BOOK OF ABSTRACTS

1. KENYNOTE PAPERS AND LEAD PAPERS (CROSS CUTTING THEMES)

Bio-energy and Development in sub-Saharan Africa: are the politics conductive?

Charles B-L. Jumbe[1], Frederick Msiska[2], Michael Madjera[3]
[1]*Centre for Agricultural Research and Development, Bunda College, Malawi*
[2]*Ministry of Agriculture and Food Security, Malawi*
[3]*Evangelical Church in Middle, Germany*

Abstract: This paper analyses different national, regional and international biofuels policies and strategies to assess how the policies promote or undermine the development of biofuels industry in sub-Saharan Africa (SSA). Despite having a huge comparative advantage in producing energy crops without disturbing the traditional farming systems and the ecosystem, few countries in sub-Saharan Africa have included biofuels strategies in their energy policies or national development frameworks. As developed countries commit huge financial resources for research, technology development and provision of tax-incentives, there is little support for promoting biofuels by SSA governments, which makes biofuels from Africa to be less competitive on international markets. While the consequences of biofuels on food supply remain uncertain, nonetheless, any significant shift in the agriculture landscape in the industrialized world will heavily affect Africa countries. Since the biofuels era is here to stay and as we now live in a global village, national governments in sub-Saharan Africa must face reality, and adjust accordingly in order to survive in the fast changing world. In particular, African governments must develop clear policies and strategies to harness the potential economic opportunities from biofuels development while at the same time protecting the environment and rural communities from large-scale production of energy crops for biofuels at the expense of food crops.
Key words: biofuels, energy policies, sub-Saharan Africa

Main messages of the high level conference FAO High-Level Conference on World Food Security and the Challenges of Climate Change and Bioenergy

Michele Bernardi
Food and Agriculture Organization of the United Nations (FAO), Climate Change and Bioenergy Unit (NRCB), Italy

Abstract: Climate change and bioenergy not only affect food production. They can influence the whole food supply chain and all four dimensions of food security, namely: availability of food from domestic production and imports, access to resources for producing or buying food, stability of food supply, both ecological and macroeconomic, utilization of food, including consumer preferences and safety of water and food.
In order to put agriculture, forestry, fisheries and food security on the international climate change agenda, the Food and Agriculture Organization of the United Nations (FAO), in cooperation with the Consultative Group on International Agricultural Research (CGIAR), the International Fund for Agricultural Development and the World Food Programme (WFP), has organized a High-Level Conference to bring together world leaders, policy makers and experts from many disciplines.
The High-Level Conference on World Food Security: The Challenges of Climate Change and Bioenergy held at FAO Headquarters in Rome, Italy on 3-5 June 2008 discussed the challenges that climate change, bioenergy and soaring food prices pose to world food security. The major outcomes of the conference are: (i) Identification of the new challenges facing world food security, (ii) A better understanding of the nexus between food security, climate change and bioenergy, (iii) Discussion of required policies, strategies and programmes for ensuring world food security, in particular measures to address soaring food prices and (iv) A declaration on "World Food Security and required actions".

..... "There is an urgent need to help developing countries and countries in transition expand agriculture and food production, and to increase investment in agriculture, agribusiness and rural development, from both public and private sources," according to the declaration and noted that *"It is essential to address the fundamental question of how to increase the resilience of present food production systems to challenges posed by climate change."*

Vulnerability, climate change and livestock: challenges and opportunities for the poor

Thornton P.K., Mude A., Ouma R., Herrero M., Notenbaert A., Van de Steeg J.A., Kariuki J., Ayantunde A.
International Livestock Research Institute (ILRI), Kenya

Abstract: For many people in Africa, livestock are of critical importance to livelihoods, human nutrition, and household resilience. In many environments livestock are the prime and sometimes only source of income. Livestock systems in developing countries are characterised by rapid change, driven by factors such as population growth, increases in the demand for livestock products as incomes rise, and urbanisation. Climate change is adding to the considerable development challenges of this dynamic situation. In some places, livestock keepers may be able to take advantage of the increasing demand for livestock products, but for many, adaptation will involve protecting livestock assets in the face of changing and increasingly variable climate. Research for development organisations need information on the vulnerability of current human populations and how this is likely to change in the future, so that appropriate technological, policy and institutional options can be made available in the places where they are needed. We outline efforts to assess vulnerability and discuss some of the resultant responses in terms of priority livestock development issues. Because climate change is likely to exacerbate the fragile balance of risks in pastoral systems across Africa, effective risk management options need to be developed and implemented that help vulnerable households cope with a wide range of shocks. Such work needs to be supported by the development of collaborative learning processes that can assist diverse stakeholders make the behavioural changes that will be required if poor and vulnerable livestock keepers are to adapt to climate change.

Reducing vulnerability of the African livestock production systems (ALPS): role of pan-African policy initiative on the impacts of climate change (CC)

Akinbamijo O. Y.[1], Nouala F. S.[1], Herrero M.[2], Ong C.[3], Kitalyi A.[4]
[1]*African Union-Interafrican Bureau for animal resources (AU-IBAR), Kenya*
[2]*International Livestock Research Institute (ILRI), Kenya*
[3]*World Agroforestry Centre (ICRAF), Kenya*
[4]*World Agroforestry Centre (ICRAF), Tanzania*

Abstract: The ALPS have come under severe threats by environmental and climatic factors and the urgency of the situation has called for immediate proactive measures to stabilize the ALPS from disintegration under the challenges of CC. The ALPS will also have to become more efficient in resource utilizations and physiologically adapted to emerging climatological scenarios such as higher ambient temperatures, incidences of drought, floods and diseases.
Rural livelihoods and livestock-dependent communities are extremely sensitive to changes in environmental indices. Compared to the developed economies, African countries are generally considered more vulnerable to the deleterious effects of Climate Change. Because of the correlation between land use and environmental phenomena, there are increasing national and international concerns on observed negative consequences such as the rapid depletion and degradation of natural resources, loss of biodiversity and the attendant threats to human health and livelihoods.
As such, there is an urgent need for Africa, to exploit new production strategies that foster greater resilience and stability of ecosystems upon which many livelihoods depend.

This requires increased understanding of the dynamics of the drivers of the Climate Change phenomenon and the evolution of a complementary sustainable adaptation process to address the domino effect triggered by Climate Change with far-reaching impacts on environmental sustainability and natural resource management in all livestock-related investments. Adaptive policies and regulatory frameworks will be required to be put in place to govern and harmonize the adaptation processes.

Climate variability, desertification and biodiversity in Africa: adaptation, an integrated approach

Dorsouma Al
Observatoire du Sahara et du Sahel (OSS), Tunisie

Abstract: Desertification and climate change are vital issues in the arid regions of Africa. Everyone knows that ecosystems affect the climate, and *vice versa*, global change has a major impact on the climate, e.g. increasing desertification and land degradation. The concept of climate change is constantly referred to while desertification, despite the numerous scientific studies on the subject, are of little interest to the political decision-makers.
Yet neither scientific connections, nor political connections resulting from synergy between the international environmental conventions have been developed on the basis of links between desertification and climate change.
Adaptation to climate change has been a key issue in the recent work of the Intergovernmental Panel on Climate Change (IPCC) and deeply concerns the arid regions stricken by desertification and climate variability/extremes. Experiences with desertification control could serve as a well-chosen starting point for studying adaptation to climate change.
This paper proposes a joint analysis of desertification and climate change from the scientific angle through definitions and signs of these two phenomena in the arid regions of Africa, and from the institutional angle through documentation, tools and decisions on the two international conventions devoted to these subjects.
Keywords: Desertification, climate change and variability, adaptation, vulnerability, arid regions of Africa, development.

2. PANEL SESSION ON CARBON SEQUESTRATION ISSUES

Politics and economic of forest carbon

Eric Bettelheim
Sustainable Forestry Management Limited, London

Abstract: The vast majority of developing countries have been excluded from the carbon markets because both the Kyoto Protocol and the EU Emissions Trading Scheme exclude forest and land-use credits. Most of the developing world remains largely dependent on farming and forestry and particularly its poorest people. Emissions from developing countries, aside from China and India, are almost entirely from land-use change and forestry. The only way in which almost all of the developing world can participate in mitigating climate change is through the forest and land-use sector. The benefits of such participation through carbon markets are measured in the tens of billions of dollars per year and for decades to come. Enough to finance sustainable, low-carbon growth and to make the largest contribution to adaptation to climate change.

Helping smallholder tree farmers in Africa participate in carbon trading: A case of Siakago, Kenya

Kung'u J.B.[1], Gichu A[2]., Mugendi D.[1]
[1]*Department of Environmental Sciences, Kenyatta University, Kenya*
[2]*Kenya Forest Service, Kenya*

Abstract: Developing countries can achieve sustainable development and at the same time contribute to the global effort to stabilize Green House Gas (GHG) levels in the atmosphere through the Clean Development Mechanism (CDM) of the Kyoto Protocol. This can be achieved through reduced industrial production, energy substitution and efficient production processes or by providing sinks of atmospheric carbon dioxide through the carbon sequestration programmes. Carbon credits accruing from such programmes can be used to offset carbon emissions in industrialized countries whose emission levels have been capped. Carbon sequestration through tree planting programmes has been approved as eligible activities for participation under the CDM. Many countries in Africa have met the requirements under the United Nations Framework Convention on Climate Change (UNFCCC) for hosting forestry projects under CDM. A study was carried out to assess whether the smallholder tree farmers in Kenya are able to participate in carbon-offset programmes among other tree outputs. Data was collected using actual measurements, an interview schedule, discussion with relevant extension agents and observation checklist and then analysed using both excel and SPSS computer packages. The study established that opportunities exist for smallholder tree farmers to incorporate carbon offset as a tree product for participation under the CDM. Currently farmers have been able to stock 2.08 tons per ha of carbon with a market value of US$ 492 process
Key words: clean development mechanism, carbon offset, sequestration

3. PANEL ON IMPACT OF LIVESTOCK CARBON EMISSION ON CLIMATE CHANGE

Livestock in Climate change

Pierre Gerber
Food and Agriculture Organization of the United Nations (FAO), Livestock Information, Sector Analysis and Policy Branch (AGAL), Italy

Abstract: Population growth, accelerated urbanisation and a higher standard of living have irreversibly boosted the demand for animal products. The 2006 report "Livestock's Long Shadow" focuses on the impact of livestock production on climate change. The livestock sector as a whole contributes an estimated 18% of the anthropogenic greenhouse emissions of which livestock production accounts for 65% of N_2O, 37% of CH_4 and 5% of CO_2. The problems of livestock production as a source of greenhouse gas, like the problems of water pollution and biodiversity loss, are issues that need to be considered in the long term.
A partial reduction in emission levels can be obtained in the relatively short term and at low cost to the sector. Various technical solutions exist and could be implemented, namely: (i) improve productivity and carefully manage animal production intensification, (ii) improve productivity of sources of animal feed, and (iii) reduce and process methane (CH_4) emissions from enteric fermentation and effluents from livestock production.
Considering population growth and persistent under-nourishment, the problem of the effects of livestock production on climate change needs to be viewed in terms of the development level of the countries concerned. In the OECD, the question that needs to be asked is whether lower consumption of animal products can improve the quality of the agricultural environment and health. On the other hand, in the poor countries, the protein ration needs to be improved by drawing on all

technologies that can contribute to higher animal production, all the while limiting the impact on climate change. Attention should also be given to adapting livestock production to climate change

4. PARALLEL SESSIONS

A. CROPPING SYSTEMS

ORAL PRESENTATIONS

The effect of climate change on agricultural systems and crops production – analysis of three countries

Chakanda, Robert[1], Kafuwa, Dalitso[2], Bah Kebba[3]
[1]CBAN, Sierra Leone, Center for Genetic Resources (CGN), Netherlands
[2]FAIR project, Malawi.
[3]GARDA, Gambia

Abstract: The authors will present in a series three papers analyzing sub-regional consequences of climate-related changes on agricultural systems and food production in their respective countries. Potential impacts are derived from similar research conducted with common objectives that are formulated towards the gradual changes in cropping patterns in the three countries: The Gambia in the drier part of West Africa threatened by land degradation and desertification caused by higher temperatures and drought; Sierra Leone in the rain forests of West Africa, facing climate related threats to the agro-ecosystem and forcing a shift in centuries old agricultural systems; and Malawi in the Southern African region where indirect impacts of climate change are felt in the agricultural sector, with threats caused by biofuel projects and the greenbelt type of agriculture.
In each of the studies, we considered the projected effects of climate change on national food supply under different environmental and social factors affecting agriculture. The goal of the joint analysis is to understand the nature of the complex interactions in different social and environmental scenarios and how they affect people at risk of hunger as a climate consequence in the coming decades. Much of the work is based on a timeline of assessment of change; linking this to climate data and the assumption of the single best estimate of population and economic future of the communities studied. The consequences in each of the research papers are estimated from both direct and indirect change scenarios observed over a period of time.

Impact of climate variability on production systems in Niger: the Gaya and Aguié zones

Amadou M. Laouali[1], Adamou Moustapha[2], Mahamadou Ali[2], Katiella Mai Moussa[3]
[1]Institut International de Recherche sur les Cultures des Zones Tropicales Arides et Semi-arides (ICRISAT), Niger
[2]Faculté d'Agronomie, Université Abdou Moumouni, Niger
[3]Faculté des Sciences, Université Abdou Moumouni, Niger

Abstract: "Impact of climate variability on the production systems in Bana (Gaya) and Zabon Mousso (Aguié)" is a study carried out in two different agro-ecological zones in Niger. Two approaches have been used: a biophysical approach and a socio-economic approach. The biophysical approach is based on the use of the CROPWAT model to estimate water availability in soils growing millet, sorghum and cowpea (*niébé*) and the effects of this water availability on crop yields. Two scenarios have been scripted: a reference period, and timeine 2025. The socio-economic approach is based on the analysis of how the agricultural production systems in these two zones function, using a farm-level diagnostic. The analysis of the results obtained from the model suggests a drop in soil water availability in the Aguié zone for rainfed crops because of an

increase in the soil humidity deficit (SMD) by the year 2025, compared to results recorded for the so-called reference period. On the other hand, in the Gaya region, where conditions are already better than in the rest of the country, conditions are expected to improve slightly. No yield drops are expected for cereal crops and cowpea yields are expected to drop only slightly. The socio-economic analysis shows major differences in farm types, with relatively different economic performances. In Zabon Mousso, most farms bring in little income, unlike the Bana area where most farms have a relatively good income level.

Keywords: climate variability, production systems, Aguié, Gara, farm typology.

Farmers in extreme north province of Cameroon and climate change: emigration or adaptation?

