Workshop Report

Global Change Research Network for African Mountains

Makarere University - Kampala, Uganda
23-25 July 2007

The workshop was organized by:
African Highlands Initiative, Kampala, Uganda
Centre for International Forestry Research (CIFOR), Bogor, Indonesia
CGIAR Global Mountain Program, Addis Ababa, Ethiopia
Egerton University, Nakuru, Kenya
Global Mountain Biodiversity Assessment (GMBA), Switzerland
Makarere University, Kampala, Uganda
The Mountain Research Initiative, Bern, Switzerland
UNESCO Man and the Biosphere Program, Paris, France
Centre for Development and Environment (CDE), University of Bern, Bern, Switzerland
University of Witswatersrand, Johannesburg, South Africa

Workshop Report:
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Rwanda, from presentation Bob Nakileza

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Dr. Gregory Greenwood
Chair of the Steering Committee

Preface

The origins for the workshop „A Global Change Research Network for African Mountains" are many. After the Perth Conference in 2005, which launched the Global Change in Mountain Regions Research Strategy, the Mountain Research Initiative (MRI) committed itself to launching regional research networks in different regions of the world. At the same time, MRI understood that other organizations had distinct but related interests in global change and African mountain regions. The Global Mountain Program of the CGIAR was interested in agriculture and rural development in mountain regions, especially in tropical areas. UNESCO was interested in the role that Biosphere Reserves and World Heritage Sites could play in research, especially regarding adaptation to climate change. The African Highland Initiative and the Center for International Forest Research were interested in rural livelihoods, and especially the role of governance in natural resources management. The Global Mountain Biodiversity Assessment of DIVERSITAS, together with FAO and SDC, was looking at the impact of changes in grazing intensity and fire frequency on African Highlands biodiversity. And various universities, within and outside Africa, had expertise and experience in the specific characteristics of individual African mountain ranges and highland areas. Thus we found a critical mass of interest in sketching out a program for continued global change research in African mountains.

What makes the sub-Saharan African mountains different from mountains on other continents? First, unlike temperate or boreal mountains, which are frequently cold and less than hospitable, African mountains and highlands are often highly productive in agricultural terms and therefore constitute a prime human habitat. One look at a population density map of Africa shows a high degree of correlation between population density and elevation, especially in drier regions and in Eastern and Southern Africa. Thus while arguments about the importance of mountains in temperate regions frequently rely on that which is exported from mountain regions (such as water or tourist experiences), African mountains are important because a vast number of people live in those mountains, deriving much of their livelihood from them. Global change in African mountains will thus immediately and directly impact a large number of people.

Second, African mountains exist within a development context entirely different from that of mountains in Europe or North America. While the conservation ethos so intimately connected with mountains in Europe and North America is not absent in Africa (witness the importance of various mountain National Parks), economic development remains the dominant discourse within which the response of mountains to global change is embedded. While one frequently reads that global change has human dimensions, in African mountains it is more appropriate to state that the development trajectory has a global change dimension. A global change research program that does not address the development trajectory will have no traction within Africa. Yet, addressing the issue does not mean becoming an uncritical advocate for development, but rather means understanding that the ideology of development is every bit as important as climate in determining the trajectory of these mountain cultures.

Third, the history of African colonialism and the generally low level of national funding for research within Africa represent a challenging institutional context for mountain research. Many, though not all, of the more comprehensive research programs on African mountains are run by universities outside of Africa. As a result they reflect the concerns of the respective funding nation, not necessarily those of African stakeholders. In addition, the lack of longer-term basic funding for research within Africa renders African researchers more dependent on the vagaries of international agency or NGO funding, where priorities are similarly set in political contexts quite distant from African realities, or on the needs of the African market, which must favor training in marketable skills over the development of new knowledge through research. As a result the knowledge that does exist regarding different mountain ranges in Africa is remarkably fragmented

from the presentation by
Stefan Grab

Background and objectives

and often subject to loss over time. From another point of view, this also means that the prospects for major improvements in understanding simply through better coordination and communication among researchers are perhaps brighter in Africa than anywhere else.

These unique aspects of Africa and African mountains pose real challenges to the development of a global change research network for African mountains. As we embark on this effort, we must be realistic about the prospects for success. Our greatest asset remains our connections with each other.

When expressed in terms of temperature and precipitation means and variances, the future expected climate change may be more pronounced in tropical than in temperate regions of the world. In Africa this climate change may lead to the disappearance of tropical mountain glaciers, increasing variation in water flows and changes in disturbance regimes in mountain flora and fauna, all of which would have important impacts on African communities and nations.

Climate change is, however, not the only nor necessarily the most important form of global change affecting sub-Saharan African highlands. Population growth and migration, economic development, global trade, and infectious diseases are all driving change in their own right and interacting with climate in African highlands. Perhaps more than in any other region worldwide, the discussion of global environmental change in sub-Saharan African highlands moves quickly to the issues of human security, vulnerability and adaptation. However, the scientific community's ability to contribute to the development of adaptation strategies is hampered by our limited scientific understanding of the coupled human–earth system in sub-Saharan African mountain environments.

The Workshop on Global Change Research for African Mountains was held at the Faculty of Food Science and Technology of Makerere University in Kampala, Uganda from 23-25 July 2007. An optional post-conference field excursion (26-28 July) was also organized, taking participants to the Rwenzori Mountains and their environs. This was to familiarize participants with typical ecosystems, land use/cover, evidence of glacial recession, water systems, hazards, adaptation and risks factors in the mountain area.

The workshop featured a total of 37 presentations of global change research projects undertaken within and among the African highlands.

There were two major goals of the Workshop on Global Change Research in African Mountains. The first was to bring researchers, site managers, stakeholders and representatives of funding agencies together to refine the Global Change in Mountain Regions (GLOCHAMORE) Research Strategy developed under the EU's 6th Framework Programme. The GLOCHAMORE Research Strategy is global in scope and the workshop sought to translate it into an agenda that responds to the realities of highland Africa. The resultant Global Change Research Strategy for African Mountains is focused and realistic and can be used by researchers in their proposals to funding agencies to augment both the volume and the efficiency of funds directed toward global change research.

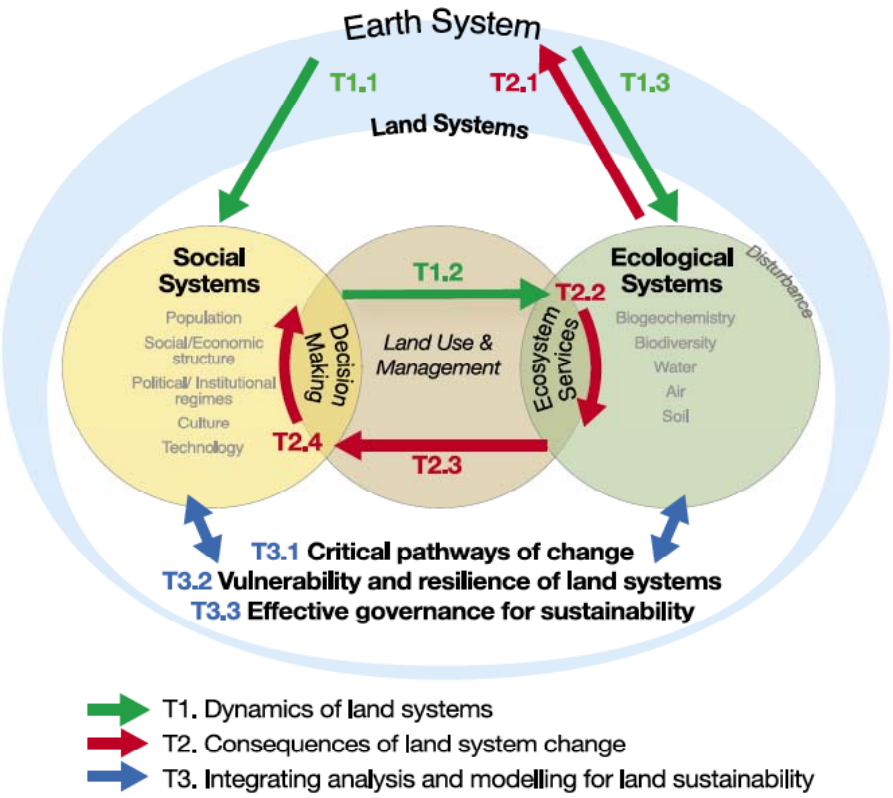


figure 1:
Conceptual framework for GLOCHAMORE Research Strategy (adapted from GLP 2005, Science Plan and Implementation Strategy, IGBP Report No. 53/IHCP Report No. 19 by Gete Zeleke)

The second goal of the workshop was to facilitate the development of a multi-site network in African highlands within which interdisciplinary and trans-disciplinary global change research is conducted. The GLOCHAMORE Research Strategy maps its topics onto a conceptual diagram and summary of themes adapted from the Global Land Project (Figure 1). This framework served as a basis for the substantive content of the workshop oral and poster presentations. Further, the presenters were also encouraged to propose what they believe to be important new directions for global change (GC) research in sub-Saharan African mountains (AM).

The workshop sessions aimed to address at least the following topics, which are keyed to the adapted Global Land Project framework in figure 1.

Inputs and comments from the workshop discussions shall be used to revise, enhance or create proposals to enhance understanding and to support adaptation to global change in African mountains.

Theme 1: Impacts of GC and dynamics of AM land systems

T1.1: What elements of GC have led to significant social change in African mountains?
What is likely to occur in the future? How do these elements affect land use and management decisions in African mountains? What new research is needed?
T1.2: What changes have occurred in African mountain land use systems? How have changes in land use and management affected ecological systems in African mountains?
What is likely to occur and what will be the impact? What new research is needed?
T1.3: How does GC affect ecological systems of African mountains? What changes have occurred? What new research is needed?

Theme 2: Consequences of land system changes

T2.1: How do changes in ecological systems of African mountains affect GC? What are critical feedbacks?
T2.2: How do changes in ecological systems of African mountains affect ecosystem services? What ecosystem services show significant change?
T2.3: How do changes in ecosystem services affect human security and well-being in AM? What is likely to occur?
T2.4: How do communities respond to changes in ecosystem services in AM? What adaptive strategies do they follow and what are the consequences of these on social and ecological systems? What is the role of cultural change on resilience and feedbacks between social and ecological systems?

Theme 3: Actions for land system sustainability

T3.1: How does governance affect social and ecological systems of AM? How does governance affect adaptive mechanisms regarding GC? How does governance affect land system sustainability? What new research is needed?
T3.2: What actions are needed for ecosystem resilience and sustainability? What new research is needed? How is it possible to link current knowledge of African mountains to create a holistic perspective?

Lesotho, foto by Stefan Grab

Overview of presentations

Regional overviews

Land use change as global change driver

Climate change as global change driver

Economy and culture under global change

Governance as an issue and a response

Poster presentations

Presentation abstracts

ICSU Regional Office for Africa's Science/Work Plan on Global Change

Janine Chantson, Achuo Enow and Sospeter Muhongo

Abstract: The International Council for Science (ICSU) Regional Office for Africa focuses its activities on four cross-cutting priority areas. These are: (a) Sustainable Energy; (b) Health and Human Well-being; (c) Natural and Human-induced Hazards and Disasters; and (d) Global Change. Science plans have been prepared for each priority area, and these will be published shortly. The plans review the current status on the African continent, identify research and capacity building needs and propose lines of action for addressing some of the numerous challenges which are faced in each priority area.

The science plan on Global Change in sub-Saharan African calls for a few large-scale interdisciplinary, multi-institutional, regional and sub-regional projects and programmes in six areas:

• Land degradation, biodiversity loss and human well-being
• Rainfall resilience for food systems
• Water resources and their governance
• Atmospheric pollution
• Africa's oceanographic uniqueness.

Research in these six areas can provide information in order to better understand, assess, predict, prevent, mitigate, adapt and respond to Global Change. In addition, the strategy for Global Change research calls for human and institutional capacity building and a well-functioning set of science-practice-policy interfaces. The ICSU Regional Office for Africa is working with other organizations to avoid duplication and to maximize the impact of Global Change initiatives on the continent.

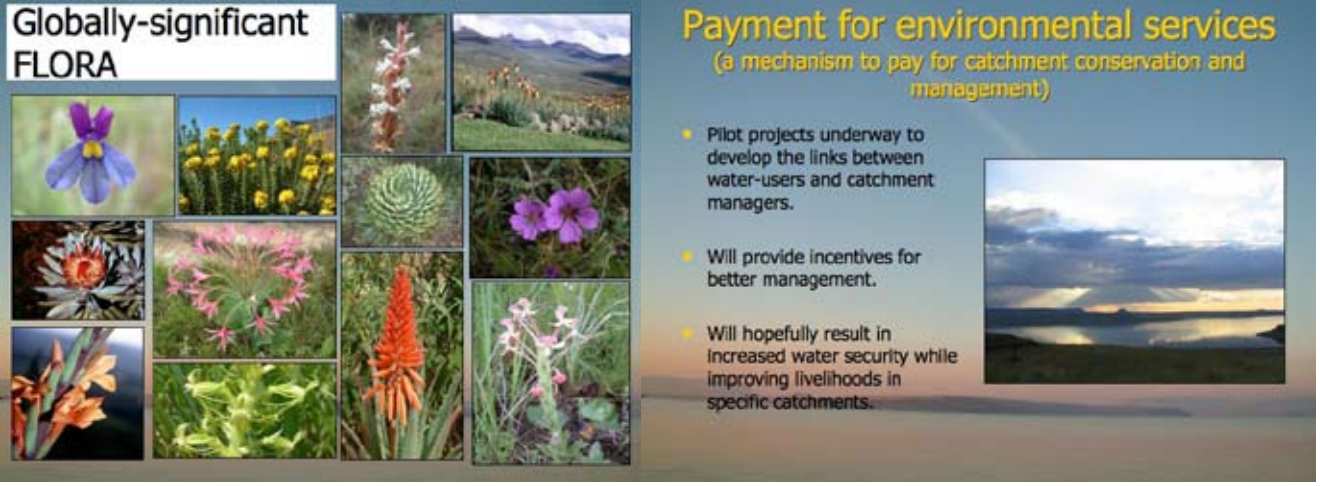
Mt. Kenya, foto Urs Wiesmann, CDE

Land use transformation and global change: the case of Mount Kenya

Boniface P. Kiteme, Thomas Kohler, Hanspeter Liniger, Bänz Notter, Urs Wiesmann

Abstract: The Mount Kenya area has experienced rapid and far-reaching change in the last 40-50 years. The population has increased manifold, both in rural and urban areas, and land use has changed from ranching to crop production, including subsistence crops as well as commodities traded on globalised markets (coffee, tea, horticulture). This puts increasing stress on natural resources, especially water, which is important for agriculture, urban areas, as well as for tourism and pastoral societies further downstream.

Based on long-term data sets, this contribution will explore selected aspects of global change as they present themselves within the region. They include population and migration dynamics and, specifically, climate (rainfall) trends in the region; the appearance of horticulture for globalised markets; and the development of international tourism. The paper will present the background to these developments, as well as their effects on the regional resource base, i.e. surface water availability (including the influence of glacier retreat) as against water use; vegetation; and wildlife. The contribution will conclude by discussing options for sustainable future development, such as the pros and cons of water user associations, and will propose an agenda for policy advice and for applied research in support of sustainable regional development.



The implications of changing landuse patterns and degradation in the Maloti-Drakensberg Mountains for water security in a semi-arid sub-continent

Richard G. Lechmere-Oertel (presented by Clinton Carbutt)

Abstract: The Maloti-Drakensberg Mountains, a grassland bioregion spanning much of the eastern half of Lesotho and three provinces in South Africa, is the primary water producing area of the sub-continent. At present, water from this bioregion supports up to 20-30% of the population of the sub-continent. This includes inter-basin transfers to the economic hubs of Gauteng and Durban. The ecological systems underpinning these catchments that make up this bioregion are biologically rich (the bioregion is an internationally recognised biodiversity hotspot containing a World Natural Heritage Site) but are vulnerable to degradation through inappropriate land use and management practices. Land tenure and management is c. 70% communal, 15% private/commercial and 15% public-sector (state-owned protected areas). Approximately 2 million people live in the area and derive at least some of their livelihoods from the natural resource base, primarily in the form of livestock (sheep, cattle and goats) and subsistence agriculture. The communal and some private lands are showing typical indications of degradation, with shifts in the grassland flora towards unpalatable species, loss of plant cover, alien plant invasions, significant sheet and gully erosion and silting of river systems. In many areas, the degradation is extreme and extensive.

