However, for these potentials to be realized, one prerequisite is that governance of global water resources is improved substantially, and that water is seen and planned for as an integral part of land and soil systems. Already, approximately 3.5 billion people live under moderate to extreme water stress. The expected 70 percent

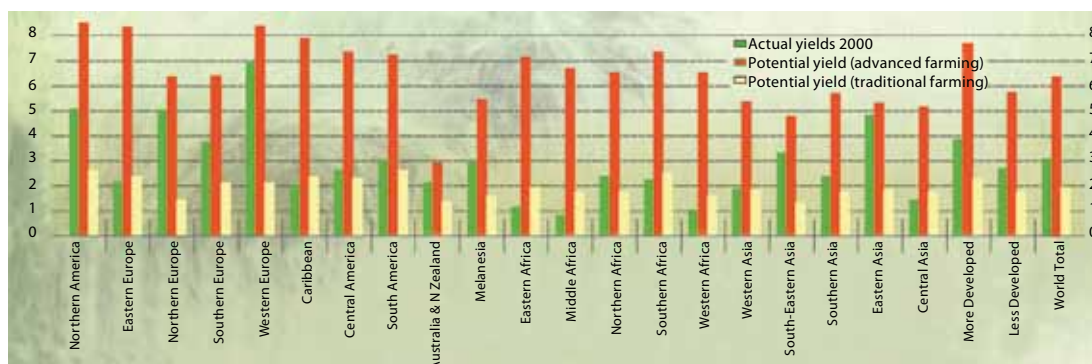


Figure 4.2 Estimated aggregate “yield gaps” for cereals in year 2000. Source: Fischer, G. & Shah, M. (2010).

growth in food production by 2050 will almost double global water use in a “business as usual” scenario, and crop production for bioenergy purposes will place further stress on production systems. Adding to the picture is, for example, also the role that forest ecosystems play in regulating the global water cycle and impacts of forest cover change on hydrological processes when agricultural land expands at the expense of forested land (see e.g. Malmer *et al.*, 2010).

Combined land-utilization an opportunity to increase productivity sustainably

Apart from the potential to increase production by, for example, improved soil management, the value of combined land utilization as an opportunity for increased production in a sustainable manner has been stressed by several speakers in the seminars. Experience from the Vi Agroforestry work in Eastern Africa shows that agroforestry as an agricultural system can have significant potential to increase the production of food and biomass at the household level, and also help farmers adapt to climatic

change. However, it has been noted that successful introduction of agroforestry requires a relatively stable institutional and political environment, meaning for example that land tenure rights have to be clear, and accessibility to well-functioning markets in place. It has also become clear that there is a gender dimension to increasing productivity since farmers more often than not, particularly in Africa, are women.

Need for cross-sectoral policies and adapted institutions

As noted by the World Bank (2010), there is an extensive literature recommending strengthening the policy and institutional conditions that influence how people manage land and water resources, with several themes recurring across sectors, such as: innovative decisions-making tools, secure property rights, pricing resources in a right way, well-regulated markets, strong institutions and information at all levels. Several challenges and opportunities related to institutional factors and policy aspects have also been addressed by the speakers.

Need for integration of land and water use policies and institutions

An overarching challenge that has been brought up is the need to stop thinking and acting in sectoral trajectories and move to cross-sectoral analyses and integrated land-use policies in order to address competing demands for food, fibre and fuel. A recent FAO report on the state of land and water resources, referred to at the seminars, concludes that land and water institutions have not kept pace with the increasing degree of interdependence and competition over land and water resources, and argues that much more adaptable and collaborative institutions are needed to respond effectively to natural resource scarcity and market opportunities (FAO, 2011b). Calls for such a transition have been heard and seen for many years in international policy fora and policy papers, but the challenge to make it happen remains.

The need to integrate water issues in land management planning is one of these cross-sectoral challenges. Another concerns the production and use of biofuels which, it has been argued in this report, should be fit into an overall resource strategy, covering energy, climate, land-use, water and agricultural issues, if their deployment is to benefit society, the economy and the environment as a whole.

