UNITED NATIONS

Convention to Combat Desertification

Distr.
GENERAL

ICCD/COP(8)/CST/INF.1
26 July 2007

ENGLISH ONLY

CONFERENCE OF THE PARTIES
Committee on Science and Technology
Eighth session
Madrid, 4–6 September 2007

Item 6 (b) of the provisional agenda
Programme of work of the Committee on Science and Technology
Report of the international workshop on climate and land degradation

Report of the international workshop on climate and land degradation

Note by the secretariat

Summary

An international workshop on climate and land degradation organized by the World Meteorological Organization, the United Nations Convention to Combat Desertification and the Tanzania Meteorological Agency was held in Arusha, United Republic of Tanzania, from 11 to 15 December 2006. The workshop focused on how climate induces and influences land degradation and what measures need to be taken to enhance the applications of weather and climate information to combat land degradation. One of the key recommendations made by the workshop was that the network of climatological, hydrological and agrometeorological stations around the world should be increased and strengthened to provide data on rainfall intensities, soil temperature, and soil moisture for land degradation monitoring, assessment and for the implementation of the national action programmes to combat desertification. Climatological and hydrological end products should be developed in coordination with end-users' needs by relevant and competent personnel and institutions.

Introduction

1. By its decision 20/COP.7, the Conference of the Parties (COP) welcomed the offer of the World Meteorological Organization (WMO) to organize an international workshop on climate and land degradation in 2006 to mark the International Year of Deserts and Desertification, and invited the Committee on Science and Technology to assist WMO in bringing together experts for the workshop and to present the workshop's results to the COP at its eighth session.

2. The full report of the workshop, which was held in Arusha, United Republic of Tanzania, from 11 to 15 December 2006, is contained in the annex to this document. It is reproduced as received from WMO, without editing by the secretariat.

3. An abridged report of this workshop presenting the key outcomes is contained in document ICCD/COP(8)/CST/8.

Annex

WORLD METEOROLOGICAL ORGANIZATION

UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION

INTERNATIONAL WORKSHOP ON CLIMATE AND LAND DEGRADATION

(Arusha, United Republic of Tanzania, 11-15 December 2006)

FINAL MEETING REPORT

1. Opening of the Workshop

1.1 The International Workshop on Climate and Land Degradation was held in Arusha, Republic of Tanzania from 11 to 15 December 2006. The workshop focused on how climate induces and influences land degradation and what measures need to be taken to enhance the applications of weather and climate information to combat land degradation. The meeting brought together experts from around the world to discuss and develop various aspects of climate and land degradation. The workshop was organized by the World Meteorological Organization, the United Nations Convention to Combat Desertification (UNCCD) and the Tanzania Meteorological Agency and was co-sponsored by the OPEC Fund for International Development (OFID), the United Nations Development Programme (UNDP) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). Sixty-four participants from 30 countries and 5 UN agencies (WMO, UNCCD, FAO, UNDP, UNEP) participated in the workshop (appendix).

1.2 Dr Mhita, Director-General of the Tanzania Meteorological Agency and Permanent Representative of the United Republic of Tanzania with WMO, welcomed all of the participants to Tanzania and thanked them for participating in the workshop. He thanked WMO and UNCCD for organizing this workshop in Tanzania.

1.3 Dr Nyenzi, Director of World Climate Programme of WMO, welcomed the participants to the workshop on behalf of Mr. Jarraud, the Secretary-General of WMO, and wished them a successful meeting. He thanked His Excellency Professor Mark Mwandosya, Minister of Environment and Her Excellency Dr Maua Daftari, Deputy Minister for Infrastructure Development of the Government of the United Republic of Tanzania for their presence at the workshop. He expressed his sincere thanks, and those of the WMO to Mr Hama Arba Diallo, Executive Secretary of the United Nations Convention to Combat Desertification (UNCCD), for agreeing to co-organize this workshop. He also thanked Dr Mohamed S. Mhita, Director General of the Tanzania Meteorological Agency and Permanent Representative of the United Republic of Tanzania with WMO and his staff, for agreeing to host the International Workshop in Arusha. He also expressed thanks to the local organizing committee for their hard work in preparing and making the arrangements for the workshop. He also thanked the other co-sponsors for their support. He stated that the workshop will focus on trends in land degradation that are assessed differently in various parts of the world. Climate variability, climate change and land degradation are intimately linked and are generating unexpected effects such as an increased occurrence of fire-weather conditions in large parts of the globe. In combating land degradation, bottom-up and top-down participatory management approaches that foster income generating activities are required.

1.4 Mr Grègoire de Kalbermatten, Deputy Executive Secretary of the United Nations Convention to Combat Desertification (UNCCD), welcomed the participants to the workshop. He expressed deep gratitude to the government and people of the United Republic of Tanzania for their warm welcome and hospitality and the support they have given to the convening of this workshop. As a co-convenor of the workshop, he thanked colleagues from WMO for the very efficient work they had put into its organization, and the TMA for hosting it. He said that as this meeting gets down to discuss the inter-linkages of climate and land degradation, we should not loose sight of the long-term effects of climate change on all humanity. He informed the participants that the workshop was given a particular role by the

Conference of the Parties to the UNCCD, as it is considered as an important input into the work the UNCCD Committee on Science and Technology. By its decision 20/COP.7, the seventh session of the COP decided that the priority theme for discussion by the Committee on Science and Technology at its next session will be *"The effects of climatic variations and human activities on land degradation: assessment, field experience gained, and integration of mitigation and adaptation practices for livelihood improvement"*. He emphasized that early warning systems will become more and more critical in the context of global change as the number and frequency of extreme events such as flash floods, rainstorms, fires and droughts increase in many parts of the world. The desert locust, dust and sand storms are major phenomena that are intricately correlated with desertification, and a better understanding of their linkages will provide the tools for better identifying and developing sound strategies and policies to address them. He noted that an important part of the populations of the drylands in developing countries are among the most vulnerable in the world, where the vagaries of climate are a constant reminder of their impoverishment and fragility of their livelihoods. Those populations need our help to adapt to and mitigate global change, our help to develop EWS that will reduce their vulnerability, minimize the risk from those disasters that strongly undermine their very survival. He underlined that this workshop will provide important input to the work of the UNCCD, especially the Committee on Science and Technology. The Parties to the UNCCD need to be informed concretely on how the effective use of early warning can improve the implementation of the national action programmes to combat desertification. He requested the participants to consider a well packaged number of examples or messages on "The effects of climatic variations and human activities on land degradation", that would inform the decision makers on the possible strategies and measures they may wish to put in place in their endeavour to achieve effective implementation of the Convention.

1.5 Dr. Maua Daftari, the Honourable Deputy Minister for Infrastructure Development of the Government of the United Republic of Tanzania, gave her appreciation to the organizers of this workshop for their decision to organize this workshop in Tanzania. The Ministry of Infrastructure Development as the parent ministry of the Tanzania Meteorological Agency (TMA) is keenly interested in the proceeding of this workshop. She mentioned that it is clear that weather and climate coupled with human activities are the principal cause of land degradation. Agriculture in Tanzania which is weather/climate dependent accounts for 56% of the country's GDP. The ongoing power rationing in Tanzania due to massive reduction in water levels at major reservoirs is also weather/climate related. The disappearing glaciers on Mt. Kilimanjaro are an alarming indicator of landscape and hydrologic changes to the environment not only to Kilimanjaro but also to the entire country and continent. She hoped that the workshop will be able to address all its specific objectives and come up with appropriate actionable recommendations for all organizations involved in land management practices in particular the National Meteorological and Hydrological Services and those charged with the responsibility of implementing the National Action Programmes (NAP) in Tanzania. She added that they will strive to assist as far as is practicable and put into practice the recommendations. She wished the participants a successful workshop and pleasant stay in Arusha.

1.6 Dr Mark Mwandosya, the Honourable Minister of Environment of the Government of the United Republic of Tanzania, addressed the participants. He took the opportunity to thank the organizers for inviting him to officiate during the opening ceremony of this important workshop. He stated that the

Government of Tanzania recognized the challenges posed by land degradation and desertification and will continue to seek international cooperation in reversing the rate of land degradation and the threat of desertification. He briefly discussed the National Strategy for Growth and Reduction of Poverty (MKUKUTA) which cites environmental degradation and climate variability to be among the factors that are the cause of poverty in Tanzania. He added that this workshop has come at a right time when land degradation continues to hamper government efforts to alleviate poverty and bring about sustainable livelihoods especially in rural communities. He appreciated the role that the WMO has played in bringing to the fore the importance of climate information to agriculture, aviation, land-use management, infrastructure development, and disaster preparedness. He also stated that UNCCD is in many respects the most important of the Rio multilateral environment agreements, especially to Africa**,** and yet it is the least funded of all the Rio Conventions**,** a situation that needs to be corrected. He concluded by wishing the participants fruitful deliberations and he looked forward to the recommendations of the workshop. He then declared the International Workshop on Climate and Land Degradation opened.

2.0 Session 2: Trends in Land Degradation

2.1 Dr. Stroosnijder was the chair of this session. Mr. Tilya was the rapporteur and he summarized the deliberations of the session.

2.2 Dr Safriel, Hebrew University of Jerusalem, Israel, gave the first presentation of the session entitled "Global Trends in Land Degradation." He started by giving highlights of past assessments of global land degradation including trends and future projections. He concluded that land degradation and thus desertification will probably increase due to increased poverty and the continued climate variability and change. He suggested that desertification can be best expressed by detecting and quantifying a persistent reduced primary productivity, relative to the potential productivity of different ecosystems. He recommended to carry out further collaborative research for distinguishing between actual desertification and desertification risks, for identifying and detecting thresholds beyond which productivity changes irreversibly, and for decoupling effects of desertification from effect of the inherent drylands low productivity, as well as to for quantifying the feedback loops between desertification and climate change.

2.3 Dr Montanarella asked him if we need to re-define desertification. Dr Safriel responded that rather than engaging with changing definitions that result from compromises of political processes, scientists should be encouraged to clearly define the process they wish to qualify and quantify. Dr Montanarella then asked him if we are getting better in assessing desertification. Dr Safriel replied that using measures of net primary production at a global scale through remote sensing can be an improvement over current methods of describing land use and land change.

2.4 Dr Sivakumar stated that Dr Safriel made a very important point of differentiating between desertified land and the risk of desertification and he suggested that Dr Safriel's should address this issue of risk of desertification most explicitly in his recommendations for future work. Dr Safriel replied that due to lack of robust and rigorous techniques to assess desertification, there are estimates that considerably differ – between 10% and 70% of dryland degradation, at the global scale. This

demonstrates that we need more rigorous science for degradation assessment. However, the major practical question is not how much desertification already occurs, but what is the risk of further desertification. He stated that after desertification is properly assessed, the next issue to be addressed should be to assess how much of the dryland that is not yet desertified, is at risk of desertification. This assessment will enable society to direct concerted effort in preventing drylands at risk from becoming desertified.