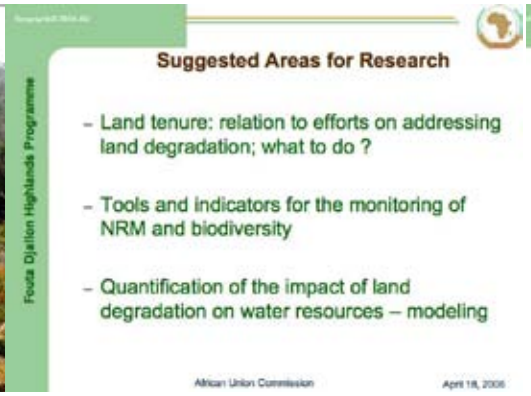
These anthropogenic changes to these strategic mountain ecosystems are reducing the quality and flow of water, with resultant impacts on the economy of the sub-continent. In this regard, water service delivery agencies undertake significant efforts to clean silt from the water and to service silt-damaged infrastructure. Furthermore, the flow-dampening and slow-release wetland systems are most vulnerable to damage by livestock and agriculture. The importance of water security is increasingly being recognised, and pilot studies are underway to test various payments for environmental service models in the area. These pilot studies seek to financially link the consumers to the people who use the catchments in an attempt to provide sufficient incentives to ensure appropriate land management that will improve water security and provide livelihood benefits – both at the source and at the destination.

Ev-K2-CNR: a new high-altitude research project on global change

Andrea Lami, Gianni Tartari, Claudio Smiraglia, Giorgio Vassena, Elisa Vuillermoz, Gian Pietro Verza

Abstract: It is well known that African glaciers have been melting at a higher pace than other glacier systems due not only to an increasing temperature trend, but also to a dramatic decrease in precipitation (Hemp 2005; Kaser et al. 2004). In general, the role of Africa in the global context has received little attention. Despite strong evidence suggesting that Africa does play an important role in the global climate, compared to other areas, there is scarcity of data and a lack of integration with international monitoring and modelling networks such as the Coordinated Energy and Water Cycle Observation Project (CEOP) or GEWEX (Global Energy and Water Cycle Experiment). In addition, there is also a need for inter- and transdisciplinary approaches, and intensive international collaboration in both research and policy design will be called for to tackle the complexity of Global Climatic Change.

Based on 20 years of research activity in remote and high-altitude areas, the Ev-K2-CNR has developed the SAHRE (Station at High Altitude for Research on the Environment) research project with the aim of creating an integrated network of data on the atmosphere and environment in mountain areas. Within this research framework, Ev-K2-CNR has made a contribution to an international multidisciplinary project on Rwenzori launched in 2006 by the environmental association L'Umana Dimora, in cooperation with the University of Kampala, the Uganda Wildlife Authority and the Italian NGO AVSI. In particular, Ev-K2-CNR has provided support for the installation of a high-altitude meteorological station on Mount Stanley, as a contribution to the environmental studies that will take place in the Rwenzori National Park. This presentation highlights the role of meteorological data acquisition and glacier measurements and discusses possible future developments.



Stakes and challenges in the regional coalition for the preservation of the Fouta Djallon Highlands in West Africa

Mamadou I. Ouattara

Abstract: The Fouta Djallon Highlands (FDH), with altitudes ranging from 500 to 1,500 m, are located in the Republic of Guinea and extend into four neighbouring countries (Guinea-Bissau, Mali, Senegal and Sierra Leone) through associated foothills and other related topographic features. Six important transboundary rivers, constituting the main international waters in the sub-region (the Niger, Senegal, Gambia, Koliba/Corubal, Kolente/ Great Scarcies and Kaba rivers), originate from the Fouta Djallon and irrigate a dozen countries in West Africa. The degradation of FDH's natural resources, which is increasing rapidly, could lead to profound changes in the hydrological regime of the main rivers and water tables in the sub-region. The Fouta Djallon Programme, coordinated by the African Union, aims at assuring the preservation and the development of natural resources and of the environment with a view to contributing to an improvement of the living conditions of populations in the highlands and their surrounding areas. The main areas of activities for the programme include coordination of Member States and other actors in the preservation of FDH's natural resources, advocacy to promote the strategic and international roles of the FDH, monitoring of natural resources (Observatory), promotion of sustainable livelihood options and resource mobilisation.

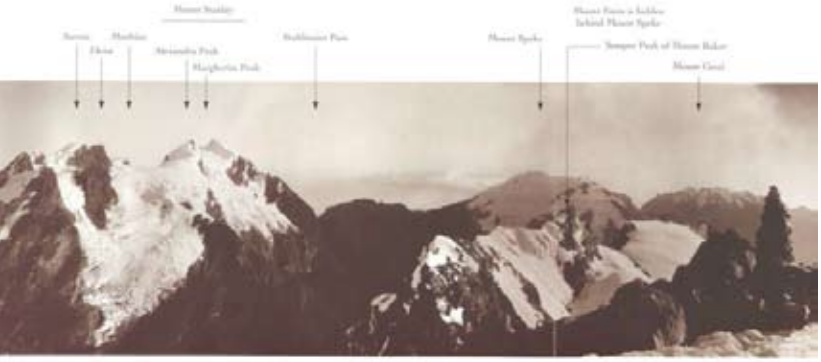
Global change and the Ethiopian mountains

Gete Zeleke and Hans Hurni

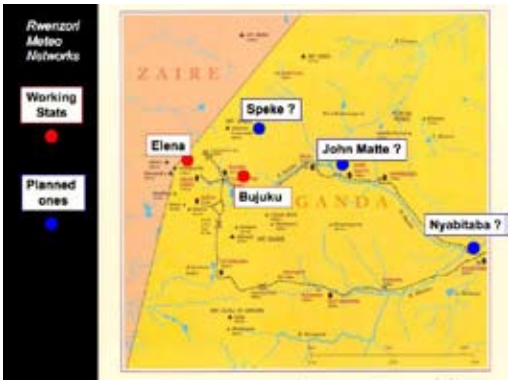
Abstract: About 50 percent of Ethiopia can be defined as mountainous, be it because of altitude above about 1,000 m, or because of steep slopes. The country's mountain zone includes about 90 percent of its agriculturally suitable areas and is occupied by 90 percent of the human population and 60 percent of all livestock. The mountains of Ethiopia offer excellent conditions for natural diversity and human development, be it on the one hand as the 'cradle of mankind' with early hominids some 3-4 million years ago, or on the other hand as the origin of homo sapiens, who started to spread over the globe from this region some 150,000 years ago. Agricultural evolution in the Ethiopian highlands began several thousand years ago, resulting in excessive impacts on natural vegetation, wildlife and soil and water resources over time, but particularly during the 20th century, when the dynamics were strongest. Agriculture has remained the primary activity of the Ethiopian people up to the present day, with over 82 percent of the current population of nearly 75 million still engaged in the primary sector. Subsistence agriculture is the dominant farming system, with little integration into the market system apart from the moderate modernization taking place in towns.

Very few places in the Ethiopian mountain complex have remained unaffected by human land use until the present time. These include mountain tops above 3,700 m as well as the steepest slopes in the highland escarpments, where some natural vegetation patches and a few original wildlife species have been able to survive. Apart from other mountaintops like those in the regions of Bale and Arsi in Southeast Ethiopia and those in North Shewa, Wello, Gojam and South Gonder in central Ethiopia, particular attention is given in this paper to the Simen Mountains in North Gonder, where favorable climatic and agro-ecological conditions enabled agricultural development to flourish, and where outstanding biodiversity and a breathtaking landscape have attracted travelers for many centuries, more recently including tourists from around the world. The Simen Mountains National Park was already registered as a World Heritage Site in 1978, during the first listing by the UNESCO World Heritage Convention.

Impacts of global change in the Simen Mountains and throughout the Ethiopian highlands have been observed by a number of research programs for many decades. With regard to natural resources, this has included observations of changes in vegetation and wildlife, the dynamics of climate and hydrology, land use and land cover, and processes of soil degradation, particularly soil erosion and sedimentation. In terms of demography and political and social dynamics, it has included observations of political transitions and the impacts of policy and economic development strategies, as well as social dynamics and population pressure on mountain ecosystems. Numerous measures for mitigating the negative impacts of global change have been developed by these research programs, the results of which have been implemented by a number of programs concerned with nature conservation and natural resource rehabilitation throughout the highlands. The Ethiopian mountains in general and the Simen World Heritage Site in particular are thus excellent areas for monitoring indicators of global and local change.



RWENZORI PANORAMA
taken from Edward Peak on Mount Baker, 1906
by Vittorio Sella



A Uganda-Italy multidisciplinary research project in Rwenzori: preliminary findings and plans for the future

Giorgio Vassena, Pippo Ciantia, Gustavo Corti, Carlo Lanzi, Gregorio Mannucci, Bob Nakileza, Matteo Sgrenzaroli

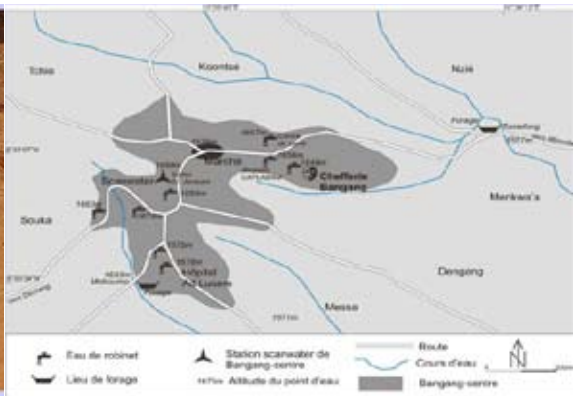
Abstract: A long-term multidisciplinary research project on Rwenzori Mountains was initiated in June 2006 when a team of twelve Italian researchers and one researcher from the Mountain Research Centre at Makerere University made an expedition to the Rwenzori Mountains National Park. The studies have been organized thanks to the coordination between the Uganda Wild Life Authority, the L'Umana Dimora Environmental Association, the Italian Alpine Club, the University of Makerere, the University of Brescia (Italy) and the Italian Embassy in Kampala.

The program focused on:

- Glacier retreat studies using a 3D laser scanning survey of the Speke glacier that allowed to develop and evaluate, within 5-10 cm accuracy, a tridimensional model of the glacier front and its mass balance.
- Meteorological studies by installing a meteorological station over the upper Bujuku.
- Geodetic studies, with a program of 3D GPS network measurements in all the Rwenzori range, and the planning of a GIS-GPS main trekking routes survey in the Park.
- Educational program for Ugandan primary schools, carried out with the support of the AVSI NGO in Uganda.

This paper presented the preliminary results of the meteorological measurements on the glacier dynamics and the 3D GPS geodetic network (of all the 6 main peaks of the Rwenzori Mountains). The planned environmental and cooperation projects in the Rwenzori were also presented.

Toumefou Pumping Station (1557 metres of altitude) constructed in 2007



Stratégie de l'eau au pied des monts Bambouto: cas de Bangang-centre

Water sources and "development" activities on the slope South of Mount Bambouto

Nodem Jean-Emet

Abstract: The slope South of Mount Bambouto is a very fertile zone. It is situated between 5° 35' N and 5° 45' N. The Bororo and the peasants from the villages of Bafou and Bangang were the very first exploiters of this milieu. The number of Bororo cattle herders among the inhabitants was reduced from 350 in 1968 to 200 in 2005; they practiced a transhumance form of cattle rearing while the peasants (about 500 inhabitants) cultivated mostly Irish potatoes. The peasants organized their cultural activities by scrupulously respecting the method of shifting cultivation. This was profitable to the Bororo cattle herds. All these activities had no major impact on the water sources.

The expulsion of these two categories of exploiters took place in May 1968 by the Cameroon Development Corporation (C.D.C.), presently named Cameroon Tea Estate (C.T.E.). The Cameroonian state had permitted this company to prune 1,660 hectares destined for the production and transformation of tea. The plantation is situated between 1,700 and 2,000 m above sea level. The teapots need 1,500 l of water per year. The tea is also transformed in this site. The use of electrical means (7 million F CFA per month) was considered as unsupportable by the C.T.E. The managers of the C.T.E. chose to use fuel wood from eucalyptus planted on the spot, on the edges of the water course. 50 m3 of wood, that is the wood of 7 eucalyptus trees, is needed to obtain 3 tons of tea. The roots of the eucalyptus trees have progressively dried out the sources of water in the area surrounding this tea culture project. The water course called "Sog mekwang" – taking into consideration its weak flow – could not supply the structure. The C.T.E. was then obliged to move to "Tsopia" at an altitude of 2,000 m to capture water at the source. It is a pressing necessity because they need 400 liters of water per day to wash 32 wheelbarrows and the machines at the factory.

The peasants and the Bororo expelled by the C.D.C. occupied other lands of more than 2000 m of altitude on the same slope where the C.T.E. is actually getting their supply of water.

Since the year 2000 the urban elites of Bafou (1) and of Bangang (10) origin have reoccupied these lands. They have chosen the model of rearing cattle in ranches encircled by eucalyptus. The water sources have been canalised to supply water to the cattle. The elites are taking care of at least 800 cows. The stamping of the cows has hardened the ranch grounds and prevented the infiltration of rain water into the soil. Hence during the dry season (from mid-November to mid-March) herdsmen go on transhumance towards the plain of Santchouto to get water and fresh grass and in the process encounter a number of conflicts.

Given that these activities have come to stay – all the actors have land titles – and no far-reaching strategy concerning the preservation of the physical environment has been presented to date, it is possible to envisage that the water sources in this zone will be seriously affected in future.

What research can do to help

- Housing small ruminants in small pens (1.2-2m^2/animal) has been successful in other regions of the world, in Asia for example.
- However, the West African Dwarf goat is known to dislike extended confinement in closed areas.
- Selection of animals with aptitude to survive permanent and total confinement with higher productivity seems necessary
- Pen feeding seems to be the alternative

Major questions that need quick answers for the survival of small ruminant farming

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- However, the West African Dwarf goat is known to dislike extended confinement in closed areas.
- Selection of animals with aptitude to survive permanent and total confinement with higher productivity seems necessary
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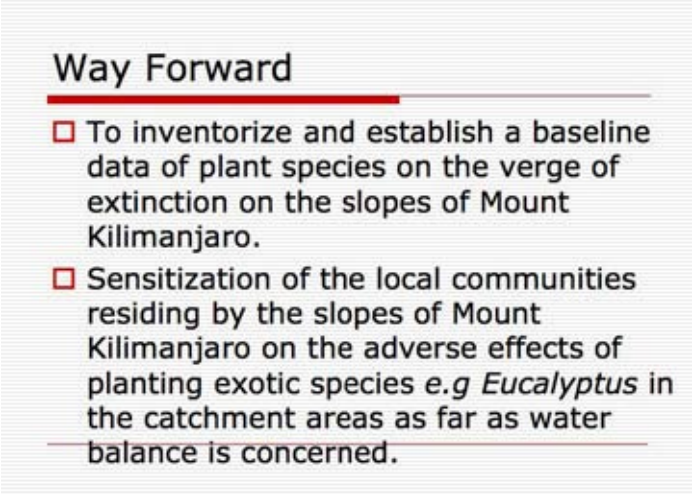
Problematic of the survival of small ruminant farming in the Western Highlands of Cameroon

Alexis Téguia and Joseph Tchoumboué

Abstract: The Western Highlands, 800 to 2 740 m above sea level, are one of the main agricultural zones and among the most populated areas of Cameroon with more than 15% of the country population in less than 1/10 of the national territory, yielding a density of 200-250 inhabitants/km² with peaks above 1,000 inhabitants in some areas as compared to the national average of 25 inhabitants/km². Crop and small ruminant farming integration is a tradition as these animals play important socio-cultural and economic roles in the life of local populations. Kept by above 70% of households, the animals are traditionally tethered on natural pasture during the cropping season and set free during the dry season to feed on crop residues and to benefit from natural mating as most of the farmers do not keep males. However, with a 3% per annum increase in the human population, there is a high pressure on land and the generalisation of a second cropping season. The disappearance of collective pastures – including marginal land formerly used as grazing land – and the absence of fallows add a further constraint to small ruminant farming because animals cannot roam freely in villages during the dry season. As a consequence, animals are poorly fed, morbidity and mortality rates as well as the number of unfertile females increase, and many farmers tend to quit small ruminant farming. The survival of this activity in the Western Highlands of Cameroon therefore depends on the capability of rural people to innovate, to develop new management strategies based on the permanent confinement of animals and control of their reproduction. However, the success of any transformation must be accompanied by an improvement of the existing animal materials, and the housing and feeding systems.