Watang Zieba Félix
Département de Géographie, Université de Ngaoundéré, Cameroun

Abstract: The Extreme North Province of Cameroon, located in the Sahelian zone, is confronted with considerable water shortages and constant climate instability. Between 1975 and 2007 over 200,000 farmers, mainly young ones, emigrated to the Bénoué plains where the climate is more favourable for agriculture, leaving behind, *inter alia,* farmers who are elderly, poor and vulnerable. The *Muskuwaariculture* (off-season sorghum, basis of local diet) was the main solution to cope with the major shortage of rainfed cereal crops in that province. Unfortunately, since 1998, short early rains and lower precipitation rates (sometimes under 750 mm) are a handicap to *Muskuwaariculture.* In 2007, rains were early and stopped in the beginning of September, inhibiting early crop development. Insufficient flooding of the vertisols (*karé* in local *Fulfuldé)* means too little water for transplanting and proper growth thereafter.

The analysis of the actors' reactions and field observations (surveys, photos) show, on the one hand, that the farmers are developing new farming techniques, original adaptation practices based on experience acquired through regular observation of rainfall patterns and, on the other, that they are spreading these new adaptation techniques, – which have proven effective, – from areas of high production to areas of marginal production. The fact that research services (IRAD, CIRAD) and agricultural services (MINADER) are developing supervision and monitoring methods for these new adaptation techniques are evidence of their effectiveness and sustainability.

Keywords: Climate change, emigration, adaptation, *Muskuwaariculture*, Extreme North Cameroon.

Rainfall deficit and pinapple production in Allada, Benin

Cyr Gervais Etene, Michel Boko
Laboratoire d'Etude des Climats, des Ressources en Eau et de la Dynamique des Ecosystèmes, Université d'Abomey-Calavi, Bénin

Abstract: As a result of the Benin government's work on agricultural diversification, renewed interest has been shown in pineapple growing, especially around the town of Allada. But the drop in rainfall since the 1970s and 1980s, followed by unfavourable spatio-temporal rainfall distribution is impacting the crop.

Data on rainfall levels, sown lands, and statistics on pineapple production for the Allada area have been used to identify wet and dry months and years and even to compare rainfall thresholds for pineapple crops.

The study shows that the slight improvement in rainfall in the 1990s and thereafter has had a positive impact on the pineapple production in this area. Yet crop yield variations are evidence of the detrimental effects of rainfall pejoration on the producers' output and income.

To cope with these changes in cropping calendars, cropping techniques and professions, etc. producers have adopted techniques that involve larger fields and repeated sowing. Furthermore, they are gradually shifting away from empirical agricultural schedules, and are adopting new varieties and the principles of fertiliser application.

Keywords: Allada, rainfall pejoration, pineapple crops, incidences.

Production systems for dry cereal crops in the Sahel: land degradation and poverty alleviation

Baraïma Diall
Association pour le Développement des Activités de Production et de Formation (ADAF), Mali

Abstract:
1. Impacts of climate change (CC) on dry crop production systems (sorghum, millet and cow pea).
Impacts of climate change on dry crop production systems in the ADAF/Galle zone:
– Squall lines that usually accompany violent winds and abundant, sometimes catastrophic rains. These winds and rains break the trees and carry away arable lands, thus leaving cultivatable lands barren;
– Regular decreases in the quantity of rainfall, and long intervals between rain spells during the cereal crop flowering stage;
– Low farm yields, mainly because of drops in rainfall;
– Reduction in the range of local cereals varieties in the zone as the selected so-called “improved” varieties become more popular.
2. Solutions implemented
Solutions to climate change have been implemented in partnership with the beneficiary populations, the technical services and the research institutes. They focus on:
– the adoption of selected varieties adapted to the intervention zone, i.e.
  * three varieties of sorghum adopted, including CSM -63 E;
  * one variety of groundnuts adopted: ICGV 86 124;
– extension of improved metallic fireplaces (foyers amélioré métallic), and improved fireplaces in banco (earthen bricks);
– reforestation and fight against deforestation by planting in exclosures;
– installation of cereal banks in selected villages.
3. How would you assess your solutions? Have they lived up to your expectations? We liked these solutions because they were useful in increasing agricultural output (e.g. improved seed), stabilising the farmers during the crucial tillage period, sowing (case of cereal banks).
4. Strategies implemented to promote solutions at various levels.
The strategies that we implemented to promote solutions at different levels were:
– organisation of beneficiary populations to focus on activities;
– development of partnerships with communal authorities and technical grassroots services;
– development of partnerships with the national and international research institutes.
5. Information and communication activities implemented
Information and communication activities included information workshops, validation of outputs, and collaboration with local radio stations in order to ensure broad dissemination of project results.
6. Difficulties encountered in developing these information activities
The main difficulty was the shortage of financial resources to reach all the ADAF/Gallé partner villages (e.g. information workshops and validation of results) or even to reach as large an audience as possible through national television.

Evaluation des contraintes pédoclimatiques au développement de la riziculture sur le plateau d’Agonlin

Guy Wokou, Michel Boko, Marcel da Matha Sant’Anna
Université d’Abomey-Calavi, Bénin

Abstract: The agricultural production is the various factor consequences in interaction. The foundations natural of the agricultural production are essentially constituted of factors climatic and

pedological. The production of the rice culture is an important activity on the tray of Agonlin. But, this production knows disruptions owed to the climatic and pedological risks.
The socio - anthropological investigatings and the analysis of data climatologic and data on rice production permitted to fear the importance of this production and the climatic factor dynamics on the tray.
The deficit or excess raining (notably of the first rainy season), accentuate the decrease of rice outputs and have some important socioeconomic repercussions. To attenuate these constraints producers developed strategies (adoption of less demanding rice varieties in water (rice nérica) and improvement of production systems).
Key words: Benin, tray of Agonlin, rice production, constraints pedoclimate.

Climate change and dynamics of production systems of the lowlands in Burkina Faso

Dembele Youssouf, Some Léopold, Sanon Moussa, Gamal Abdel-Rahman Ahmed
Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso

Abstract*:* In Burkina, the lowlands are used in a variety of ways during the wet season: pastureland, cereal crops (sorghum, maize, rice), and tuber crops. During the off-season, market garden crops and fruit trees can be combined with livestock production (watering the animals, grazing). Furthermore, the natural resources in the lowlands are exploited in various manners. A link has been established between the deteriorating climatic conditions, especially less rainfall, and the deteriorating production systems. Increased interest for the lowlands since the droughts of the 1970s and the 1980s, coupled with ecological change in the plateaux as a result of population pressure have changed the hydrology of the area. Furthermore, the national agricultural development policy stresses the importance of the lowlands to ensure food security and territorial construction. This policy is supported by major diversification (specific to the agro-climatic zones) in the technical models used to develop the lowlands.
Climate change has profoundly altered the methods for developing the lowlands: diversification and adaptation of production systems, development of off-season crops, changes in farming techniques, aggravated conflicts over land tenure, etc.
Keywords: Lowland, production systems, climate, Burkina.

The Effect of Climate Change and Adaptability on Arable Food Crop Farmers in South western, Nigeria

Apata T.G.
Department of Agricultural Economics & Extension Services, Joseph Ayo Babalola University, Nigeria

Abstract: Agriculture places a heavy burden on the environment in the process of providing humanity with food and fibres. It is the largest consumer of water and the main source of nitrate pollution of ground and surface waters as well as the principal source of ammonia pollution. Likewise, it is a major contributor to the phosphate pollution of waterways and to the release of the powerful greenhouse gases methane and nitrous oxide into the atmosphere. Increasingly however, it is recognised that agriculture has also positive externalities such as the environmental services and amenities that it provides, for example through the creation or maintenance of rural landscapes which is given high priority by some developed countries. Trade-offs between food security and the environment is what is being practised in most developing countries. This has drastically reduced soil fertility and poor agricultural outputs. Consequently, this study assesses the pressures on the environment emanating from agricultural activities and how these might evolve over time. Agricultural livelihood activity provides a larger proportion of the active working population means of earning income. Efforts that focuses on the environmental impacts which can be explicitly or implicitly determined from the crop and livestock production projections presented will be most appropriate. Food crop farmers in south western, Nigeria provides the bulk of arable crops that are

consumed locally and also are the major supplies to other regions in the country. Simple random sampling was adopted for data collection and where two states were selected for further investigation. The study revealed that, knowledge about the impact of climate change on agriculture is still a mirage to most food crop farmers
The socio-economic determinants of the environmental impacts, such as land tenure or the marginalisation of small farmers, and with technological and policy options for reducing or avoiding them were looked into. The study concluded that a lot need to be done by all stakeholders to come to term with negative impacts of climate change particularly on agriculture where majority derive their livelihood. Among recommendations made include readily available or emerging technologies and land management practices that could greatly reduce agriculture's negative impacts on the environment and enhance its positive impacts.
Keywords: environmental impact, food safety, agricultural occupation, effective land administration policy, welfare improvement.

Use of seasonal forecasts in predicting agricultural yields and gross domestic product over east Africa

P. A. Omondi [1], E. T Komutunga[2], T. E. Mmbaga[3], J. N. Maundu[4], L. A. Ogallo[1]
[1]*IGAD Climate Prediction and Applications Centre (ICPAC), Kenya*
[2]*National Agricultural Research Organization (NARO), Uganda*
[3]*Selian Agricultural Research Institute, Arusha (SARI), Tanzania*
[4]*Ministry of Agriculture, Nairobi, Kenya*

Abstract: Anticipated crop yield prior to the season is critical in food security management decision in any country. Predicted crop yields become meaningful when rainfall forecast is skillful over the agro-ecological zones where crops' phonological stages highly depend on rainfall. Rainfall is one of the most important parameters for crops in the tropics and consequently food security. This research study was carried out for some food crops in agro-ecological zones of eastern Africa.
Data used for period 1990-2006 were monthly rainfall from Meteorological Services; crop yields from the planning Unit of the ministry of Agriculture while Gross Domestic Product (GDP) from central banks of east African countries. Sea Surface Temperature (SST) was from Climate Prediction Center of the National Oceanic and Atmospheric Administration. The methods used in this study were statistical prediction by non-linear regression, correlation and Principal Component Analyses.
The results showed similar trend in crop yields, seasonal rainfall and agricultural GDP over the agro-ecological zones studied with correlation coefficient of over 0.67. SST anomalies predicted over 48% of total rainfall variance during October-December season. Climatic indices to predicted maize yields prior to the season with a skill of 0.71 at 95% confidence level. Results from this study give a clear indication that crop yields and consequently agricultural GDP are predictable using long-term rainfall predictors.
Skillful seasonal rainfall forecast is therefore critical for early warning mechanisms and impact assessment on agriculture. This information is useful for governments or policy makers in taking timely decisions to ensure food security.

POSTER PRESENTATIONS

Estimating crop coefficient model for upland rice (NERICA) under sprinkler irrigation system

C .O. Akinbile[1], A.Y Sangodoyin[2]
[1]*Department of Agricultural Engineering, Federal University of Technology, Akure, Nigeria*
[2]*Department of Agricultural & Environmental Engineering, Faculty of Technology, University of Ibadan, Nigeria*

Abstract: Efficient crop coefficient (K_c) estimation is very important in adequately determining water use of selected crop. In this study, crop coefficient was determined for upland rice (NERICA)

under a sprinkler irrigation system. The estimation was derived from the relationship $f_c = \int (LAI, MTA)$ under standard environmental conditions in Ibadan, Nigeria. The fraction of the wetted surface f_c was determined for the three stages of crop development. The stages are initial, mid season and maturity. These were incorporated into the model flowchart that produced K_e, K_{cb} and K_c. Several assumptions were made and a visual basic (VB) 6.0 software was used as programming language. The derived K_c was compared with existing crop coefficients and results were subjected to statistical analysis.

From the study, three f_c models were derived for the three crop development stages. $f_c = 0.9392 - 0.0095LAI + 0.0010COSMTA$ as initial, $1.1917 - 0.0753LAI + 0.0164COSMTA$ (mid season) and -0.1308 + 0.1193LAI - 0.024COSMTA for maturity. The final equation describing this relationship that was introduced into the flowchart is $f_c = 0.9167 - 0.026LAI + 0.219COSMTA$. The K_c values were obtained from the relationship, $k_c = k_{cb} + k_e$. K_c (initial) = 0.9, K_c (mid season) = 1.12 and K_c (maturity) = 0.7. The coefficient of distribution R^2 between the modeled K_c and K_c values of FAO-24 and FAO-56 were 0.99 and 0.98 respectively. This showed good agreement with the existing coefficients. It also supported the improvised conversion factor from K_c (paddy) to K_c (upland) as it is used in FAO-24 paper.

The dominant effect of fraction of wetted surface f_c, leaf area index (LAI) and mean tilt angle (MTA) in influencing the crop coefficient of upland rice is evident from the study. Soil characteristics, degree of saturation and the fraction covered by vegetation ($1-f_c$) are also considered to have indirect effect on K_c measurements.

Keywords: Crop coefficient, Upland Rice, Sprinkler Irrigation.

Rice production and rainfall/hydrological constraints around the town of Dangbo in Benin

Afouda Fulgence
Laboratoire "Pierre Pagney" Climat, Eau, Ecosystème, Développement (LACED), Département de Géographie et Aménagement du Territoire (DGAT), Université d'Abomey-Calavi, Bénin

Abstract: The town of Dangbo is located in the lower valley of the Ouémé where natural conditions are generally favourable for rice growing. But despite efforts by the rice growers, there are several problems, including rainfall levels and hydrology that curtail optimal use of these natural advantages. The methodological approach focuses on processing rainfall data (at the annual, seasonal and monthly scales), hydrometric data, statistics on rice production and information obtained from people working in rice production. Results show that most rice is grown as an off-season crop, using rudimentary facilities and techniques and that it is affected by rainfall variability and its hydrology-related corollaries.

In especially rainy years, for instance, when the rains start early, flooding limits the farmers' access to the rice fields where the plants risk being washed away. On the other hand, during especially dry years, the rains start late, and the water-stressed rice plants dry up prematurely.

Suggestions are made concerning water harnessing, improved cropping techniques, development of rural trails, etc.

Keywords: Town of Dangbo, rice production, rainfall/hydrological constraints, suggestions.

Market garden cropping on the shores of Lake Dang in north Cameroon: what are the socio-environmental stakes?

Baska Toussia Daniel Valérie
Département de Géographie, Université de Ngaoundéré, Cameroun

Abstract: Market garden crops are fast gaining ground on the banks of Lake Dang not far from Ngaoundéré University in the Adamaoua province of Cameroon. These crops represent high socio-economic stakes since they are needed to feed the student population plus the surrounding communities. Cropping practices, however, are affected by climate and the farmers' cropping techniques. Direct observation and interviews with producers bring out the unarguable effects of coupling climate and cropping techniques in transforming the banks of Lake Dang. The socio-environmental consequences (bank erosion, lake drying up, dearth of aloetic resources, changes in the cropping calendar, population movement) are significant. A solution must be found to protect this lake without interfering with the market garden crop production needed to feed the surrounding populations.
Keywords: cropping practices, market garden crops, shores of Lake Dang, socio-environmental challenges, North Cameroon.

