

Photo 1: Mount Kenya seen from the North. The different altitudinal zones (farming, forest, and afro-alpine and nival zones) are clearly visible; copyright Hanspeter Liniger



Dimensions of Global Change in African Mountains: The Example of Mount Kenya

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

This paper discusses the effects of global change in African mountains, with the example of Mount Kenya. The geographical focus is the northwestern, semi-arid foot zone of the mountain (Laikipia District). Over the past 50 years, this area has experienced rapid and profound transformation, the respective processes of which are all linked to global change. The main driving forces behind these processes have been political and economic in nature. To these an environmental change factor has been added in recent years – climate change.

After introducing the area of research, the paper presents three dimensions of global change that are manifested in the region and largely shape its development:

- **Socio-political change:** this refers to the 1960s, the decade that brought independence to large parts of Africa, certainly a change of global dimensions. One of the major effects of Kenya's independence in 1963 was land redistribution, which resulted in large-scale internal migration involving many regions of the country, particularly the regions northwest of Mount Kenya.
- **Economic change:** this refers to a period that began in the mid 1980s and which saw the increasing incorporation of Kenya, and the area northwest of Mount Kenya, into globalised food markets, with a focus on horticultural production for European markets.

- **Environmental change:** this refers to global climate change and hence looks back to the effects of changes that have already occurred, as well as anticipating changes that might occur in future. For the regions northwest of Mount Kenya, climate models predict important changes in rainfall distribution that will have a profound impact on freshwater availability and management.

The results presented here are based on research undertaken northwest of Mount Kenya within the framework of a series of long-term Kenyan-Swiss research programmes that began in the early 1980s. Funding was provided mainly by the Swiss National Science Foundation and the Swiss Agency for Development and Cooperation, with contributions from the Kenyan Government and a number of international donors such as the Rockefeller Foundation and others.

Mount Kenya – a water tower in a semiarid region

Mount Kenya is the second highest peak in Africa (5,199 m). It contains a World Heritage Site and a National Park in its upper zones. There are 12 remnant glaciers, all receding rapidly. With its glacier-clad rocky summits, Mount Kenya is one of the most impressive landscapes in East Africa

(PHOTO 1). Biodiversity is outstanding, owing to the succession of different bioecological zones at close range, extending from nival and afroalpine to forest and savannah. The summit area is a major destination for mountain tourism in Kenya, including trekking, mountaineering, and game watching. Differentiation within the densely populated foot slopes around the mountain is also high; land use includes such diverse forms as small-scale farming based on multi-cropping, as well as horticulture, ranching, and pastoralism. The mountain is regarded with great respect by local communities and many people still consider it a repository of spiritual power.

Mount Kenya is an island of resources in a dry environment. Specifically, it is a water tower providing water to over 7 million people living in its surroundings. All the major rivers in the region originate from Mount Kenya, with most of the water coming from the middle and upper zones of the mountain, especially in the dry season. These zones provided 73% of the dry season flow between 1985 and 1999, with forests and moorlands contributing 65%, and the Alpine zone, including the glaciers, 8%. From the point of view of water supply, therefore, the disappearance of the glaciers will have a negligible impact, which stands in marked contrast to the situation found in other mountain areas of the world.

The greater Mount Kenya region has experienced rapid and far-reaching change over the last 50-60 years. Population has increased manifold, both in rural and urban areas, and traditional subsistence farming has incorporated coffee and tea production, and most recently horticulture, which have all become major export earners for Kenya. These developments put increasing stress on natural resources, especially water, which is important not only for agriculture and the growing urban centres in the areas immediately adjacent to the mountain, but also for pastoralism and tourism (also a major foreign currency earner) which are located further downstream.

Political change – Kenya's independence and its effects northwest of Mount Kenya

Change and transition have been especially fundamental and far-reaching in Laikipia, the region located in the drier northwestern foreland of Mount Kenya. Following Kenya's independence in 1963, this region, which had formed part of the so-called "White Highlands", was opened up for African settlement. Many of the large-scale properties were sold and subdivided, and land use changed from ranching to small-scale mixed farming (PHOTO 2). This major transition was accompanied by a large influx of people who mainly

immigrated from high-potential but densely populated Central Kenya. The population increased from 58,000 in 1962 to over 300,000 in 1999, which corresponds to an average annual growth rate of 4.7% compared to the national average of 3.3% for Kenya as a whole. Today, population densities are as high as 150 persons per square kilometer in what was a pastoral area before colonial times. Unfortunately, rainfall in the area is marginal for crop production; annual rainfall is low and highly unreliable in terms of amount and timing. Crop failures are frequent and widespread, especially for maize, Kenya's most important staple and the crop preferred by immigrant small-scale farmers. Food production in this sector covers about 65% of household needs in the less dry areas closer to the mountain, but only 5-10% in the drier areas further away from the mountain. As a consequence, food security is very low and poverty is widespread in the smallholder settlements in the area. Originally from high-potential areas, many of the small-scale farmers did not invest primarily in adapting rain-fed agriculture to semi-arid conditions, but turned to river water for irrigation in order to secure production. This has increased legal and, to a greater extent, illegal water abstractions from mountain rivers tremendously since the 1960s. For example, within the five-year period from 1997 to 2002 river water abstractions increased by 250 to 300 % for the different rivers.