Land use change and indicators of land degradation along a gradient on Mount Kilimanjaro, Tanzania

Herbert Valentine Lyaruu

Abstract: A survey was carried out along two transects located on the southern slopes of Mount Kilimanjaro, with the objective of finding out how different land use practices influence plant biodiversity and consequently land degradation. The two transects run from the forest belt (popularly known as the half-mile strip) to the lowlands where the major land use is irrigation agriculture. The Machame transect extended from an altitude of 1,840 meters asl down to Kikafu Chini at 770 meters asl, whereas the Mbokomu transect extended from around 1,830 meters asl down to Mabogini at an elevation of 686 meters asl. The transects traversed four major agro-ecological zones, namely: coffee/banana zone (both high and mid-altitude); cultivated land; lowlands (mainly for pastoral activities); and irrigation agriculture. Depending on the vegetation type, sampling quadrants of different sizes were employed, in addition to conducting semi-structured interviews. A total of 40 quadrants were sampled along Mbokomu transect with eleven land use categories, with coffee/banana emerging as the major land use type. Machame transect had more land use categories, and a total of 81 quadrants were sampled, with maize cultivation and coffee/banana emerging as the major land use categories. The common uses of plants in this area included use as herbal remedies, timber trees, fodder and shade trees. The interviews revealed that there has been a tremendous loss of biodiversity of economically useful plants, a trend that is explained by the land tenure system that has been adopted by the Chagga tribe. This practice results in a severe and massive fragmentation of the land as each new-born boy is allocated a portion of the family shamba that he then owns legally. Other factors that could possibly account for the observed loss of biodiversity include poor agricultural soils, management practices such as weeding, and variations in precipitation.

the study site

Impact of sustained large-scale afforestation on Afromontane grassland biodiversity of the Drakensberg mountains, South Africa

Willem Ferguson

Abstract: The Drakensberg mountains in Mpumalanga, South Africa constitute a center of endemism for both plants and animals. The Afromontane grassland of these mountains is threatened by extensive afforestation over the last 70 years. With regard to plants, this region has a large number of endemics. Many plant taxa also reproduce asexually, making them vulnerable to disturbance. Many Coleoptera species are extremely habitat-specific, restricted to particular grassland associations. As for Orthoptera, the degree of endemism is surprising for such a polyphagous taxon. The same applies to vertebrates. Afforestation has two main effects: habitat fragmentation and changes in soil water availability. A grassland habitat fragmentation experiment has been conducted in this area over the last ten years: both plants and vertebrates have a remarkable resilience within planted plantations, with communities only collapsing when total shade of the plantation prevents grassland survival under the trees. However, the community structure of invertebrates is affected from an early age of a plantation. For the adjacent grassland, there do not appear to be strong ecotone effects at a small spatial scale (100 m). However, bird species diversity is negatively affected at spatial scales of several km from plantations. Invertebrates and birds therefore appear particularly vulnerable to the effects of grassland fragmentation. The challenges for biodiversity conservation in these mountains include the maintenance of a large degree of variation in Afromontane grassland communities as well as the maintenance of connective corridors between grassland patches. Long-term effects of grassland fragmentation still need to be measured. In contrast, for plants, the effect of plantations on ground water supply is crucial. However, a quantitative assessment of the effect of this ecological factor on plant community structure and biodiversity still remains to be done, and any effect is also expected to be noticed only over long time periods.

from the presentation
by Richard Lechmere Oertel

Territorial dynamics of East African mountains / New challenges

Bernard Charlery de la Masselière

Abstract: In stark contrast to wide-open arid plains, East Africa's mountains possess astounding wealth. From mountain to plain, from plain to mountain, from one side to the other, each mountain's geography unfolds along an immense variety of transects, in terms of multiple natural and cultural sequences and countless transfers of humans, goods, water and other resources. Indeed, fertile but densely populated, these mountains provide resources that are strongly coveted by many actors at different geographical levels. This fact puts pressure on the environment, and the competition for increasingly scarce natural resources leads to a broad range of tensions and conflicts. Generally, the transition from local to national control of the resources has had a significant impact on access to resources, as well as their exploitation and management. In essence, what is at stake is the means of managing the coveted natural resources of generous but complex, diversified and fragile mountains.

For a long time, East Africa's mountains were studied as rather isolated units from the angle of natural resources, of their reclamation, exploitation, degradation and their mode of management. Studies showed, however, that these mountains were 'open' mountains, included in exchange systems integrating multi-scale geographic dimensions: highland and lowland systems, humid and arid systems, rural–urban mobility, long-term fluctuations (tourism, business sectors), etc. Moreover, these mountains are situated in border areas and/or on rangeland axes or even along fault lines between highly contrasting areas.

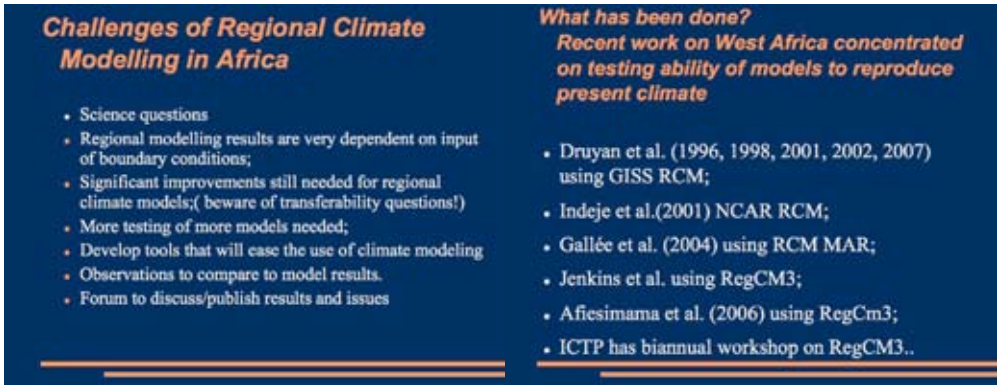
This pushes scientific research to come up with an approach that is sector-based (whether it is naturalist or social) and segmented (humid, arid or even strictly mountain) to integrate these spaces into larger territorial dynamics, where areas in the periphery of mountains (dry lowlands, pastoral lands, medium-altitude plateaus) or further away from them (towns, market areas) take on a new and determinant dimension for their future, putting them into complex situations of multi-territorialisation and archipellisation.

Climate and cryospheric changes within the Trans-African Alpine zone: scientific advances and future prospects

Stefan Grab

Abstract: The eastern arc of African high mountain environments spans from northern Eritrea (Jabal Hamoyet: 2,780 m) at ca 18°N to the southern Cape (Matroosberg: 2,249 m) at ca 33°S. This synopsis examines the scientific contributions made towards our current understanding of the climatic and cryospheric dynamics across the eastern arc mountains of Africa. Whilst some mountains of international interest such as Kilimanjaro and Mt Kenya have had some well-established science programs focusing on glacier recession, ice core data and contemporary weather recording, many other high-altitude ranges exceeding 3,000 m have few or no climate/cryogenic records. A full understanding of climate change within the African alpine belt requires an assessment of Quaternary (particularly Holocene) climate changes through palaeoclimate records, historical changes (last 2 to 3 centuries) through archival and instrumental records, and contemporary changes through ongoing long-term climate and cryospheric monitoring.

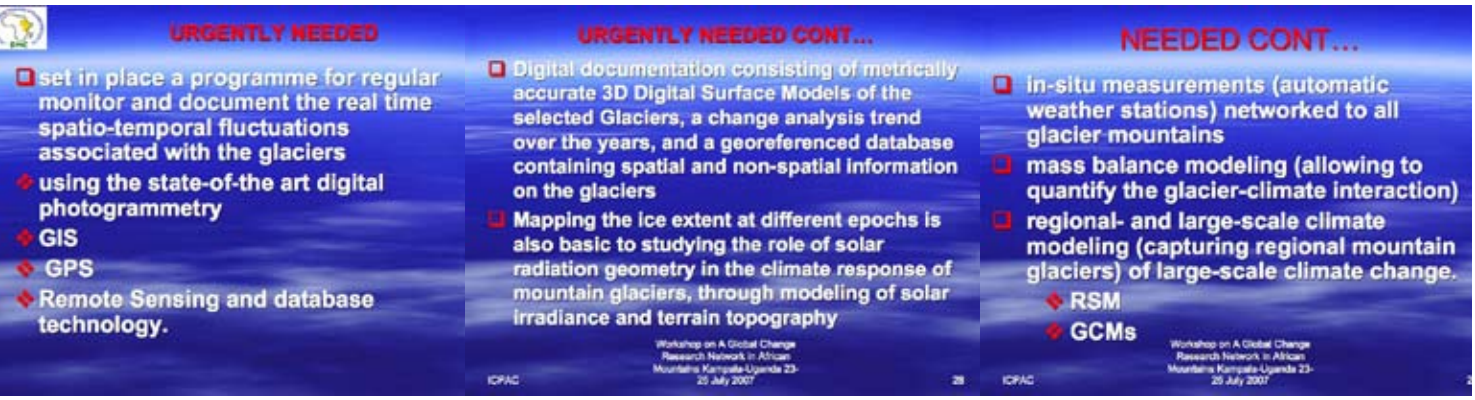
An example of such records is presented for Lesotho. Due to a complete absence of climate records from many high-summit regions, the cause for regional differences in climate variability and change remains a major gap in our current knowledge. It is proposed that future multi-national and interdisciplinary projects focus on setting up permanent and standardized automatic weather stations across the primary eastern arc summits of Africa, which could additionally establish changes in ground thermal and moisture patterns. Such an establishment would be critical to our understanding of other biophysical changes, particularly in areas where anthropogenic impacts remain low.



Climate Change and mountain ecosystems in West Africa: the challenge of climate projections

François Mkankam

Abstract: Mountain ecosystems are mostly very limited in spatial extension, and climatic variables needed for vulnerability assessment must be projected at regional or local scales. But the spatial resolutions of current global climate models are too coarse. With a view to using regional climate models to downscale the outputs from global models, we are testing the ability of RegCM3, a regional model being developed by ICTP in Trieste, to reproduce key variables in the current climate.
By adjusting some physical parameters of the model, we were able to improve the simulation of rainfall over West Africa. Results are presented for June to July 1993.



Monitoring of tropical mountain glaciers and development of a Regional Climate Change Data and Information Center

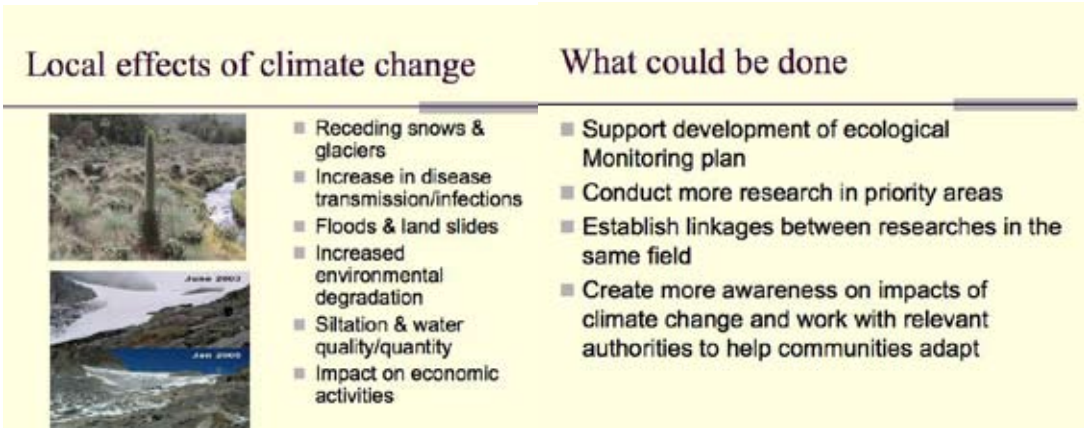
Philip Omondi and Laban Ogallo

Abstract: Climate change is one of the greatest challenges facing mankind in the 21st century due to close linkages between climate, environmental resources and sustainable development. For example floods, droughts and other climate/weather extremes are very common in the Greater Horn of Africa countries with negative effects on agriculture, livestock, wildlife, tourism, health, water resources, hydroelectric power generation and many other socio-economic sectors that form the core of the basic livelihood and survival strategies of society. Any climate changes leading to changes in the space–time patterns of local climate will therefore have enormously devastating socio-economic impacts. The gradual yet dramatic disappearance of tropical mountain glaciers such as on Mount Kilimanjaro has been attributed partly to global warming. Approximately 82% of the ice cap that crowned Mount Kilimanjaro when it was first thoroughly surveyed in 1912 is no more. According to recent projections, if recession continues at the present rate, the majority of the glaciers on the mountain could vanish in 15 years. Glaciers on the other African mountains are also retreating very fast. The snow and glaciers act as a water tower, and several rivers are drying out in the warm season due to the loss of this frozen reservoir. Availability of long-term, high-quality data with good spatial coverage that is representative of all climatological zones, is critical for understanding past and present climates as well as deriving climate expectations for the future; an assessment of the impacts and vulnerability; and the development of appropriate mitigation and adaptation strategies.

Mountains are a source of freshwater for human use and storehouses of genetic diversity that help feed the world yet they are under continuous threat from climate change, overexploitation and environmental degradation. Fluctuations of the volume and areal extent of mountain ice and glaciers are also good indicators of the state of the local, regional and global climate conditions. Cryospheric processes are important components of the climate system. They also form an integral part of the regional hydrological and energy cycles. For example, some large rivers providing water for livelihoods in some arid and semi-arid lands have their sources in glaciers in the mountains. There are several tropical glacier-capped mountains in the Greater Horn of Africa (GHA). These include Mts Kenya and Kilimanjaro with permanent glaciers as well as Mt Rwenzori. The rivers and streams that flow from mountain slopes in the GHA region are living bonds connecting mountain and lowland communities.

There are no frameworks for regular and sustainable monitoring of glacier fluctuations in regional mountains with permanent glaciers as well as Rwenzori.

The presentation will highlight some efforts by the IGAD Climate Prediction and Application Centre (ICPAC) to monitor and archive regional glacier volumes and areal extents using both traditional and space-based methods; to monitor relevant climate and other related parameters; and use the results for regional climate change studies.



Conservation & Management Status of Rwenzori Mountains National Park (World Heritage Site) and local effects of climate change

Nelson Guma

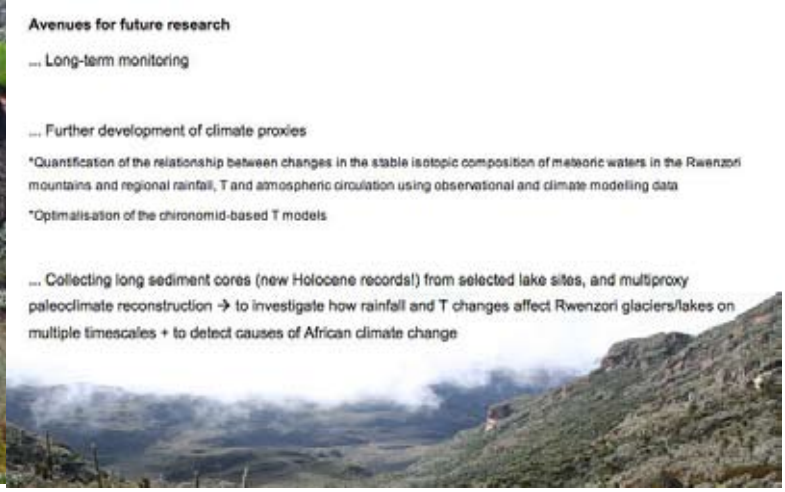
Abstract: Rwenzori Mountains National Park lies in Western Uganda. It borders the Democratic Republic of Congo (DRC) in the West and is located in the three districts of Kasese, Kabarole and Bundibugyo. It covers an area of 995 km2 and rises from 1,670 m to 5,109 m above sea level, including Margherita, Africa's third highest peak. The mountain ranges run 80 km in N–S direction and 40 km E–W. The park is a habitat to several endemic, endangered, threatened and rare species of the Albertine Rift, and an important bird area.

In 2004 a general management plan was formulated, including community conservation, resource conservation and management, monitoring and research, park operations and maintenance, tourism development and regional cooperation. "Resource conservation and protection" has to deal with the following threats: timber cutting, poaching of animals, illegal harvesting of resources, fires, pollution, mineral prospecting, receding snows and glaciers. Protection efforts include patrols, arrest and prosecution, bye-laws, sensitization and collaborative management. "Community conservation" includes the following tasks: awareness raising and education, benefit sharing (revenue and resources), collaborative management, promotion of alternatives, livelihood support. Tourism (mountaineering) is increasing at an average rate of 20% per year. The park management has to revise concessions, train guides, improve the facilities, maintain trails and work on a diversification of mountaineering experiences. The "Monitoring & Research" program supports management-oriented research and monitoring, informed decision-making, and defines the research priorities. It includes water quality monitoring (ranger-based monitoring). Regional cooperation is another part of the management plan.

Local effects of climate change include receding snows and glaciers, an increase in disease transmission/infections, floods and land slides, increased environmental degradation, siltation and changed water quality/quantity, as well as impacts on economic activities.

What could be the way forward with regard to conservation and management in Ruwenzori Mountains National Park?

- Support development of ecological monitoring plan.
- Conduct more research in priority areas.
- Establish linkages between research projects in the same field.
- Create more awareness of impacts of climate change and work with relevant authorities to help communities adapt.