Practicing profitable agriculture and environmental conservation in rural Uganda: the CELAC experience

Mary Nakirya
Busoga Rural Open Source and Development Initiative (BROSDI), Collecting and exchange of local agriculture content (CELAC), Uganda

Abstract: CELAC, Collecting and Exchange of Local Agricultural Content Project, works with government and the civil society towards enabling a platform from where local content can be effectively collected and shared amongst especially the grassroots women farmers for improved food security and eventually household development. Methods used include monthly knowledge sharing forums, annual knowledge fair, telephones (SMS, teleconferencing and calls with the grassroots community), web 2.0 applications (audio and textual blogs, information website, Google maps, wikis), and information from the digital satellite. The project is existent in seventeen districts in the country.
The farming methods exchanged by the farmers encompass use of organic materials for seed and garden preparation, planting, weeding, pest and disease control, including harvesting and post harvest methods. The farmers continued preference to use these methods is based on the fact that the materials are locally available and affordable, yet hardly destroy the environment. Also, they realise bumper harvest, enabling them to compete favourably with those practising chemical farming whose inputs are more expensive. Yet another benefit they enjoy is that their land continues to gain fertility and they are able to reap maximally from the small land available.
Success examples for all quoted above to be availed.

Some crop management practices in Jamaica and Dominica for combating the effects of global climate change

Simpson Leslie Anthony, St Luce Mervin
Caribbean Agricultural Research and Development Institute (CARDI), Jamaica

Abstract: There is enough evidence to conclude that climate in the Caribbean is changing in line with global trends. The effect of this is already being felt by agricultural producers in the region. The response to this change has, as yet, not been well planned and organized, but some agricultural practices have been emerging and evolving to deal with this crisis. In Jamaica and Dominica,

agriculture's contribution to the national economy is quite significant, six and eighteen per cent respectively and adapting to the changing climate is critical to socio-economical survival. In this presentation some of crop management practices which are evolving to deal with this situation in these two countries are highlighted. These practices include defining specific cropping seasons, increased irrigation and soil water management systems, mulch farming, multiple cropping to decrease economic risk, planting of contrasting crop species, protective agricultural systems, and varietal changes. The effectiveness of these practices is still being assessed.
Keywords: Climate change, agriculture, crop management practices, Dominica, Jamaica, Caribbean

B. AGROPASTORAL SYSTEMS

ORAL PRESENTATIONS

Climate change and sustainable animal production systems

Didier Richard
Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), France

Abstract: In areas of Sub-Saharan Africa where crop- and livestock-farming are combined, the animal population figures have been going up for the last four decades. This is closely connected to agricultural development, improved animal health conditions and the economic value of animals and animal products. The overall situation, which is largely due to population growth, has led to intensive land use and, hence, frequent soil fertility losses.
The increase in livestock can be traced to more secure pastoral and cultivated fodder resources for livestock producers and their herds in the agro-pastoral zones, but also leads to increased pressure on resources that predicate heavily on climatic conditions. Agriculture and livestock production in today's world need to be reconciled with global climate change (GCC), although it is difficult to separate GCC from anthropogenic actions.
To decrease their vulnerability to GCC, livestock production systems need to be constantly adapted. The extensive livestock production system is the most common, but results in animal production depend on the availability of natural resources. Decisions to maintain this system must consider the sustainability of fodder and water resources, the system's contribution to greenhouses gases and the storage of carbon, access to markets and the socio-economics of all categories of livestock producers. Methods that allow livestock production systems to adapt to GCC should be explored and implemented. This includes better integration of agricultural and livestock activities, community land management, development of agro-forestry, intensification of animal production, and the development of monogastric production animals.

Vulnerability of agropastoralists to climate change in the area around Parc W in Burkina Faso

Somda Jacques[1], Zombra Abdoul Wahab[2], Toé Patrice[2]
[1]*International Union for Conservation of Nature (UICN), Guinée-Bissau*
[2]*Université Polytechnique de Bobo-Dioulasso, Burkina Faso*

Abstract: The protected areas have been designed as natural resources protection tools for the present and future populations. But efforts to manage these areas are countered by certain pastoral practices and trigger conflicts between area conservation workers and the herders. In the *Parc W* in Burkina Faso, the management system was changed in 1984 to include the participation of the local communities. Have institutional changes improved the capacity of the agropastoralists in the

surrounding villages to withstand climate change? A 2007-2008 survey of 60 agropastoralists' households and 120 individual men and women living around *Parc W* provided responses to this question. Data from the survey showed cross effects of the existence of the park and the effects of climate change that increased the vulnerability of the agropastoralists: greater risk of losing livestock with the attendant threat of poverty. The development of uncooperative strategies, such as agropastoralists entering the park, are a reaction to the unsatisfactory alternative proposals for ways of making a living. The alternative sources of revenue being proposed do not contribute to the resilience of their core activities. The recommendation, thus, is to promote a participatory approach to *Parc W* management, taking account of the effects of climate change and optimising cooperative strategies developed by the agropastoralists to increase their resilience.
Keywords: Protected areas, local communities, revenue, resilience, climate change.

Evolution of annual rainfall and impact on the distribution zones of the riparian tsetse fly in Senegal

M.T. Seck[1], B. Sall[2], L. Guerrini[3], J. Bouyer[3]
[1]*Laboratoire National d'Elevage et de Recherches Vétérinaires (LNERV), Sénégal*
[2]*Direction des Services Vétérinaires, Ministère de l'Elevage du Sénégal*
[3]*Centre International de Recherche-Développement sur l'Elevage en zone Sub-humide (CIRDES), Bobo Dioulasso, Burkina Faso*

Abstract: African animal trypanosomiasis (AAT) is a major obstacle to the development of livestock production in much of the humid and sub-humid zones of West Africa. The distribution of the glossina, their cyclical vectors, depends mainly on local anthropic and climatic constraints (state of degradation of vegetation). The main vectors of AAT in Senegal are *Glossina palpalis gambiensis* (G.p.g.), a riparian species that prefers riparian vegetation along the waterways, and *G. morsitans submorsitans* (G.m.s.), a savanna species. The density of the riparian glossina depends mainly on the presence and quality of the forest habitat or its manmade equivalent, the fruit tree plantations. On the other hand, the density of the G.m.s. depends more on the level of savanna degradation and the availability of wild hosts. Along the coast of Senegal, the isohyets get lower for about 100 km towards the south, which has meant over 100 mm less rainfall in the 1970-1980 and 1980-1990 decades. This aroused our interest in the evolution of the distribution of these glossina in Senegal from 1972 to 1979 (Touré et al.) and from 2003 to 2008 (project DIREL C3-SEN/5/029 03 01). In Senegal, the northern limit of G.p.g., the only specie covered by the study, did not change, but it disappeared from La petite côte located more to the south as the appealing forest vegetation faded out. These results provide confirmation that the microclimatic factors (linked to plant formations and their level of degradation) are more important than the macroclimatic factors in explaining the distribution of these vectors.

Conflict prevention and natural resource preservation strategies in Mali

Jérôme Dakouo, Sébastien Cognet
Programme d'Appui aux Collectivités Territoriales (PACT)-Mali, Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), Germany

Abstract: In the Sahel, climate change is a reality that leads to increased movement among the transhumant livestock producers, thus causing numerous conflicts with the crop farmers, jeopardizing social peace and attracting the full attention of the young territorial communities. At present, climate change has led to less rainfall and, ergo, far less Sahelian grazing land. The result is that the animals are moving onto zones, such as the lowlands, where transhumance is unknown. This situation, together with changes in social behavior, aggravates the conflicts between the farmers and the transhumant herders.
The Malian support programme for local communities (Programme d'Appui aux Collectivités Territoriales) encourages the joint preparation of local rules on the utilization of natural resources

and the agro-pastoral lands by everyone concerned with the process. These local agreements are approved by supervisory bodies and then certified by the Ministry of Justice giving them the force of law. They have been vital in the regeneration of certain plant species threatened with extinction and more importantly have contributed to the significant drop in the number of conflicts between the stock- and crop-farmers. The resident populations are involved in implementing these agreements through their management committees.
The centuries-old transhumant trails that were being wiped out by agriculture have been consolidated by pilot communities, with support from the PACT, in order to ensure the permanency of these trails and thus secure regional cattle movement.

Climate change and eastern Africa pastoral livelihoods

MacOpiyo L. A., Angerer J., Kaitho R.
Livestock Information Network and Knowledge System (LINKS) Global Livestock-CRSP Project, Ethiopia

Abstract: Pastoral livestock systems in East African countries are changing rapidly in response to many drivers. These include, rising human populations, rising global food prices, land tenure and land-use changes, frequent climatic shocks (droughts) among others. The potential impact of local and global drivers of change on the resource-poor pastoral systems is considerable. In addition, the climate is changing, and with it climate variability and this adds to the already considerable vulnerability of livelihoods' faced by many pastoral communities residing here and indeed in most of the Sahel. Climate change will add burdens to pastoralists who are already poor and vulnerable. The implications for pastoral livelihoods are yet to be fully understood, and indeed two quite different opinions seem to prevail. Some see pastoral groups as already surrendering to ongoing processes, as rangelands will tend to become drier, and existing water shortages will worsen, thus affecting the overall sustainability of their livelihoods. Others see pastoralists as the most capable to adapt to climate change, since pastoral livelihoods are shaped to deal with scarce and variable natural resources and to tackle difficult and uncertain agro-ecological conditions, and that climate change could conceivably lead to the extension of territories where pastoralism could show comparative advantages. This article looks at the risks and challenges confronting pastoral communities of eastern Africa due to climate change, and highlights practices and policies that could help them to adapt.

Impacts of climate change on agropastoral communities in the Tahoua and Tillabery regions of Niger

Sylvain Garraud
Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), Niger

Abstract: For close to 30 years, German technical cooperation (GTZ) in Niger has been working on natural resources management in the Tillabéry and Tahoua regions, located between parallels 13° to the south and 18° to the north. The isohyet is between 200 and 600 mm. The area is considered highly prone to climate variability and change. A study was conducted in Niger by the GTZ "Combating Poverty" programme to incorporate climate change in the programme's intervention strategies. Climate variability is characteristic of the Sahelian climate but changes can be noticed, the most tangible one being the continual lowering of the isohyets over more than 200 kilometers. The effects of climate variability and change in these regions are visible. Climatic extremes are clearly becoming more frequent and more intense. The resident populations have adapted to variations in their climate. Local adaptation strategies have been based on diversification of economic resources at the family level, especially by developing market gardens, commercializing natural resources, rural exodus, transhumance, and extensification of agricultural practices through rainfed cropping. But, the local responses to the climate variability and change

phenomenon are inefficient, partly because of the problem of population growth. The challenge, thus, is to help these communities with an adaptation process that can predict the impacts of climate change and, at the same time, secure the future of these lands for the coming generations.

Coping Mechanisms and Their Efficacy in Disaster-prone Pastoral Systems of the Greater Horn of Africa (GHA)

J. Ndikumana[1], J. Stuth[2], R. Kamidi[1], S. Ossiya[3], R. Marambii[1], P. Hamlett[2]
[1]*International Livestock Research Institute (ILRI), Kenya*
[2]*Dept., Rangeland Ecology and Management, Texas A&M University, USA,*
[3]*Panos Pastoralist Communication Program, PANOS Eastern Africa, Panos Kampala, Uganda*

Abstract: A survey of 663 households investigating traditional coping mechanisms of pastoralists during the 1995-97 drought and 1997-98 El Niño rains, was conducted in drought prone zones of Ethiopia, Kenya, Tanzania and Uganda. The purpose of the study was to investigate what pastoralists do to protect their livestock and welfare during crisis periods of drought and floods.
The investigated period was divided into pre-drought, peak drought, minor rains, El Niño rains and La Niña dry phases. The pastoral zones were stratified into clusters indicating level of vulnerability to crises. Statistical analysis was performed on herd dynamics and movement during the climatic phases.
During drought, cattle and small ruminant mortality rates were highest in southern Ethiopia and northern Kenya where they increased to 49 and 35%, respectively for cattle, 52 and 43%, respectively for small ruminants. Cattle mortality during floods was highest in southern Ethiopia (37%) while small ruminant mortality was highest in northern Kenya (52%).
Although migration was observed throughout the year, it increased during the drought.
Cattle sales and slaughters were not significantly different across phases (below 10%) indicating that few pastoralists prepare for crises by increasing sales or slaughter of their animals.
At all sites, relief food aid distributed was considered “too little, too late”.
Several overarching factors including water and grazing for livestock, food and clean water supply determined pastoralists’ coping behaviours.

Pastoral agenda and climate risk minimisation strategies in the Sahelian region of Senegal

Mame Arame Soumare
Université Cheikh Anta Diop, Sénégal

Abstract: Our paper is on the livestock producers east of the *lac de Guiers* in the Mbane rural community. Livestock production is one of the two main economic activities. Traditional practices are used, based on various strategies to cope with the harmful effects of the uncertain Sahelian climate on the local environment.
The *Action Thématique Programmée* (ATP, 2004-2007), introduced by CIRAD, has provided the scientific framework for our research procedures, which mainly entail focus groups and guided interviews on the structure of the agricultural calendar, and a "mobility questionnaire" directed to the herders *(aynaabe)* since they are generally responsible for annual herding practices. Our field studies have also enabled us to capitalise on data describing environmental dynamics around the *lac de Guiers*.
The results of the computer-processed data encouraged us to demonstrate that the pastoral agenda, used as a livestock management tool, was composed of risk minimisation strategies developed by the local producers.
The presentation adopts two angles to the endogenous climate risk minimisation strategies: the temporal angle which is related to the annual planning of pastoral activities and the spatial angle which refers to the land areas used in the pastoral agenda.
As a conclusion, we explain lessons learned from this endogenous planning model in order to consider the replication of the model and its contribution to decentralised territorial management.

Keywords: livestock production, climate change, hydro-agricultural installations, actors' strategies, decentralization, environment, risks, natural resources.