2.5 Mr. Muheto commented that based on the map of desertification trends that Dr Safriel projected, it was obvious that there were differences between the remote sensing data and what is actually happening on the ground, at least in the case of Tanzania. He asked Dr Safriel to what extent can developing countries, who have little capacity to carry out these assessments, continue to rely on satellite data alone since it can be different from the situation on the ground. Dr Safriel replied that the current global maps of land degradation are still in an experimental or exploratory state. What is now required is for each Focal Point of UNCCD to recommend an expert of his country that would be willing to check his country's relevant section of the global maps against the reality on the ground, and in this way validate or contest the methodology. He recommended that funding sources should be allocated for enabling representatives of developing countries to assist them in checking the methods' application to their own drylands.

2.6 Dr Zeidler asked in regards to Normalized Difference Vegetation Index (NDVI), how does one deal with the encroachment of invasive alien species. Dr Safriel responded that there is a need to carry out ground truthing for the global maps of degradation that result from defining reduction of Net Primary Production (NPP) from potential NPP for each ecosystem type. He continued that it is likely that a shrub area which replaced a grassland may have a higher NPP than the grassland it replaced, but this has to be checked, and ways to incorporate such phenomena need to be developed.

2.7 Dr Zeidler then asked what kind of messages do we want or need to communicate, that changes in scientific information raises many questions and therefore what is our responsibility. Dr Safriel replied that, in his opinion, our responsibility is not to attach more significance to the claim of high desertification, than to the claim of low desertification, and vice versa. Rather, the fact that we have these differences in results only point at the need to improve our science for addressing societal needs. Until then, our message should be what is the extent of risk, and what preparedness is needed for mitigation. He added that, however, assessment of risk may be even more complex than assessing the already occurring desertification, since risk is in interaction between biophysical and societal-political processes.

2.8 Dr Ma Hong, Chinese Academy of Forestry, China, gave the second presentation of the session entitled "Combating Desertification and promoting sustainable development: Assessing current land degradation status and trends in the Asia Region." She stressed that trends in land degradation in Asia are enhanced or dampened by a variety of factors including human activities, irrational utilization of land, water, forest resources, rapid increase of population and overgrazing. She then discussed the activities of the Asian Regional Thematic Programme Network on Desertification Monitoring and Assessment (TPN1). A proposed common set of benchmarks and indicators were developed. The proposed indicator system includes four aspects: pressure indicators that characterize the natural and man-made driving

forces leading to desertification; state indicators that characterize the status of natural resources; desertification impact indicators to evaluate the effects of desertification on human beings and environment; and implementation indicators for assessing the actions in combating desertification and impact assessment. She stated that remote sensing, geographic information systems, the global positioning system technology developments have provided powerful technical support for land degradation monitoring and assessment and it will also provide early-warning indicators of desertification trends. She then gave an overview of TPN1 activities in other Asian in other countries.

2.9 The discussions after Dr Hong's presentation focused on earthquakes as causes of land degradation over a limited areas in Asia, global trends of desertification in Asia, and desertification indicators for Asia.

2.10 Dr Santibanez, University of Chile, gave the third presentation of the session entitled "Trends In Land Degradation In Latin America And Caribbean." He stated that the loss of biodiversity and deterioration of soil productivity has been the result from agricultural practices, ecosystem fragility, human pressure and climate variability. He highlighted several examples of land degradation that occurred in South America over time involving unsustainable practices such as the impact of sugar cane cultivation in several regions, cotton and sugar production in the semiarid region of Northeast Brazil, poor land management practices in the Andean region, increased urbanization that increased runoff and flooding in areas of steep slopes, intensive agriculture and grazing pressure in the populated highlands of Bolivia. He mentioned that in the arid and semiarid regions of the continent, low rainfall and frequent periods of drought stress generally produce poor stands of sparse vegetation, which provide ineffective protection to the soil from the erosive effects of rainfall. He gave several examples of land degradation in forest areas in South America including southern Chile temperate rainforest, the Amazon rainforest, the southwestern coast of Brazil, and Central America. He mentioned that the human drivers of land degradation interact in South America with climatic trends and highlighted several cases such as reduced rainfall along the South Pacific coast of Chile, increased rainfall along the Atlantic coast of Argentina and Southern Brazil, increased climatic variability in the North Eastern Brazil and the Amazonian basin, increased temperatures in the Andes that contribute to a rapid reduction in permafrost and glaciers. These trends are affecting the global hydrology and water availability for irrigation and other uses.

2.11 The discussions after Dr Santibanez's presentation focused on the relationship between decreasing maximum temperatures and the retreat of glaciers; defining the sensitivity of different ecosystems and methods of measurement (remote sensing and field measurements); changes in the range of maximum and minimum temperature; and the extent monocropping or lack of crop diversification is contributing to the increased rate of land degradation.

2.12 Dr Montanarella, European Commission, Joint Research Centre, Italy, gave the last presentation of the session entitled "Trends in Land Degradation in Europe." He gave an overview of the EU Thematic Strategy for Soil Protection by the European Commission which gave formal recognition of the severity of the soil and land degradation processes within the European Union and its bordering countries. The Strategy includes an extended impact assessment that has quantified soil degradation in Europe, both in environmental and economic terms. He stated that the available information suggests that, over recent

decades, there has been a significant increase in soil degradation processes and that these processes will further increase if no action is taken. Soil degradation processes are driven or exacerbated by human activity. Climate change, together with individual extreme weather events, which are becoming more frequent, will also have negative effects on the soil. He then gave detailed information including estimated annual costs of several soil degradation processes such as erosion, organic matter decline, compaction, salinisation, landslides, soil contamination, sealing and biodiversity decline. He mentioned that evidence shows that the majority of the costs are borne by society in the form of damage to infrastructures due to sediment run off, increased health-care needs for people affected by contamination, treatment of water contaminated through the soil, disposal of sediments, depreciation of land surrounding contaminated sites, increased food safety controls, and also costs related to the ecosystem functions of soil.

2.13 After his presentation, Dr Montanarella was asked if he made a distinction between European dry lands and European non-dry lands with respect to quantifiable indicators of land degradation. He replied that in Europe there is no distinction based on climate when addressing soil degradation through their new strategy. The main distinction is based on the local soil conditions, such as soil type, land use, slope, etc. He added that the EU wants to address soil degradation on the basis soil multi-functionality that addresses soil functions such as food production, water filtration, biodiversity, and cultural heritage rather than addressing soils directly.

2.14 Dr Inbar asked what is the impact of the EC subsidy policy on agriculture. Dr Montanarella replied that there is an undeniable impact of the Common Agricultural Policy (CAP) on land and soils in Europe and at a global scale. The CAP reform has for this reason introduced the concept of cross-compliance that links farmer subsidies to the implementation at farm level of good agricultural practices such as soil erosion protection, limiting organic matter loss and avoiding soil compaction. He added that more focus is needed on the global impacts of the CAP on land degradation, stressing that it would be interesting to fully assess the impacts of this on land degradation, particularly in developing countries.

2.15 Dr Tengberg asked if the EC/EU equates soil degradation with “land degradation” or are there other aspects/symptoms of land degradation. Dr Montanarella responded that the distinction between land and soil remains a very ambiguous topic and in various EU languages the terminology is often different and contradictory. In the EU, concerning land degradation, they have consistently adopted the terminology of soil protection for all legislative initiatives with the implicit understanding that protecting soils is equivalent to protecting land from further degradation.

2.16 At the end of the session, all of the presenters participated in a summary discussion with the participants on the topic of the session. Many questions focused on the wide range of land degradation definitions and assessment results.

3.0 Session 3: Weather and Climate Information for Monitoring and Assessing Land Degradation

3.1 Dr. Montanarella was the chair of this session. Dr. Zeidler was the rapporteur and she summarized the deliberations of the session.

3.2 Dr Sivakumar, Chief, Agricultural Meteorology Division of WMO, gave the first presentation of the session entitled "Climate and Land Degradation – An Overview." He started by discussing that climatic variations are one of the major factors contributing to land degradation. He added that to accurately assess sustainable land management practices, the climate resources and the risk of climate-related or induced natural disasters in a region must be known. He then discussed several physical processes related to land surface characteristics that can modify the characteristics of the regional atmospheric circulation and the large-scale external moisture fluxes. He described the various climate parameters such as precipitation and temperature that exert a strong influence over dry land vegetation type, biomass and diversity. He also discussed the current advances in weather and climate science to deal more effectively with the impacts of different climatic parameters on land degradation are explained with suitable examples. He then described several activities promoted by WMO's programmes around the world that help to promote a better understanding of the interactions between climate and land degradation through dedicated observations of the climate system; improvements in the application of agrometeorological methods and the proper assessment and management of water resources; advances in climate science and prediction; and promotion of capacity building in the application of meteorological and hydrological data and information in drought preparedness and management.

3.3 After the presentation, Prof. El Bagouri discussed the opportunity for renewable energies as a way of taking advantage of destructive forces such as enhanced winds, and reducing pressure on natural resources as energy/fuelwood source; stressing especially the importance for North Africa and the Middle East. Mr Badripour mentioned that ecosystems at disequilibrium and related equilibrium/non-equilibrium theories are important as they raise issues over the role of human/livestock induced land degradation versus climate impacts. Dr Sidle asked that since land fragmentation can affect local circulation and rainfall patterns, as in hydrology, what is the impact on rainfall.

3.4 Dr Sivakumar responded that the potential for strategic linkages between climate appropriate technologies and land degradation management are acknowledged and should be promoted in future. There are real opportunities especially on the local implementation level where natural synergy can be capitalized on in this regard. The challenge of reaching out to the end user communities, both through effective implementation of projects as well as good communication is acknowledged as a major constraint that requires future work and enhanced effort.

3.5 There were further questions and discussions from participants including a call for concrete recommendations that could be distilled for integration into the workshop report and as guidance for the UNCCD as well as WMO communities and the importance of communicating the research and science information was stressed.

3.6 Dr Clarke, University of Nottingham, UK, gave the second presentation of the session entitled "Climate, Extreme Events and Land Degradation." She stated that the frequency of occurrence of climate extremes (for example, heat waves, droughts, heavy precipitation) is expected to increase during the next century. In her paper, she examined the impact of climate extremes on processes of land degradation including floods, mass movements, soil erosion by both water and wind, and salinisation. She noted that land degradation impacts of climate-driven extreme events have lacked systematic study and that case studies which combine daily meteorological records spanning decades with individual event impact records are rare. She mentioned that there are various methods of classifying extreme events and not every extreme event will have a similar impact on land degradation. She reviewed the global analysis of trends in daily climate extremes for the 20th century along with the coverage of baseline daily temperature and precipitation data for arid, semi-arid and dry sub-humid areas. She then discussed future trends in the frequency of extreme events, based on an ensemble of general circulation models or on regional climate models. She presented a number of case studies to explore the impacts of individual events on land degradation and decadal scale temporal and spatial variability.