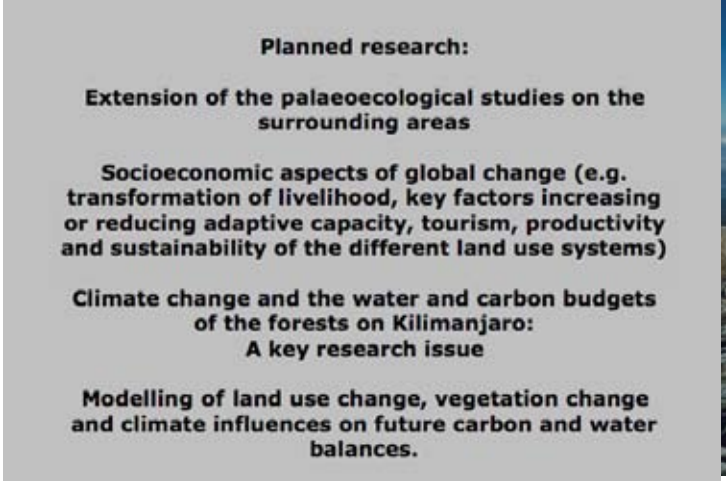


Response of Rwenzori mountain lake ecosystems (Uganda-DR Congo) to climate change: past, present, future

Hilde Eggermont, James Russell, Dirk Verschuren

Abstract: As a result of global warming, ice caps and glaciers in the mountain regions of tropical Africa are expected to disappear within two decades. Clearly, loss of permanent ice from the tops of the highest mountains in Africa will have profound effects on the hydrology and temperature regime of the unique tropical cold-water lakes located downstream from those glaciers. This by itself may have a severe impact on the integrity and function of Afro-alpine lakes and the biological diversity they harbor, in addition to the direct effects of a regional rise in air temperature. Consequently, there is an urgent need to determine the intrinsic ecological resilience of these unique tropical ecosystems to past (natural) climate change, and to establish the baseline conditions against which to evaluate future environmental and biological changes. Sediments accumulating on the bottom of these glacial lakes chronicle the history of central African climate and glacier dynamics, and can thus produce the historical perspective needed for conservation of Rwenzori's natural resources.

In this context, we surveyed virtually all of the lakes on the Ugandan side of the Rwenzori range to calibrate geochemical and paleoecological temperature and water-balance proxy indicators against the modern, altitude-dependent environmental gradients, and to evaluate the sensitivity of these lake ecosystems to both climate change and glacier extent. Here, we present an overview of our currently available data sets, including physical and (geo)chemical data on the lakes and pools, annual series of surface air temperature at nine elevations between 2,500 and 4,600 m elevation, comprehensive species distribution data on aquatic invertebrates and algal communities, and top–bottom analyses of short sediment cores illustrating the ecological sensitivity of individual mountain lakes to climate warming and glacier retreat over the last ca. 200 years. Together, our data show that Rwenzori's high-elevation lakes constitute a unique laboratory to assess quantitatively the relationship between the extent of its glaciers and changes in central African rainfall and temperature.



Global change impacts on Mt. Kilimanjaro

Andreas Hemp, Claudia Hemp, Sampurno Bruijnzeel, Wolfgang Zech

Abstract: Kilimanjaro, a world heritage site, is not only Africa's highest mountain, it is also the highest solitary mountain of the world (700–5,895 m). As a consequence it has a huge variety of bioclimatic zones that consist on the one hand of wilderness areas (savanna, tropical montane rainforest with about 1,000 km2, afroalpine areas), on the other of extremely densely populated areas (in the coffee-banana belt), and include completely different land use systems (sustainable agroforestry systems, intensely used crop fields and coffee plantations, pastoralism). Kilimanjaro harbors about 3,000 vascular plants and many endemic insect species and is a biodiversity hotspot. Kilimanjaro is the main water catchment for northern Tanzania, feeding not only the Chagga people with their extensive irrigation system, but also the economically most important Pangani river system with its hydropower plants.

However, during the last century precipitation on Kilimanjaro decreased by about 30 percent (i.e. by between 400 and 1,000 mm), whereas temperature data reveal a drastic increase since 1976. These climatic changes cause not only the retreat of the glaciers, but also fires to become more aggressive on the higher slopes. The result was a lowering of the tree line by 800 m and a loss of 150 km2 of cloud forest during the last three decades. This almost certainly means a considerable reduction in potential fog water captured by the vegetation. The problem will be further exacerbated by population growth and the associated increases in water demands. Since 1895 the population on Kilimanjaro has grown from 50,000 to over 1 million. In addition to devastating fires in high altitudes the forests below 2,500 m elevation are heavily impacted by illegal logging. Therefore Kilimanjaro is a hotspot of biodiversity under high pressure. Most of the endemic species present are (wet) forest inhabitants that will be affected by decreasing precipitation and increasing human activities. Changes of Kilimanjaro's environment could also affect tourism and thus the economy, as Kilimanjaro National Park is a major tourist attraction, being the top foreign exchange earner among all national parks in Tanzania.

Available biophysical information on Kilimanjaro includes data on biodiversity (vascular plants, bryophytes, mammals, birds, Saltatoria; overview about the plant communities occurring, a detailed map of the present vegetation of Kilimanjaro, ethnobotanical and ethnozoological data), climatic data (mainly rainfall, temperature, humidity) from about 50 stations from the savanna to the alpine zone, a rainfall map and data on the retreat of the glaciers.

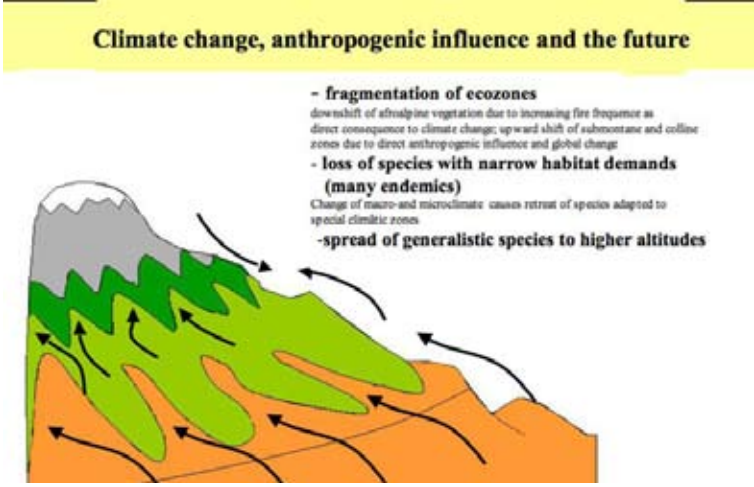
Areas for further research:

- Water budget of cloud forest belt and hydrological impacts of wildfires in the cloud forest.
- Evaluation of impacts of land use change and vegetation change on biodiversity of vulnerable key habitats (rain and cloud forest, alpine vegetation, savanna) and associated carbon and water balances
- Evaluation of gross primary production as a key variable related to vulnerability determining useful products and ecosystem services at risk
- Modeling of land use change, vegetation change and climate influences on future gross primary production, carbon and water balances, crop yields, relating estimated carbon gain to forestry production patterns, and relating landscape water balances (including groundwater recharge) to downstream catchment water yields
- Reconstruction of climate and vegetation fluctuations using palaeobotanical data as a basis for future scenario building.

Biodiversity patterns in the montane habitats of Africa

Simon Loader, David J. Gower, Samy Saber, Roman Kassahun, Jan Beckk, Peter Nagel

Abstract: With pressure on forest systems and projected climate change, forest-associated species can be expected to become increasingly threatened. The study of the impact of historical climate change and how it has influenced diversification of African organisms has largely focused on the large mammal fauna, located in savanna habitats, and less so on montane forest-distributed species. The threat to montane species is thought to be most severe because of proportionally smaller species ranges. The Institute of Biogeography at the University of Basel (http://www.nlu.unibas.ch/), along with collaborating partners based in Africa and elsewhere in Europe, are focused on understanding the biodiversity of African mountain systems and how processes such as climate change might impact these assemblages both in the past and in the future. Using a number of different model groups (including Amphibia, Coleoptera and Lepidoptera) our research has concentrated, and will continue to concentrate, on inventorying the biodiversity of these fragile ecosystems, identifying species and the habitats they occur in. This objective is achieved principally through fieldwork and by building up in-country capacity, facilitating both independent and collaborative research projects. Using these data we explore patterns of species richness and historical relationships between species and areas. From molecular species phylogenies we assess species richness and infer biogeographical relationships between areas, establishing how African land systems have changed temporally and spatially. Preliminary analyses of sequence data from amphibians indicate a major underestimation of montane species diversity and a large phylogenetic diversity, which both suggest that conservation efforts should be prioritized in these habitats. In addition to the increased numbers of species and phylogenetic diversity, montane species are often found to have highly restricted distribution, which is of particular concern considering predicted changes in forest habitats due to climate change.



Diversity and refuge function for indigenous fauna and flora in anthropogenically influenced habitats in tropical regions: a case study on the Chagga home gardens on Mt. Kilimanjaro, TZ

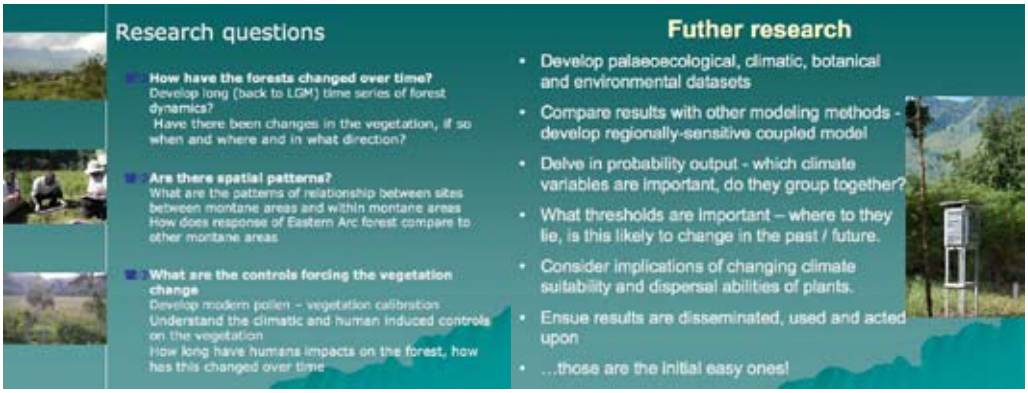
Claudia Hemp, Andreas Hemp

Abstract: The former sub-montane forests on the southern and eastern slopes of Kilimanjaro have now been substituted by small coffee-banana plantations, the so-called Chagga home gardens. Since these cultivated fields still have the structure of a forest, they are a potential refuge for forest plants but also for animals, which is investigated in this study for grasshoppers, locusts and katydids (Saltatoria). 62 permanent plots (usually 0.1 ha) were established between 1996 and 2004 in the Chagga home gardens along transects from 800–1,800 m and compared with the other vegetation formations on this volcano on the basis of over 1,500 plots following the method of Braun-Blanquet. Saltatoria were recorded by sight, netsweeping, and shaking of trees.

Saltatoria: Due to the forest structure of the Chagga home gardens with tree, shrub and herb layers, more than half of the 52 recorded species are forest species, whilst the remainder originate from open habitats. Moreover, the Chagga home gardens harbor >70% of all forest species and >50% of the endemic species of Mount Kilimanjaro. Most endemics in the plantations originate from sub-montane habitats, and contribute 72% of the total number of sub-montane endemics found in the region. More than half of all endemics from the montane zone are also found in the Chagga home gardens.

Flora: The Chagga home gardens maintain a high biodiversity of about 520 vascular plant species, including over 400 non-cultivated plants. Most species (194) are forest species, followed by 128 ruderal species, including 41 neophytes. Beside relicts of the former forest cover, which lost most of their former habitats, there are on the other hand (apophytic) forest species, which were directly or indirectly favored by the land use of the Chagga people.

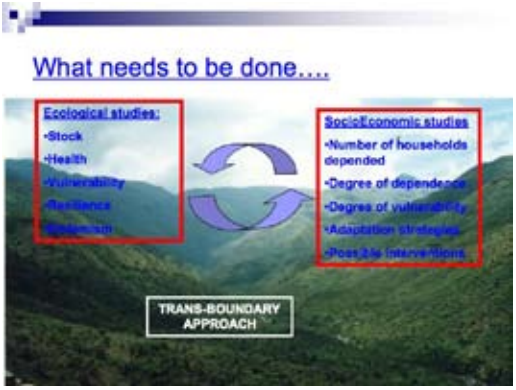
Therefore, the Chagga home gardens act as an important refuge for both generalist forest species and endemic fauna. In recent years new coffee varieties have been introduced to the gardens that are less shade-demanding, and tree removal may impinge on the indigenous Saltatoria fauna and endanger this effective and sustainable system.



Past, present and future impacts of climate change-induced ecosystem shifts within a tropical African biodiversity hotspot - the Eastern Arc Mountains

By Rob Marchant, Antje Ahrends, Jemma Finch, Alistair Jump, Jon Lovett, Colin McClean, Phil Platts

Abstract: Understanding ecosystem response to environmental variability, how this impacts on ecosystem dynamics, and how this may develop over the past, present and an uncertain future requires novel approaches. Although information is available to demonstrate the responsive nature of tropical montane ecosystems to climate change, principally from pollen, biogeographic data and/or future model scenarios, this is generally not available from the same location, and rarely in a format suitable for policy development. For the Eastern Arc Mountains of Tanzania and Kenya, an area regarded as one of the world's hotspots of biodiversity, the York Institute of Tropical Ecosystem Dynamics (http://www.york.ac.uk/res/kite/index.htm) is combining palaeoecological information on past ecosystem sites with a biogeographic, phylogeographic analysis to constrain a modeling framework on ecosystem response to climate and environmental change. In addition to understanding ecosystem functioning, such as the impact of changing moisture levels on the Eastern Arc Mountain ecosystems, the York Institute for Tropical Ecosystems Dynamics (KITE) is fostering new international relationships between Europe and East Africa. Research findings, although at present specific to the Eastern Arc ecosystem, are generic and hence transferable to other montane areas, and research methodologies applicable to understanding broader issues focus on montane ecosystem functioning under different climates. The practical implications of this research are increasingly being realized as improvements are made in forecasting impacts of climate variability on ecosystem functioning and using these forecasts as a platform for developing conservation policy under a changing climate.



Challenges facing biodiversity in the wake of global climate change in Lesotho: a case study of medicinal plants

Taelo Letšela

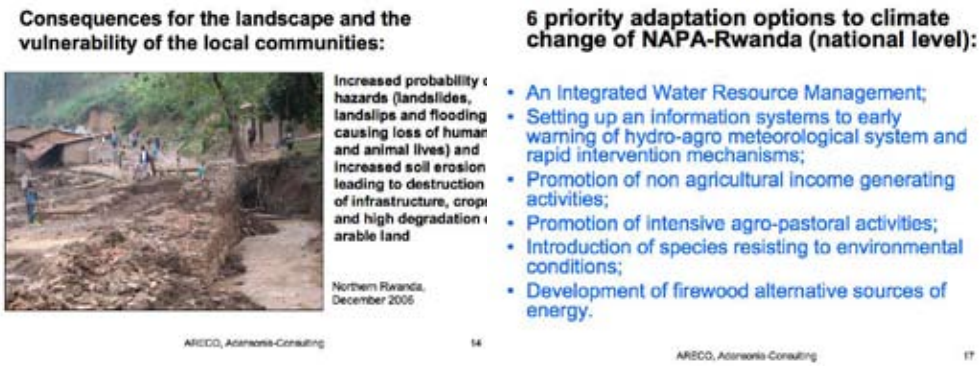
Abstract: We began in 2003 to investigate commoditization of medicinal species and have established that there is a high extraction rate of medicinal species in the mountains of Lesotho. These extractions not only support the sale of these species in local markets but also support export to other countries in the region especially South Africa. This gave us the impression that there seems to be a free flow of medicinal plants between regions and across national boundaries, not regulated or even detected by national institutions. The scale of this problem is unfathomable with several truck loads impounded between the Lesotho-South Africa border in 2006 only. Medicinal plants have always formed part of the health care system in many developing countries around the world, including Lesotho, and are largely used by the poor and underprivileged members of society.

The HIV/AIDS pandemic that is ravaging this part of the world has worsened the problem as medicinal plants are seen as the last resort in the wake of the failure of Western medicine. Although in the past the practice of traditional medicine was the preserve of a few well-trained practitioners it has now become free for all with predictably disastrous impacts on populations from which the materials are harvested. The participation of untrained practitioners has opened up a new avenue of selling markets and commoditizing species. This new practice has commoditized many species regardless of their vulnerability or endemism, no habitats are beyond reach and no species are safe. Trade in medicinal plants in this part of the world has become a lucrative business with many markets mushrooming in most cities. The local institutions are bedazzled by the scale of the problem, paucity of data and the difficult decisions between human wellbeing and conservation. In the past, many households tended to exploit medicinal resources for self-medication. Rarely was it ever necessary for resources to be moved to other areas and countries. Thus consumption was limited to the local environments, giving rise to the concept of the human-in-the-ecosystem. Although there are still examples of unsustainable exploitation of biological resources in the past, it was comparatively easier to stay within ecosystem thresholds because human populations were small and mobile allowing resources to bounce back after disturbances. Currently, human populations are large, sedentary and connected globally in a complex system. The boundaries between national and global regions have faded away allowing resources to move back and forth. Our shortage of practical field experience is the main barrier to understanding ecosystem thresholds in a manner that promotes sustainable use.
Our study is aimed at analyzing the markets in the cities and establishing links with the habitats from which the species on sale were derived. The second layer of our analysis will be on understanding the adaptive strategies of the communities that have depended on those biological resources for many years given the emerging scenario of degradation. The study is also aimed at unraveling the nexus between commoditization of wild species and the impact that climate has on those species. This is to explore the social and ecological ramifications that arise in the wake of the changing environment. The old paradigms that were used to manage resources are under relentless challenge, which necessitates the development of new paradigms that explain the intricate relationship that the modern man has with his environment.