Strengthening land and water tenure rights for improved land management

It is well established that secure access to productive land is critical to people living in rural areas and depending on agriculture, livestock or forests for their livelihood. Land tenure issues have also come to be of particular concern in the context of global demand for production of food, fibre and fuel since increased compe-

tition for land has placed further stresses on land tenure systems. One issue that has been widely discussed as a consequence of what is by many seen as a “land-grabbing trend” of the past years, is how to secure land tenure rights for local and forest-dependent people in negotiations on land deals.

It has also been stressed that, in this context, water tenure must not be forgotten. As stated by FAO (2011a), the lack of clear and stable land and water rights, as well as weak regulatory capacity and enforcement, have contributed to conflict over land access and competition for water use.

Enhancing functioning of and accessibility to markets to improve food-availability

It has become clear that challenges are not only related to the need to increase agricultural productivity and enhance conservation, but also to distributive aspects of, and market infrastructure for, agricultural commodities. Presentations have shown the importance of well-functioning markets and trade from the local level to the global level in order to increase availability of, in this context, mainly food, and above all, the importance of markets being accessible for those who need them. As for the local farmer level, it has been said that failure to help small-scale farmers to access markets is a key cause to hunger. Farmers have to know where to sell their products, and it has been stressed that there is a need for good farmers’ organizations in this respect.

It has also been pointed out that with increased urbanization, and the changed food consumption patterns coming with that, changes call for farmers in rural areas to work with longer production chains. In turn, the functioning of longer production chains calls

for more services, from logistics and information on market and prices, to credit, finance and insurance. Most of these services need to be produced and made available in rural areas, and this presents further challenges to local food distribution.

As for the global food market, world trade in agricultural commodities will continue to increase. There are projections indicating that trade in cereals will more than double in volume by 2050, and trade in meat products more than quadruple (World Bank, 2010). Thus, the trade system will have to accommodate to a greater share of global food production being traded across borders. This makes it even more important that the global agricultural market is an open, well-functioning and reliable one as is securing sufficient buffer stocks. Several factors that may distort global trade, such as export restrictions and subsidies, have been brought up. And, as has been pointed out in this report, the food price crises of 2008/09 made the effects of export restrictions clear. In this situation, many grain surplus countries blocked or restricted exports, and importing countries were faced with a situation where, despite they having the money for import, there was no grain to buy. Thus, many importing-countries lost faith in the international market while food-availability could not be secured by it.

Increased trade also carries risks for increased spread of animal diseases and plant pests. Different preventive regulations may be a limiting factor in world agricultural trade, as may, for some areas, insufficient infrastructure for handling increased amounts produced. Several of these factors can potentially be dealt with in trade agreements, preferably at a global level, such as the WTO-agreements.

Need for more efficient use of existing resources

As a parallel route to increasing availability of food, fibre and fuel through increased production rates, the issue of using existing resources more efficiently has been brought up by several speakers and during panel discussions.

Use existing resources more efficiently and minimizing waste

Several of the speakers have pointed at the need to be more cautious of what is today regarded as waste products in the chain of production for food, fibre and fuel, in order to increase availability. It has been stressed that, to an increasing extent, we have to see waste as a resource and that a shift of mind is needed in this respect.

Going to the literature regarding waste of food, Hallström *et al.* (2011) for example state that the minimizing of losses and waste throughout the food supply chain might be the most efficient way of reducing the need for further land expansion and to improve global food security. Figures show that as much as 40 percent of food may be lost post-harvest in developing countries. The losses in industrialized countries are lower in the production phase, but may instead be more than 40 percent at the retail or consumer levels (Foley *et al.*, 2011).

Regarding wood fibre, the question has been raised whether existing fibre resources can be used more efficiently, for example through increased use of left-behinds in forestry, or by using the large quantities of fuelwood harvested globally more efficiently. Another theme addressed has been the need to use energy more efficiently to sustain the physical basis of economies and societies, and the general need to move towards more resource efficient and recycling-based industries.