3.7 After Dr Clarke's presentation, Dr Tengberg asked if effects observed in the southern Europe Mediterranean area also occur in North Africa. Dr Clarke responded that effects could extend to areas across the Mediterranean, thus it was important to look at broader scales of the impacts.

3.8 Dr Sidle commented that landslides and debris flows do not always occur during the same rain events. Shallow landslides are triggered during major rain events with high total precipitation and/or high intensity bursts of rain usually preceded by wet conditions. On the other hand, some debris flows are triggered during only moderate storms after the accumulation of substantial sediment in channels. Thus probability of shallow landslides can be assessed stochastically based on rainfall probability, while debris flow may be more complex to predict as they require knowledge of channel/infilling. Further discussion noted that impacts such as past and current land use may have strong impacts on the probability of landslides to occur.

3.9 Roy Novelli asked what is the confounding impact of land condition on the capacity to predict the impact of extreme events. He added that would the land condition not have an impact in defining if a specific event was on "extreme event"? Dr Clarke responded that this linkage is particularly important in the land degradation – climate nexus.

3.10 Dr Matari, Tanzania Meteorological Agency, gave the third presentation of the session entitled "Effects of Some Meteorological Parameters on Land Degradation in Tanzania." He discussed the impact of some meteorological parameters to land degradation in Tanzania. Rainfall is responsible for floods when in excess and drought in case of deficit. He mentioned that in recent years portions of Tanzania have experienced recurring droughts with the most devastating occurring during 1983-1984 and 1993-1994. He described the areas where droughts and floods most frequently occur in Tanzania and their impacts. He then discussed the impact of El Niño rains, the probability of rainfall exceeding specific thresholds, wind erosion, solar radiation, temperature and evaporation, climate change on Tanzania and its impact to land degradation. He concluded that the use of climate information must be applied in developing sustainable practices as climatic variations contribute to land degradation and there is a clear

need to consider carefully how climate induces and influences land degradation. The paper recommends that there is a need to: make an inventory of national land resources; assess potentials and constraints in dryland farming, identify agricultural options to safely increase cropping intensity and yields, adopt more sustainable forms of land use, encourage pastoralists to reduce their herds of stocks and encourage the use of indigenous knowledge in land preservation.

3.11 After Dr Matari's presentation, Mr Badripour asked if there are any policies in place that would encourage pastoralists in Tanzania to reduce livestock numbers especially in times of drought? He commented that this would be quite a challenge especially considering that livestock is their only source for livelihood support. Dr Matari replied that a major challenge is to provide pastoralists with livelihood support and safety nets in times of drought. Re-stocking after drought is a particular handicap for people who do not have cash savings for re-investment. Overall there are efforts in Tanzania to improve pastoral farming systems to become more adaptive and responsive to climatic and natural resource conditions.

3.12 Dr Stroosnijder, Wageningen University, Netherlands, gave the fourth presentation of the session entitled "Land Degradation and Rainfall." He first discussed the complexity of the term 'land' and the many different definitions of land and land degradation. Desertification, soil degradation, erosion are components of land degradation. He then discussed the pessimistic literature that claims land degradation is very serious based on remote sensing, GIS and computer models and conversely many papers that question how serious is the problem of land degradation. He stated that there are four spatial-temporal scales that should be distinguished in a discussion on land degradation: the regional, watershed, field and point scale. He continued to mention that the common assessment of land degradation may be overestimating the phenomenon due to different spatial and temporal dimensions of land degradation. Due to these different scales, it is necessary to study rainfall at these multiple scales in regards to land degradation. He then gave examples for using rainfall data and their interpretation with respect to land degradation at these different scales. He described the various processes of the infiltration water balance and its relation to green water that is defined as the rainfall that is stored in the soil and available to plants. He gave an overview of the Green Water Use Efficiency (GWUE) that is defined as the ratio of transpiration over precipitation. He stressed that land degradation mitigation concepts are derived from the rainwater balance. He concluded by stating several conclusions and 10 recommendations to improve the understanding of land degradation through improved rainfall data availability at multiple scales.

3.13 After Dr Stroosnijder's presentation, Ndegwa Ndiang'ui commented that the observation made by the presenter that land degradation is proven to occur at local scales and not proven to occur at higher scales does not conform to scientific logic, and contradicts ecological processes observed in dryland areas. He said that land degradation processes take place as a mosaic, where localized degraded spots are dispersed and not continuous, but taken together, many disaggregated degraded spots would add up to what is observable as degraded land even on higher scales. Dr Stroosnijder replied that the local level processes are not yet fully understood, however overall there is an understanding that drylands are actually more resilient to degradation than previously thought. He added that the aggregation of mosaic level information to higher scales may not give a proper reflection of the extent of degradation and that measures should be made at the appropriate scale.

3.14 Dr Novelly asked if the reversal of land degradation does not necessarily mean a return to the same state. He also asked what was the cause of this reversal and was it simply a change in rainfall or was there also the removal of another stress, for example, overgrazing. Dr Stroosnijder responded that there is evidence that plant species that were believed to have gone locally extinct or reduced, fully recovered after sufficiently good rainfall periods.

3.15 Dr Matari asked if Dr Stroosnijder took into account the impact of potential short-term rainfall cycles versus long-term changes/decline of rainfall linked to land degradation impacts. Dr Stroosnijder replied that this notion places the issue of dryland degradation into an important temporal context on natural variation.

3.16 There were further questions that addressed the potential impact of slow occurring and long-term degradation effects, which cannot be readily assessed at certain time scales and how could they be taken into account.

3.17 Dr Tilya, Tanzania Meteorological Agency, gave the fifth presentation of the session entitled "Frequency of Wet and Dry Spells in Tanzania." He gave an overview of the method of study where 41 years of daily data from 1960-2000 were used to investigate the spatial and temporal distribution of wet and dry spells during the rainfall seasons of Tanzania based the threshold of 1.0 mm of daily rainfall events. He stated that the observed frequency of wet and dry spells during the rainfall seasons showed that at both bimodal and unimodal locations the frequency of occurrence of one-day wet and dry spell was highest at all locations then reduced smoothly as the length of the season progressed.

3.18 After Dr Tilya's presentation, Dr Sivakumar asked that given the importance of the presented information, to which extent should this information be communicated to the community level. Dr Tilya replied that he agreed that the communication of climate and weather data to the end user is very important and that there are a number of mechanisms in Tanzania to communicate such information. Dr Stroosnijder asked what was the scientific justification for the threshold of 1 mm in the definition of a "wet" day. Dr Tilya replied that the measure of a "wet" day is an internationally set standard.

3.19 Dr Henry, Queensland Department of Natural Resources and Water, Australia, gave the sixth presentation of the session entitled "Climate Variability, Climate Change and Land Degradation." She stated that climate and management have major impacts on natural resources and agricultural production and that effective response by government and individuals to the risk of land degradation requires an understanding of regional climate variability and climate change. She discussed several approaches to provide climate information to support better management of the risk of land degradation. She described the situation of the domestic livestock grazing in Australia and that much of this area has high natural climate variability associated with the El Niño-Southern Oscillation (ENSO). She described the AussieGRASS process model developed by the Queensland Department of Natural Resources and Water that is an operational spatial modelling framework which provides data and map products in near-real time, and for historical periods and the next season and has been extensively calibrated and validated. She stated that based on historical information over the past hundred years, some recommendations can be made for more sustainable grazing land management that take into account the impacts of climate on

characteristics such as carrying capacity. She added that better climate risk management requires improved understanding of climate systems and the drivers of variability and change. She concluded that further research is needed in areas such as improving rainfall outlooks using Pacific sea surface temperatures; the atmospheric feedback of low soil moisture in prolonging drought conditions; and the importance of greenhouse gases, natural variability, and other factors in understanding trends in rainfall and providing improved projections for climate impact studies.

3.20 After Dr Henry's presentation, Dr Stroosnijder asked if she excluded the possibility that long-term productivity can recover completely in case of a sequence of wet years as in the example she showed. Dr Henry responded that due to long-term lifecycles of certain plants it is difficult to say if long-term productivity would be impaired, however there are indications that rangeland productivity has declined in certain areas.

3.21 Mr Badripour from Iran commented on the issue that the circumstances involving land degradation caused by overgrazing are very different in different countries. He discussed the comparison between Iran and Australia and the policy instruments that aid farmers. He stated that there is a need to acknowledge the diverse different and specifically targeted strategies and actions, depending on the socio-economic and environmental conditions. Dr Henry replied that it was important to note that in Australia there is a trend to have policy guidance that aims to encourage the farmer to take positive actions. Other discussions pertained to changes in temperature and rainfall due to climate change in Australia and the impact of forest fires and droughts to land degradation in Australia.

3.22 Dr Dube, University of Botswana, Botswana, gave the seventh presentation of the session entitled "Fire Weather and Land Degradation." She started her presentation by stating that in recent years we have witnessed a global increase in more intense, widespread and frequent fires that threaten human security and ecosystems and contribute to greenhouse gas emissions which can result in climate change with feedbacks on both fire patterns and land degradation. She added that there is a complex interplay between fire weather-risk and land degradation and then discussed several nonlinear interactions that influence trends in both fire patterns and land degradation processes. She stated that the majority of fires are started by humans but the human influence on fire patterns is closely related to fire weather. She stated that weather conditions are the main factor of fire readiness and that observations in different regions already link more intense fires over the past decade to climate change that generates hotter and drier summer weather. She discussed the issue and concern about the competition of invasive highly flammable herbaceous species between native vegetation and that an increase of these invasive species would put the landscape under a perpetual cycle of increased susceptibility to land degradation and fire. She concluded that future land degradation studies need to put greater emphasis on the role of fire weather for a better assessment of burning conditions and interaction with land degradation processes.

3.23 After Dr Dube's presentation Dr Imaita from Kenya asked Dr Dube what methods communities use to control forest fires. She responded that the communities hold the key in fire management. Outreach programmes are needed and are being implemented; and that local communities usually have their own fire management regimes that are not compatible with the recommended expert systems. Solutions ought to be sought to devise the most effective methods. She described the situation of the

southern African Fire Network (SAFNET). She added that climate change impacts such as bush encroachment may not be so much related to changes in rainfall regimes, but rather to changes in atmospheric CO_2 levels.