The temporal dynamics of crop yield responses to climate change in East Africa

Andrew Farrow

Abstract:
There is general consensus that the impacts of climate change on agriculture will add significantly to the development challenges of ensuring food security and reducing poverty, particularly in Africa. It is often assumed that these changes will influence agriculture at a broad scale, such that regional or country recommendations might cope with the results. To refute this we use high-resolution methods to generate characteristic daily weather data for a combination of different SRES (Special Report on Emissions Scenarios) and Global Circulation Models to drive detailed simulation models of maize and bean crops. For the East African region, we find that there are considerable differences in crop response and that there is substantial spatial and temporal variation in this response. The analysis suggests that the impacts on households will be neither linear nor constant through time. The results argue strongly against the idea of spatially contiguous and large "development domains" for identifying and implementing adaptation options. Rather, they underline the crucial importance of localized, community-based efforts to increase local adaptive capacity and take advantage of changes that may lead to increased crop and livestock productivity and to buffer the situations where increased stresses are likely to occur.

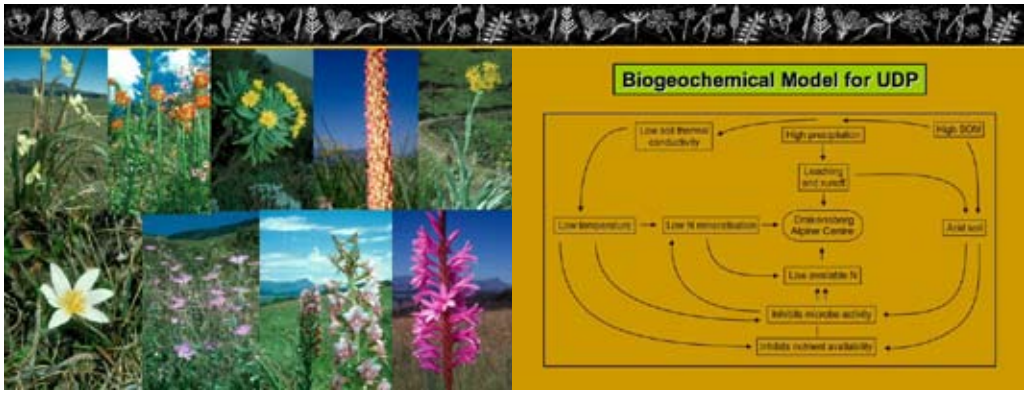


Impact of predicted climate change on the management of a montane forest and its adjacent areas in Rwanda

Urs Bloesch and Dancilla Mukakamari

Abstract: The Mukura montane forest with a size of about 1,500 ha is a remnant of the formerly widespread rainforest along the Congo–Nile watershed in Rwanda. The protection of this catchment forest is vital for the livelihoods of the downstream rural communities. In view of promoting a sustainable use of the forest and its adjacent agricultural land, ARECO is currently running a community-based development project to the benefit of the local communities.

This study will a) present the prediction of climate change for this very vulnerable area using the high-resolution Japanese model of AOGCM (MIROC) and b) analyze the impact of climate change on natural hazards, ecosystems, water systems, immigration, land use (rain-fed agriculture) and on the livelihoods of the local communities. An adaptation strategy for the protection of these montane ecosystems and the sustainable management of the area will be defined. Mitigation and adaptation measures at the project level will be discussed with a view to enhancing the capacity to cope with the expected impact of climate change. The adaptation strategy will be accompanied by a research plan focusing on gaps in current knowledge.



Possible effect of global warming on ecosystem function in Ukhahlamba-Drakensberg Park, South Africa

Clinton Carbutt, Maloti-Drakensberg Transfrontier Project, South Africa

Abstract: The Ukhahlamba-Drakensberg Park (UDP) is a 243,000 ha mountain wilderness forming part of the Drakensberg Alpine Centre (DAC), one of southern Africa's 18 recognized centers of plant diversity and endemism, and southern Africa's only true alpine region. The UDP was declared a World Heritage site in December 2000. The UDP's alpine and sub-alpine soils are derived from outpourings of nutrient-rich basaltic lava. Total nitrogen (N) levels are particularly high (values of 4% are not unusual). However, most of this N is either locked up in organic forms, or is in short supply inorganically because low temperatures arrest microbial action and hence N mineralization. Plant communities bear testament to its nutrient-poor N economy; the dominant floristic element is affiliated to the nutrient-poor Cape Region. Will global warming result in higher rates of N mineralization? If so, will the native plant communities accustomed to low N availability be able to withstand higher N availability? If not, what form of plant life will replace our native mountain flora? These questions were addressed using pot experiments and N incubation (simulation) experiments. A species belonging to a genus well represented in the UDP, but one also tolerant of warmer temperatures and with strong Cape affiliation was established in pots filled with basalt-derived soil along an altitudinal gradient from coast to mountain, with the lower-lying midlands and coastal areas being far warmer and hence simulating a warming effect. N incubation experiments showed that Drakensberg soil mineralized less than 2% of its total N budget at 12°C because the microbes responsible for the conversion of organic N to inorganic N were severely inhibited at this spring temperature (when pulses of N mineralization follow early season wet-up). The pot experiments were also informative. The few remaining individuals grown in the warmer environments were stunted with small leaves and had abnormally high shoot N concentrations. We believe that the high levels of N mineralization under these conditions were deleterious. We thereby predict that the plant communities thriving in the UDP's (currently temperature-mediated) nutrient-poor soils will be extirpated by future episodes of warming because of their inability to cope with N concentrations far beyond their natural tolerance range. Such communities will therefore be replaced by common nitrophilous ruderals that are neither conservation-worthy nor native to the UDP.

Integrated management of livelihood and environmental service concerns of smallholders in the Eastern African Highlands: lessons for institutions and governance

Laura A. German, Ann Stroud and NARI Partners

Abstract: Highland residents rely on a host of ecosystem goods and services whose management and use tends to be mediated by human motivations at the individual level, and systems of governance at the collective level. This paper summarizes 4 years of work aimed at strengthening the integrated management of livelihood and environmental service concerns of local residents in diverse highland sites of the eastern African highlands. Results of participatory landscape-level natural resource assessments are presented, highlighting the environmental services of critical concern to local livelihoods based on stakeholder consultations regarding landscape degradation. Curiously, even when there are a strong local knowledge base and strong motivations for effecting change in unsustainable land use practices, these problems remain. This is argued to be the result of an incomplete transition from traditional to modern systems of governance, and the governance break-down which has emerged in the process. Experiences using action research to address this "governance gap" are summarized, drawing implications for revitalizing institutions and natural resource governance in eastern Africa. This work was carried out in partnership with national agricultural research and extension systems under the rubric of the African Highlands Initiative, an eco-regional research program of the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and the Consultative Group on International Agricultural Research (CGIAR).

Noteworthy aspects of project

- Focus on regional economy small enough to capture important environmental features
- Interview-based data gathering lends "tangibility"
- Mapping of physical, financial, and environmental flows is useful in and of itself
- Valuation of selected environmental flows (water and forest)
- Shadow price of environmental flows based on trade-offs among all of the households' activities
- Nonmarket activities included in trade-offs faced by household
- Addresses both environmental preservation and livelihood issues

Mt. Kilimanjaro, presentation A. Hemp et al

Economic methods for climate change assessment in mountain regions

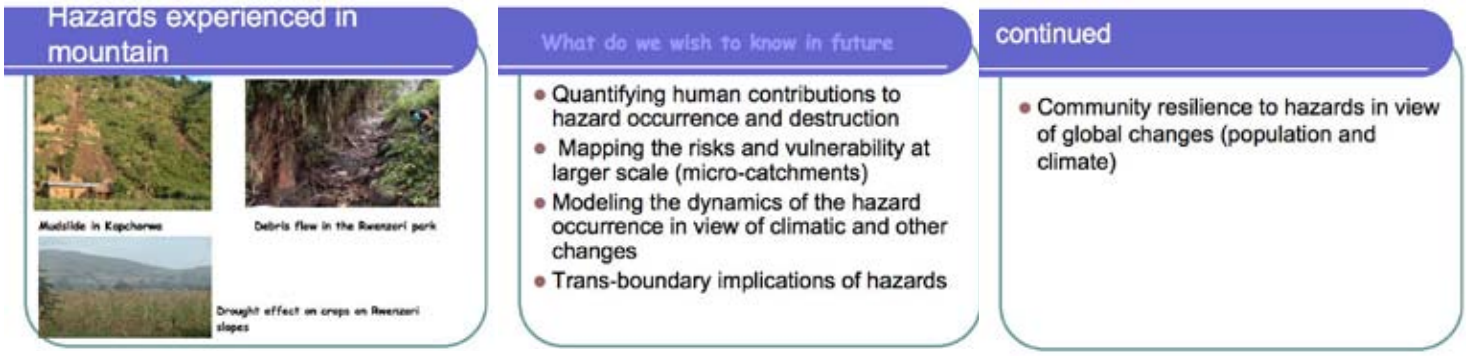
David Kraybill

Abstract: Most economic studies of climate change focus on impacts at the national level. Models constructed at that scale treat the environment as homogeneous, ignoring regional ecological and economic differences that are evident at a finer scale. This paper surveys methods suitable for studying the economic effects of climate change in small areas, such as mountain regions, with distinctive environmental characteristics. Categories of methods surveyed here include economic surplus frameworks, natural resource and environmental accounting methods, economic and social accounts and models, and computable general equilibrium models. The methods are evaluated in terms of their theoretical soundness, grounding in empirical reality, practicality of implementation, data requirements, and amenability to the modeling of policy changes.

Environmental incomes derived from mountain forest ecosystems of Mt. Elgon National Park, Eastern Uganda

Buyinza Mukadasi, John R. Kaboggoza, Muhammod Wambede

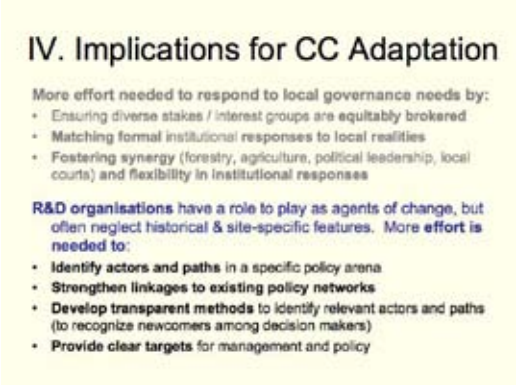
Abstract: Conservation of biodiversity in mountain forest ecosystems proves to be more challenging if local communities are heavily dependent on them for energy, nutritional, medicinal and other subsistence needs. This study estimated environmental incomes for households living around Mt. Elgon National Park (ENP), Eastern Uganda. Data from a household survey conducted in 2005 were analyzed using logistic regression. The results show that the poor people collect several types of goods from the forest for both direct consumption and trading for their basic livelihoods. The rich households with diverse and reliable sources of incomes had less incentive to go for environmental incomes compared to the poor. In addition, we discovered that several household-level factors – such as ethnicity, distance of the settlement to the park boundary, age, household size, landholding and the level of education – significantly affect the total income derived from the national park. However, this study proved that the assets owned by households and the level of income do not provide an additional explanation of the absolute park income differences between groups of households. According to these findings, the management of mountain forest ecosystems should be consistent with the overall socio-economic development. Finally, we argue that if the poor, rural communities have diverse and reliable sources of incomes, they will extract fewer resources from the mountain forest ecosystem.



Global change impacts on mountain hazards and ecosystem services in Uganda

Bob Nakileza

Abstract: Increase in temperature and rainfall conditions have far-reaching consequences on the intensity and occurrences of hazards in mountain areas. This paper provides an overview of the past and ongoing research activities on consequences of global changes (in temperatures and rainfall) on mountain hazards in Uganda. The analysis is based on the two prominent mountains of Rwenzori and Elgon. The key question pursued here is: what implications does/will increase in rainfall and temperatures have on hazards in the mountains in the alpine environments, the montane forests and agricultural lands? What is known and/or needs to be done?
Landslides, floods, soil erosion and disease epidemics are the common hazards accentuated by global changes in these mountains. There is no hazard research in the alpine environments. Most studies on landslides in Uganda (e.g. Bagoora, 1996; Kitutu, 2006; Knapen et al., 2006; Nakileza et al., 2007) have focused on establishing the causes, distribution and the general socio-economic consequences on agricultural lands. Limited studies have been undertaken on determining the rainfall thresholds, quantifying the economic effects and adaptation mechanisms regarding the landslides. Virtually no studies have focused on the effects of landslides on ecosystems, ecosystem services and functions (e.g. nutrient cycling, water quality, rate of soil regeneration), and the interactions with the lowlands. UNEDRA (University Network for Disaster Risk Reduction in Africa) is training and encouraging researchers in the African region to integrate geospatial analysis in their studies of disasters. However, there are no studies yet employing common methodologies for many mountain environments.
Many studies of erosion in the mountains/highlands (e.g. Nakileza, 1992; Tukahirwa-Bitete, 1995; Bagoora, 1997; Tenywa et al., 2004) have quantified the rates under different cropping systems on different slopes. There has been little work done in relating erosion on agricultural lands in the uplands to water quality and ecosystems in the low-lying areas.
Studies on disease epidemics such as malaria, which were never or little experienced before particularly at higher altitudes, are now a major threat to the mountain population. The mountain population has low immunity to malaria. Thus, thousands of people have lost their lives and many have been rendered less productive. Further studies should focus on the dynamics of such diseases in relationship to human adaptation and land use/cover changes, including increased urbanization.



The role of governance in climate change adaptation: understanding and managing the interface between individual and institutional responses

Laura German and Maria Brockhaus

Abstract: Global change, with its different faces and appearances, induces transformations of economies, societies and ecosystems. Populations rely on a host of ecosystem goods and services, whose management and use tends to be mediated by human motivations at the individual level and systems of governance at the collective level. In the face of exogenous change of critical significance to local livelihoods, human behaviors – mediated by human motivations and collective rules – interface with a new set of dynamics which defy prior experience and expectations. Institutions of governance, an important co-determinant of human behavior, are a product of unique historical processes as well as of expected patterns in the natural world (ecosystem structure, function and dynamics; market dynamics; etc.). When those patterns change in unexpected ways, an array of new vulnerabilities sets in unless these institutions and other triggers influencing adaptive behavior can be adapted to new realities. This adaptation hinges on learning at diverse levels, and feedbacks between levels, to equitably distribute risks and opportunities and facilitate information flows related to both – thus enabling informed responses at individual and institutional/group levels.

The paper draws from the literature on resilience, social network analysis and common property resources to posit important components of resilience and adaptive governance in the context of climate change. It then builds upon these concepts to analyze current institutions of governance in socio-ecological systems of east and west Africa. In each case study, the properties of governance are highlighted and contrasted with factors known to enhance adaptive capacity, and implications for climate change adaptation are drawn. Key governance challenges are identified and implications for future research highlighted. The paper concludes with a discussion of research contributions that can help to strengthen learning for improved adaptive capacity of individuals and institutions in the context of climate change and variability.

foto by Nelson Guma,
Rwenzori National Park

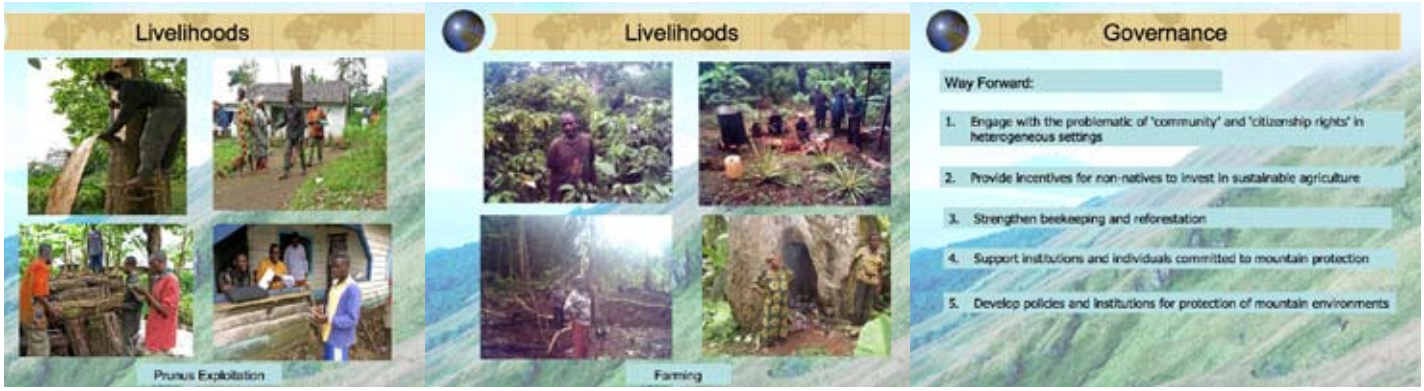
The institutional infrastructure for rural representation

Godberg Tumshabe

Abstract: Africa's rural poor are under-represented in policymaking and policy implementation processes. In many countries, the rural poor constitute a majority, yet public policy and government actions typically fail to reflect their needs and priorities while favoring the interests of small, powerful groups of political and economic elites. Who brings the needs and aspirations of the rural poor into public policy and service delivery decisions?