Changing dietary preferences

Apart from improving efficiency in production chains and minimizing waste, more food can also be delivered by changing our agricultural and dietary preferences (see e.g. Foley *et al.*, 2011), and this is also an issue that has been touched upon during the seminars. Especially demand for animal protein is a crucial concern since livestock production is by far the most resource consuming agricultural activity. FAO figures (2006) showed that while meat at present represents only 15 percent of the total global diet, approximately 80 percent of the agricultural land is used for animal grazing or the production of feed and fodder for animals. Looking at the EU27 area, Wirsenius (2011) in Chapter 1 shows that beef requires almost 20 times more land than pork and chicken meat, and about 80 times more than cereal products (per amount of calories). These facts are reasons why past years have seen calls for dietary changes from both ENGOs and UN-organizations. UNEP (2010) concludes that a substantial reduction of negative impacts on the environment from agriculture would only be possible with a substantial worldwide diet change, away from animal products. The World Bank (2010) concludes that aquaculture must, to an increasing extent, help in meeting growing demand for food, and especially animal protein.

It has also been pointed out that shifts in dietary preferences are desirable for global health reasons. In the coming decades, changes in food consumption will reflect above all the rising consumption of developing countries, and these changes will imply a switch towards energy-dense diets, high in saturated fat, sugar and salt, and low in unrefined carbohydrates. Combined with lifestyle changes driven by urbanization, such transitions are likely to be accompanied by increases in diet-related chronic Non-Communicable Diseases. Therefore, a rel-

evant policy challenge in this area will be that of orienting consumers toward healthy diets and lifestyles, allowing a reduction in the social and economic burden of food-related diseases.

Certification and different kinds of sustainability standards has been pointed at as one means to move consumptive trends towards taking account of environmental and social issues to a greater extent, and so help in guaranteeing food safety. This is one way for retailers and consumers to differentiate products and influence producers and production systems.

Need for enhanced knowledge and capacity-building

Several of the speakers have stressed the need for more research and better statistics in different areas in order to enhance the knowledge base for decisions around future land use. This concern for example further research on how to enhance productivity in economic, ecological, and socially sustainable manners as well as research on climate change mitigation and adaptation.

Need for better land use statistics and cross-sectoral analyses

There are today data available to undertake analysis of future land use change. However, it has been noted that available tools to study land use change are limited in their abilities and that there are great uncertainties in available data sets. Thus, improvement of data on land use would be one challenge, and one proposal put forward is establishing a new global Remote-Sensing Program (high resolution) and platform for analyses of land use and land availability.

Another challenge is further development of analyses across sectors. Despite many years of calls internationally for cross-sectoral policy cooperation and analysis, it seems that policy practice remains to a large extent in sectoral trajectories. In research, systems perspectives are today well established in natural resource management and governance research, but it seems that the challenge to put the whole “food-fibre-fuel-feed-forest ecosystems-fresh water nexus” to analysis from a land use perspective is, to a large extent, still ahead of us.

Building capacity for negotiations of fair land deals

The need for enhanced capacity building has generally been pointed out for many areas related to the themes addressed by the speakers. One specific area for capacity-building relates to the trend of “land grabbing”, and specifically to large-scale farmland deals in Africa. It has been stated that in many cases, the reason why negotiations by African governments of land deals become unfair to their own people is that governments have weak capacities for legal knowledge and weak awareness of international best practice, among other things. Therefore, there is a strong case for external support, by the international donor community, to quickly upgrade African capacities for negotiations of more fair land deals, and to help build capacity to negotiate deals with investors using the guidelines being developed by FAO.

Concluding remarks

It is clear from the seminars and from literature that there is a lot of thinking done on what strategies to pursue to meet a growing global demand for food, fibre and fuel in a sustainable manner. However, as also pointed out by many, the question of how to translate strategies into action remains to a large extent to be answered. It has also become clear that deficiencies in available data sets on larger scale land use change is currently one of the constraints, and that improvements in this respect is an important part of future analysis, assessments and planning of land use and land availability. However, although the global dimension of land use issues and planning have become very clear, it has also become clear that there is a need for context-specific and locally adapted solutions.