3.24 Additional questions from participants focused on the combined effect of fire weather and climate change impacts, the operational aspects of the southern African Fire Network and the comparison of the two major El Niño events in relation to fire impact.

3.25 Dr Inbar, University of Haifa, Israel, gave the eighth presentation of the session entitled "Importance of Drought Information in Monitoring and Assessing Land Degradation." He began his presentation by stating that drought is one of the most common and severe natural disasters and the cause of most of the economic damage from natural disasters. He continued to state that global population growth has intensified the pressure on water resources and increased the vulnerability to drought and that prolonged drought cycles are a major factor in land degradation processes. He mentioned research which indicates the drought frequency in Israel as three consecutive dry years for every 50 years period and that the recent drought of 1998-2001 in northern Israel was the most extreme during the last 130 years. He described the various factors such as land-use changes, flow diversion, and the increased use of urban treated wastewater for irrigation as having exacerbated the negative impact of droughts and caused land degradation. He mentioned that various solutions have been applied: drip irrigation, recycling of wastewater, reduced allocations and increased pricing of water supplies, desalinization plants. In his conclusion, he stated that the failure by successive governments to introduce drought contingency planning and sustainable management of water resources has already damaged agriculture and nature conservation.

3.26 After Dr Inbar's presentation, Dr Matari of Tanzania asked Dr Inbar if drip irrigation schemes are economically viable. Dr Inbar replied that drip irrigation is known to be very effective, in financial terms as well as conserving water. This method is widely applied in dryland production systems around the world, but an important consideration is the appropriate crops which can be cultivated in various areas. Dr Msangi from Namibia asked how sustainable are the agricultural activities in Israel. Dr Inbar responded that in relation to drought impact and overall sustainability there are no clear answers, however Israel will have to depend largely on desalination of sea water for its water requirements in the future.

3.27 Dr Tengberg, UNEP, Kenya, gave the last presentation of the session entitled "Analysis of the Agriculture-Environment Nexus." She stated that this paper draws on 10 years of Global Environment Facility (GEF) and UNEP experience in working at the environment-agriculture nexus. The relationship between agriculture and environment could be viewed as conflicting (win-lose) or as synergistic (win-win). She mentioned that one central goal of the UNEP/GEF is to mainstream sustainable land management into sectors such as agriculture and forestry, thus assuming that win-win situations are possible. She gave an overview of how the relationship between agriculture and environment can be analysed using different models and approaches depending on the scale and level of analysis. The People, Land Management and Environmental Change Project (PLEC) model is useful at the local level in reconciling environmental and livelihood goals. The Land Use Change, Impacts and Dynamics Project (LUCID) developed a model on how to use land-use change analysis in combination with social and

economic variables as a tool to assess biodiversity loss and land degradation across landscapes. The ecosystem services approach by the Millennium Ecosystem Assessment (MA) provides a tool for decision-makers at national level to make informed decisions about trade-offs between agriculture/human well-being and the environment. Finally, the Land Degradation Assessment in Drylands (LADA) project will use the Driving Forces-Pressures-State-Impact-Responses (DPSIR) framework for integration of information collected at different scales, from the local to the global.

3.28 After Dr Tengberg's presentation, Dr Zeidler from Namibia asked that since the MA has been finalized are there any further follow-up activities planned to ensure that the products are being used and applied more widely. Dr Tengberg replied that there are a number of follow-up activities currently planned on the MA. It is important to note that the MA was undertaken especially to feed into the processes of various international conventions including the UNCCD, and findings and recommendations will be considered by the respective Conferences of the Parties to the Conventions (COPs) and other relevant bodies. Mr Badripour asked how do we ensure that outcomes of pilot projects going through the UN system can be used elsewhere in different regions and countries.

3.29 Ms Edwards from Ethiopia asked if pastoralists are actually involved in the LADA project. And how participatory is the assessment. Dr Tengberg responded that LADA is a multi-scale assessment and that consultations with farmers and pastoralists are relevant to the local scale context and are planned on a pilot study basis. As regards to turning the focus from the environment to agriculture this could be done, but it is important to retain the environment focus and emphasis.

3.30 Dr Safriel commented that instead of "environmentally friendly agriculture" he would propose to turn this around to an "agriculture friendly environment".

3.31 At the end of the session, all of the presenters participated in a general panel discussion with the participants on the topic of the session. The first question focused on what should we worry about: extreme events or year to year fluctuations in land management? The presenters stated that we need to worry about both, especially in areas with naturally highly variable climates, it is equally important to address the year to year fluctuation, as it is important to deal with extreme events. In both cases, it is the knowledge of the end user and land manager that determines how well management decisions react to the specific climatic conditions. Therefore, there is a real need to help farmers to be prepared in dealing with climatic variations. It must be acknowledged that extreme events place extra stress on ecosystems and pose additional challenges to adequate response actions, which reduce land degradation impacts. It is recognized that in some environments extreme events will have the greatest and most visible impacts, however the chronic ongoing processes need to be appreciated.

3.32 The second question of general discussion was if ecological security has a bearing on all of these effects and what is the relation, if any, with human pressure? The discussion focused on the issue that human impacts are often exacerbated due to increased population pressures, often leading to land use change and intensification, therefore the notion of ecological security should be linked to development. Incentives for the development of alternative land uses as well as sustainable land management practices can help curb land degradation, and win-win situations for farmers as well as the environment can be

achieved. Some examples on incentive setting were given for Australia. It was noted that, especially for developing countries, it is global policies that currently set disincentives or even prevent sustainable land management in developing countries. An example was given of fence cutting across southern Africa on the request of EU regulations that has led to increased land degradation, impaired land management due to reduced land access and mobility, and provided disincentives/prohibition for livestock product sales. It is important to change large systems such as international agricultural policies that currently disadvantage developing countries in order to seriously address land degradation and drought.

3.33 The third question of general discussion was despite the existence of UNCCD for more than a decade, what real improvements can be noted. A number of presenters noted that in those countries with National Action Programmes and relatively good financial and other support, some good progress can be demonstrated. It is important to highlight the good responses developed and implemented in certain countries. Some presenters also noted that land degradation has to be addressed in the long-term investments into reducing land degradation and that preparing farmers and land managers for adaptive and sustainable management, especially under difficult climatic conditions is essential.

3.34 The fourth question of the discussion was in relation to the assertions made by Dr Stroosnijder on the lack of evidence of land degradation at certain scales is alarming, therefore, are new definitions needed to better understand and agree on the thresholds and how do we differentiate impacts? There was no strong agreement among the presenters on this assertion. It was stated that land degradation and desertification are often observed at a local level. The responsibility of scientists to provide a balanced view on the extent, impact and threat of land degradation on the local level and higher aggregated levels was highlighted. We have to think about which messages we want/should formulate and propagate to achieve more sustainable land management and development.

3.35 The fifth question of the discussion was in reference to the issue that geomorphological baseline conditions determine the vulnerability of soils to degradation and certain soil systems are more or less resilient. The question was do we need to determine risk/hot spot areas. The response was that in principle it is useful to identify risk/hotspot areas (both in terms of climate and land degradation risk) so that targeted support actions can be carried out in such areas. However, it is recognized that not only biophysical risks will determine the impact but also socio-economic factors as well as past and current land uses and management practices. There is extremely high variability in local conditions and one needs to keep the diversity of conditions in mind and continue to develop and apply specific and targeted responses. Land use and human impact have led to large-scale habitat transformations worldwide. We have to accept that such systems and requirements continuously change, thus we need to continuously adapt our management practices accordingly. The Millennium Ecosystem Assessment (MA) framework on ecosystem services is useful in this context and the UNCCD should apply an ecosystem approach in the broadest sense to its work.

3.36 The last question of the general discussion of this session was the issue of missing human and socio-economic issues in analyses. The question was due to the issue of poverty, how do we address vulnerability and how can the communication of science understanding help reduce vulnerability. The presenters replied that poverty should be addressed systematically as it is a key driver as well as outcome

of drought, potentially climate change, and land degradation. It was recognized that the deliberations of the workshop need to take a stronger socio-economic and development outlook. Considering that globally a majority of people are subsistence farmers, often poor, who inhabit large land areas, the empowerment of local farmers needs to be a key focus of climate and land degradation work.

3.37 The rapporteur of session three, Dr Zeidler, provided the following recommendations for the session under three themes: climate - land degradation linkages; monitoring and assessment; information and its application.

3.38 For the first theme of climate – land degradation linkages, there are clear inter-linkages between climate and land degradation and the provision and integration of climate and weather data in land degradation assessment and management is important. It is as important to address (natural) year to year climatic variability as it is to address extreme events in the climate – land degradation context, as both may impact significantly on land condition both in the short and long term. A special consideration may need to be placed on climate – land degradation effects on fire weather; fires and the management thereof can be an important tool in support of more sustainable land management.

3.39 For the second theme of monitoring and assessment, the following points were listed:

- Monitoring and assessment are important to provide relevant information and generate knowledge and understanding on climate and land degradation and the linkages between both;
- The MA applied ecosystem services framework provides a useful context for land degradation assessments, also including climate and weather information. An ecosystem approach in the broadest sense should form a foundation for assessment work;
- The identification of risk areas and hotspots is useful to guide targeted priority actions and responses;
- It is important to integrate socio-economic elements in risk analysis; additionally vulnerability assessments (providing information e.g. on the local coping capacities in a risk area) need to be carried out to allow for appropriate responses;
- Currently climate (& land degradation) information and data sources are inadequate in most areas of the world and the establishment of a better network of observatories should be promoted and supported especially in developing countries;
- After decades of assessing land degradation there is no unifying view of the extent, threat and full impacts of land degradation. Recent assessment results on the global scale do not necessarily reflect local scale realities. Because of these discrepancies – and uncertainties - it is important to communicate the information resulting from these assessments in the most responsible manner – and in light of intended best responses.

3.40 For the third theme of information and it's applications, information, knowledge and understanding have to be systematically and adequately communicated to the relevant key users. This may include higher level decision makers in service organizations and reach to the level of the individual land manager and farmer. There is the assertion that a wealth of relevant information exists that could and should be applied in land management decision making, however it is usually not readily accessible to the

land manager. Acknowledging the different communication needs of land managers around the world a strong emphasis and effort has to be placed on devising appropriate communication strategies and how to implement them. Based on assessment information it is essential to recommend best responses and place emphasis on implementing them. It was observed that the development of incentive measures, and the removal of perverse incentives, will be an appropriate tool for reaching more satisfactory implementation levels and impacts. It is especially recognized that perverse incentives are often international in extent and have to be addressed in a multi-lateral context.

4.0 Session 4: Strategies For More Efficient Use of Weather and Climate Information and Applications for Reducing Land Degradation

4.1 Dr. Blujdea was the chair of this session. Mr. Matari was the rapporteur and he summarized the session's deliberations.