Agropastoral activities, natural resources management and desertification control

Mama Djaouga[1,2], Torou Chabi Bogo[1], Cossi J. Houndagba[1], Brice Sinsin[2]
[1]*Laboratoire de Biogéographie et d'Expertise Environnementale, LABEE/FLASH/UAC, Université d'Abomey-Calavi, Bénin*
[2]*Laboratoire d'Ecologie Appliquée, LEA/FSA/UAC, Université d'Abomey-Calavi, Bénin*

Abstract: The study on agropastoral activities, natural resources management, and desertification control was carried out in the Kalalé Commune in northeast Benin. The purpose was to analyze the effects of man's agropastoral practices on the overall deterioration of biological, social and agro-ecosystem regulation mechanisms confronted with climate change. The main methods involved desk studies, socio-economic surveys, the recording of GPS coordinates and diachronic mapping of agropastoral lands. Specific methods were used to process the data. Results show that the needs of the Kalalé population have grown during the last few years to a stage that has created an imbalance between the production methods and the available natural resources. Current farming techniques will not be able to maintain an ecological equilibrium, although agroforestry techniques, based on cashew trees, are used to protect the soils and secure land tenure.
When managing rangelands and arable lands, it is important to take account of the agrosylvopastoral integration of the various production systems and to ensure sustainable natural resources management.
Keywords: Agropastoral, management, desertification, ecological, change, climate change, Kalalé, Bénin.

Adapting to climate change in the Caribbean: rural communities' wish list

Candice R. Ramessar
Eastern Caribbean Trading Agriculture and Development Organization (ECTAD), Caribbean Farmers Network (CaFAN) St Vincent and the Grenadines

Abstract: Climate change represents a serious developmental challenge to the small island states of the Caribbean region. Its projected impacts will be felt greatly in the coastal communities, rural populations and agricultural sector. This paper will describe, in brief detail, the projected impacts of climate change on the Caribbean regional agricultural sector. It will then assess the various national and regional initiatives (and proposed frameworks) for mitigating the effects of climate change in the Caribbean's agricultural sector. Whilst laudable, these frameworks are too often centralized at the governmental planning level, which means that they very rarely filter to local agricultural and rural communities. In other words, they rarely reach the very sectors that are most vulnerable to climate change. An examination of rural communities in the region confirms that the local knowledge and capital needed to assess its vulnerability, respond to emergency situations, mitigate risks, access links to governmental and other resources and increase its resilience is not very readily available. A list of suggestions on increasing local participation and action, including the use of local knowledge in the existing frameworks, is presented in the paper. The paper also explores a wish list of practical requirements for rural readiness to climate change.

Enhancing the resilience of small-scale fisheries to climate change

Ann Gordon
The WorldFish Center, Egypt

Abstract: Fisheries and aquaculture make a significant contribution to development. Fish provides nutritious food, fishing and fish farming generate income and employment to millions of poor people, and trade in fishery products contributes to poverty reduction and national economic growth in many developing nations. Climate change, however, presents a challenge for fisheries and aquaculture. Global warming affects aquatic ecosystems and their fishery productivity. Fisheries and aquaculture are also threatened by the secondary effects of warming: changes in ocean currents, precipitation that affects lake levels and river flows, and increasing storminess and extreme floods and droughts. This makes living near water and catching or farming fish more hazardous than it is already.
While greater climate variability and uncertainty complicate the task of governing fisheries and expanding aquaculture sustainably, this sector can also strengthen the ability of communities to maintain their livelihoods in the face of a changing climate. Fish can provide opportunities to adapt to climate change by, for example, integrating aquaculture and agriculture, which can help farmers cope with drought while boosting profits and household nutrition. Fisheries management must move from seeking to maximize yield to increasing adaptive capacity. Research is needed to find innovative ways to further improve the existing adaptability of fishers and aquaculturists.

Participatory information platform on the adaptation of vulnerable communities to climate change (Infoclim)

Amadou Sall, Assize Toure
Centre de Suivi Ecologique (CSE), Sénégal

Abstract: Climate change obliges Sahelian communities to face the difficult challenge of surviving in a fast-changing, fragile environment. To cope with this challenge, local and national actors need to become aware of the phenomenon, monitor change as it occurs in the field, and prepare adaptation and predictive strategies. Recognising that the availability of good quality information is central to working out solutions to problems of natural resources management and that, furthermore, knowledge-sharing is a precious tool for innovation and decision-making, the *Centre de Suivi Écologique* (CSE) in Senegal, with the help of the Climate Change Adaptation in Africa (CCAA) programme run by the International Development Research Centre (IDRC), has started a project to create a participatory information platform on the uptake of scientific information, local adaptation strategies, and policies to reduce the vulnerability of rural populations in Senegal to the impacts of impending climate changes. The InfoClim project works with several villages in four local communities in the Thiès region. The InfoClim project approach advocates working with the producers (farmers, horticulturists, livestock producers), rural community organisations, NGOs and local decision-makers. The InfoClim platform is also going to be open to national decision-makers, especially the *Comité National sur les Changements Climatiques du Sénégal* (COMNACC). The project was started about a year ago and intends to capitalise results from the IMAP research projects conducted between 2003 and 2006 with the *École Polytechnique Fédérale de Lausanne* (EPFL).

POSTER PRESENTATIONS

Effects of rainfall, temperature and humidity patterns on production levels in crop-livestock systems in Uganda

Mubiru S. L.[1], Nanyeenya[1] W., Ssali[2] A.

[1]*National Livestock Resources Research Institute (NaLIRRI), Uganda*
[2]*National Crop Resources Research Institute (NaCRRI), Uganda*

Abstract: Effect of climate change on production in crop-livestock systems is mainly expressed through depression of crop yields. Reduction in productivity of livestock also subsequently occurs as a result of their dependence on crops and pastures. Changes in temperature affect livestock feed intake and milk production. Studies done in Uganda analyzed patterns of rainfall (RF), temperature (T) and relative humidity (RH) in Mbarara, Masaka and Jinja districts over a period of nine years. Patterns were also studied in relation with current crop and livestock production levels. General Linear Regression showed that over the nine year period, rainfall was decreasing, however, although the model was statistically significant ($p<0.01$) the patterns within each district were not. Rainfall was highest in Jinja (1380 mm $year^{-1}$) and lowest in Mbarara (960 mm $year^{-1}$). Minimum T in Mbarara was increasing with a coefficient of 0.051 ($p<0.05$) and maximum T in Jinja with a coefficient of 0.078 ($p<0.05$). Regression models for RH showed increasing trends for the 9am recordings and a decreasing trend for the 3pm recordings. Yield response patterns for bananas, beans and elephant grass showed sensitivity to climatic pattern. This was expressed through the effects of the season of growth in the year (long or short rains) and the district where the field was located on yields. Feed availability (kg DM TLU^{-1} $season^{-1}$) for dairy cattle in Jinja, where RF was highest, was five-folds that in Masaka. Similarly, daily milk yields (kg TLU^{-1}) in Jinja were approximately two-folds those in Masaka and Mbarara.

Gender, pastoralism and climate change in northern Kenya: vulnerability & adaptation

Akinyi N. Omolo
Governance, Gender and Climate Change African Regional Forum on Sustainable Development (ARISUD), Kenya

Abstract: Pastoralism is an important means of earning livelihood in the Arid and Semi-arid lands (ASALs). Pastoralists constitute 13.2% of Kenya's 30 million people and their livestock accounts for 70% of the country's livestock. To date, there has been no studies performed to identify indigenous and emerging technologies, gender dimensions of vulnerability as well as socio-economic, and policy constraints of adaptation to climate change in Turkana and Mandera. A participatory approach was used in collecting data through adoption of open ended questionnaires which were administered to the participants in groups. Disaggregated data was collected and analyzed by age and sex. The results have clearly demonstrated that women are more vulnerable as compared to men since climate change affects the poor more and women constitute 70% of the poor in developing countries. Pastoralists have a variety of indigenous and alternative strategies to improve adaptability while reducing risks caused by climate change. So far, there is no specific Kenya government policy on pastoralism to enhance socio-economic development in the region. In conclusion, pastoralism has a great potential as an alternative livelihood for the majority of the population living in ASALs. Since the majority of the 50% of Kenyans leaving below poverty line are found in ASALs, investing in ASALs therefore is strategy for reducing poverty levels.
Key words: Adaptation, ASALs, Biodiversity, Climate Change, Gender, Livelihood, Participatory approach, Pastoralism, Turkana, Vulnerability

Effects of gradient and climate change on forage diversity in sylvopastoral systems in Senegal

Mayécor Diouf[1], Mame Sokhna Sarr[1,2], El Hadji Traore[3], Momar Wade[1], Samba Arona Ndiaye Samba[1]
[1] *L'Institut Sénégalais de Recherches Agricoles (ISRA)/Centre National de Recherches. Forestières (CNRF), Sénégal*
[2] *L'Université Cheikh Anta Diop de Dakar (UCAD), Département de Biologie végétale, Sénégal*
[3] *L'Institut Sénégalais de Recherches Agricoles (ISRA)/ Centre de Recherches Agronomiques (CRA), Sénégal*

Abstract: Livestock production is the main activity in the sylvopastoral zone in northern Senegal, and ranks second after agriculture as a source of revenue in the Sudanian part of the Senegalese groundnut basin. But drought in the 1970s seriously changed the diversity of fodder in the ecosystem which, in former times, was suitable for livestock production. This means that the natural pastures no longer provide adequate feed for livestock, and the animals now suffer from permanent feed insecurity. The study focuses on the analysis made of a series of vegetation observations, climate data and data from surveys on the population's perception of pasture degradation. The study is rounded out by work to characterize the fodder diversity in the pastoral systems and to optimize potential fodder species in order to improve fodder production in the sylvopastoral systems. In Senegal, the vagaries of climate over the last few years have strongly accentuated the climate differences between the north and the south, which resulted in a relocation of certain species, and changes in their diversity and dynamics. Some forage species endemic to the north Sahelian area, including Dioda scandens, seem to have invaded the pastures in the Sudanian part of the Senegalese groundnut basin. Higher stocking rates in increasingly smaller areas are leading to overgrazing and gradual elimination of a large number of fodder species. This means that the dynamics of these species, often related to gradient and climate change, also seem to be governed by the increasing anthropic pression of livestock in search of better grazing.
Keywords: Climate gradient, diversity, fodder, sylvopastoral zone, Senegal.

Climate change and the development of water resources in the Lac de Guiers area (Senegal): effects on potentials, access and uses

Aïssatou Wade, Amadou Tamsir Diop, Adrien Coly, Grégoire Leclerc
La recherche agronomique au service des pays du Sud (CIRAD), Sénégal

Abstract: For several decades the dynamics of water resources in the lac de Guiers area (Senegal) became increasingly pronounced because of climatic disturbances, land development and operating methods that caused changes which impacted the landscape in various ways, depending on the year, the season and the sub-zone. The impact was also conditioned by the socio-economic stakes, the agronomic value of the land and water access. Thus, in areas where most of the waters come from the river and/or the lake, changes in the availability and the conditions of access to the water can often be traced to the multiplicity of uses of these waters, decided upon as soon as the waters improved. Livestock production is being put to a difficult test in this region. In other zones, however, the dynamics of the pastoral landscape are reflected in the construction of permanent water installations and improvements in cattle health coverage. The high stocking rate in this area causes a major imbalance between supply and demand and forces the herders to go on the move early.
In conclusion, the unique dynamics of the pastoral areas in the zone near the lac de Guiers lead many observers to ponder about the future of pastoralism in these ecosystems, especially with increasingly pronounced phenomena linked to climate change.

Identifying the implications of climate change on agriculture and livestock production for ASARECA

Van de Steeg J. A., Herrero M., Naibei O., Thornton P.K
International Livestock Research Institute (ILRI), Kenya

Abstract: Agricultural Research-for-Development in Eastern and Central Africa (ASARECA) is a non-political association of research institutes in 10 eastern and central African countries: Burundi, Democratic Republic of Congo (DRC), Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania, and Uganda. It serves as a forum for promoting agricultural research and strengthening relations between the research communities. It focuses on solving agricultural research for development issues to attain economic growth, food security and eradicate poverty through the development of efficient, effective and sustainable agriculture. ASARECA follows a strategic research plan that helps them reach their development goals. However, this plan currently does not include the potential impacts of climate change on selected commodities or technological options that are promoted. Currently the International Livestock Research Institute is supporting ASARECA by undertaking a review of information of the state of knowledge of agricultural and pastoral implications of climate variability and future climate change within East and Central Africa (ECA). This study is considering the impacts of climate change on production systems, the magnitude of these implications and the consequences for agricultural commodities and natural resources at a range of scales ranging from the household and community level to those at district, national and regional levels. The study also includes an evaluation of technology options promoted by ASARECA and their effectiveness in the future in the face of changing climate. The information will be made available and disseminated to policy makers and rural communities to raise the awareness about the impacts of climate variability and climate change on agricultural and rural development. The research community of ASARECA will have easy access to the information enabling them to guide optimal decision making and target activities to protect their livelihood systems against climate change and to help to alleviate poverty.

Livestock movement and migration during crisis situations in the greater horn of Africa: experiences from the 1995-1997 and the 1999-2000 drought in dry areas of Kenya, Uganda, Ethiopia and Tanzania

J. Ndikumana
ASARECA Livestock and Fisheries Programme, International Livestock Research Institute (ILRI), Kenya

Abstract: Mobility and migration is a key strategy utilized by pastoralist communities in the Greater Horn of Africa (GHA) to cope with the devastating effects of crises particularly drought on their livestock. Two studies carried out by the ASARECA Animal Agriculture Research Network between 1998 and 2000 looked into traditional coping mechanisms in pastoral systems of the GHA covering drought prone areas in Ethiopia, Kenya, Tanzania and Uganda. Mobility was observed to be an inherent strategy that pastoralists use to optimize production off a heterogeneous landscape under a precarious climate. The search for water (for human and livestock consumption) and forage triggered mobility and migration, strategies that were most intensified by drought.
During the 1995-97 drought, distances trekked to livestock water sources were almost tripled during the drought, from an average (across zones) of 5.9 km pre-drought to 15.8 km during the drought; pure-pastoralists trekked greater distances than agro-pastoralists. Distances to grazing sites also increased, from an average (across zones) of 5.5 km pre-drought to 20.4 km during the drought, with pure-pastoralists trekking greater distances than agro-pastoralists.
A major lesson learnt from the two studies is that crisis situations such as severe droughts are community managed and it is concluded that information should be gathered on the distribution of forage and water resources, market places, diseases and security hotspots along migration routes. This information may be used to develop appropriate interventions and contingency plans for crises managements in pastoral systems, and shape appropriate strategies and policies for optimization

of resource use and productivity of the rangelands. Formulated policy should be subsequently implemented in line with general principles of the community based resource management model. The interventions should be entrenched in existing community institutions and ecosystem states to ensure sustainability.