Perhaps most important, as Lennart Båge, moderator of the two seminars, pointed out, it should be kept in mind that increasing the supply of food, fibre and fuel is a means to an end. There are still one billion people in the world that are poor and hungry, and there is no panacea solution to this problem, but many dimensions that need to be addressed, and investments that need to be made in the whole value chain. Further, in order to address the challenge of meeting a growing demand in the face of scarcer land resources, we need to move from the current “food *versus* fibre *versus* fuel” thinking to approaches where we try to seek synergies in food *and* fibre *and* fuel production in a long term perspective.

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Annex: seminar programmes

Seminar No. 1 – The global need for food, fibre and fuel – is there enough land to satisfy the demands?

Tuesday 27 September 2011

- 09.00 Coffee and registration
- 09.30 Welcome and presentation of KSLA, *Mr. Åke Barklund*, Secretary General and Managing Director, KSLA
Introduction to the conferences – their purpose, scope, structure and goals,
Dr. Björn Lundgren, Chair KSLA Committee on International Forestry Issues
- 09.50 Session 1: Global demand for food in the next 20 years
Presentation No. 1: *Dr. Stefan Wirsenius*, associate Professor, Division of Physical Resource Theory, Chalmers University, Gothenburg
Presentation No. 2: *Dr. Dominique van der Mensbrugghe*, Team Leader of FAO's Global Perspectives Studies team Director, Agriculture Development Economics Division, FAO, Rome
Presentation No. 3: *Mr. Harald Svensson*, Chief Economist, Swedish Board of Agriculture, Jönköping
- 11.00 Session 2: Global demand for wood and fibre in the next 20 years
Presentation: *Mr. Jan Wintzell*, Director, Pöry Sweden AB, Stockholm
- 11.30 Session 3: Global demand for bioenergy crops in the next 20 years
Presentation No. 1: *Dr. Stefan Bringezu*, Wuppertal Institute for Climate, Environment and Energy, Germany
Presentation No. 2: *Anders Dahlberg*, handling officer, Swedish Energy Agency
- 12.15 Lunch
- 13.00 Session 4: Availability of and competition for land to meet increased demands of food, fibre and fuel
Presentation: *Prof. Sten Nilsson*, CEO, Forest Sector Insights AB, ex-IIASA
- 14.00 Panel – discussion and questions
- 15.00 Coffee
- 15.15 Continued discussion and question session
- 15.45 Summary and round-up by moderator and KSLA organizers
- 16.00 Mingle in Oscars Källare

Seminar No. 2 – The global need for food, fibre and fuel– how do we address constraints/
opportunities to meet the demands?

Tuesday 22 November 2011

- 09.00 Coffee and registration
- 09.30 Welcome and presentation of KSLA, *Mr. Åke Barklund*, General Secretary and Managing Director, KSLA
Introduction to the seminars – their purpose, scope, structure and goals; summary of seminar No. 1, *Dr. Björn Lundgren*, Chair KSLA Committee on International Forestry Issues
- 09.50 Session 1: The productivity of land and how this can/must be increased in a sustainable way
Presentation No. 1: *Prof. Mats Olsson*, Swedish University of Agricultural Sciences
Presentation No. 2: *Adjunct Prof. Johan Kuylensstierna*, Stockholm Environmental Institute
- 10.30 Session 2: Economic and related issues
Presentation No. 1: *Mrs. Gabriella Cahlin*, Head of the Market Department, Swedish Board of Agriculture
Presentation No. 2: *Mrs. Hanna Wetterstrand*, programme officer, Vi Agroforestry
- 11.15 Session 3: Social issues
Presentation: *Dr. Jeremy Woods*, Lecturer in Bioenergy, Imperial College, UK
- 11.45 Session 4: Environmental issues
Presentation: *Dr. James Stevenson*, Agricultural Research Officer, CGIAR Science Council, Rome
- 12.15 Lunch
- 13.00 View from countries in Africa with perceived land reserves
Presentation: *Mr. Mafa E. Chipeta*, FAO Subregional Coordinator for Eastern Africa, Addis Ababa
- 13.45 Five cases with Swedish involvement in larger food, wood and bio-energy production programmes outside Sweden
Mr. Heikki Rissanen, Group Forest Operations, StoraEnso
Mr. Jörgen Sandström, Vice-President, Addax Bioenergy
Dr. Jörgen Levin, the Environmental Economics Department of Gothenburg University
Prof. Johan Schnürer, Assistant Vice-chancellor, Swedish University of Agricultural Sciences
- 14.45 Coffee
- 15.00 Panel – discussion and questions
- 15.45 Summary and round-up by moderator and KSLA organizers