4.2 Dr Sidle, Kyoto University, Japan, gave the first presentation of the session entitled "Using Weather and Climate Information for Landslide Prevention and Mitigation." He stated that landslides are normally initiated by heavy rainfall for a short period and that landslides are mainly common on steep slopes. He also mentioned that antecedent soil moisture greatly affects the stability of slopes during individual rainfall events. He listed and briefly discussed four available methods for linking available weather and climate information to landslide formation such as the following: simple rainfall – landslide relationships; real-time warning systems; multi-factor empirical assessment methods; and distributed, physically-based models. He added that most available methods do not differentiate among the various landslide types, and therefore different climatic triggering responses or thresholds are needed. He then stated that both models and empirical approaches are needed to assess deep landslides and related hazards and that linking real-time climate data with physically-based landslide models may prove beneficial for assessments in high risk areas. He mentioned the limitations of the study on landslides as lumping all landslides in the study together and the lack of assessment detail. He noted that there is a need to use all proper tools to address all physical and land management processes.

4.3 After Dr Sidle's presentation, Dr Clarke asked that instead of using a two-day antecedent moisture value for the wet and dry threshold for initiating landslides would using a 30 days antecedent moisture value significantly affect the threshold relationship. Dr Sidle replied that it would not significantly change.

4.4 Dr Muthui, UNDP, South Africa, gave the second presentation of the session entitled "GEF – UNDP Adaptation." She gave an overview of the UNDP approach to adaptation with regards to the UNDP Adaptation Fund and projects. The goals of this fund are to develop pilot or demonstration projects to integrate adaptation into national policy, meet global environmental objectives and have development benefits, and provide resources to include adaptation within climate change, biodiversity, international waters and land degradation projects. She described the four phases of the UNDP-GEF adaptation strategy as the following: the methodological development, improvement, and dissemination phase, the regional assessment phase, national assessment phase, and the implementation phase. She then

provided details on the Adaptation Policy Framework (APF) and the climate risks associated with the various Millennium Development Goals. She stated that under this framework, UNDP-GEF has full or medium-size projects in 43 countries around the world. She listed the distribution of UNDP-GEF projects in the following themes: water management, agriculture, health, coastal zones, disaster risk management, and community-based adaptation. She then gave some examples of the projects. She concluded by stating that some of the key issues of these adaptation projects are that they must be clearly related to climate change, must differentiate between short and long term and matching funds, must link to national priorities and programmes, must have a clear learning component, the monitoring of outcomes must be explicit, and the APF must be used in the project design.

4.5 After Dr Muthui's presentation, questions and discussions focused on whether farmers have gained from the programme, what is the programme framework in order to avoid duplication of work, what kind of partnerships exist, and if there is an extension of this programme to other parts of the world.

4.6 Dr Zeidler, Integrated Environmental Consultants Namibia (IECN), Namibia, gave the third presentation of the session entitled "Drought Hazard and Land Degradation Management in the Drylands of Southern Africa." She began her presentation by stating that there are several positive case studies and best practices occurring in southern Africa in terms of drought hazard and land degradation management. She described the recent findings of the Southern African Millennium Assessment (SAFMA) that suggests links between ecosystem degradation and declining well-being and that this is likely to be a two-way pathway. She then talked about climate and land degradation linkages between water scarcity, food insecurity, potential health impacts, less income, and potential land/resource degradation. She emphasized three drought impact and land degradation management responses as local level responses, early warning systems (EWS), and policy instruments. She listed some examples of local level responses as adaptive resource management, water harvesting/conservation techniques, soil improvement techniques, and promotion of local/ traditional varieties. She stated that EWS are important because they allow farmers and producers to prepare, react, and adjust to seasonal fluctuations and can alert decision makers to prepare for emergencies. She noted the need for weather forecasts from main African weather centres. She described the key challenges that remain for farmers in applying the forecasts, regional and national institutions, and policy instruments. She concluded that actions are most direly needed at the local level of the natural resource user/farmer and that outreach to these levels remain true challenges, that capacity bottlenecks at the country level need to be urgently addressed, severe impacts of HIV/AIDS have had negative effects, and more support to local and national level actions are required.

4.7 After Dr Zeidler's presentation, the questions and discussions focused on the effect of land degradation in Southern Africa and dependency on food aid, especially in the Horn of Africa. Mr. Badripour stated that a segment of a drought management plan especially for the poor countries is government assistance and most arid countries have two kinds of pastoralists: commercial and common property pastoralists. During a drought, most countries usually pay a certain amount of money to commercial farmers to decrease the number of livestock on rangeland. However, this can create a problem in which commercial farmers can get more subsidy than the common property pastoralists.

4.8 Dr Garanganga, Southern Africa Development Community (SADC) Drought Monitoring Center, Zimbabwe, gave the fourth presentation of the session entitled "Drought Monitoring for SADC Countries." He gave an overview of role of SADC institutions in drought montioring. He stated that the SADC centre serves 14 countries with a population of 220 million. He addressed the issue of recurrent droughts in the region and their impacts, the impact of weather and epidemiology in the region, and socio-economic issues. He explained in detail about the products which can be obtained from the Drought Monitoring Centre (DMC) and their usefulness to the region. The products provided by the centre include forecasts for decadal, annual, monthly rainfall and temperature patterns. He then described the various training activities that the centre conducts in all member states and he mentioned the good partnerships with other sectors and the user community. He also talked about the impact of El-Niño and La-Niña to the region. He concluded by stating that some challenges in drought monitoring are on data flow and capacity building.

4.9 After Dr Garanganga's presentation, Mr Badripour asked about the linkages between the DMC and the various governments and whether governments make drought declarations with this drought monitoring information.

4.10 Dr Franzleubbers, United States Department of Agriculture–Agricultural Research Service, Georgia, USA, gave the fifth presentation of the session entitled "Carbon Sequestration and Land Degradation." His presentation described carbon sequestration concepts and rationale, relevant management approaches to avoid land degradation and foster carbon sequestration, and a summary of research quantifying soil carbon sequestration. He began his presentation by stressing the importance of greenhouse gases and the need to reduce fossil fuel use. He stated that because of these concerns, there is a need to retain CO_2 in plant material. He then listed several recommended management practices such as planting crops which consume CO_2, good tillage practices, using less organic fertilizers, using less intensive tillage, planting trees, rotation of cropland and grasslands, using green manure cropping systems, and using animal manure to increase yields. He then gave examples of research quantifying soil carbon sequestration rates with these practices. He noted the gaps in knowledge and stated that strategies to sequester soil carbon will restore degraded land and avoid further degradation.

4.11 After Dr Franzleubbers's presentation, Dr Zdruli stated that in order to calculate carbon stocks**,** good and reliable soil data such as bulk density are needed. Dr Zdruli asked that if these data are not available, how this problem could be resolved. Dr Franzleubbers replied that this is an important point and actual soil bulk density data is indeed very hard to found in many countries but there are estimation methods that can be employed to derive bulk density from other soil parameters.

4.12 Dr Sessay, UNEP-GEF, Kenya, gave the sixth presentation of the session entitled "Sustainable Land Management through Soil Organic Carbon Management and Sequestration: The GEFSOC Modeling System." He began his presentation by noting that carbon determines soil structure and water holding capacity. He stated that there is a need to adhere to the Kyoto Protocol on the removal of CO_2 from the atmosphere. He noted that soil organic carbon is sensitive to changes in land use. He mentioned that researchers should use the IPCC inventory. He stated that there is a need to use a statistical approach to address some of the problems, to document soil organic carbon by drawing appropriate maps, to

improve national assessment methodologies, and for specific research objectives. He finally concluded that there is need for a transferable system, to quantify current soil organic soil organic carbon and to analyze the impacts.

4.13 After Dr Sessay's presentation, the questions and discussions dealt with the use of good data for soil organic carbon determination, the use of the IPCC method in determine SOC, the issue of using charcoal, and the issue of modeling that includes the impact of fire and the contribution of charcoal in the soil profile.

4.14 Dr Adosi, Tanzania Meteorological Agency, gave the seventh presentation of the session entitled "Seasonal Variation of Carbon Dioxide, Rainfall and NDVI and their Association to Land Degradation in Tanzania." She stated that there has been recent concern over extreme weather events like droughts and floods that can be linked to climate change. She mentioned the observed and modeling studies that link increased CO_2 and possible climate change and while studies on global scale show significant increase in CO_2 resulting to global warming, few regional studies have been carried out to demonstrate changes at regional level. She stated that this study examined the trends and variability of CO_2, rainfall and NDVI over Tanzania to find out their association on land degradation. She described the global CO_2 distribution with maximums occurring in March and December and minimum values in January and May that is associated with annual cycle of vegetation cover. She stated that NDVI and rainfall have been decreasing around most of the country and that decreased rainfall results in decreased vegetation**,** and that without vegetation cover, land is exposed to degradation. She also gave an overview of the reduction of glaciers on Mount Kilimanjaro. Her main conclusion was that the increase of CO_2 will increase land degradation due to increases in frequency and intensity of severe weather and extreme climatic events (floods and droughts). She gave the following recommendations: plant trees to reduce land degradation, affordable energy sources should be sought to reduce the destruction of forests, and the need to institute proper land use plans.

4.15 After Dr Adosi's presentation, Dr Sidle asked if the depletion of glaciers on Mount Kilimanjaro was directly caused by climate change and the association to land degradation.

4.16 Dr Hamdi El Bagouri, Desert Research Center, Egypt, gave the last presentation of the session entitled "Strategies for Land Degradation Control." He stated that the main causes of land degradation are the following: overgrazing; cultivation in marginal lands; the removal of plant cover; over exploitation of irrigated arid land; deforestation; conflicts and wars; and sand encroachment. He mentioned that to combat land degradation there is a need to introduce sectoral systems, avoid duplication of activities, elaborate thematic data bases, identify potential change, and examine climate change impacts. He then described the loss of wet lands and loss of Nile water with time. He concluded by stating that there is need for technology transfer, and compilation and data processing.

4.17 At the end of the fourth session, all of the presenters participated in a panel discussion with the participants on the topic of the session. The first question dealt with a CGIAR program called "Challenge Program for water and Food" (CPWF)" that has 16 pilot areas around the world and how can factors contributing to land degradation be integrated in that pilot project. The panelists responded that scientists

need work in groups, provide tools to the community to work against land degradation, and obtain weather and climate information from national meteorological services.

4.18 The second panel discussion question focused on how to obtain reliable land degradation information from users. The panelists replied that it is important that in attempting to address the problem of land degradation governments don't impose a very large number of reporting monitoring and permit application requirements on land managers (farmers and grazers). It is unreasonable to expect individual farmers and grazers to undertake a large amount of administrative paperwork. They also noted that time should not be spent filling out forms, but solving land degradation problems.