Photo 2: Close neighbourhoods: large-scale and small-scale farming, northwestern foot zone of Mount Kenya; copyright Hanspeter Liniger

Economic change – the appearance of large-scale horticulture

Kenya has been integrated in global markets since colonial times, especially the coffee, tea and tourism markets. Since independence, coffee and tea have also been grown by smallholders, including those South and East of Mount Kenya, while tourism has been concentrated on the coast and in semi-arid areas. None of these global markets therefore made a noticeable impact in Laikipia. This changed with horticulture.

Large-scale irrigation horticultural production began to make its appearance in Laikipia, and elsewhere in Kenya, in the early 1980s (PHOTO 3). The sector has since experienced a boom. With a 20-fold increase in export value between 1983 and 2002 for the country as a whole, it is now second to tea and has surpassed coffee as an export commodity. This boom is reflected in developments in Laikipia. Between 1991 and 2003, 24 large horticultural firms were established there, with a total area of 1085 ha. Production of

vegetables for national and international (mainly European) markets accounts for 94% of the output. Large-scale horticulture has become the single most important formal generator of employment and income in the rural areas north-west of Mount Kenya. Its total salary disbursements are equivalent to 10,000 Euros per day for a labour force of 4700 to 7400 persons. At the same time, the sector has become a major competitor for the scarce water resources originating from the Mountain.

The legacy of change: water conflicts and conflict management

These developments – massive immigration, transition of land use from large-scale ranching to small-scale farming, and the booming horticulture sector – have put increasing pressure on regional water resources and resulted in growing competition and conflicts among the different user groups. Increasing demand from upstream users such as small-scale farmers and horticultural firms, as well as from growing urban areas and central places has virtually cut off supplies of water to downstream areas, especially in the dry season. In the arid lowlands north of Mount Kenya, for example, dry season flow dwindled from 9 m³ in the 1960s to less than 1 m³ per second in the late 1990s; in recent years the main rivers there have dried up completely for certain periods, at increasingly frequent intervals and increasingly closer to the mountain (FIGURE 1). The main users in these lowland areas – distant small-scale farm settlements, pastoralists, and the tourism industry with its lodges – are heavily affected. The very existence of pastoral communities is threatened by rivers drying up. But the future of tourism is also critically linked to rivers, as these are vital for the wildlife on which tourism in these areas depends. Moreover, wildlife has increasingly moved upstream in search of water in recent years, causing serious human-wildlife conflicts as manifested by frequent crop raids and, at times, loss of human life.

In a bid to control regional water management, the authorities followed the recommendations made by the research community and engaged in a series of initiatives, starting with multi-stakeholder campaigns focusing on the challenges of sustainable and equitable water use. The campaigns started in the mid 1980s (1984) and intensified in subsequent years, attracting major support from relevant government departments and various development programmes, including research programmes that provided key data on the region's water resources and socio-economy, based on long-term records and extensive field surveys. A

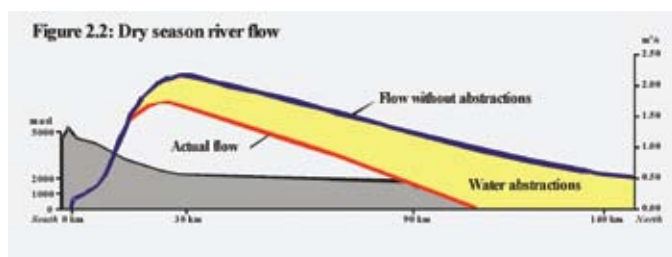


Figure 1: Dry season river flow, Northwest of Mount Kenya. In recent decades, water abstractions for smallscale farming and horticulture have grossly contracted the area where water is reliably available during dry seasons, cutting off most lowland areas and their main water users – pastoralism, safari tourism, and wildlife (Sources: Wiesmann et al 2000; Liniger et al 2007).

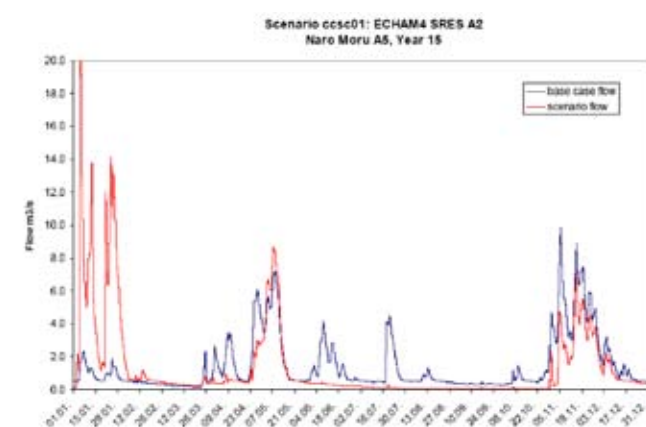


Figure 2: The graphs from Naro Moru River, one of the main water courses northwest of Mount Kenya, show that seasonality of runoff is projected to change drastically as a result of climate change. Long dry periods will become remarkably dryer, while short periods will experience extremely high flows that will be difficult to manage. (Base case flow: 1987 – 2001, measured values (river gauge recordings); Scenario flow: 2040 – 2069, based on climate change scenario csc01/ECHAM4 SRES A2). (Source: Notter et al 2007)