Moderator of conferences: *Mr. Lennart Båge*, Ambassador and ex-President IFAD.

Utgivna nummer av Kungl. Skogs- och Lantbruksakademiens TIDSKRIFT (KSLAT)

(Titlar markerade med * publiceras endast elektroniskt på KSLAs hemsida www.ksla.se. Där finns även tidigare utgåvor.)

2008

- Nr 1 Kungl. Skogs- och Lantbruksakademiens verksamhetsberättelse 2007
- Nr 2 Fiskets kollaps utanför Nordamerika – vad kan Sverige och Europa lära?
- Nr 3 Edens lustgård tur och retur – framtidsvägar till ett hållbart naturbruk
- Nr 4 Utveckling av den svenska resursbasen för internationellt skogligt arbete
- Nr 5 Skogens roll i ett framtida globalt klimatavtal
- Nr 6 Jakten på den gröna marknadskraften – del 2*
- Nr 7 Golden Rice and other biofortified food crops for developing countries – challenges and potential

2009

- Nr 1 Does forestry contribute to mercury in Swedish fish?*
- Nr 2 Kungl. Skogs- och Lantbruksakademiens verksamhetsberättelse 2008
- Nr 3 Klassificering av sjöar och vattendrag – nordisk jämförelse utifrån svenska bedömningsgrunder
- Nr 4 Return to Eden – future paths to sustainable, natural resources management
- Nr 5 Landet utanför – landskapsetetikens betydelse för den urbana människan

2010

- Nr 1 Växtskyddsmedlens miljöpåverkan – idag och i morgon
- Nr 2 Kungl. Skogs- och Lantbruksakademiens verksamhetsberättelse 2009
- Nr 3 Vindkraft, javisst! Men inte alltid och inte överallt
- Nr 4 Skogsbrukets bidrag till ett bättre klimat
- Nr 5 Internationell skogspolicy – en översikt
- Nr 6 International forest policy – an overview

2011

- Nr 1 Food security and the futures of farms: 2020 and toward 2050
- Nr 2 Swedish-African forest relations
- Nr 3 Kungl. Skogs- och Lantbruksakademiens verksamhetsberättelse 2010
- Nr 4 Landskapsperspektiv – hur gör det skillnad?

2012

- Nr 1 Forskning och innovation för produktiv och skonsam skogsteknik
- Nr 2 Inte av bröd och bräddor allena – en skrift om skönheten i naturen
- Nr 3 Kungl. Skogs- och Lantbruksakademiens verksamhetsberättelse 2011
- Nr 4 The global need for food, fibre and fuel

With an expected world population of 9 billion people in 2050, the global need for Food, Fibre and Fuel has become a matter of high political concern. Beyond 2030 the production of “the three F’s” is expected to compete for limited land and water resources. The response to this is largely to increase productivity on land already under cultivation and to expand cultivated areas – with ecological, economic and social consequences as well as greenhouse gas emissions as a result. The overall question is how to manage land and water to meet the demands while at the same time protecting the natural ecosystems that sustain life on the planet. Cross-sectoral policies, efficient use of existing resources and capacity building are some of the necessary strategies to do this, but the question of how to translate strategies into action remains to be answered.

Some of the world’s foremost experts in the various fields concerning food, fibre and fuel discussed this topic from a land use perspective at two seminars arranged by the Royal Swedish Academy of Agriculture and Forestry in 2011. This publication serves as a valuable summary of the presentations and comments made during the seminars. A list of recent articles and reports of relevance to the subject of matter is included.



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