4.19 The last panel discussion question focused on how carbon sequestration is considered in international agreements. The panelists responded that under current rules as agreed in the Marrakech Accords and Kyoto Protocol, soil carbon sequestration could be counted only for afforestation or reforestation projects. Currently, soil carbon gains as a result of changes in grazing or cropping practices would not apply in Clean Development Mechanism. They stressed that this does not diminish the value of carbon sequestration projects and their contribution to total environmental benefits or to future carbon trading or greenhouse abatement.

5.0 Session 5: Case Studies on Successful Measures to Manage Land Use, Protect Land and Mitigate Land Degradation

5.1 Dr. Muthui was the chair of this session. Ms. Adosi was the rapporteur and she summarized the session's deliberations.

5.2 Dr Paupiah, UNDP/GEF/Medium Size Project/Sustainable Land Management Project, Mauritius, gave the first presentation of the session entitled "Adaptation by Small Island Developing States and Sustainable Land Management: The Case of Mauritius." He began his presentation by giving an overview of Mauritius which is one of the most densely populated countries of the world due to its small size and a relatively large population. He added that land is a very scarce resource and mismanagement of land resources in the past has led to severe land degradation. He described several initiatives Mauritius has taken to address this issue in the context of the UNCCD. He then talked about the effects of climate change, climate variability and sea level rise that will further exacerbate current land degradation. He mentioned recent observations and studies over the past 30 years carried out by the National Meteorological Services confirm that there is an increase temperature and cyclone intensity. He stated that the effects of extreme weather events are already seen in certain areas in the form of receding shorelines, landslides, sheet and gulley erosion. Mauritius has developed a Climate Change Action Plan and the agriculture, forestry, livestock, and housing sectors are developing mitigation measures to minimize the effects of extreme weather conditions associated with climate change. He mentioned some adaptation measures such as research and creation of database, mainstreaming of climate change and sustainable land management concerns into policy and regulatory frameworks, capacity building, and field level interventions.

5.3 Dr Blujdea, Forest Research and Management Institute Bucharest, Romania, (and current Chair of the UNCCD Committee on Science and Technology) gave the second presentation of the session entitled "Environmental and Financial Synergy on Afforestation of Degraded Lands – a Case Study." He began his presentation by describing the issues of the unproductive and marginal lands at the local, regional and national levels in Romania. He stated that from scientific, technological and practical points of view there are solutions to these issues, and he cited the lack of major financing that makes it difficult to implement them on a large scale. He added that the lack of an integrated land use framework hampers balancing land use and thus subsequent benefits. He mentioned that in Romania, rural society needs to be reinvigorated by returning to local cultural traditions and values**,** but also through environmental tools offered by national and international political frameworks. He highlighted the establishment of the United Nations Framework Convention for Climate Change and the Kyoto Protocol in regards to development of the CO_2 emissions trading schemes. He stated that emissions reduction marketing acts as an incentive for national resource mobilization and offers multiple opportunities for land use improvement. He mentioned that in Romania the forestry sector already has a comprehensive database on the forest and wood features that would facilitate greenhouse gas (GHG)national inventory and carbon sequestration projects. He then described the current potential carbon sequestration in Romania. He stated that forestry projects oriented toward carbon sequestration have several multiple risks such as forest fire, increased vulnerability due to illegal cutting, unsustainable management practices and climate change.

5.4 After Dr Blujdea's presentation, questions and discussions focused on which monitoring indicators are important to prove the effectiveness of interventions, which indicators are used for river hydrology and sediment flow, community involvement in afforestation projects, reafforestation incentives and parameters for monitoring biodiversity.

5.5 Dr Zdruli, Mediterranean Agronomic Institute of Bari, Italy, gave the third presentation of the session entitled "The EU-Funded MEDCOASTLAND Thematic Network and its findings in Combating Land Degradation in the Mediterranean Region." He started his presentation by giving an overview of the Mediterranean region in terms of impact of tourism, population growth, and urbanization on the coastal areas and the subsequent land use changes for the last fifty years. He pointed out that the history of land management shows excellent examples of sustainable land use as well man-made catastrophic events. He stated that many North African and Middle Eastern countries are water stressed and have limited suitable land for agriculture. He listed soil erosion by water and wind, salinisation, overgrazing and vegetation degradation, loss of organic matter and biodiversity as the most alarming land degradation factors in the region. He mentioned that the population projections for the Southern Mediterranean are still very high and that addressing the problems of land degradation and desertification should become strategic priorities of national and regional importance. He then described the EC funded MEDCOASTLAND Thematic Network that has partners from 13 Euro-Mediterranean countries with 36 members and three levels of decision-making. The period of the project was from 2002-2006 and results indicate that combating land degradation could be successful if the right balance between bottom-up and top-down management approaches enhance income-generating activities. He concluded by stating that MEDCOASTLAND has promoted many good examples of sustainable land management and rural development through the publications and the Internet.

5.6 After Dr Zdruli's presentation, questions and discussions focused on the effects of decreasing EU agricutlural subsidies on land degradation in the region, the historic shift of populations from rural to urban areas, and the challenge of separating natural processes with human induced effects in regards to land degradation.

5.7 On behalf of Dr Muyungi, his colleague Dr Kafumu, Vice President's Office, Division of Environment, The United Republic of Tanzania, gave the fourth presentation of the session entitled "Managing Land Use, Protecting Land and Mitigating Land Degradation: Tanzania Case Study." Dr Kafumu stated that for Tanzania, efforts to combat desertification and land degradation are part of the national efforts to address poverty and sustainable development. He described many milestones of the government of Tanzania since the 1992 Rio Conference including the most recent National Strategy for Growth and Reduction of Poverty (NSGRP) developed in 2005 that provides a close relationship between reduction of poverty and sustainable agricultural production and energy. He stated that Tanzania has recently adopted a Strategy on Urgent Action to Combat Land Degradation and Conserve Water catchment areas in Tanzania. He then listed some of the challenges on land degradation and water catchment that the strategy identifies: invasion of water sources/catchment areas by herdsmen; illegal human activities related to agriculture and livestock keeping; deforestation and massive tree cutting for firewood, charcoal and house construction in urban areas; unsustainable small and large scale irrigation projects; wild fires; water use by alien and exotic tree species; land use conflicts; and from mining activities. He then made the following conclusions: sustainable land management can be achieved by integrating international and national efforts at different levels (UNCCD, GEF, etc); there should be a renewed commitment from developed countries to support the implementation of the NAP and such strategies through the UNCCD; improved linkages between UNCCD and UNFCC such as sustainable afforestation and reforestation and carbon trading; supporting capacity building; and make efforts towards better land use planning and land reforms.

5.8 After Dr Kafumu's presentation, questions and discussions focused on problems with rewards for people reporting fires, relationships between the country focal points for UNCCD, CBD, UNFCCC, and GEF, and issues related to relocation and resettlement of people living in environmentally fragile areas.

5.9 Dr Fuentes, Caloocan City, Philippines, gave the fifth presentation of the session entitled "Philippine experiences in the implementation of initiatives that address climate change and land degradation." He stated that climate change and land degradation are serious environmental issues for the Philippines given their implications to economic growth. He highlighted the fact that the location and topography of the Philippines make it very susceptible to climatic anomalies. He then listed several causal factors of land degradation. He noted that many coping mechanisms have been developed over the years with regards to drought during dry spells and flooding during monsoon seasons. These capacities are becoming inadequate due to economic growth, population increase, urbanization and changing consumption and production patterns that are combining to create intense pressures on the country's limited resources. He describes the current efforts that are being pursued with regard to Climate Change, Land Degradation and Desertification and, Biodiversity Conventions. He stressed that the role of scientific information particularly the collection, analysis and dissemination of climatological data cannot be understated. He provided some of the following recommendations: policies relating to agriculture, land

use and energy systems need to be integrated with climate change mitigation and adaptation policies; capacity-building continues to be vital; the NAPs should be viewed as critical inputs to the entire development process; debates and activities aimed at the inclusion of the private sector; and investment in infrastructure to reduce future greenhouse gas emissions and arresting land degradation.

5.10 After Dr Fuentes' presentation, questions and discussions focused on the speed of environmental and social recovery from land degradation and the relationship between the perceived trend of increased landslides and deforestation.

5.11 Dr Novelly, Department of Agriculture and Food, Western Australia, gave the sixth presentation of the session entitled "Successful grassland regeneration in a severely degraded catchment: A whole of government approach in North West Australia." His presentation gave an example of the Ord River area in north-western Australia as an example of the regeneration of degraded rangelands. He then gave an overview of the area in regards to climate, vegetation, historical situation, and the rehabilitation program. He stated that the grassland rehabilitation was successful with significant re-establishment of native grass species and that in 2006, the regenerated area was included in Western Australia's conservation estate. He then discussed the five reasons why this program was successful. He gave the first reason as a catalyst for action based on a change of land use that was needed and that without potential financial returns from the irrigation proposal, there would have been limited capacity to initiate the rehabilitation program. Secondly, the state government, not just an individual agency or department, supported the program. The third reason was that control of animals within the rehabilitation area was rigidly enforced. Rainfall was another reason, although this was totally beyond management control. He noted that significant and extended periods of poor rainfall were recorded with rehabilitation stagnating during such periods. Lastly, he mentioned the long time frame of the project that allowed institutional patience to work. He concluded that success in rehabilitation requires more than technical expertise, it requires a strong commitment from Government, a willingness to make hard decisions is important and an initial acceptance that the timeframe of the project will be long.

5.12 After Dr Novelly's presentation, Hossein Badripour from Iran commented that it is not correct to only look at rangelands for the forage they produce, because only 25% of the services produced by rangelands go to forage and the remainder goes to the environmental services which everyone can enjoy, therefore governments should invest in rehabilitation of rangelands. Mr Badripour also commented that there should be other opportunities available to pastoralists to reduce the pressure on rangelands. Dr Muthui commented that successful reseeding provides a good account of payment for ecosystem services to pay for ecosystem restoration. She mentioned that they have tried to apply this concept in Africa and one of the problems was to determine costs of restoration or addressing land degradation. There was then a discussion of the basis for estimating such costs. Other questions and discussions directed to Dr Novellly focused on the affordability of rehabilitation programs and the rainfall trend in the region.