Development assistance often focuses on promoting popular participation to support inclusion, yet representation is the most effective means of bringing citizen input into policy processes in all but the smallest of societies. Representation addresses the intellectual, time-related and motivational obstacles to direct participation that many citizens experience. In representative democracies, voters elect leaders and delegate to them the authority to govern on their behalf. Through representation, policymaking becomes a process in which professional policymakers balance competing and often contradictory interests. Representatives reconcile the many positions within their constituencies and exercise their discretionary powers to integrate and balance local views, national interests and global concerns. Unlike participation and direct democracy, which can lead to fragmented and inefficient policy, representative democracy relies on deliberation, negotiation and compromise to resolve conflicts and balance clashing interests.

WRI's (World Resources Institute) Legislative Representation and the Environment project conducts research to better understand the institutional infrastructure to legislative representation, the incentives and disincentives that lawmakers face in performing their fundamental representation roles, and their implications for rural people and local needs. The research focuses on three critical elements of representation – accountability, autonomy and authority. WRI's presentation will draw on case material from nine countries (Cameroon, Kenya, Liberia, Malawi, Mozambique, Tanzania, Uganda, Zambia, Zimbabwe), several background papers (South Africa, Burkina Faso, Mali, Senegal), and multiple national and sub-regional workshops to share the principal findings and discuss policy options.



Governance, livelihoods and forest management in the Mt. Cameroon region: case study of the Bimbia-Bonadikombo Natural Resource Management Council (BBNRMC)

Emmanuel Nuesiri

Abstract: Timber from Cameroon's forest is a significant income earner for the Government of Cameroon (GoC); timber export revenues are second only to crude oil. The main actors in the timber sector are the GoC and multinational logging firms. The forest is also a direct or indirect source of livelihood for about 70% of the population in the forest zone. Since 1990, international donors, notably the IMF/World Bank and DFID, the UK Department for International Development, have, also become major actors in the forest sector. They persuaded the GoC to adopt a new forest policy in 1994, which makes room for community-based conservation (CBC) in the form of community forests. Donor justification is that good governance in the forestry sector is a key entry point to broader governance reform.

Donor prerogatives were operationalized through conservation with development projects such as the DFID-led Mt. Cameroon Project (MCP) Limbe. The MCP Limbe, using a participatory biodiversity conservation strategy (PBCS), designed community forest institutions including the Bimbia-Bonadikombo Natural Resource Management Council (BBNRMC). This paper, which adopts a political ecology approach, shows that the governance regime in the BBNRMC is the key determinant of livelihoods and forest management outcomes. The paper also shows that the local regime reflects the governance style of the GoC. The paper argues that conserving the biodiversity of Mt. Cameroon requires long-term, twin track, adaptive local and national initiatives.

The governance of natural resources in the Maloti areas of Lesotho: an overview

Moliehi T. Shale

Abstract: Like many developing countries, Lesotho is in search of innovative ways of satisfying its development objectives. This paper draws on two aspects of development: governance and conservation. The governance of natural resources in Lesotho is an engaging issue as there are multiple spheres and levels of governance, each making use of its own laws and guidelines. For example, at the village scale where the chief presides, communal laws are applied while at the scale of the constituency, local government is represented by community councilors and recognizes and employs national, Western-based laws. Synergizing the efforts of the two institutions has been difficult as they often do not speak to each other nor overlap. It has been particularly challenging for the Basotho people to follow these developments – especially the laws relating to the use of and access to natural resources.

Following the principles of sustainable development, nations across the globe have set aside land for natural resource conservation. Development discourse has often been counter-developmental in that spaces set aside for conservation are often crucial for supplying the natural resources that locals need to support their livelihoods. Where conservation areas are remote and uninhabited, problems such as overgrazing, illegal drug cultivation and the unlawful movement of people and livestock are often experienced – as a result of misunderstanding the idea of conservation or because of the ambiguity concerning authority in those areas.

Using the cases of the Sehlabathebe National Park and the Mohale Dam, this paper highlights how the indistinct characteristics of governance in the Maloti areas of Lesotho make control practices difficult, and it argues that governance structures need to be appropriate to both the people and the physical land that they govern.

Ecosystem approach to restoration and conservation of Uganda's degraded mountain and highland water catchments – a mechanism for response to environmental change

Festus D.K. Bagoora and George M. Lubega

Abstract: Conservation of the fragile environment is well provided for in existing policies and laws of the country. These environments are increasingly facing pressures of degradation from population growth and economic activities. And yet, these ecosystems form the roof, gutter and storage systems of the water we use in our daily life. The ecosystem approach started as a central principle in the implementation of the Convention on Biological Diversity, but has been extended to other areas of the ecosystem. The objective is the conservation of fragile areas of Uganda through proper utilization, as well as the protection of natural resources therein, and to safeguard the integrity of the physical and biological processes at work.
In Uganda, fragile ecosystems have been categorized by the Government as mountainous and hilly areas, wetlands, riverbanks and lakeshores. Like most of other areas of the country, these ecosystems are experiencing severe pressure from population growth and over-utilization, leading to degradation. As a result the Government has made policies and laws to protect these areas. The National Environment Management Authority has adopted a community-based ecosystem approach. It entails capacity building at the district and community levels in using the ecosystem concept.

The ecosystem approach is likely to be most successful in areas that have been negatively impacted upon so that the community response to restoration and conservation efforts, as well as a visible impact on the ground, can be realized in a fairly short time period. In this regard, important practices that degrade the ecosystems have been used as a criterion. This paper takes Bwera in Kasese District as an example of mountain ecosystem restoration and Buhanama-Ndaija as an example of hilly areas ecosystems selected for piloting community-based ecosystem restoration and conservation. In line with the ecosystem approach, communities are assumed to be willing to work towards conservation.

Both approach and site selection recognize that availability of water, as well as control of slope erosion and related hazards are directly linked with many other ecosystem-processes. Consequently, determination of the location and size of the pilot sites has taken into account important boundaries of ecosystem processes such as catchments, wetlands, riverbanks, biota niches, and feeding areas, and their relationship with people's livelihoods and development activities. The uniqueness of the approach consists in the fact that it engages communities through sensitization, consultations and negotiations to obtain a win-win situation in terms of planning and implementation of management interventions. Not only has this approach proved to build community capacity of understanding and management of local ecosystems but it has also recorded a built-in incentive to conserve or use of sustainable practices among the communities after understanding the incremental credits associated with their efforts.

This paper discusses the approaches used and the impact realized during a period of four years of intervention amongst selected communities. Results of the efforts clearly indicate that whereas any impact in the form of ecosystem recovery takes a long time to be realized, there are significant indicators of recovery that can be realized in a short time, for example in two years.

Finally, the paper proposes community-based participatory research to monitor the nature and dynamics of the ecosystem recovery. This will provide the much-needed information on the best options for restoration and conservation of both the already degraded as well as the degrading or threatened ecosystems for posterity.

Integrating indigenous knowledge (IK) and exogenous knowledge (EK) systems in natural resources management: the case of Baringo and Didinga Hills in Kenya and South Sudan

Paul M. Makenzi and Joshua Akong'a

Abstract: Environmental degradation arising from ineffective natural resources management (NRM), depletion of forest biodiversity and the resultant problems, such as soil erosion or water shortage, have become issues of global concern. The worst hit by these problems are the arid and semi-arid lands (ASALs) of sub-Saharan Africa. In Kenya, environmental degradation of most ASALs has persisted despite efforts by the governments and by non-governmental organizations (NGOs) to improve the quality of natural resources and to provide solutions to NRM problems. The effectiveness of traditional strategies for natural resources management using IK as the only source of knowledge has increasingly become a question for investigation. Two case studies were conducted. The objective of these studies was to determine the significance of integrating indigenous and exogenous knowledge systems in NRM and biodiversity conservation by pastoral communities in arid and semi-arid areas in Kenya and South Sudan.

An ex post facto research design was used, covering six divisions in Baringo District in Kenya and seven payams in Budi County in South Sudan. 300 farmers were randomly selected and 30 extension agents selected through purposive sampling from both study areas. Data were collected through survey research using semi-structured questionnaires. Spatial, temporal and social qualitative household data were gathered using participatory research tools as described in the PRA handbook (2002). To determine the relationship between Indigenous Technical Knowledge (ITK) and Exogenous Technical Knowledge (ETK) as sources of knowledge in NRM at household level, the households were categorized based on the level of NRM and the literacy level of the head of household, and the knowledge source was determined as described by Makenzi (2003).

The paper presents the results of the research findings for the Baringo District in Kenya.

Central questions in modeling the economics of adaptation to climate change

Andy Keeler

Abstract: Large-scale and long time-horizon estimates of the damages associated with climate change have been useful in assessing the order of magnitude of economic effects on a sectorally and geographically disaggregated basis. As the certainty of impacts has become greater and more immediate, attention has turned to a more detailed and holistic view of the consequences of climate change that focuses on adaptation. There are some key questions that emerge from this evolution of thought that have important implications for both research and public policy in African mountain regions.

One central question is the mix between adaptation that is specifically driven by policy decisions and adaptation that takes place autonomously in response to the conditions that individuals and institutions experience. This depends critically on how well information can be assimilated and acted upon. A second key question is whether climate change poses a discontinuous set of challenges different from those faced by poor households that are vulnerable to both environmental and economic stressors. This is related to the larger question of how adaptation fits into the larger question of economic and social development. The extent to which wealth is a more effective adaptation strategy than specific environmental and infrastructure investments and actions is essential, and depends on the nature of the disruption of environmental services.

The policy and economic literature has been generally concerned with whether adaptation is a substitute or complement to mitigation – do efforts to reduce the risks of climate change through adaptation reduce or increase the value of reducing greenhouse gases? In a developing country context, the more appropriate question is: which is a higher priority for the use of the scarce domestic and international resources available to address the risks of climate change?

Poster: Regeneration ecology of dominant woody species at tropical timberline

Yoseph Assefa, K. Wesche and Masresha Fetene

Abstract: Being located between the wet east (proper) African and the dry northeast African mountains, the Bale mountain range hosts some of the endemic flora and fauna which are in danger of extinction. The most extensive ericaceous vegetation in the continent is found in the Bale Mountains. The southern slope of this mountain range is known for its distinct vegetation zonation of Afromontane forests.

A study on the recruitment and structure of the ericaceous vegetation was made on the southern slope of the Bale Mountains, Harrena escarpment. The ericaceous vegetation north of Rira village, between 3,000 m and 4,200 m, was sampled systematically along altitudinal gradients. Seedlings and saplings of the woody species were enumerated in a subplot of 25 m2.

Erica trimera is the only species that was distributed in the entire altitudinal range, while E. arboreal was absent in the lower subzone. A major constituent of the vegetation in question, E. trimera, showed a gradual transition in height and life-form along altitudinal gradients. Schefflera volkensii was restricted to the lower subzones. Hypericum revolutum, Myrsine melanophloes and Discopoduim penninervium were distributed in the lower and central subzones of the ericaceous vegetation. The analysis of the population structure of woody species revealed that only Myrsine melanophloes showed a healthy distribution (inverted "J" shape distribution). The other species exhibited abnormal distribution, indicating a problem in reproduction and/or recruitment.

The ericaceous belt of the Bale Mountains is seriously affected by progressively increasing human activities. Cattle and horses exert heavy pressure on the vegetation, especially at lower altitudes. The ericaceous shrubs are cut for fuel wood and are frequently burnt by the local people for various reasons. This is leading to a reduction in the biodiversity of the region with possible consequences on other ecological services such as water retention. Supplementary fuel from plantation forest is urgently required to reduce pressure on the natural forest. Alternative income-generating activities need to be introduced to reduce the pressure on the natural vegetation.

Poster: Melissopalynology: annual variation of melliferous plants in the Soudano Guinean highlands of West Cameroon

Delphine Dongock N. and Joseph Tchoumboué

Abstract: The variation of melliferous plants exploited by Apis mellifera adansonii was studied in the Soudano-Guinean highlands of West Cameroon (5°21'45"–5°35'44" N and 10°4'72"–10°26'24" E) between September 2001 and March 2003 using melissopalynology methods (Louveaux et al., 1978). The aim of this study was to determine melliferous species during these periods in honey samples annually collected. A total of 104 honey samples was collected to this effect: 29 in 2001, 39 in 2002 and 36 in 2003. The spectrum of melliferous plants exploited by Apis mellifera adansonii in that mountain zone is large and diversified. A total of 141 species belonging to 61 families was identified: 98 species in 2001, 126 in 2002 and 112 in 2003. According to the frequency of different species in the honey samples, 76.2% of plants are frequently found in 60% of honey samples of each year cited above; 23.8% of melliferous species vary from one year to another. This variation can be accounted for by bees' carrying away some melliferous plants important for the fabrication of hive products in the mountain chain of West Cameroon. Many reasons can explain the disappearance of these species: anthropic action, agricultural activities, land erosion, evolution of ecosystems due to climatic change. This study must be regularly done in this mountain zone, principally in the fragile ecosystem of the Mt. Mbamboutos.

Poster: Water quality monitoring to assess the conservation status of streams and rivers in the Albertine Rift region of Uganda

Aventino Kasangaki

Abstract: Streams and rivers in mountainous regions are undergoing rapid degradation, yet there are no standard methods for measuring and monitoring the ecological health of these fragile ecosystems. In collaboration with the Ugandan Wildlife Authority, we trained park rangers in rapid bioassessment methods to assess the ecological health of wadable streams in five National Parks and their surrounding areas within the Albertine Rift region of Uganda. In addition, rangers were trained to carry out habitat assessments to link terrestrial and aquatic ecosystem change. Metrics calculated from the data revealed that they can be used effectively to assess the status of freshwater resources in protected areas at low cost. For example, metrics such as number of taxa and EPT (Ephemeroptera, Plecoptera, and Trichoptera species) were efficient at separating sites according to level of stream degradation. Moreover, high habitat assessment scores were an indicator of good quality stream habitat. Protected area sites had high habitat and invertebrate scores compared to sites outside the parks. We conclude that metrics derived from benthic macroinvertebrates may be a valuable tool for assessing the conservation status of streams and rivers and for revealing important linkages between terrestrial and aquatic ecosystem health. However, the metrics need to be standardized to be applicable on a large scale. Given the fact that protected area rangers are spread throughout the country, ranger training programs present an opportunity to effectively monitor the health of freshwaters over a large area at minimal costs.

There is a need for developing a standard water quality monitoring protocol for streams and rivers in mountainous regions so as to assess human impacts on these ecosystems. There is also a need for enhanced, government-supported, long-term environmental monitoring, so that consequences of climatic change can be studied, understood, and used to drive policy. The water quantity and quality of mountainous regions needs to be monitored as they are the major water sources for the lowland communities and for preservation of freshwater biodiversity therein.

Community conservation fotos by Nelson Guma, Rwenzori National Park

Mid-workshop Review: land-use and climate change - what do we need to know? Brainstorming moderated by Greg Greenwood

Theory and Practice	• Revisit the changed nature of terms, e.g. "land use" • Land use systems (types) • Land use policies (what are they?) • Better databases (covering local, regional, continental levels) • Knowledge systems • Causal/reciprocal relations between land use/land use change and climate change • Nexus between land use/land management and food insecurity • Land use as a history • Research on solutions, on problems?
Regional Scope	• Comparisons to other regions in the world • Regional differences • Use of regionally appropriate models
Community Involvement	• Being able to inform decisions at multiple scales • Hindcasting and forecasting • Need to drive analysis all the way into socio-economic dynamics • Partnerships with policy, practitioners in adaptive managements • Human adaptation is on-going in mountain regions
Data Generation and Utilization	• Need for systemic data sharing • Remotely-sensed data • Regional climate scenarios from RCM/GCMs • GBIF; open access climate data • Do not reinforce but use existing tools • Haven't tapped LIK enough • Data dissemination – deliberate effort • Lobby for more observation (meteo) in mountains • Linking to existing efforts/databases (e.g. SAEON) • Multi-disciplinary data collection • But, impossible to get enough data

Climate Modeling	• Regional climate model to guide measurements, monitoring • Models need to be validated/informed by data; ground-truthing • Climate reconstructions, e.g. paleo-reconstructions have been very relevant in management decisions regarding Colorado river • Need to be sure that we understand current climate • Need to look at both positive and negative impacts • Need to look into work on mitigation of global warming impacts
Coordination	• Need for coordination across projects on interaction of land use and climate change of researchers operating within Africa • Databases on people (who is doing what?) and data themselves
Research Focus	• What is particularly relevant to mountains? • Restoration research • Globally cross-cutting issues • New emerging issues • Gaps in climate, paleo-environment and other mountain environments

from the presentation
by Carbutt/Edwards

Results of the final discussion: the way forward

Brainstorming moderated by Greg Greenwood

Next steps in a GCRN for African Mountains: Who will do What Where?