C. BIOPHYSIQUES ISSUES

ORAL PRESENTATIONS

Best practices on sustainable land management and forestry for reversing land degradation and mitigation of the impacts of climate change

Tesfai Mebrahtu
GTZ Sustainable Utilization of Natural Resources Program, Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), Ethiopia

Abstract: The agriculture sector is the back bone of Ethiopia's economic growth contributing to about 50% of GDP, 90% to export revenues and 80% of employment. This important sector is threatened by severe land degradation. About 85% of the land surface of the country is considered prone to moderate to severe land degradation. Over 1.5 billion tons of top soil is estimated to be lost each year due to soil erosion. Although land degradation is attributed to many factors, loss of vegetation cover is the main factor aggravating land degradation. Ethiopia's natural forests are believed to have covered about 40% of the country's land surface some fifty years ago, but have dwindled to a mere 3% currently. The estimated 77 million heads of cattle and shoats which are mostly grazing in the highlands (beyond the carrying capacity) contribute to the slow recovery of rangelands. The agricultural sector and the livelihood small holder farmers are further threatened by micro and macro climatic changes which are observed worldwide. Changes in precipitation patters (less, excessive, late onset), occurrence of hailstorms and increased temperature have been observed in many parts of the country in the past many years.
The government and development partners have acknowledged the need for devising new ways of reversing land degradation as well as mitigation of the effects of climatic changes. The country has been applying a diverse set of interventions to reverse land degradation. There are many good practices resulting from the interventions of the government, development partners, NGOs and individual farmers. However, these isolated and uncoordinated efforts did not put a dent on the rapidly expanding rates of land degradation. The new approach being pursed by the government is the scaling up of integrated and mutually reinforcing best practices in micro watersheds (200-500 ha) so that tangible improvements in livelihood of farmers are linked to sustainable land management. Efforts are underway to screen best practices (technologies, approaches, species, procedures, etc) from all over the country on sustainable land management for wider dissemination. The German Development Cooperation (GTZ) has been involved for many years in the introduction and testing of innovative technologies, approaches and species appropriate for sustainable land management and has already identified some for inclusion in the scaling up efforts of the government. The paper will present some of the best practices on land rehabilitation including forestry interventions outside the micro-watersheds developed with the support of GTZ. Emphasis will be given to the reclamation of gullies, agro-forestry, enclosures and community based forest management.

Agroforestry, a viable choice in climate change adaptation in West Africa

S. K. Adessou, L. Faye, S. Dembele
Investir Dans l'Humain (IDH), Togo

Abstract: The African continent as a whole and more specifically West Africa must cope with numerous challenges in this, the 21st century, including its vulnerability and adaptation to climate change.
Considering the models that predict a reduction of up to 9% in potential farmlands in the 2080s and a drop in cereal yields of close to 10% (Fisher, 2002) by the year 2050, and the IPCC report indicating potential yield drops from rainfed agriculture of about 50% by the year 2020 in certain regions of Africa, agricultural activities must, without delay, adopt a genuine natural resources management approach.
A multicriteria analysis designed to evaluate the contribution of certain options to climate change adaptation shows the value of agroforestry practices that, as a corollary, include natural resources conservation.
The methodology used starts with the preparation of a list of potential adaptation-promoting options and criteria, then constructs weighting and classification tables for these options on the basis of their advantages and drawbacks.
In order to promote sustainable options for adapting agriculture to climate change, all the while protecting the environment and guaranteeing regular agricultural output levels in West Africa, it is recommended that development policies and programmes, post-2012 negotiations and climate change adaptation plans assign a major role to agroforestry.

Caribbean: integrating biofuels into existing agricultural systems

Wilson M. R.
Sugar Industry Research Institute, Jamaica

Abstract: The Caribbean as a traditional sugarcane producer has the capacity to develop a sustainable biofuels industry, producing fuel grade ethanol, generating electricity from bagasse and producing biogas. Increased production of biodiesel from oil nuts eg *Jatropha*, castor seed and palm is possible and crops can be intercropped with sugarcane. The development of a sustainable biofuels industry will increase the competitiveness of traditional agricultural-based industries, allow countries to partially meet their energy needs, export to several markets and play a useful role in tackling climate change.
Legislation mandating the local production and use of biofuels has been found to be the driving force for the development of the Brazilian biofuels industry and so this should be the first step implemented to provide the framework within which Science, Technology and Innovation coupled with effective communication strategies and a participatory approach can be employed to rapidly advance biofuels production. Policy coherence is encouraged, nationally among the different Ministries as well as between national policies and those of the EU and the USA, which will seek to buy surplus biofuels. Effective information and communication strategies engaging civil society are needed to inform and foster full support.
Caribbean territories must act now and build on the partnership agreements with Brazil and other Governments and foster relationships with companies owning proprietary information so that the most efficient conversion technologies can be employed will allow for the building of local skills, development of research capabilities and stringent management protocols to protect and sustain the environment.

The "Power" of an Invasive Species: Exploring *Cuasarina* Farms for Biomass Gasification in the Bahamas

Devon O. Niel Gardner
School of Sciences and Technology, College of the Bahamas, The Bahamas

Abstract: Lately, there has been a rash of calls for Bahamians to turn to large-scale farming to address skyrocketing fuel and food prices. The fact is however, that since the failure of loyalist plantations, large-scale agriculture has never worked here – except for a few brief exceptions such as the export trade in pineapples and sisal during the 19th century. Bahamian conditions are seemingly not conducive to commercial agriculture.
One plant does however seem to thrive especially well in the harsh soil and climatic conditions of The Bahamas; the *Cuasarina Glauca*, commonly known as the Australian suckering pine, is categorized as an "invasive species". Clearly, the *Cuasarina* has "out-competed" other more indigenous plants to eke its place as one of the commonly encountered plants in the Bahamian natural environment. Cultivating the same on a commercial scale will therefore require very little input. Further, *Cuasarina* farms may occupy large portions of government lands that are marginal for traditional agriculture or housing and will therefore not compete for space with either.
The C*uasarina* has one of the highest known caloric content – 5,000 kilocalories per kilogram of dried wood and application of relevant renewable energy technologies can transform this significant potential energy that is locked within its carbonaceous trunks into useful forms for electricity generation. This presentation will explore the pre-requisites for development of a sustainable agricultural sector around this activity and examine its role in effecting poverty eradication, energy sustainability and climate change mitigation in The Bahamas – a country of over seven hundred isles and cays in which fuel transport is a significant economic and environmental costs.

Climate change in semi-arid areas. Integrated management of drylands and wetlands for mutual benefit

Brouwer J.
Brouwer Envir. & Agric. Consultanc, Netherlands

Abstract: Climate change will increase uncertainty for farmers in the Sahel. There are two main ways in which dryland farmers can attempt to deal with this uncertainty: diversify to reduce risks, or move to local wetlands, where water and nutrients collect and production risks are lower. In Niger alone there are more than 1000 such isolated permanent and semi-permanent wetlands. These wetlands, however, also have important uses for other activities than cropping, including pastoralism, fisheries, collection of natural products and biodiversity. In the proposed presentation interactions between drylands and wetlands will be discussed. For instance: no wetland, then often no water for livestock and no manure for the fields. No dryland, then no grazing for the livestock and no manure for increased production in the wetlands. It will be shown how climate risks in dryland agriculture can be reduced, and nutrient use efficiency increased, through better knowledge of soil and crop growth variability. And how participative integrated natural resources management (PINReM) can contribute to wetlands health for the benefit of the people in the drylands as well as at the wetlands. A checklist for such PINReM will be presented for discussion.

Addressing land degradation in Tanzania: contemporary issue related to policies and strategies

Mongi H. J.[1], Majule A. E. [2], Mushi R.[2], Andrew B.[2], Ndesanjo R.[2]
[1]*Tumbi Agricultural Research Institute, Tanzania*
[2]*Institute of Resource Assessment, University of Dar es Salaam, Tanzania*

Abstract: Several attempts have been made since the early years of independence of Tanzania to

address land degradation. Policies and strategies were formulated that emphasized on the importance of land conservation in achieving economic growth. However, the context in which the earlier strategies were designed and implemented led to further land degradation. Failure of these interventions was partly because policies which backed them remained sectoral and most of them adopted the top-down approach with very little involvement of communities. The United Nations Conference on Environment and Development (UNCED) of 1992 in Rio de Janeiro created a new chapter in the country by insisting on the importance of sustainable development. The new policies and strategies were formulated with intentions to correct the past mistakes. This paper has assessed the extent to which Tanzania's post-UNCED policies and strategies address the recent challenges of climate change on land degradation as reported by the IPCC in 2007. It involved review of selected policies, strategies and related literature on land degradation and climate change. The National Strategy for Growth and Reduction of Poverty (NSGRP) and two other sectoral strategies were reviewed in addition to the environmental, agricultural and water policies. The study finds that significant short and long-term measures to combat the negative effect of land use practices on the land resource are addressed. However, constant review of the policies and strategies is required to ensure that emerging challenges are addressed as part of the overall efforts to combat impacts of global climate change.

Climate change and farmers' strategies for sustainable management of farmlands: the pilot project in the *plateau central* (Zondoma province – Burkina Faso)

Hubert N'Djafa Ouaga[1], Seydou Traore[1], Moussa Sanon[2]
[1]*Centre Régional AGRHYMET, Burkina Faso*
[2]*l'Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso*

Abstract: Global warming is a source of concern and is causing the international community to worry about the foreseeable short- medium- and long-term effects on human, animal and plant life.
In its 4th report (2007), the Intergovernmental Panel on Climate Change (IPCC) indicated that climate change would have very pronounced negative repercussions on West Africa, especially the Sahel. Land degradation and water shortage are among the many, most plausible impacts mentioned and lead to lower agricultural output. Climate variability and change can already be seen as major and potential inhibitors to sustainable development in the Sahel. Because of their production systems' strong dependence on natural resources and climate, the only alternative for the Sahelian populations, deemed especially vulnerable, is to adapt to the climate change.
In Burkina Faso, CILSS is implementing the pilot phase of the project on developing the capacity to adapt to climate change in the Sahel, funded by the Canadian International Development Agency (CIDA). This project has helped identify endogenous adaptation strategies for sustainable farmland management. The adaptation strategies, implemented together with the inhabitants of 24 villages in the Zondoma province, shows that these technology packages can be effective in increasing crop yields.
Keywords: Burkina Faso, Zondoma, Sahel, climate variability and change, adaptation, sustainable land management, yields.

Sustainable soil and water management technologies to mitigate climatic vulnerability in drought prone areas of Malawi

Amon Mkondambiri Kabuli
World Association of Soil & Water Conservation (WASWC), Malawi

Abstract: Land, water and climate management are essential ingredients for increased food security and sustainable livelihoods in Sub-Saharan Africa. This is particularly significant in countries whose populations are heavily dependent on smallholder rain fed agriculture. In Malawi for example, 90% of the population is rural–based and is engaged in subsistence farming. However

attainment of food security and sustainable livelihoods under these conditions are often compromised by poor investments in land, water and climate management techniques. While the former is caused by man made causes, the latter relates to natural causes as a result of recurrent droughts and floods. These climatic extremes have taken a toll on lives, health, assets and infrastructure of poor households. Despite this, farmers have shown to have vast and rich indigenous knowledge and skills acquired over a long period of time to diagnose and develop mitigating practices for land and water degradation. This has proved to be effective in determining which technologies to invest to counter climatic variability given the diversity of constraints at household level. In Malawi, as in many other parts of the Southern Africa, households have been observed to employ the use of various water harvesting structures, soil fertility management technologies and drought tolerant cultivars to survive the vulnerability context of their farming systems. The study concluded that researchers and policy makers need to broaden their understanding of farmer and community preferences with regard to selection of land and water management technologies to better manage vulnerability brought about by climatic changes.

Monitoring and predicting weather, climate and related events for improved decision making in the Caribbean

Adrian Trotman
Caribbean Institute for Meteorology and Hydrology (CIMH), Barbados

Abstract: In the Caribbean, farmers often rely on their experience with weather and climate to aid in making decisions on their farms. However, most farmers have been lamenting about changes in weather patterns, particularly rainfall, which bring their many years of experience to naught. “No more can we rely on traditional knowledge of weather and climate” they say. This emphasizes the importance of monitoring and scientifically predicting weather and climate. The Caribbean Institute for Meteorology and Hydrology’s (CIMH) mandate is to develop the meteorological and hydrological services as well as providing the awareness of the benefits of meteorology and hydrology for the economic well-being of the CIMH Member States through training, research, investigations, and the provision of related specialized services and advice. CIMH has taken on the concerns of the agricultural community in the region by taking steps toward monitoring and prediction the weather and climate. With the use of drought and precipitation indices and other indicators, the region is embarking on a major campaign to provide information on the status of drought and precipitation and to provide projections of future (up to 3 months) drought and wet conditions to enhance decision making. Weather models, such as WRF and MM5 will provide improved predictions of weather and, when coupled with hydrological models will provide predictions of flooding on a much shorter time scales (up to 48 hours). Efforts are also under way to improve monitoring of meso-scale weather events in the Caribbean region.
Keywords: Weather monitoring, climate monitoring, predicting, flood, drought, decision making, Caribbean

Strategies for promoting smallholder farmers’ stewardship of ecosystem services in Africa: wielding the stick or dangling the carrot?

Ajayi O.C.[1], Akinnifesi F.K. [1], Sileshi G.[1], Chakeredza, S. [1], Mng’omba S.[1], Mullila-Mitti J.[2], Gondwe F.M.T.[1], Kitalyi A.[3]
[1]*World Agroforestry Centre (ICRAF), Malawi*
[2]*Food and Agriculture Organization of the United Nations (FAO), Sub-Regional Office, Zimbabwe*
[3]*World Agroforestry Centre (ICRAF), Tanzania*

Abstract: Land degradation and, in particular declining soil fertility is one of the greatest biophysical constraints to food production in sub-Saharan Africa. For many countries that face seasonal food deficits, in the effort to reconcile present food deficits with future environmental debt, they often sacrifice the latter for the former. Some land use practices offer opportunities to achieve

the two seemingly opposing objectives by assisting farmers to replenish soil fertility (improve food production) and simultaneously help farmers to adapt to climate change, in addition to generating environmental services (e.g. carbon sink) which contribute to climate change mitigation. The diffusion of such technologies among smallholder farmers is however generally low due to several factors especially policy and institutional constraints. The dissemination of the technologies has primarily been based on sensitization, training ("sermons"), and "wielding the stick" (regulations and enforcements). Based on several studies carried out in southern Africa for over a decade, this paper highlights agroforestry as an example of technologies for meeting household food security and contribute to climate change mitigation and adaptation. It discusses how farmer adoption of such technologies can be enhanced through conditional incentive mechanism that reward farmers for the environmental services ("offering carrots") generated by specific technologies. In conclusion, policy options to explore existing opportunities for satisfying both food security and environmental services are identified.

Keywords: Agroforestry, Adoption, Externality, Path dependence, Policy, Southern Africa.