5.13 Dr Msangi, University of Namibia, gave the seventh presentation of the session entitled "Land Degradation Management in Southern Africa." She stated that most people in the region live in rural areas and depend on subsistence agriculture for their livelihoods. In the region, land degradation occurs mostly from soil erosion, chemical degradation (loss of nutrients, depletion of organic matter and

acidification) and biological depletion. She listed other factors which contribute to land degradation in the region which include compaction from overgrazing of rangelands, uncontrolled burning and improper cultivation of steep slopes, alternating flooding and crusting, salinization and pollution. She highlighted the nature and causes of land degradation in the region, linking it to population characteristics, land ownership, low technological capacity, poverty, poor governance, low literacy and inappropriate land management practices. She pointed out that numerous interventions targeted at reducing poverty and improvement in land resource management have not achieved their targets due to lack of coordination, rigidity and imposition which culminated in failure of the interveners to recognize and incorporate indigenous knowledge and peoples' preferences and/or indigenous age-old land management strategies. She listed several recommendations such as adopting "people centered" interventions taking into account access to land, land ownership, land development and management; an increase in training and awareness on land use planning and management, soil fertility and farming systems, appropriate policies and viable practical smart partnerships should be explored and instituted; improved coordination and networking; and realistic planning periods are essential in order to realize and assess expected outputs.

5.14 After Dr Msangi's presentation, Dr Chencho Norbu from Bhutan (and current vice-Chair of the UNCCD CST) commented that problems of land management appear to be the same across Asian, African and Latin American small scale farmers and that there is a need to study the difference between how large and small-scale farmers respond to mitigation incentives provided to them. Other questions and discussions focused on managing land degradation due to mining operations in Tanzania and the budget for land degradation in Southern Africa.

5.15 Dr Torres, National Agricultural University, Peru, gave the eighth presentation of the session entitled "Successful Experiences of Sustainable Land Use in Arid and Semi-arid Zones of Peru." His presentation gave three case studies of successful measures of sustainable use of arid coastal and semi-arid Andean mountain ecosystems in Peru. The first case study that he presented was located in the northern arid coast where agroforestry and herding systems had been promoted and that experienced impacts from 1997-98 El Niño event. The second case study he presented was located in the northern and central Andean mountain ecosystems of Peru that dealt with the agrobiodiversity of the Andean crops and their wild relatives. He stated that in these experiences not only the crop areas and the culture of the traditional farmers had been conserved, but also their natural environment. The third case study that he presented was located on the southern coastal desert of Peru that was inhabited by a peasant community. During the winter seasons (June-October), this community harvested fog water that was used for the reforestation of the high zones for livestock, human consumption, and food crops.

5.16 After Dr Torres' presentation, questions and discussions focused on the impact of the current weak El-Nino event in Peru and long-term water storage in dams or aquifers after El Niño events.

5.17 Ms Edwards, Institute for Sustainable Development, Ethiopia, gave the ninth and last presentation of the session entitled "Role of organic agriculture in preventing and reversing land degradation." She started her presentation by giving an overview of the International Federation of Organic Agriculture Movements (IFOAM) whose goal is the worldwide adoption of ecologically, socially and economically sound systems that are based on the principles of organic agriculture. She defined organic agriculture as a

whole system approach based upon a set of processes resulting in sustainable ecosystems, safe food, good nutrition, animal welfare and social justice. She stated the basic principles of organic farming as encouraging and enhancing biological cycles within the farming system, maintaining and increasing long-term fertility in soils, using renewable resources, and minimizing all forms of pollution. She then stated that an understanding of how to maintain a healthy soil is essential to reverse and prevent land degradation. A healthy soil tends to carry a good plant cover and enables rain water to infiltrate and recharge both soil water and underlying aquifers. She used examples from Africa to demonstrate that it is already contributing to improved land management, food security, and combating poverty. She highlighted the following indicators of sustainability that organic farming can provide: maintaining or increasing agricultural biodiversity, reduced weeds; increased soil moisture retention; better disease and pest resistant crops; composting effects; better economic returns; and better tasting food.

5.18 After Ms Edwards' presentation, questions and discussions focused on the practicability of using organic farming in large scale farming, monitoring changes in soil properties due to organic farming practices, differences in plant responses and economic returns due to organic farming in various climates, and the relationship between pest and disease control and costs associated with organic farming.

5.19 At the end of the fifth session, all of the presenters participated in a panel discussion with the participants on the topic of the session. Dr Sivakumar asked the panel to give their opinion regarding the nature of the successes in the case studies and what they learn from their past experiences and how these experiences could be used to better organize and plan case studies in the future. One participant also commented that given that future adaptation to climate change is important, we need to recognize that the disasters (including land degradation) are occurring in the present so that current adaptation strategies are also important.

6.0 Session 6: Improving Implementation of National Action Programmes (NAPS)

6.1 Mr George Kafumu was the chair of this session. Ms. Hong was the rapporteur and she summarized the deliberations of the session.

6.2 Dr. Alexandrov, National Institute of Meteorology and Hydrology, Sofia, Bulgaria, gave the first presentation of the session entitled "Using Better Climate Prediction in the Implementation of NAPs." He gave an overview of applications of climate predictions from Eastern European countries. He listed the capabilities of certain Eastern European countries in the development of their own seasonal to interannual predictions or adaptation and interpretation of predictions issued by specialized climate prediction centers. He stated that attempts to improve climate predictions in Eastern Europe are typically based on the Northern Atlantic Oscillation. He then discussed various programs, projects and centers related to the development and application of climate predictions for the European region. He mentioned climate change scenarios for Eastern Europe and their relation to the UNCCD and NAPs. He also described the establishment of the Drought Management Center for Southeastern Europe that will serve as an operational centre for southeastern Europe for drought preparedness, monitoring and management.

The center will among other responsibilities also prepare drought monitoring and forecast products and make them available to relevant institutions in participating countries.

6.3 After Dr Alexandrov's presentation, the questions and discussions focused on the accuracy of weather/climate models and their validation methods, major challenges of developing medium to long-range prediction in eastern Europe, and how models take into account human made land use changes.

6.4 Mr. Sinange, Intergovernmental Authority on Development (IGAD), Djibouti, gave a presentation entitled "Improving NAPs Implementation through the Effective Use of Early Warning." He started his presentation by giving a brief overview of land degradation definition and the various processes that lead to reduction of land productivity. He then reviewed the various Early Warning Systems (EWS) at the global, regional, sub-regional, national, and sub-national levels, and mentioned that most of them are focused on food security. He also discussed some of the unique challenges experienced by these EWS such as data quality and reliability, weak institutional set up, poor communication networking, lack of co-ordination, and results and products not released in a timely manner. He described the successes and failures of a sub-regional case study in Eastern Africa. He then discussed the issues of establishing an EWS related to environmental hazards like desertification and this system would be an improvement on the existing food security monitoring system. The parameters and indicators of a desertification early warning system (DEWS) would take into consideration the primary causes, processes, manifestations, and impacts of land degradation. He concluded that EWSs are now delivering fairly well in the eastern African region with more rapid responses with little political interference; information and knowledge is power for timely early warnings and disaster management; and there is a disconnect between data and information sources of the EWSs and information users. He finally added that a minimum number of parameters and data sets necessary for DEWS should be developed to justify the setting up of a DEWS.

6.5 After Mr Sinange's presentation, the questions and discussions focused how EWS can reach out to end-users and how EWSs apply to extreme events.

6.6 Mr. Badripour, Forest, Range and Watershed Management Organization, Islamic Republic of Iran, gave a presentation entitled "The role of drought monitoring & management in improving NAPs implementation - western Asia." He started his presentation by giving an overview of the importance of land degradation to the international community that decided to develop a convention to encourage countries to take measures to control land degradation processes. He also mentioned that since drought is a climatic feature that exacerbates land degradation**,** the mitigation of drought impacts also features in the climate change process. He described the issues of drought in Iran that are similar to other countries in the arid zones. He then talked about drought as the primary focus of NAPs and that in order to control the impacts of drought on land degradation, an integrated management model is needed. He then discussed the various aspects of drought indices, monitoring, and management. He listed the major components of a drought plan as monitoring, early warning, impact assessment, preparedness, response, recovery, and mitigation. He concluded that when efficient drought monitoring and management systems have been established, drought vulnerabilities will be reduced for people and the environment.

6.7 After Mr Badripour's presentation, the questions and discussions focused on the use of high-resolution satellite data in drought monitoring.

6.8 Dr. Beekman, Inter-American Institute for Cooperation on Agriculture (IICA), Brazil, gave a presentation entitled "Implementation of NAPs through Improved Climate Knowledge - Latin America." He first discussed the program to combat desertification in South America that is being implemented at a regional scale and the general objective is to provide a sound basis for addressing dry land degradation and drought. The Central American countries are also willing to engage in the same approach of the program, significantly expanding the basis for south-south and north-south cooperation. He stated that in Latin America, the vast majority of the countries that are signatories to the UNCCD have elaborated their NAPs. He mentioned that a number of them are engaged in the process of having their NAPs fully implemented and guided by national policies targeted to control the continuous land degradation associated either with natural climatic variations or anthropogenic activities. He then discussed the program as having a set of socio-economic and environmental indicators identified in all participating countries and that use a common base line of indicators derived in order to establish a common ground for the simulation of future scenarios. This is particularly of importance regarding the climate indicators that constitute components of the aridity index used to delimit the arid, semi-arid and the dry sub-humid areas. The global warming trend is likely to change the distribution patterns of such indicators and redefine the boundaries. These changes, as predicted by future scenarios, should be taken into account in NAP implementation and be given due consideration in the formulation of public policies towards combating desertification.

6.9 After Dr Beekman's presentation, the questions and discussions focused on the possible need to redefine desertification within UNCCD, the difference between structural mitigation and on-the-ground planning measures, coordination and communication within a country among the various institution that deal with land degradation, and development of a list common indicators for all countries and institutional arrangements for collecting these indicators in the field.

6.10 At the end of the sixth session, all of the presenters participated in a panel discussion with the participants on the topic of the session. The questions and subsequent discussion focused on methodologies for assessing the economic benefits in applying weather and climate information to combat land degradation.

7.0 Conclusions and Recommendations

7.1 Dr. Sivakumar discussed the organization of the working groups and all of the participants were organized into three working groups. Each group was given it's terms of reference. In addition, each group was asked to provide additional recommendations to be added to the workshop draft statement .

7.2 The first working group was chaired by Dr Clarke while Dr. Garanganga was the rapporteur. The following were the terms of reference for this working group:

Current use of weather and climate information for monitoring and assessing land degradation and in developing sustainable land management practices.

- What kind of information is needed and how accessible is this information currently from the information providers eg., NMHSs?
- Where information is available, is it being used optimally? If not, what are the constraints?

7.3 The working group stated there were some useful data and products available, but there were the following constraints to their optimum use: inadequacy of data/info coverage and verification due to poor infrastructure; not readily accessible; inconsistent quality of data/products; weak cooperation between producers and users; weak communication/dissemination strategies; costs attached to data/info impede accessibility; the need for tailor-made products for users; and timeliness of data & products needs to improve.