Land development, poverty and society, and climate change were explored separately during the workshop in relation to their effects on the mountains/highlands of Africa. The interplay among these aspects and their linkage to African mountains was also firmly established. The key recommendations and various knowledge gaps made evident in the presentations strengthen the notion that there is a serious need to look into the challenges of global change in African mountains.

The establishment of a multi-site network in African highlands (which will pursue interdisciplinary and trans-disciplinary global change research) was realized as a result of the workshop discussions. On behalf of the participants, therefore, Dr. Gete Zeleke presented a proposal on "The Way Forward" for this newly-established Global Change Research Network in African Mountains. The network will address the need of African mountain researchers to join hands, efforts and resources, and share experiences.

The key functions of the network proposed and adopted are as follows:

1) To engage in well-harmonized, networked research
2) To influence policy and decision-making in order to improve livelihoods and the environment in African Mountains/Highlands (AM/H)
3) To advocate use of different mechanisms at different levels
4) To create synergies with existing local, regional and global initiatives (development and research)
5) To create an AM/H ecosystem GIS-based database platform
6) To create a forum on mountain research and initiatives
7) To mobilize the research community for networking and carrying out research

Thematic groups in the network were also created in order to develop synergies between research proposals and ongoing projects.

The working groups in the network were divided into the following thematic areas:

1) Climate Change
2) Land Use / Land Management Change, and
3) Governance – Socioeconomic

The role of potential partners involved in the community and at the grassroots level (NGOs) was emphasized during the discussion, as this should be fully integrated into the 'governance' thematic area. Research conducted needs to be disseminated, and NGOs will be key partners in facilitating dissemination of information among communities.

The biophysical environment (biodiversity, water, soil) was also proposed as another research cluster in the thematic groups but has yet to be formalized. Key messages from each of the thematic groups are expected to support research proposals to be drafted.

from the presentation
by Richard Lechmere Oertel

Overall, the function of the thematic working groups is as follows:

1) To continue current ongoing research but create a network in the process
2) To jointly identify gaps and design additional well-harmonized and networked research projects
3) To create synergies with existing local, regional and global initiatives (development and research)
4) To influence policy and decision-making for the improvement of livelihoods and the environment in AM/H
5) To undertake advocacy activities
6) To create a thematic GIS-based database platform for the AM/H and feed into the network
7) To create a forum (if needed outside the network)
8) To mobilize resources for networking and doing research
9) To link with other themes

The heads of each of the thematic groups in the network will work independently with their own working groups. However, regular consultations among the groups were deemed highly necessary. The aforementioned thematic groups are headed by Stefan Grab of the University of Witwatersrand, South Africa, for the Climate Change Theme; Gete Zeleke of the Global Mountain Program-CGIAR, Ethiopia, Paul Makenzi, Egerton University, Kenya, and Eva Spehn of Global Mountain Biodiversity Assessment/ DIVERSITAS for the Land Use/Land Management Change Theme; David Kraybill of Department of Agricultural, Environmental and Development Economics-The Ohio State University, and Andrew Keeler of the John Glenn School of Public Affairs, The Ohio State University for the Governance – Socioeconomic Theme.

The coordinating group for the thematic areas will:

1) Define the Terms of Reference of the thematic group, including governance
2) Identify gaps and key priority interventions for the group
3) Develop joint projects
4) Mobilize resources for immediate thematic area functions

The Mountain Research Initiative (MRI) was tasked to be Coordinator of the network, supported by the Global Mountain Program of CGIAR (through the African Mountain Forum node) and the Center for Development and Environment, University of Bern (through North-South linkage and GIS support). The Mountain Resource Center of Makerere University was assigned to be the focal institute in Africa to provide support to the network, including resource mobilization. The key function of this central networking is to periodically get the network together through dialogues and updates. Full disclosure of materials and current developments will be available on the network's site at: http://mri.scnatweb.ch/content/category/3/61/80/ (temporarily housed in MRI website until further notice).

For more information, please email to Bob Nakileza nakilezab@yahoo.com / nakilezab@arts.mak.ac.ug.

The workshop participants (foto Philip Omondi Aming'o)

APPENDIX I
List of participants

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APPENDIX II
Post-conference study tour

An optional post-conference field excursion was organized to familiarize participants with typical ecosystems, land use/cover, evidence of glacial recession, water systems, as well as hazards, adaptation and risk factors in the mountain environs of Mt. Rwenzori situated in Western Uganda.

Itinerary

Day 1

7am Departure from Kampala

9am Breakfast at Masaka

11am Arrival in Mbarara and drive to Mwizi Highlands (observe intensive land use, land degradation, PLEC project response)

1pm Lunch

2pm Travel to Bunyaruguru (observe landscape and the Kalinzu Forest natural eco system)

3pm Arrival in Kalinzu forest sta tion (walk down the forest, observe the natural forest and eucalyptus plantation)

3.30pm Drive to Kishunju Hill view point (observe the Nyungu crater lake, Kichwamba 1 Crater Lake)

4pm Drive to Kichwamba 11 (observe the edge of the rift valley, distant views of the Rwenzori Mountains and their environments, the dry crater lakes and the interacting rift valley ecosystem)

5pm Game drive through Queen Elizabeth National Park eco system (stop-over at Kazin ga Channel - observe the hydrology/river system, or the water ecosystem)

6pm Arrival in Kasese

Day 2

8am Breakfast at Virena Gardens & Cottages in Kasese

9am Drive to Bwera (observe the impacts of urbanization on the foot hills of the Rwenzori Mt., interact with local comunities, National Envi ronment Management Aut hority, ecosystem approach activities)

1pm Lunch

2pm Visit Uganda Wildlife Autho rity office in Bugoye Kasese (orientation talk by UWA Management)

3pm Drive to Nyakalenjija (get into Rwenzori National Park and explore the colla- borative park management practices and challenges)

Day 3

8am Breakfast

8.30am Visit Kilembe mines (look at alternative sources of livelihood for former copper mining communities, observe land use/cover visit UWA site, local NGO, land manage ment challenges)

10am Drive to Fort Portal (observe River Mobuko flow patterns and commu nity land management practices)

1pm Lunch

2pm Depart for Kampala (stop-over at the Kibale National Park – elephant cross-over trails, land uses and ecosystems, deforesta tion)

5pm Arrival in Kampala

Field-trip fotos by Willem Ferguson

Network mapping for a Global Change Research Network in African Mountains

Makarere University, CDE (Centre for Development and Environment, University of Bern), and MRI have developed an overview of African Mountain Research. The workshop participants form the core of the Who is Who list. It has then been supplemented with national lists (provided by the members of the conference steering committee) of researchers working on global change in the African mountains. The list is updated by the Mountain Research Initiative on a regular basis, and is always open for new entries. The readers are called upon to complete the list, i.e. to send MRI the names of scientists who are not listed!

Name	Inst.		Contact	Research Region	Discipline	Current Research Topic	Research Partners	Funding
Ahal Rajeev	German technical Cooperation (GTZ)	**ZA**	Rajeev@gtz.org.ls	Lesotho Highlands	Highland wetlands			
Bezuidenhout Hugo	South African National Parks	**ZA**	hugob@sanparks.org	Southern African highlands	Research, management			
Pauw Johan	South African Observation Network	**ZA**	johan@saeon.ac.za	Southern African highlands	Data base			
South African National Biodiversity Institute		**ZA**	info@sanbi.org	Southern African highlands	Management, governance, research			
Anchor Environmental Consultants CC	University of Cape town	**ZA**	ANCHOR@botzoo.uct.ac.za	Southern African highlands	Highland wetlands			
Boshoff Andre	Nelson Mandela Metropolitan University	**ZA**	andre.boshoff@nmmu.ac.za	Eastern Cape Mountains	Ecology			
Carbutt Clinton	Ezemvelo KZN Wildlife	**ZA**	emc@futurenet.co.za	Drakensberg mountains	Botany (plant systematics, plant ecology, plant biogeography)	Conservation planning	Dr Stefan Grab (Wits University, ZA), past colleagues / supervisors at the University of KwaZulu-Natal (Prof. Trevor Edwards)	
Cunningham M.	University of Free State	**ZA**	cunninghammj@qwa.uovs.ac.za	Drakensberg mountains	Zoology			
De Villiers Stephanie	University of Stellenbosch,	**ZA**	steph@sun.ac.za	Lesotho highlands	Earth science, aquatic chemistry, isotope geochemistry, marine and continental records of climate change	1. Southern Africa continental weathering rates, as reflected in river geochemistry, denudation rates and offshore sediment accummulations; 2. Soil geochemical characteristics in Southern Africa; 3. Hominid evolution in Africa, climate and environmental change	Large number of people in Southern Africa, Europe and the USA	NRF (National Research Foundation, ZA), NSF (National Science Foundation, USA)
Esterhuysen Amanda	Wits University, Johannesburg	**ZA**	amanda.esterhuysen@wits.ac.za	Lesotho highlands	Archaeology			

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Ferguson Willem	University of Pretoria	**ZA**	willemferguson@zoology.up.ac.za	Drakensberg mountains	Ecology	Mountain grassland conservation	SAPPI, Global Forest products	National Research Foundation
Grab Stefan	School of Geography, Archaeology & Environmental Studies, University of the Witwatersrand	**ZA**	stefan.grab@wits.ac.za	Mount Kenya, Aberdare ranges and Kenyan highland; Lesotho highlands	Geomorphology, climate	Mass movement classification and processes, footpath management, change analysis of gully systems, palaeo-glacial, periglacial and climate studies, historical climate change, channel change analysis of the Limpopo River system, sandstone weathering and erosion	Institute of Nuclear Science, University of Nairobi, Goddard Earth Sciences and Technology centre (US), funded by Wits University Funds; Ezemvelo Wildlife Services	Wits University Funds; National Research Foundation
Kakembo Vincent	Geography, Nelson Mandela Metropolitan University	**ZA**	Vincent.kakembo@nmmu.ac.za	Eastern Cape Mountains	Applied geomorphology		Prof Kate Rowntree (Rhodes University), Dr Tony Palmer (Research and Agricultural Council), postgraduate students	
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Marchant Rob	Environment Department, University of York	**UK**	rm524@york.ac.uk	Eastern Arc Mountains, Mount Kenya, Kilimanjaro, Meru, Aberdares, Albertine Rift (Rukiga Highlands)	Palaeoecology, biuogeography, ecosystem modeling	Tracing ecosystem responses to climate change and human impacts, using understanding on ecosystem dynamics to inform management options	Numerous, a.o. Universities of Bloemfontein, Cape Town, Dar es Salaam, Nairobi, Mbarara, TAWIRI, National Museums of Nairobi, WWF-Tanzania	EU, NERC, Royal Society, NSF-START, National Geographic, McArthur Foundation, Linnaean Society
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Taylor Richard	Department of Geography, Univ. College London	**UK**	r.taylor@geog.ucl.ac.uk	Mount Rwenzori in Congo DRC/UG	Water resources	Impacts of climatic change on hydrological flows and glaciers		
Aguti Caroline	Association for Strengthening Agricultural Research in Eastern and Central Africa	**UG**	caguti@yahoo.com	Mount Rwenzori in Congo DRC/UG		Comparative study of Amphimbian diversity		
Bagoora Festus D.K.	National Environment Management Authority (NEMA), Uganda	**UG**	fbagoora@nemaug.org	Mount Rwenzori in Congo DRC/UG	Hydro-Geomorphology (drainage basin processes / watershed management)	A watershed-scale understanding of nature and dynamics of drainage basin processes in Uganda; community-based integrated management systems in water catchments using ecosystem approach.	Goerge Lubega, Bob Nakileza and Mr. Bamutaze Yazidi, plus several other associates.	On and off funds form different agencies including FAO, National Environment Management Authority, Makerere University, African Academy of Sciences, among others
Bamutaze Yazid	Department of Geography, Makerere University	**UG**	bamutaze@arts.mak.ac.ug	Mount Elgon in Uganda/ Kenya		Spatial patterns of soil erosion, landuse impacts of runoff		
Farrow Andrew	Int. Center of Tropical Agriculture, Agricultural Research Institute	**UG**	a.farrow@cgiar.org	Eastern African highlands / mountains	Geography	Adaptation to climate change, access to agricultural markets, socio-ecological niches for high value agricultural products, urban agriculture	ILRI, AHI, CIP, Diobass, Africare, ISAR, INERA, NARO, CRS, TiP Tanzania	various
German Laura	African Highlands Initiative, CGIAR, Uganda	**UG**	L.German@cgiar.org	Eastern African highlands / mountains	Ecological anthropology	Forest governance, integrated NRM	National agricultural research systems, local government, NGOs	
Guma Nelson	Rwenzori Mountains National Park / Uganda Wildlife Authority	**UG**	guma_nelson@yahoo.co.uk			Conservation and Management Status of Rwenzori Mountains National Park, World Heritage Site		
Kasangaki Aventino	Institute of Tropical Forest Conservation, Mbarara University of Science & Technology	**UG**	kasangaki@itfc.org	Mount Rwenzori in Congo DRC/UG	Freshwater ecology	Effects of deforestation on stream ecosystems and development of monitoring metrics for streams and rivers	Several researchers at the fisheries research institute in Uganda. Prof. Vincent Resh, University of California Berkeley and Prof Lauren Chapman, McGill University	Various agencies outside Uganda
Kitutu Gorette		**UG**	Gkitutu@nemauganda.org	Mount Elgon in Uganda/ Kenya		Impact of landuse on landslides		
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Mukwaya Paul	Mountain Resource Center, Department of Geography, Makerere University	**UG**	mukwaya@arts.mak.ac.ug	Mount Elgon in Uganda/ Kenya		Urbanisation processes and patterns		
Nakileza Bob	Mountain Resource Center, Department of Geography, Makerere University	**UG**	nakilezab@yahoo.com	Mount Rwenzori in Congo DRC/UG	Environmental Geography	Soil degradation and landuse change impacts, landslide rehabilitation and monitoring, impact of urbanization in mountain environments; impacts of glacial recession	IFRA, University of Brescia, University College of London (Richard Taylor) , Toulouse University, Dr. Bagoora Festus (NEMA), GEF	IFRA and French government (CORUS programme), NEMA, GEF, Royal Geographical Society
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Tukahirwa Joy B.	The Environmental Conservation Trust of Uganda	**UG**	jtukahirwa@ecotrust.org.ug	Kabale and Kigezi highlands in Western Uganda		Soil erosion, landuse, environmental change		
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Turyabanabwe Loy G.		**UG**	turyaloy@yahoo.com	Mount Elgon in Uganda/ Kenya		Impact of geomorphic processes and landuse on slope stability		
Coppolilo Pete	Wildlife Conservation Society (WCS)	**TZ**		The Southern Highlands of Tanzania	Land-scarp ecology	Ruaha National Park Land scarps		WCS
Davenport Tim	Wildlife Conservation Society (WCS)	**TZ**	tdavenport@wcs.org	The Southern Highlands of Tanzania	Naturalist	Butterflies, Reptiles (especially chameleons), Amphibians, beetles, Primates, Range ecology etc.	Tanzania National Parks, Tanzania Government, The University of Dar-Es-Salaam, The Open university of Tanzania. TFCG. TAWIRI, Game and Forest Division in Tanzania.	WCS
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Howell Kim	University of Dar es Salaam	**TZ**	khowel@udsm.ac.tz	Eastern Arc Mountains in Tanzania	Cryptology		Department of Zoology and Wildlife Ecology, University of Dar es Salaam	WCS
Loverro Francesca		**TZ**		Eastern Arc Mountains in Tanzania	Ecology	Flora and Fauna Monitoring	Government of Tanzania	Italian Government
Lyaruu Herbert Valentine	Department of Botany, University of Dar es Salaam	**TZ**	lyaruu@amu.udsm.ac.tz	Mount Kilimajaro in Tanzania	Ecology cum taxonomy	Ethnobotany	Prof Missana and Prof. Mbonile, University of Dar es Salaam; Drs. Jan Axmacher and Marion Schrumpf, University of Bayreuth (D)	Funded by UNEP, German Government
Machaga Sophie	Wildlife Conservation Society (WCS)	**TZ**	smachaga@wcs.org	The Southern Highlands of Tanzania	Ecology	Duiker distribution and Ecology, Reptiles and amphibians	Tanzania National Parks, Tanzania Government, The University of Dar-Es-Salaam, The Open university of Tanzania	WCS
Mpunga Noah	Wildlife Conservation Society (WCS)	**TZ**	nmpunga@wcs.org	The Southern Highlands of Tanzania	Conservation ecology	1. Scat analysis for diet identification for carnivores of southern Tanzania, 2. Carnivore abundance in the Southern TZ by Camera Trapping. Red Colobus and Kipunji ecology in Rungwe forest Reserve Mbeya region Tanzania, and Mbizi Forest Reserve Rukwa Region.	Tanzania Govenment Local and National Level, Tanzania National Parks, Tanzania Forestry Division.	WCS
Mwakilema William	Tanzania National Parks	**TZ**		The Southern Highlands of Tanzania	Ecology	Ecological Monitoring Kitulo Plateau, and Livingstone Ranges	Tanzania National Parks, WCS	Tanzania National Parks
Ndangalsasi Henry	University of Dar es Salaam	**TZ**	hjndangalasi@yahoo.com	Eastern Arc Mountains in Tanzania	Botany	Long-term monitoring of vegetation	Department of Botany, Uniiversity of Dar es Salaam	
Ngowi W.	Forest Division, Tanzania	**TZ**		The Southern Highlands of Tanzania	Botany	Catchments areas monitoring	WCS, Local Governments	Tanzanian Government
Nikundiwe A.M.	Department of Zoology and Wildlife Conservation, University of Dar es Salaam	**TZ**	nikundiwe@science.udsm.ac.tz	Eastern Arc Mountains in Tanzania	Biology	Long Term Monitoring of Vegetation, Bund Beetle, Primates, Birds, Epiphytes, Road kills	Department of Botany, University of Dar es Salaam	MacArthur Foundation
Nuhu Daniel		**TZ**	nuhu.daniel@gmail.com	The Southern Highlands of Tanzania	Ecology	Environmental Education to local people in Southern Tanzania	Tanzania National Parks, Tanzania Government, The University of Dar-Es-Salaam, The Open university of Tanzania	WCS