POSTER PRESENTATIONS

Abiotic factors influencing ecological diversity and productivity of baobab in the agroforestry systems of Benin

Assogbadjo A. E, B. Sinsin, P. Van Damme
University d'Abomey-Calavi, Benin

Abstract: Baobab (*Adansonia digitata L.*) is a multipurpose tree widely used by local farmers in Africa. The objectives of this study are to evaluate the ecological diversity in Benin of *A. digitata* populations across the climatic gradient, quantify the average productivity of its pulp, seeds, kernel and plan its restoration within the traditional agroforestry systems where it is threatened. The study was carried out in the Sudanian (9°45' - 12° N), Sudano-Guinean (7°30' - 9°45' N) and Guinean (6°25' - 7°30' N) zones of Benin. The density, morphology and productivity of the individual baobabs varied significantly from one zone to another. The zones with high values of potential evaporation, rainfall, relative humidity, temperature, pH water and percentage of fine silt are associated with a low seed and fruit pulp production. The higher the pH_{kcl}, the percentage of total nitrogen, organic carbon and organic matter, the higher the number of seeds produced by the individual baobab. The higher the clay and crude silt content of the soil, the better the productivity. The high values of C/N ratio and rainfall are negatively associated with biotic characteristics of the baobab. The distribution of the diameter classes shows that the species is facing a natural regeneration problem. There were very few individuals recorded with a diameter less than 100 cm. Based on the aforementioned outputs, the zones most suitable for baobab restoration are identified within each climatic zone for the benefit of the local people.

Transforming waste to wealth: *Gmelina arborea* fruit-pulp potentials for ethanol production as biofuel resource

Onyekwelu Jonathan C. [1], Adeniji, Abiodun O.[1], Sanni David M.[2]
[1] *Department of Forestry and Wood Technology, Federal University of Technology Akure, Nigeria*
[2] *Center of Biosystem Research, Biotechnology Institute, University of Maryland, USA*

Abstract: Enormous amount of biomass are wasted annually in Africa as they are not utilized, thus their conversion to forms beneficial to man will amount to transforming waste to wealth. *Gmelina arborea* fruit-pulp was investigated for ethanol yield as potential biofuel resource. Fruits were collected from plantations of six different ages. Fermentation agents were baker's yeast (*Saccharomyces cereviacae*) and palm wine. Distillation was carried out at 90°C. The distillate was subjected to spectrophotometry technique using ethanol standard solution (0.5%). Mean ethanol

yield ranged from 1.45 to 9.71% and 1.21 to 9.38% for fruit-pulp fermented with baker's yeast and palm wine, respectively. Baker's yeast yielded a significantly higher ethanol than palm wine. A significant effect of plantation age on ethanol yield was obtained. However, since there was no discernable pattern of ethanol yield with respect to plantation age, the significant effect could not be attributed to plantation age effect. It was concluded that *Gmelina* fruit-pulp has good potential for ethanol production and thus a good biofuel resource. The potential is better appreciated if the huge annual *Gmelina* fruit production and large extent of *Gmelina* plantations are considered. Utilizing *Gmelina* fruit-pulp for ethanol production will amount to transforming "waste to wealth" since *Gmelina* fruits are always left to waste as no use currently exist for them. Using ethanol from *Gmelina* fruit-pulp for biofuel could be a cheaper substitute for fossil fuel, would produce "zero emission" since it is renewable, thus leading to less environmental pollution and contributing to climate change adaptation.

Key words: *Gmelina arborea*, fruit pulp, ethanol yield, biofuel, plantation, fermentation agent

Commercial algae farming for sustainable energy and carbon free environment

Kibaya Robert, Rael Kampanya, Bagenda Henry
Kikandwa Rural Communities Development Organization (KIRUCODO), Uganda

Abstract: The purpose of this paper is to point out the usefulness of this technology and to find out how it can be developed in Africa to reduce the felling of trees for firewood fuel, and the increase in atmospheric CO_2 concentrations that result from it. The overall aim is therefore to conserve the environment. While a number of bio-feedstocks are currently being used for biodiesel and ethanol production, algae have emerged as one of the most promising sources especially for biodiesel production and algae paste used for other industries. This is a relatively new field of study and algae are not nearly as well understood as other organisms that have found a role in today's biotechnology industry. The burning of fossil fuel is the major source of the current buildup of atmospheric CO_2. Thus, identifying alternatives to fossil fuels must be a key strategy in reducing greenhouse gas emission. While no one single fuel can substitute for fossil fuels in all of energy sectors, we believe that biodiesels made from algae oils is a fuel which can make a major contribution to the reduction of CO_2 generated by power plants and commercial diesel engines. Algae technology offers the opportunity to utilize land and water resources that are, today, unsuited for any other use. Land use needs for micro-algae complement, rather than compete, with other biomass-based fuel technologies. We wish to propose the Growth of Algae Farms in Africa with the assistance of Custom Designed Algae Systems to help the earth and also provide employment for people.

Changing adversity to assets: biofuel generation potential of developing countries from municipal organic wastes

Muziri T.[1], F. Tagwira[2]
[1]*Midlands State University, Zimbabwe*
[2]*Africa University, Zimbabwe*

Abstract: The southern African region is anticipating an energy crisis in few years. The region's electricity generation capacity is failing to keep pace with the demands of expanding industry and domestic use. In cities of these developing countries however, large quantities of organic wastes are generated which are costly to dispose of and yet have potential use in generating biofuels. A purposive sampling survey was carried out to investigate the nature, quantities and composition of organic wastes generated by the city of Mutare. Data was collected using a questionnaire. Results from the survey showed that Mutare, a city with an estimated population of 300 000 people generates an average of 189 987.4 tonnes of dry organic waste, constituting 79% of all waste produced by the city. Waste emanating from marketing and processing of farm produce contributed

an estimated 37% of the organic waste generated. The survey also showed that the majority (>63%) of organic waste ends up at the municipal landfills. Decomposition of organic waste at the landfill generates CO_2 and methane, which are potential biogases. These gases are lost into the atmosphere contributing towards climate change through their effects on temperature and the ozone layer. The study therefore recommends anaerobic digestion of municipal organic waste to produce biogas. Municipalities are recommended to improve capacity to generate energy using low cost methods available in order to reduce their national energy demands and contribute towards reducing greenhouse gas emissions.
Keywords: Municipal organic waste, biogas, energy.

Managing drought for food security in eastern Nigeria

Joachim Ibeziako Ezeji
Rural Africa Water Development Project (RAWDP), Nigeria

Abstract: Around the World, hundreds of millions of men, women and children live in extreme poverty. Their poverty is multi-faceted: besides lacking money, they have limited access to education, suffer from poor health, have little political weight, and are vulnerable to all manner of external shocks such as droughts etc. Throughout Nigeria, people are becoming increasingly affected by extreme climate and environmental change events. Worsening droughts in particular is ruining the lives and livelihood of many households and have continued to hamper farming activities. Water mismanagement, inappropriate land use, as well as poor knowledge of anti-drought measures by farmers have led to land degradation such as soil erosion and loss of the soil's productive capacity to produce food. Also the limited potential for dry season farming through soil and water conservation, the non-employment of rain water harvesting technology, as well as conflicts over limited water resources have not helped the situation. Consequently, local livelihoods are being jeopardized while increasing poverty for thousands of farmers expands. Using the WOCAT methodology, this paper discusses how poor men and women in Owerri, eastern Nigeria; whose livelihoods are based on small-scale cropping and livestock agriculture sustainably harvest and use rain water through agronomic, vegetative, and structural measures. Underscoring the sheer grit, courage and the determination poor people bring to the endless challenge of survival; this paper concludes by underscoring the lesson that -individuals, households and communities are not passive in the face of economic change, and even climate change.

Water management and development issues in the arid lands of Cameroon

Anselme Wakponou[1], Frédéric Dumay[2], Monique Mainguet[2]
[1]*Département de Géographie, Université de Ngaoundéré, Cameroun*
[2]*Laboratoire de géographie zonale pour le Développement, Université de Reims Champagne-Ardenne, Paris*

Abstract: Climate variability in the Sudano-Sahelian and Sahelian parts of Cameroon cause sporadic droughts. The resulting desiccation leads to chronic water shortages for the local populations. Because of the increasing "Sahelianisation", prudent water management is essential in all activities. This article is based on an inventory of traditional farming techniques to combat the effects of run-off and to protect soils by storing surface waters in a plot-level micro-system to retain and infiltrate surface waters. It is based on direct observation and field studies.
Keywords: development, water, environment, management, Extreme North Province of Cameroon.

Poverty & land degradation: the effect of the rural womans role to climatic change in Uganda

Karamagi Ednah
Busoga Rural Open Source and Development Initiative (BROSDI), Uganda

Abstract: Uganda is one of the poorest countries in the world, with more than 70% of her population residing in rural settings. This population is highly dependent on agriculture for survival, with the women being the more productive gender. Culture in Uganda dictates that the role of a woman is that of feeding and taking care of the family, as well as bearing children to till the fields which are a main source of livelihood. She tills the land and sells the produce to fend for the family. Whereas she is the main income earner, the man is the decision maker in resource allocation; who often diverts family income to personal expenditures like drinking, polygamy, witchcraft and womanizing, leaving very little if any at all for more productive household expenditures. This is a common trend in the rural parts of the country where we work as BROSDI.
To meet the household and cultural expectations, she subconsciously engages in activities detrimental to the environment and climate. These include over cultivation, overgrazing, monoculture and digging in the swampy areas which are destructive farming practices. In addition, because she cannot afford electricity, she resorts to firewood and sometimes charcoal fuel for cooking and lighting. House construction ingredients are mud, clay, firewood and sticks that further degrade swamps, water levels and forests. These combined are destructive to the environment and eventual climate.

Sustainable agriculture as an adaptation strategy to climato-edaphic constraints in north Cameroon

Bring[1], Sadou Fernand[2]
[1]*Faculté des Arts, Lettres et Sciences Humaines, Université de Ngaoundéré, Cameroun*
[2]*Projet ESA –Sodecoton, Cameroun*

Abstract: By determining the evaporation deficit through a frequential analysis of statistically significant threshold overruns (median, lower quintiles, upper quintiles), this article shows that the North Cameroonian plains are in a region regularly constrained by rainfall problems, marked by droughts, but without a specific seasonal pattern. This upsets the calendar of agricultural activities in the region: re-sowing, floods, food shortages, soil degradation, etc. To cope with this situation, the local populations develop strategies or adopt those proposed by development support services such as the ESA project (water, soil, trees). These innovations (erosion control measures, agroforestry, crops under plant cover, production of organic manure, etc.) are remarkably effective in improving productivity and the cropping system.
Keywords: climato-edaphic constraints, adaptation strategy, sustainable agriculture, North Cameroon.

Solar Cookers offer alternatives for cooking in Atoll Countries

Koin Etuati[1], Akira Sato[2], Ryoko Matsumoto[2]
[1]*Secretariat of the Pacific Islands Applied Geoscience Commission (SOPAC), Energy -SOPAC Community Lifelines Programme, Fiji Islands*
[2]*Ferris University, Japan*

Abstract: Solar cooker demonstration and monitoring of performance in Kiribati and Tuvalu emanated through a collaborative partnership between SOPAC and Ferris University1 of Japan.

The demonstration of two types of solar cookers, Parabolic and a Hand-Made Cooker was carried out in Kiribati and Tuvalu in February and September 2008, respectively.
This provided the opportunity for locals to observe first-hand on how the technology works and gauge its applicability, particularly for atoll countries where there is limited biodiversity and fuel wood for cooking. The high cost of kerosene and LPG has further added burden to the atoll-country households' energy budget.
The Kiribati activity included the monitoring of performance of the Hand Made Cooker during a day. The results show a savings of 0.3 litres of kerosene (AUD0.43) – cost of 1 litre of kerosene is $1.30 – or a reduction of 9 litres of kerosene per month equivalent to about 22.401 kg of CO_2. During the monitoring, rice, fish, breadfruit, pumpkin, shell fish and octopus were cooked at different times of the day. Factors such as temperature, wind and cloud cover. The poster presentation will highlight two types of solar cookers being demonstrated and monitored in Kiribati and Tuvalu. The solar cookers can be replicated or re-designed to an appropriate model suitable for the community's needs.
Key words: solar cookers, performance, atoll countries

D. SOCIO ECONOMICS ISSUES

ORAL PRESENTATIONS

Vulnerability and adaptation to climate change: the case of the Ejura-Sekyedumase district of Ghana.

G. K. S. Aflakpui
Crops Research Institute, Council for Scientific and Industrial Research, Ghana

Abstract: This study was conducted in the Ejura-Sekyedumase District of Ghana to gain insight into the level of awareness to climate change, how vulnerable farmers are to climate change and how different groups respond and adapt to climate change. Questionnaires were administered to a total of 70 respondents chosen at random from 5 villages between May and June 2007. The study showed that more than 75% of the respondents are aware of climate change. They also perceived that the causes of changes climate were: felling of trees 54.3%, natural variability 35.7%, bush burning 2.9%, and others 7.1%. The changes they had observed in agriculture as a consequence of the changes in climate were: reduced crop yields 31.5%, more insect pests 27.1%, total crop failure 21.4%, and more diseases on crops 20%. The respondents indicated that male farmers were most vulnerable to climate change. The predominant means of adapting to climate change were to plant different crops, rotate crops, mulch, or plant short duration crops. The four most dominant coping mechanisms identified by the respondents were to purchase food from the market, produce charcoal, and sell their livestock.
Key words: climate change; vulnerability; adaptation; coping mechanisms

Reducing vulnerability through natural hazard mitigation, using hazard analysis critical mitigation points (HACMP)

Maximay, Steve V.
Science based Initiatives, Trinidad and Tobago

Abstract: A mechanism is proposed for decision makers and rural communities, utilizing available information and communication tools, to protect their livelihood systems from the effects of climate change. Hazard, Exposure and Vulnerability represent three sides of the Climate Change Risk Triangle. Reducing any side of the triangle lowers the amount of risk. Individuals and rural communities are limited in their ability to eliminate the climate change hazards or totally avoid exposure. In order to reduce vulnerability, a policy-led mechanism is proposed that can consolidate mitigation methods. The proposed framework provides a missing link in the natural hazard mitigation milieu, by establishing a structured, auditable system to amalgamate the disparate efforts of international, regional and national agencies. The approach is based on Hazard Analysis and Critical Mitigation Point (HACMP), will mirror the Hazard Analysis Critical Control Point (HACCP) principles and further institutionalize the critical point concept within the agricultural sector. It will also provide a structured mechanism to inculcate gender-sensitive, participatory methods into hazard analysis, vulnerability assessment and mitigation. The benefits to be derived as well as the implementation challenges are also acknowledged.