number of concrete initiatives resulted from these campaigns and from related work. Among the most successful were Water User Associations (WUAs), which include the main users along a river course. These associations have provided a platform for negotiating resource sharing arrangements and conflict resolution mechanisms with clearly defined rules and procedures of enforcement.

The Water User Associations (WUAs) have grown quite rapidly and have become effective grassroots structures for handling user conflicts in the area. The first WUA in Laikipia was formed in 1997, and by 2003 13 associations were in place, increasing to 32 in 2007. Large-scale horticultural firms are members of many of these associations; the firms have played a key role in the formation of some of the associations and have helped to sustain their operations. Out of the 52 cases of water-related conflicts that came before the authorities between 1997 and 2003, 48 were resolved by the WUAs, while 4 were referred to law courts. The work of the associations now extends beyond conflict resolution and includes resource mobilization through fund raising; environmental education and awareness creation; water conservation through better irrigation practices such as drip irrigation, rainwater harvesting, and improved river water storage; and catchment protection through afforestation, among other measures. Exchange visits serve as platforms for sharing experience between associations from within and outside the catchment.

Climate change and anticipated impacts

It should be noted that evidence available from research attributes the causes of dwindling water resources more to the socioeconomic changes discussed above than to the effects of climate change in the catchment. However, climate change is likely to further complicate the delicate situation in the region in future, especially with respect to water resources. A study recently completed on the Naro Moru River, one of the main rivers northwest of Mount Kenya, predicts an increase of 26% in the annual flow for the period 2040-2069 compared to the current flow (FIGURE 2). More importantly, though, seasonal distribution is projected to change dramatically. January and February, now the months with the lowest flows, are expected to show extreme flood peaks with up to 20 times the present flow. On the other hand, low flows will dominate for most of the rest of the year, reaching only about



Photo 3: Horticultural fields with dam, Laikipia District; copyright Hanspeter Liniger

1/10 of present values. Despite the uncertainties regarding climate modeling in Tropical Africa due to limited monitoring data and the lack of regional climate models, the study gives an initial indication of the magnitude and direction of future climate change. If these predictions come true, present water consumption levels and allocation arrangements are very unlikely to be sustainable, and water distribution will have to be fundamentally rethought. Destructive flood flows might present an additional challenge. As the local potential for adaptation relating to farming and livelihood strategies is severely limited by poverty and continued immigration, resource conflicts in the highland-lowland system of Mount Kenya will continue to increase and may erupt uncontrollably. Early anticipation of potential developments and a multi-stakeholder-based search for pathways to more sustainable water use, including water conservation and water distribution, are therefore a necessity in this delicate situation. Hence, monitoring and accompanying research are an essential component of this search.

Conclusions and challenges

- In the past 50-60 years, economic, political and social driving forces such as migration, population growth, changing land use, and global food markets have been the main drivers of change and resource conflict northwest of Mount Kenya. These driving forces will continue to be present in the years to come.
- In future, climate change and its consequences could have an impact similar to that of these other drivers. It should therefore be factored into plan-

ning and decision making dealing with regional and local development.

- In the complex highland-lowland system of Mount Kenya, endogenous or self-regulating solutions to the threats posed by these drivers cannot be expected without regulatory support from national and international agencies, and without a solid information base supporting negotiations focusing on sustainability.
- In the past, the research community has been an important partner in regional development discourse, both in formal and informal fora. The role of research as a broker will remain important in future, both in relation to sharing information with stakeholders and in helping negotiate lasting solutions for resource use and sustainable development.
- This will only be possible if potential donors acknowledge that this requires adequate funding, especially to maintain basic long-term monitoring networks and analyses. The areas concerned include socio-economy, land management, rainfall and water resources, in a research approach that aims to bridge the gap between local needs and the effects of global change.

AUTHORS

Boniface P. Kiteme, *Director CETRAD* (Centre for Training and Integrated Research in Arid and Semiarid Areas), Nanyuki, Kenya. email: b.kiteme@cetrad.org

Hanspeter Liniger, Centre for Development and Environment, University of Bern, Switzerland

Benedikt Notter, National Centre of Competence in Research North-South, University of Bern, Switzerland

Urs Wiesmann, *Director*, Centre for Development and Environment, University of Bern, Switzerland

Thomas Kohler, Centre for Development and Environment, University of Bern, Switzerland



Boniface P. Kiteme and Thomas Kohler are members of MRI's Global Change Research Network in African Mountains

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