Nyambo Damas Alois	Community Optional Renewable Resources and Environmental Conservation Trust (CORRECT), Tanzania	**TZ**	damasalois@yahoo.com	The Southern Highlands of Tanzania	Forestry	Agro-forestry, Environmental Conservation, Tourism, Research and Training	Various	WCS-Mbeya, Tanzania Coalition and Debt Development (TCCD-DSM),TANGO, TAF
Picton Phillips Guy	Wildlife Conservation Society (WCS)	**TZ**	gpictonphillips@wcs.org	The Southern Highlands of Tanzania	GIS		Uganda Forest Division, Tanzania National Parks, Tanzania Government, The University of Dar-Es-Salaam, The Open university of Tanzania. TFCG. TAWIRI, Game and Forest Division in Tanzania.	WCS
Senzota Ramadhan	Department of Zoology and Wildlife Conservation, University of Dar es Salaam	**TZ**		Eastern Arc Mountains in Tanzania	Range Ecology	Long Term Monitoring of Vegetation, Bund Beetle, Primates, Birds, Epiphytes, Road kills	Department of Botany, University of Dar es Salaam	MacArthur Foundation
Yanda Pius Z.	Inst. of Resource Assessment, University of Dar es Salaam	**TZ**	yanda@ira.udsm.ac.tz	Eastern Arc Mountains in Tanzania	Natural Resources Management		University of Dar es Salaam	Various
Mukakamari Dancilla	The Association Rwandaise des Ecologistes "ARECO-Rwanda Nziza"	**RW**	arecorwa@yahoo.fr			Impact of predicted climate change on the management of a montane forest and its adjacent areas in Rwanda		
Ambrose David	National University of Lesotho, Lesotho	**LS**	Nat. Univ. of Lesotho, P.O. Roma 180, Lesotho	Lesotho Highlands	Database			
Damane Stanley	Lesotho Ministry of Tourism, Environment & Culture	**LS**	stanleydamane@hotmail.com	Lesotho Highlands	Tourism, environment			
Green Thuso	Sechaba Consultants	**LS**	tgreen@sechaba.co.ls	Lesotho highlands	Environment, agriculture	Lesotho highlands		
Lesotho Highlands Development Authority		**LS**	Phone: 2231 3728	Lesotho highlands	Development	Lesotho highlands		
Letsela Taelo	Department of Biology, National University of Lesotho, Lesotho	**LS**	Tj.letsela@nul.ls	Lesotho highlands	Ecology	1. Exploitation of medicinal plants particularly for commoditization and its impact thereof ; 2. Impact of foresting Lesotho's grassland landscape	The medicinal plants study is funded by the National University of Lesotho. The Forestration project by the Leverhulme Trust, UK.	
Maluti Drakensberg Transfrontier Project		**LS**	info@maloti.org	Lesotho highlands	Multi-purpose mountain initiatives	Lesotho highlands		
Matete M.	National University of Lesotho	**LS**	me.matete@nul.ls	Lesotho highlands	Agriculture	Lesotho highlands		
Mokitimi None	National University of Lesotho, Lesotho	**LS**	n.mokitimi@nul.ls	Lesotho highlands	Agriculture			
Ntselikane Matseliso	Transformation Resource Centre Lesotho	**LS**	Director@trc.org.ls	Lesotho highlands	Transformation			
Shale Moliehi	Shell Environmental and Geographical Science, Stockholm Environment Institute	**LS**	Moliehi.shale@gmail.com	Lesotho highlands	Environmental management (human Geography)	NeWater Project (adaptive water management under uncertainty, wetlands and their contribution to rural livelihoods)	Department of Water Affairs (wetlands unit), Department of Range Management, Maluti-DrakensbErg Transfrontier Park, CARE Lesotho	
Tsehlo Moshe	Participatory Ecological Land Use Management	**LS**	tsehlo@yahoo.com	Lesotho highlands	Land use			
Charlery de la Masselière Bernard	Institut français de Recherche en Afrique	**KE**	bcharlery@ifra-nairobi.net	Eastern African highlands / mountains	Geography	Small farmers in East African Mountains	French Research Teams, East African universities, universities of Stockolm (SE), Bayreuth (D), Musée royal d'afrique central (BG)	French Government

Chiuri Wanjiku	Egerton University	**KE**	chiuriw@wananchi.com	Eastern African highlands / mountains	Environmental studies	Gender and water	GLCRSP, interdisciplinary team from Univ. of Wyoming, UC Davis, Univ- of Uttah, Moi Univ., Egerton Univ., Kenya Wildlife Service and Dept. of Fisheries	USAID
Kiteme, Boniface P.	Director of the Centre for Training and Integrated Research in Arid and Semi Arid Lands Development (CETRAD)	**KE**	b.kiteme@africaonline.co.ke	Mount Kenya, Aberdare ranges and Kenyan highlands; Mount Kilimanjaro in TZ; Eastern Arc Mountains in TZ	Geography / planning (highlands-lowlands interactions; water resources management; food security and livelihoods systems; Institutional arrangements for natural resources management (etc.)	1. Water Users Ass. as institutions to promote sust. water use and management; 2. Water use conflicts mapping and characterization; 3. Water awareness campaigns; 4. Evolution and impacts of central places on the ecosystems of Mt. Kenya and Mt. Kilimanjaro; 5. Sust. utilisation of Prunus Africana in Rombo (TZ) and Taveta (KE)	1.-3. Collaboration with government departments and parastatals, ngo's, private sector, including the civil society. 4. Depts. of Geography, Univ. of Nairobi and Univ. of Dar es Salaam, TZ; 5. Dept. of Forest Biology Sokoine Univ. of Agriculture, TZ; and Dept. of Economics, Egerton Univ., KE	1.-4. SDC, through CDE (Univ. Bern, CH); Eastern and Southern Africa Partnership Programme (ESAPP); NCCR North-South; 5. Funded by the African Academy of Sciences through AFORNET
Makenzi Paul	Egerton University / UNESCO-MAB, Kenya	**KE**	pmakenzi@yahoo.com	Mount Kenya, Aberdare ranges and Kenyan highlands	Environmental sciences, human ecology	Biosphere Reserves management	Kenya-Man and Biosphere Committee	UNESCO-MAB and EU
Ndiritu Francis Gichuki	Physics and Computer Science Department, Egerton University, Kenya	**KE**	fgichukin@yahoo.com	Mount Kenya, Aberdare ranges and Kenyan highlands	Physics, Material science	Renewable energy, solar energy	Local: Mr. Ngumbu R.G., Mr. Gaithom	Not yet attracted funding
Omondi Philip	Climate Predication &Application Centre (ICPAC), Intergovernmental Authority on Development (IGAD),	**KE**	pomondi@icpac.net	Eastern African highlands / mountains	Climate Research	Modeling climate variability and change on interannual to decadal timescale over Eastern Africa region	Tropical glaciology group of Univ Innsbruck (A), Cooperative Institute for Research in Environmental Sciences of Univ Colorado (US), Climate systems research center of Univ Massachusetts (US), Univ Nairobi (KE)	Various donor organizations
Lami Andrea	EV-K2-CNR Committee	**I**	a.lami@ise.cnr.it		environment, paleolimnology, climatic research	meterology	CNR	Italian governmental institution
Vassena Giorgio	University of Brescia	**I**	Giorgio.vassena@unibs.it	Mount Rwenzori in Congo DRC/UG	Cartography and surveying	Glacier laser scanning survey, trekking routes surveying, WEB GIS	L'Umana Dimora, University of Makerere, Italian Alpine Club, OIKOS ambiente, Topotek	L'Umana Dimora Environmental Association, Italian Alpine Club
Ouattara Mamadou	Regional Programme for the Integrated Development of the Fouta Djallon Highlands, African Union Coordination Office (UA/BCI)	**GU**	unafrik@sotelgui.net.gn	Fouta Djallon Highlands, central part of Guinea, Extending through foothills to neighbouring countries	Soil science, research management, sustainable deveopment	Coord., advocacy, resource mobilization: establishment of an Observatory of natural resources of the Fouta Djallon Highlands, promotion of approaches, know how and alternative technologies in participatory management of natural resources and local income generation opportunities to improve the livelihood of populations in the highlands	Member States (including their agricultural research institutions and universities), UNEP, FAO, regional organisations specialized in natural resource monitoring, River Basin Organizations	
Assefa Yoseph	Addis Ababa University	**ET**	yoseph1assefa@yahoo.com	Bale Mountains in Ethiopia		Regeneration Ecology of Woody Timberline Species in Bale Mountains, Ethiopia		
McCartney Matthew	International Water Management Insititute	**ET**	m.mccartney@cgiar.org	Bale Mountains in Ethiopia, Ethiopian highlands	Hydrology and water resources	Decision support systems for large dams, evaluation of wetlands to support livelihoods	Addis Ababa University, Ministry of Water Resources (ET)	
Zeleke Gete	Global Mountain Programme	**ET**	g.zeleke@cgiar.org	Ethiopian Highlands	Natural Resources Management			
Hemp Andreas	Department of Plant Systematics, Bayreuth University	**D**	andreas.hemp@uni-bayreuth.de	Eastern Arc Mountains in Tanzania	Botany	Climate change, ecology, palaeobotany, biogeography	COSTECH, Nat. Museums of Kenya, UNEP Nairobi, Oslo University, Amsterdam University, Potsdam University, TANAPA-KINAPA	Deutsche Forschungs-gemeinschaft
Hemp Claudia	Department of Animal Ecology II, Bayreuth University	**D**	andreas.hemp@uni-bayreuth.de	Eastern Arc Mountains in Tanzania	Entomology	Speciation processes of flightless East African Saltatoria	National Museums of Kenya, TANAPA	Deutsche Forschungs-gemeinschaft

Dongock Nguemo Delphine	Department of Plants Biology, University of Dschang	**CM**	dndongock@yahoo.fr	Highlands of West Cameroon		Melissopalynology : annual variation of melliferous plants in the soudano guinean highlands of West Cameroon		
Lemougue Joséphine	University of Dschang	**CM**	Josechrist5@yahoo.fr	Rwanda	Geography	PHD student, Member of geomatic laboratry and, member of "Centre de Recherche sur les Hautes Terres" of Dschang University. Topics: towns /villages relations; agricultural production on the Western highland.	Prof. Laurien UWIZEYIMANA of the University of Toulouse (F) with prof. Jean-Marie FOTSING of the University of Orleans (F) and with Prof. Martin KUETE of the University of Dschang (CM)	Diff. sources
Manga Veronica	Dept of Env. Sci and Geology, University of BUEA	**CM**	ebotmangav@yahoo.com		Environmental studies			
Mkankam Kamga François	Department of Physics, University of Yaounde 1, Cameroon	**CM**	fmkankam@yahoo.co.uk	Eastern African highlands / mountains	Atmospheric physics	Climate variability and climate change projections	ICTP, Trieste	University of Yaounde 1
Nkembi Louis	ERuDeF	**CM**	lnkembi@yahoo.com	Cameroon Mountains	Social Scientist	Biodiversity research and conservation in Cameroon Mountain areas		
Meutchieye Felix	Raffia-Rattan Project, Dschang University	**CM**	meutche@yahoo.fr	Westen highlands of Cameroon		Importance socio-économique des écosystèmes à raphiales dans la région des hautes terres de l'Ouest Cameroun		
Nodem Jean-Emet	Department of Philosophy and Social Sciences Dschang University	**CM**	jeanemet@yahoo.com	Westen highlands of Cameroon	Sociology	Colonization of mountains by urban elites, agriculture and breeding, exploitation of freshwater sources	Team of 8 students	No external funding
Ondoa Antoine Zita	Consultant	**CM**	zitaondoa@yahoo.fr	Westen highlands of Cameroon	Forest Governance, Community Forest Certification	SmartWood, SNV, WWF, etc		Consultancy fees
Tanyi Divine Ebai	Limbe Botanic Garden	**CM**		Mount Cameroon	Vegetation ecology	The effects of climate change on the vegetation, ecology and the biodiversity of the Mt.Cameroon		
Teguia Alexis	Dept. of Animal Productions Faculty of Agronomy and Agricultural Sciences Univ. of Dschang	**CM**	alexisteguia@yahoo.fr / alexisteguia@justice.com			Problematic of the survival of small ruminant farming in the Western Highlands of Cameroon		
Bloesch, Urs	Adansonia-Consulting, Switzerland	**CH**	bloesch@swissonline.ch	Eastern Arc Mountains in Tanzania	Tropical terrestrial ecosystems	Vegetation history of savanna landscapes and miombo woodland, biodiversity assessment of coastal forests, planning of an oil palm plantation in TZ, pub. of ethnobotanical book about the woody plants of Rwanda	Tanzania University of Dar es Salaam, Sokoine University of Agriculture in Morogoro, Areco (RW)	Critical Ecosystem Partnership Fund and Syngenta Foundation for Sustainable Agriculture
Kohler Thomas	Centre for Development and Environment, University of Bern	**CH**	Thomas.kohler@cde.unibe.ch	Eritrea, Kenya	Geography	Rural livelihoods, mountain development, geoinformation in development	Kenya: CETRAD/Nanyuki, Eritrea: a number of governmental and non-governmental partners and institutions of higher education	div. institutions including SDC
Loader Simon	Institute of Biogeography, University of Basel,	**CH**	Simon.Loader@unibas.ch	Eastern Arc Mountains in Tanzania	Biogeography and systematics	Distribution, taxonomy and biogeographic patterns of the amphibian fauna of East African mountains	Colleagues from other Universities or Natural History Museums (UK, I, BG, D, US), partners in host countries (Prof. Kim Howell , University of Dar es Salaam, Prof. Samy Saber, Addis Abba University)	Mainly UK based funding bodies. Applied for Swiss National Science Foundation for future work.
Eggermont Hilde	Limnology Unit, Ghent University	**BE**	hilde.eggermont@ugent.be	Mount Rwenzori in Congo DRC/UG	Biology, paleolimnology	Patterns and causes of natural climate variability in Africa using paleoclimate records. Assessing hydrological and ecological sensitivity of lakes to natural and human-induced climate change.	Dr. Immaculate Ssemmanda (UG), Prof. James Russell (US), Prof. Dirk Verschuren (BG), international consortium of scientists	
Moeyersons Jan	Africamuseum, Belgium	**BE**	Jan.moeyersons@africamuseum.be	Rwanda	Geomorphology			

Nyssen Jan	University of Ghent	**BE**	Jan.Nyssen@UGent.be	Bale Mountains in Ethiopia, Ethiopian highlands	Geomorphology	Slope processes, landscape evolution	Mekelle University, K.U.Leuven, Africamuseum		
Brockhaus Maria	CIFOR		M.Brockhaus@cgiar.org	Fouta Djallon Highlands, central part of Guinea, Extending through foothills to neighbouring countries	Agricultural Economy and Policy	Climate Change Adaptation and Tropical Forests; Governance; Policy Networks	Gos, IGOs & NGOs, INGOs, NARS	BMZ, EU	
Musigunzi Kule A.			kuleasamusinguzi@yahoo.com	Mount Rwenzori in Congo DRC/UG		Root causes on environmental change in Kasese district			

Rwanda, Bob Nakileza

Icterine Warbler, Willem Ferguson

Rwenzori, Mt.Speke, Bob Nakileza

Lesotho, Stefan Grab

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Workshop Report

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