Vulnerability, poverty and adaptation to climate change in Burkina Faso

Léopold Some, Moussa Sanon, Youssouf Dembele, Bernadette Some
Institut de l'Environnement et de Recherches Agricoles (CNRST/INERA), Burkina Faso

Abstract: Climate change has become a clearly perceivable reality and already has serious repercussions on people and nature around the world.
As a poor, land-locked country, Burkina suffers severely from the deleterious effects of climate change. Burkina is one of those least-developed countries which are very sensitive to climate change because of the very limited resources they have to cope with the challenges of development and climate shocks.
The population's vulnerability and adaptive capacities were assessed as part of the preparations for the National Adaptation Programme of Action. The results were analyzed in relation to the poverty indices that had been worked out in the PRSP (Poverty Reduction Strategic Paper) for each region.
After presenting the general characteristics of the country and explaining the methodology that was used, we analyzed signs of climate change and their effects on the main sectors, i.e. agriculture, livestock production, forestry, and water resources. Then projections were made for climate variables in timelines 2025 and 2050. The most pronounced climatic factor is rainfall, which is prone to major seasonal and inter-annual variations that cause ever-more-frequent droughts and floods.
The national economy is driven essentially by the most vulnerable sectors, which generate the livelihood of 85% of the population and account for 40% of the GDP.
The rural populations are the driving force of the nation but suffer most from poverty: 52.3% of the rural population lives below the absolute poverty threshold, as against 19.9% of the urban population.
Climate change will indubitably aggravate poverty unless the appropriate, adaptive measures are adopted and popularized.
Keywords: Vulnerability, adaptation, poverty indices, climate change.

Lessons Learned from Vulnerability and Risk Reductions in selected Pacific Islands Countries

Pelesikoti N.
The Pacific Islands Applied Geoscience Commission (SOPAC), Fiji

Abstract: Pacific Island countries are highly vulnerable to natural and human induced disasters. Amongst the key challenges include risks posed by natural hazards such as cyclones, earthquakes, volcanoes, as well as extreme vulnerability to the effects of climate change. Although the frequency and types of disasters may vary considerably across the Pacific; there are generally the same high social, economic and environmental costs that continue into the medium and long term. It is widely acknowledged that climate change impacts and other hydrological and geological hazards can greatly reduce the ability of the Pacific island countries to achieve their sustainable development goals and in the worst case can even reverse the benefits of existing development. Pacific Island countries are further constrained by limited availability of human, institutional and financial resources to mitigate against the risks of climate change impacts. Therefore, Pacific Island countries resilience remains fragile, particularly as countries also faces increasing population pressures, become more urbanized, lose traditional knowledge and struggle with the challenges of globalization and modernization, changing social, economic and environmental conditions that impact communities' resilience. The challenge of achieving sustainable development goals, including the reduction of poverty, increasing economic growth and protection of the environment, will be undermined unless the impact of climate change, such as sea level rises, storm surges, prolonged drought periods and increase in the intensity and frequency of cyclones and typhoons on vulnerable communities and economies is addressed.

The "vulnerability identity matrix" approach for evaluating households' responses to climate change impacts

Dovie D.B.K.[1,2], Huddleston B.[3,] Witkowski E.T.F.[2]
[1]*IDRC Developmental Universities Project Department of Geography & Resource Development, University of Ghana*
[2]*School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, South Africa*
[3]*United Nations Food and Agriculture Organization (FAO)*

Abstract: The external interventions of mitigating climate change impacts often homogenize and conflict existing needs of society, a result of unclear existing models for understanding households' adaptation. As a result, households' livelihoods, mostly crops and livestock production are compromised, and exposing households to opportunistic risks such as poverty. A study of drought in South Africa's semi-arid savannas showed categories of households that responded to (i) effects of drought only, (ii) impacts only, and (iii) combination of the two. Four categories of identified stresses were, acute recurring, chronic, and intermittent stress. The ensuing vulnerability of households to drought was explained by matrices of demography, total livelihoods and other households' attributes. Resource poor, weak and least diversified households suffered food shortages, hunger and malnutrition, and depended mostly on wild resources (e.g. non-timber forest products). The study outcome was a "Vulnerability Identity Matrix" (VIM), which represents the boundaries and heterogeneity of adaptive capacity of households and the interventions elicited. Households with diverse livelihood options responded better to the impacts of the drought. Traditional safety nets constituted better adaptation. VIM is an outcome-based and pro-poor model for informing expectations from climate change impacts and risks. The VIM separated events occurring at the human – biophysical environment interface, differentiating between effects and impacts. It was observed that households respond differently to impacts of climate change events. Thus VIM provides rapid evaluation of the vulnerability of society to climate change impacts and managing ensuing heterogeneity for mitigation and interventions that are minimal of conflicts.

Impacts of climate change on farm income in Burkina Faso

Mathieu Ouedraogo, Léopold Some, Youssouf Dembele,
Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso

Abstract: This paper reports the results of the study to evaluate the economic impact of climate change on agricultural output in Burkina Faso. The study uses the Ricardian approach for modeling agricultural revenue in relation to climatic, edaphic, hydrological and socio-economic variables. Several econometric models, which were tested with reference to the database from the 2002-2003 growing season, have been used to analyse the effects of climate on farm incomes, by estimating the marginal impact of climate (temperature and rainfall) on agricultural revenue and the elasticity of this revenue in relation to climatic variables. Simulations were made using ICPP forecasts (2001).Results show that the marginal impact of temperature on agricultural revenue is US$19.90 per hectaure, and that of rainfall, US$2.70 per hectare. The elasticity analysis shows that agriculture is very sensitive to rainfall levels. The simulations show that, all else being equal, a 5% temperature increase would cause the farmers to lose 93% of their income, and a 14% decrease in rainfall would result in their total loss of income.Since climatic conditions are already harsh, prospects of rainfall decline and/or temperature increase would be very harmful to agriculture.
Furthermore, the study shows that irrigation and extension work favourable impact agricultural revenue and could be used as viable options to help agriculture adapt to climate change in Burkina Faso.
Keywords: Climate change, economic impact, agricultural revenue, Burkina Faso

Transformations in the lowlands of the Tararé watershed in the Serer region

Sarr Joseph, Dacosta Honoré
Département de Géographie, Faculté des Lettres et Sciences Humaines, Université Cheikh Anta Diop, Sénégal

Abstract: Spatial strategies are defined as forms of land use usually induced by constraints in an environment that supports a given population. Recent environmental transformations, mainly observed in the lowlands, reflect changes in the spatial organisation of activities. Improvements in the quality of life amount to a race between agricultural output (the mainly source of income) and population growth. This dialectic is attuned to the pace of population growth, as shown through spatial pressure with its multiple consequences for the Tararé watershed. A change in the landscape is forcing the local populations to adopt parallel solutions to the traditional ancient practices used in these low-lying areas. Traditional activities, e.g. livestock production, are seeing their favourite areas subjected to vying interests with the development of another type of agriculture, intensive agriculture, being combined with the expansion of the traditionally cropped local areas. This article considers the impact of climate change, with rainfall shortages, that obliges the local populations to adapt their behaviour so as to make better use of natural resources by controlling the low-lying areas of the catchment basin. This conquest, called transformation or spatial strategy in the Serer agricultural landscape, has led to the creation of a farming area that could improve living conditions substantially by combining endogenous and exogenous interventions in the Tararé catchment area**.**

Prioritizing farm-level skills that can assist grassroots communities in Africa cope with climate change

Nkwanga K.D.
Nature's Palace Foundation, Uganda

Abstract: In Africa, the most important impact of climate change at grassroots level is expressed in terms of deficiencies in food production i.e. escalating levels of food insecurity characterized by extreme hunger and malnutrition. In this regard, the impacts of climate change include a reduction in soil productivity; unpredictable-irregular seasons characterized by extremes of both dryness and precipitation that result into destructive floods; crop failure; escalating incidence of pest attacks; and decreased livestock productivity. Because of poverty, limited resources and poor infrastructure African countries are constrained to invest in and develop technologies to enable adaptation to global warming. Prioritizing and supporting farm-level skills integrated in agricultural activities promise a sustainable answer to concerns of food security, soil rejuvenation, and increased incidence of disease and pest attack for the poor subsistence farmers in the wake of climate in Uganda. These skills include cultivation of neglected traditional food crops highly adapted to local ninces and can provide sustainable production and food security of rural communities particularly under poor conditions; Diversified ecological-perennial-based agriculture, and innovative soil and water conservation techniques. Such skills which are integrated in the peoples day-to-day activities are easy to adopt, cheap and culturally acceptable and are easy to replicate.
Climate change must be viewed not only as a danger to natural systems, but more so as a direct threat to human survival and well-being. Efforts on adaptation must include vulnerability assessments, enhanced resilience to climate impacts, building human and institutional capacity in making countries less vulnerable to climate change.

Climate change and variability information access and adaptation: the case of smallholder farming communities in Zimbabwe

ChambokoT.[1], Mtambanengwe F.[2], Chikowo R.[2], Mapfumo P. [2,3], Mekuria M.[4]
[1]*Department of Agricultural Economics and Extension, University of Zimbabwe*
[2]*Department of Soil Science and Agricultural Engineering, University of Zimbabwe*
[3]*Soil Fertility Consortium for Southern Africa (SOFECSA), CIMMYT- Zimbabwe*
[4]*CIMMYT Southern Africa Regional Office, Zimbabwe*

Abstract: Adaptation is key in shaping the future severity of impacts of climate change to rural communities. As part of an Africa-wide research initiative, a cross-sectional survey of 208 households was conducted in Chinyika and Wedza smallholder farming communities in Zimbabwe. The main objectives of the study were to establish (i) farmers' understanding of climate change and variability, (ii) degree of access to climate change information, and (iii) current adaptation strategies. Fifty-eight percent of farmers reported having access to climate change and variability related information through the national media including radio and television. Notable concerns were raised over inadequacies of such information, apparent lack of reliability, as well as issues of timing and frequency of dissemination that directly influenced the utilization of the information on appropriate farmers' adaptation strategies decision making. The study also indicated that farmers were already responding to climatic changes and seasonal variability. Common adaptation strategies included adoption of suitable crop varieties, practicing winter ploughing, water conservation techniques such as tied ridges, and use of leaf litter and manure. However, the link between such behavioral changes and access to climate change information could not be clearly defined. Long term sustainability of agricultural systems in the context of global climate change requires that smallholder farmers are able to access relevant and appropriately packaged climate change information to enable them to make informed decisions. This has policy implications on strategies for providing farmers with climate change information for development and transformation of smallholder farms into economically sustainable units.
Key words: access to information; adaptation strategy, smallholder farming communities.

The impact of climate change on the household economy: a case of drought impact in Malawi

Franklin Peter Simtowe, Aliou Diagne
The Africa Rice Center (WARDA), Benin

Abstract: Drought is one of the most serious adverse climate hazards that have hit most of the developing world including Malawi over the last several decades although it's frequency, intensity and magnitude increased over the last two decades. This study examines the impact of drought among households in Malawi. It is identifies the factors that explain who and what is at risk and why (i.e., the underlying factors behind the vulnerability) – including human-induced global climate change. The specific objectives of the study are:

1 To assess the impact of drought on food and livelihood security situation in Malawi
2 To analyze household's drought-coping mechanisms and identify factors that influences the choice of such mechanisms and
3 T o examine the extent of household resilience to drought and its determinants.

Results indicate that drought had negative impact on household food security, consumer prices, water availability and the availability forestry and fish resources. Results further revealed that irrigation improved household resilience to the impact of drought. The knowledge of whether or not a drought will occur (early warning) also improved the household's resilience to drought as households with prior expectation of the occurrence of drought recovered from the shock much faster than households that lacked prior knowledge of its occurrence. The findings suggest that there is scope for using early warning system and irrigation to mitigate the negative impact of climate change.

POSTER PRESENTATIONS

The Potential impact and adaptation of climate change on smallholder farming and food security in Shire Valley, Malawi

Isaac R. Fandika[1], Shamie Zingore[2]
[1]*Kasinthula Agricultural Research Station, Malawi*
[2]*CIAT-TSBF, Chitedze Agricultural Research Station, Malawi*

Abstract: Climate change is among HIV/AIDS, chronic malnutrition, land and soil fertility decline pandemics that the Shire Valley, Southern Malawi is seriously facing. The region is very vulnerable to the effects of changes in weather patterns from both the physical and the socio-economic view. This paper objectively and subjectively analyses the physical adverse effects of climate change on smallholder farming and food security and its adaptation basing on previous reports and current experiences. Several reports show that climate change has been strongly evidenced through increased disasters traced back to the 1991/92 Southern Africa droughts that caused suffering to over 6.1 million people. Physically, farmers in Shire valley are experiencing extreme temperature and evaporation change such that certain crops are grown near their limits of maximum temperature tolerance. Disasters have continued to escalate in Shire Valley since 1990s. The number of districts affected has also increased from nine in 2001 to 16 and 22 in 2002 and 2003 respectively, causing deaths and damaging homes and crops with the highest in Shire Valley. The impacts of climate change due to floods and erratic rain are causing soil erosion resulting in river silting, soil fertility losses and soil moisture deficit. Both disasters results into serious damage to crops and high pest and disease incidences that results Shire Valley into annual food insecurity. Both disasters are also responsible for the destruction of fish and wildlife habitats, displacement of people and environmental degradation in the valley. Impacts resulting from changes in the precipitation pattern, shortages of fresh water resources, loss of already scarce vegetation cover, increased desertification and associated socio-economic impacts need detailed studies. It is observed that climate change is a threat to national security in the Shire Valley, for it does not only

reduces natural resources supplies but also increases the amount of resources needed for animal and plant use. Malawi government is widely adapting to climate change through high-efficient, water-conserving irrigation technologies, integrated soil water and nutrient management research, breeding of heat- and drought-resistant crop varieties that adapt new climatic conditions, disease and pests pressure. But the limitation to the adaptations is that adaptation cannot be taken for granted for improvements in agriculture have always depended upon the investment that is made in agricultural research and infrastructure. It would help to identify, through research, the specific ways that farmers can now adapt to present variations in climate.
Keywords: Shire Valley, Climate change, drought, floods

Vulnerability to climate change and climate variability in the greater Horn of Africa

Kinyangi J., Herrero M., Thornton P.K, van de Steeg J. A., Omolo A., Notenbaert A.
International Livestock Research Institute (ILRI), Kenya

Abstract: The ability of African institutions and people to adapt climate change impacts is limited by social, technological and environmental factors including, widespread poverty, fragile ecosystems, weak institutions, and ineffective governance. By scoping vulnerability to climate change and climate variability, we propose a framework for developing adaptive capacity through regional institutions involved in climate science research and policy implementation. Survey information from project partners is used to scout for gaps in regional climate data, as well as gaps in assessment of climate sensitive sectors and projects. Climate–sensitive sectors represent environmental conditions encompassing biophysical endowments in agriculture, water and health as well as human capital within social and institutional structures. Basic knowledge elements were combined with spatial mapping to identify dynamic drivers of vulnerability at different spatial and temporal scales. The resulting output provided trends in present and future vulnerability of the human population, climate sectors and agricultural livelihood systems. By deriving hot spots of change, their characterization is intended to help decision makers to define areas where policy efforts could be directed to reduce vulnerability and to facilitate adaptation. Through a systems approach, this study maps human population projections and describes evolving livestock systems as robust indicators of climate impacts on crop-livestock productions systems. The study further presents a regional framework for increasing adaptive capacity in the horn of Africa. It aims to support future planning and to inform climate change projects, their design and implementation through targeting the most vulnerable people and institutions.