7.4 The working group listed the following parameters of what is currently available historically and in realtime: precipitation, air and soil temperature, wind, sunshine, derived evaporation, and radiation. For satellite data there are rainfall estimates and NDVI. Then there are climate information and prediction products and customer services.

7.5 The working group noted some approaches for progress such as improved coverage of data, allowing selective cost-recovery of data/product delivery, adopting ISO standards in data and products; improving availability of specialized data (precipitation, temperature, soil moisture and temperature, and evaporation); providing tailor-make products together with users in a timely manner and provide training.

7.6 This working group also noted the need for increased spatial coverage of stations in collaboration with private or agrometeorological networks if possible and ensure timely delivery of information/products, to attain an international standard for data and product quality controlled by WMO, and to facilitate the delivery of products, adequate resources be provided and capacity strengthened. They acknowledged that to provide better**,** access the data and information have to be as accessible as possible for the public good and where necessary package them appropriately for end users, especially those in sustainable land management with the recognition that different users have different data and information needs. They finally noted that institutions developing climate variability and climate change information should be encouraged to examine various scale projections that take into consideration feedbacks between land cover change and land degradation on future precipitation and temperature patterns to aid adaptation and mitigation.

7.7 The second working group was chaired by Dr Sidle while Dr. Montanarella was the rapporteur. The following were the terms of reference for this working group:

Promoting more effective use of weather and climate information for reducing land degradation

- What are the different ways and means to make the use of weather and climate information more effective?

- What are the needs in the area of training and capacity building to make this happen?

7.8 The second working group made the following conclusions on the first question:

- There is a range of stakeholders with a role in land and water management. This diversity must be appreciated in the development of any strategy to address land degradation.

- The wealth of hydro-meteorological data and information in both developing and developed countries is not fully available to local populations and end users for several reasons, including restriction of access by the data holding institutions. Data need to be made freely available to end users.

- The following needs to be differentiated: raw data, summarized data, interpreted information and final integrated assessment of land degradation phenomena.

- Language needs to be tailored to the end users needs.

- More detailed spatial resolution of climate data is needed for area specific assessments. There is the need to maintain the density and quality of the stations, as well as maintenance and operational aspects, of existing networks.

- Networks of stations need to be adjusted to areas that are highly susceptible to land degradation, for example mountainous areas.

- Interpretation of information and integrated land degradation assessments need to be delegated to appropriate institutions and experts with competence in the respective scientific areas.

- Dissemination of information and final products for specialized demand driven applications requires additional training of technology transfer specialists and local staff.

- The important role of WMO in standardizing meteorological data should be continued and enhanced.

- Meteorological and relevant remote sensing data alone are not sufficient. Any integrated assessment of land degradation may need a combination of various data including hydrological information, soil data, socio-economic information, etc.

7.9 The working group made the following recommendations on question 1:

- Detailed, accurate and spatially distributed rainfall intensity data are needed that can be used for surface erosion assessment and modeling, and design of draining structures;
- Historical climate data and climate change scenarios are needed for future strategic planning, agro-climatological zoning and crop pattern scheduling;

- Targeted weather forecasts at all levels are needed at very local scales to help stakeholders make the appropriate decisions;
- Every effort should be made to identify relevant entities outside the WMO structure that operate and maintain networks (National or International) and are in possession of climate information. The release of that information to the interested stakeholders should be pursued.

7.10 The second working group made the following conclusions on the second question:

- Training and capacity building needs to be organized in a proactive way for stakeholders at all levels in order to make the final information useful for the end users and assure long term sustainability of the technology and information transfer process.

- Prior to any training and capacity building initiative there must be a clear identification of needs by the final end users.

- End users must be put in a position to fully understand the implications and value of the information provided.

- The uncertainties and risks of the decision making process need to be reduced and eventually fully explained.

- Every step from raw data collection up to the final integrated assessment needs to be covered by specific training and capacity building activities.

- National Meteorological Services need to be strengthened in their capacities in performing the raw data collection and interpretation tasks as well as improving their visibility in the local and National media. This would assure the very much needed long term sustainability of the National Services concerned.

- Without similar training and capacity building efforts also in other are of competence, like land use planning, soil survey, etc. it will be difficult to have an integrated approach to land degradation assessment and mitigation.

7.11 The third working group was chaired by Dr Inbar while Mr. Torheim was the rapporteur. The following were the terms of reference for this working group:

Weather and climate information to improve the implementation of National Action Programmes (NAPs) of the UNCCD

7.12 The third working group made the following conclusions:

- In some countries, National Meteorological and Hydrological Services (NMHSs) are not currently included as members of bodies responsible for the implementation of NAPs.

- Although climate and weather information is routinely collected, in some cases this information is not accessible to the agencies/departments who are responsible for implementing NAPs.
- Currently, in some of the NAPs, adequate use of climate and weather information is not being made.
- In some countries, lack of adequate trained personnel and weak institutional capacity is recognised as a constraint in the efficient use of climate and weather information.

7.13 The third working group made the following recommendations:

- Weather and climate data should be made available in a timely manner and be synthesized for use in the implementation of NAPs. Hence, it is important to strengthen the capacity of NMHSs in the acquisition, analysis and dissemination of data.
- A Multi-Disciplinary Team (MDT) of data providers and data users for developing early warning systems for drought and desertification should be established at the national level to determine how information would be analysed and packaged for the end users.
- MDTs should take into account local community knowledge to complement scientific expertise.
- Given the current technological advances in the availability of satellite data, greater efforts should be made for the use of these data in the implementation of NAPs.
- Given the current concerns with recurrent droughts and their impacts on local communities, it is important to develop and implement a National Drought Policy (NDP) that supports effective implementation of the NAPs.
- Representatives of NMHSs should be included in the national delegations to the sessions of UNCCD COPs to ensure that the issue of climatic factors in land degradation is effectively addressed.
- NMHSs, in collaboration with agricultural extension services and national coordinating bodies of UNCCD, should provide seminars on weather, climate and land use to farmers to promote implementation of NAPs.

8.0 Plenary and Workshop Closure

8.1 The workshop participants met in plenary to discuss the conclusions and recommendations from the workshop. The participants were asked to make any changes to the draft workshop statement and many points were raised.

8.2 Dr Sivakumar then discussed the publishing of the workshop proceedings. He suggested that the proceedings could be published as a book by Springer. He asked the participants for their concurrence and they agreed. He stated that an agreement had already been finalized with Springer and Dr Sivakumar and Dr Ndiang'ui will edit the book. He stated that the book needs to be published by September 2007 in time for presentation and distribution at COP-8 of the UNCCD to be held in Madrid, Spain in September 2007. To meet this deadline, all authors should prepare their papers by 31 January 2007 and send them to the Dr Sivakumar. Then the editors will edit the papers and correspond with authors for any clarifications

and compile the final version by 30 April 2007 and then the book will be published and be ready by September 2007.

8.3 Dr Sivakumar then discussed the meeting report of the workshop and stated that it will be compiled and finalized by Bob Stefanski. The report will consist of an introduction, session summaries, conclusions and recommendations and the list of participants. Mr Stefanski will compile the draft report in early 2007 and send it to all participants for their comments and suggestions. This report will then be finalized and submitted to the UNCCD Committee on Science and Technology during COP8 in Madrid. The report will also be posted on both the WMO and UNCCD web pages.

8.4 Dr Sivakumar from WMO and then Ndegwa Ndiang'ui from the UNCCD Secretariat gave their vote of thanks to local organizers and to the participants for their hard work. Mr Mohamed Matitu from the Tanzania Meteorological Agency gave a vote of thanks to WMO, UNCCD and the participants.

8.5 Then Mohamed S. Mhita, Director-General, Tanzania Meteorological Agency and Permanent Representative of the United Republic of Tanzania with WMO, expressed his appreciation to WMO and UNCCD, the other co-sponsors and wished the participants a safe trip back to their respective homes, and officially closed the workshop.

Appendix

Workshop Statement

An International Workshop on Climate and Land Degradation organized by the World Meteorological Organization, the United Nations Convention to Combat Desertification (UNCCD) and the Tanzania Meteorological Agency was held in Arusha, Tanzania, from 11 to 15 December 2006. The workshop was co-sponsored by the OPEC Fund for International Development (OFID), the United Nations Development Programme (UNDP) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). The workshop focused on how climate induces and influences land degradation and what measures need to be taken to enhance the applications of weather and climate information to combat land degradation.

Land degradation is a threat to natural resources with consequences on food security, poverty, and environmental and political stability. The workshop noted that trends in land degradation are assessed differently in various parts of the world. The increasing occurrence of climate extremes (for example heat waves, droughts, heavy precipitation) is having an impact on land degradation processes, including floods, mass movements, soil erosion by water and wind and salinization in all parts of the globe. Climate variability, climate change and land degradation are intimately linked and are generating unexpected effects eg., an increased occurrence of fire-weather conditions in large parts of the globe. In combating land degradation, bottom-up and top-down participatory management approaches that foster income generating activities are required.

The workshop recommended that:

1. As the relationship between locally observed land degradation processes and their aggregation at different scales (National, Regional, and Global) requires further exploration of scale transfer methodologies and procedures, it is essential to improve the monitoring of land degradation as well as climate at these scales. Global assessments need to take into account the perceived reality of land degradation by local populations.

2. There is a need to strengthen the knowledge and understanding as well as the functions of ecosystems (thresholds, resilience and dynamic equilibria in order to better understand, predict and value the risks of land degradation and fully understand the complex interrelations between land use and environment.

3. Innovative and adaptive land management responses to inherent climatic variability and natural hazards (droughts, floods, landslides, sand and dust storms, wildland fires etc.) must be identified and implemented for sustainable land management.

4. Land management practices in affected areas, particularly in Africa and other developing countries, should focus on improving the amount of rainfall that is used in biomass production. This can be facilitated by unlimited hydro-meteorological data and increased human and institutional capacity building.

5. The network of climatological, hydrological and agrometeorological stations around the world should be increased and strengthened to provide data on rainfall intensities, soil temperature and soil moisture for land degradation monitoring, assessment and for the implementation of the NAPs. Climatological and hydrological end products should be developed in coordination with end user needs by relevant and competent personnel and institutions.

6. An integrated approach backed up by institutional support and regeneration of affected areas by means of agro-ecological practices and other physical interventions to reduce land degradation. Direct interactions between National Meteorological and Hydrological Services (NMHSs) and the land users can help enhance the direct communication of weather and climate information. There is a need to develop a cost-effective system to communicate early climate forecasts to various stakeholders, in particular to farmers, so that they can improve their land management practices.

7. Given the current concerns with recurrent droughts and their impacts on local communities, it is important to develop and implement a National Drought Policy (NDP) that supports effective implementation of the NAPs.

- - - - -