5. PANEL ON FUNDING OF ADAPTATION PROGRAMMES ON CLIMATE CHANGE IN ACP COUNTRIES, DONORS / INSTITUTIONS

Sustainable agriculture and climate change -GTZ perspective and research approaches in Africa

Lea Herberg, Kerstin Silvestre Garcia
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Germany

Abstract: Estimations show that agricultural productivity in developing countries will be decreased substantially by climate change. Therefore, adaptation measures will become essential in the near future. At the same time agriculture is contributing to greenhouse gas emissions, particularly of methane and nitrous oxide and thus contributing to climate change. Consequently the agriculture

division of GTZ considers agriculture in this dual role and looks at sustainable agriculture as an answer to adapt to climate change and to mitigate greenhouse gases.
Sustainable agriculture increases the water retention capacity of soils as e.g. organic matter in soils is increased or through diverse adapted cropping systems which help farmers to cope with climate change. In contrast to conventional agriculture with a high external input, sustainable agriculture also contributes to the mitigation of greenhouse gases through a reduced use of chemicals and the promotion of soil carbon storage. Besides these practical approaches a precise understanding of the local and regional consequences is still lacking but is essential to deal with climate change. To develop measures of adaptation to climate change, the Federal Ministry for Economic Cooperation and Development (BMZ) assigned the Advisory Service on Agricultural Research for Development (BEAF) with the design of the research priority area "Adaptation of African Agriculture to Climate Change". Nine projects were selected: Five international agricultural research institutes (CIP, ICRISAT, IFPRI, ILRI, IWMI)2, two German universities (Göttingen, Hohenheim) and one of the Leibniz centres (ZALF)3 have received research funding totalling EUR 10 million for the programme, which is scheduled to run for three years. There is a manifold network between the participating institutes and universities to achieve an interdisciplinary and multi-institutional cooperation. Professional tasks range from climatology over classical agricultural disciplines - cropping systems, plant breeding, grazing management and agroforestry - to water management and policy research. Regional focuses are in West Africa as well as Eastern Africa.
Keywords: Climate change, agriculture, research, Africa, climatology, cropping system, plant breeding, grazing management, agroforestry, water management, food policy, non-governmental organization, famer association, national agricultural research center, sustainable agriculture

Impact of climate change on interactions between soil degradation and agricultural production systems in the CILSS zone. Policies and strategies implemented by CILSS

Edwige Botoni, Hubert N'Djafa Ouaga, Dramane Coulibaly
Le Comité Permanent Inter Etats de lutte contre la Sécheresse dans le Sahel (CILSS), Burkina Faso

Abstract: According to forecasts on the evolution of climate, the production systems in the Sahel are among the most vulnerable because of the overriding role of rainfed agriculture and the weakness in harnessing water. Actually, the various drought episodes in the Sahelian countries have produced evidence of the great vulnerability of the ecosystems and the populations when faced with climate change and variability. The birth in 1973, of the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), was a sign of the sub-region's awareness of the need for a collective response to cope with the harmful effects of climate change and variability. Since its creation, CILSS has been implementing strategies and policies to mitigate the effects of drought via a series of actions: running drought and food security early warning information systems, knowledge production and capacity-building for state agents, and support for local populations in micro-projects to hold back land degradation in order to reduce project vulnerability to climate change.

Adaptation programmes to climate change (CRDI/DFID)

Butare Innocent
The Internetional Development Research centre (IRDI), Senegal

Abstract: The Climate Change Adaptation in Africa (CCAA) research and capacity development program was launched in 2006. It is jointly funded by Canada's International Development

[2] CIP: International Potato Center, ICRISAT: International Crops Research Institute for the Semi-Arid Tropics, IFPRI: International Food Policy Research Institute, ILRI: International Livestock Research Institute, IWMI: International Water Management Institute
[3] ZALF: Leibniz-Centre for Agricultural Landscape Research, Germany

Research Centre (IDRC) and the United Kingdom's Department for International Development (DFID). It is hosted and managed by IDRC. Its original mandate is for a five years program activity with initial funding of $65 millions CAD. It will gradually devolve to African institutions.
CCAA's overall strategy is premised on the development of capacities (human, organizational and institutional) with regard to climate change adaptation. In CCAA's philosophy, capacity development is both a process and an outcome which target the reduction of climate vulnerabilities. Hence, the Programme is using participatory action research as the foundational pillar to support adaptation work and to communicate and share scientific findings with key stakeholders.
CCAA's first call for concept notes resulted in some 280 submissions. Ten of them were developed into full proposals.
2007-2008 has been a very full year of activity for CCAA. A total amount of 19,905,078 CAD served to: enrich CCAA pipeline with 11 new research projects; launch a knowledge sharing project; organize 5 workshops for strengthening the capacity of project teams; implement an African climate change fellowship; fund African participation at climate change meetings; attend the UN COP13; launch a demand-led adaptation process; support CCAA project teams for monitoring and evaluation of adaptive capacity relative to climate change and co-fund with Ecohealth projects on water, health and climate change.
For 2008/09, the programme has three main objectives. They can be summarized in 3 key words: consolidation, engagement (Community based organizations, policy makers) and learning.

6. INFORMATION AND COMMUNICATION STRATEGIES

Searching on line for information on climate change in ACP countries

Thierry Helmer
La recherche agronomique au service des pays du Sud (CIRAD), France

Abstract: The Scientific and Technical Information System (SIST) project was designed by the French Ministry of Foreign and European Affairs. One of its objectives is to create an open source mechanism that is available, free of charge, in the nine SIST project countries of Africa.
SIST was designed to meet three basic needs:

1 – access to electronic scientific and technical information available on the Internet, regardless of form;

2 – popularize access to new information and communication technologies (NICT) to enable scientists to communicate with each other, be creative and share information;

3 – publish on the Internet, even without being conversant with IT.

SIST has a federated search engine that makes it possible to query all types of resources available on the Internet and summarize the research results. SIST, thus, in one go can question databases on line, Web sites, open archives, RSS flows and document repositories and then present the results (web articles, annual files, bibliographic references, full texts, current events, project profiles, statistics, etc.) in a standard form.
SIST is a mechanism that allows for the rapid creation of thematic portals and observatories and without any intervention at the information source's end (SIST uses information in its original format; no reformatting required).
Its alerting service ensures selective daily data dissemination to its subscribers.

Strengthening the capacity building and the training in climate change in ACP countries

Aissétou Dramé Yayé
African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE), Kenya

Abstract: Cognisant of the major challenges linked to climate change, the academic community and its partners, at a symposium organised in July 2008 in Malawi by African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE), considered aspects of the following four major themes:

- Development and capacity-building for better global competitiveness in Africa; Conservation of biodiversity and sustainable agricultural production;
- Global trend to enhance bioenergy production;
- Effectiveness of African agricultural education institutions.

This presentation refers to the symposium's conclusions and recommendations, and focuses, *inter alia*, on the inclusion of climate change in the higher education curricula, teaching teachers at this level to make didactic materials that include local knowledge and are adapted to the needs of Africa, and the promotion of agricultural research that maximises the contribution of biodiversity in agricultural production. The symposium unanimously agreed that African higher education in its present form is not well equipped and needs substantial ongoing political support as well as strong interministerial cooperation through networks such as ANAFE.
Keywords: Climate change, ANAFE, Higher Education

Information and communication strategies for coping with climate change

Rod Harbinson
Panos, London

Abstract: Information and communication strategies can make a valuable contribution to both the mitigation of and adaptation to climate change, through enhancing the communication processes involved in developing joined up solutions to this global problem.

The media is a powerful tool in societies for increasing widespread awareness of both the causes and effects of climate change. It is important that the volume and accuracy of media coverage is comprehensive so that the whole of society is informed including those most marginalized in society. To ensure this, media institutions require both the capacity to fulfill this goal and commitment to the climate change issue.

Tools such as remote sensing can be used for climate change measuring and monitoring. ICTs can play a critical role in translating and conveying scientific forecasts (such as from climate models) to local populations which can help to inform local adaptive strategies. Using ICTs like Web 2.0 to develop social networks can increase dialogue and encourage local populations to get involved in shaping external adaptive support programmes to their needs. ICTs such as mobile telephones and radio can also prepare people for disasters and provide early warning systems for extreme weather events. Methodologies such as participatory video can give voice to the local experiences of people in creating adaptive responses to changing climate patterns. They can enhance the comparative assessment of such experiences and help to build a common body of best practice on which sound policies can be built. Debating forums can themselves provide platforms of networked governance as participatory means to develop climate change policies.

This variety of methodologies and technologies has different relevance depending on the situation that they applied to. A key question in evaluating their relevance is the degree to which they are accessible and open to input and use by all the stakeholders involved.

Communication for Development in climate change adaptation: challenges and efforts

Matteoli Federica
Research and Extension Unit (NRRR), Natural Resources Management and Environment Department, Food and Agriculture Organization of the United Nations (FAO)

Abstract:

The need for Communication for Development in Climate Change Adaptation

Climate Change Adaptation (CCA) requires multidisciplinary, multi-stakeholders action and a process of social learning for adaptive livelihoods. Within this framework, communication plays a key role. *Communication for Development* (ComDev), an approach that combines participatory *communication* methods and processes with a variety of tools ranging from rural radio to Information and Communication Technologies, is central to CCA. It enables rural people and institutions to: (i) facilitating equitable access to knowledge and information; (ii) promoting people' participation and collaborative approaches of climate change adaptation; (iii) enhancing the capability of development institutions; and (iv) supporting innovative research and advisory services.

Communication for Sustainable Development Initiative (CSDI)

FAO and the Italian Ministry of the Environment and Territory have launched a joint project called *Communication for Sustainable Development Initiative (CSDI)*, to support the application of communication strategies and approaches to CCA. CSDI aims at strengthening and up scaling communication services in selected countries, and to make available suitable methods and tools at the international level through knowledge networks and partnerships. The project strategy is based on three main components:

- At the normative level systematize approaches, best practices, training materials and policies on the application of ComDev to CCA, and make it available at the international level;
- Support to field projects through Communication Action Plans including the design of communication strategies and services to be piloted at the field level in connection with NRM and CCA initiatives; and
- Networking and partnerships for capacity building and advocacy for mainstream ComDev services through regional and thematic.

An example of communication action plan developed by CSDI is the support of agriculture and forestry research and extension activities in Congo (DRC).

The way forward

The project intends to concentrate on the following priorities:
Develop and test a model for Communication in community based CCA;
Support to field projects in Africa, Asia, Latin America, the Caribbean, and the Near East;
Systematize best practices for ComDev services in support to research and extension systems;
Support regional platforms, consultations and knowledge networks on ComDev and CCA;
Expand the world repository on locally adapted agricultural technologies (TECA) and support a specific section on adaptation options;
Expand the FAO partnerships in ComDev to other institutions (E.g. CTA, IIED and others).

Media coverage of climate change in SADC Region: the Case of Mozambique, Swaziland and Zambia

Parkie Mbozi
PANOS Southern Africa, Zambia

Abstract: Mass mediated messages, when properly planned and systematically executed, contribute to shaping and affecting science and policy discourses as well as increasing public understanding and action. The public learns a large amount of science through consuming mass mediated messages. Questions have, however, been asked about the effectiveness of the mass media in climate change awareness creation. This prompted Panos Southern Africa (PSAf) to

commission a study to investigate media coverage, community awareness and national responses to climate change and change adaptation. It intended to examine how media in southern Africa handled the issue of climate change. It focused on current trends, strengths and weaknesses in print and electronic media.
The results showed that the knowledge base of journalists in climate change and climate change adaptation was limited. Their attitudes towards featuring climate change in their media were equally not very supportive; the media (editors and journalists) don't consider climate change a sellable topic. There is neither specialization on the subject nor journalists specifically assigned to report on it. The media also indicated lack of incentives and support to cover climate change issues. These leads to limited coverage of climate change issues in the media, and yet the public relies on media for both news and information. The public understanding of climate change and climate change adaptation is limited. The countries were yet to finalize policies and legislation that directly address issues of climate change and climate change adaptation. There was also limited coordination on climate change issues in all the three countries.

Agrimonde: Farming and food systems of the world in 2050?

Sébastien Treyer
AgroParisTech, ENGREF, France

Abstract: *Challenges and goals.* Current population growth forecasts suggest that one of the major challenges in coming decades will be to adapt agricultural product supply to the growth in demand for food, while at the same time ensuring more sustainable production, both in social and environmental terms. The trends observed at present – the increase in food prices that is perturbing agricultural markets, the emergence of new agricultural production areas, the effect of climate change on the variability of agricultural yields, opportunities relative to bioenergy and changes to diet, notably in developing countries – will have effects on the balance between supply and demand at a global level. Preserving the resources of our planet while alleviating poverty and reducing inequalities is a major challenge for sustainable development, as well as for global geopolitical equilibria and relationships between industrialized Northern countries and developing countries.
The prospective study entitled "Farming and food systems of the world" has been conducted for the past two years (2006-2008) by INRA and CIRAD. It should serve to foresee the role of policies and regulations, and of the agricultural knowledge, science and technology system at the world, European and French scale, under different scenarios for world change, taking into account the affirmation of plurality of southern countries and contexts. This foresight exercise will provide CIRAD and INRA with the means to anticipate and prepare for the future in terms of both resources and the orientation of public-sector research, and their strategic positioning at an international level. In addition, it should facilitate the understanding of work by international expert forecasting groups, so that French experts are better prepared to play an active role in such groups, and so that innovative alternative scenarios can also more easily be put into discussion in these international expert groups.
The operation is inspired by and based partly on the discussion of the scenarios built for the Millennium Ecosystem Assessment and is set in the dynamics initiated by International Agriculture Assessment of Science and Technologies for Development (IAASTD, an intergovernmental process launched in 2004). The results expected will include publication of a preliminary report on the study in June 2008. This will be followed by discussions, further analysis and debate on the report till December 2008 leading to publication of a more elaborated report end of 2008.
In the end, the project will lead to a permanent foresight intelligence in order to set up and develop relevant research programs via the construction of a perennial simulation platform.