

Climate change: an additional risk factor for agriculture and food security in the South

by Markus Giger¹

Climate change is expected to have far-reaching negative effects on agricultural production and food security in developing and transition countries. What do we know about these expected impacts, what are the factors that might affect production, and what are the implications for agricultural extension systems? These questions are discussed below.

I. Expected impacts of climate change

Climate change has become a very prominent issue in the media and in international and national policy processes. The 4th Assessment Report of the International Panel on Climate Change (IPCC, 2007) summarized the expected impacts of climate change and served as a wake-up call for policy-makers and the public alike. The main projected future climate changes are a continued rise in temperature (very likely greater than what was observed in the 20th century), increased incidence of heat waves and heavy precipitation events, decrease of rainfall in sub-tropical areas, rising sea levels and the increased likelihood that these aspects will develop in a non-linear and non-predictable manner. In many mountain areas, vanishing glaciers and reduced snow cover will reduce and change patterns of water flow in river and irrigation schemes. These changes have the potential to cause heavy damage to crops and reduce harvests in many developing countries. In some countries in Africa, yields from rain-fed agriculture could be reduced by 20-50 % by 2020.

Nevertheless, the impact of climate change could also have positive effects in some regions. For instance, growing seasons might become longer where the climate is cold i.e. in the high latitudes and in highland areas. Increased CO₂ content in the atmosphere could also have a positive influence on plant growth, even though in practice the beneficial effect of this factor is expected to be rather low because of other limitations on plant growth.

Studies have been done that estimate the overall reduction of agricultural output at 3-15 % globally but up to 21 % in the developing world by 2080 (Cline, 2007). Agriculture in developing countries is expected to be most affected by climate change, since most of it is in tropical and sub-tropical zones, often already suffering from drought, water scarcity and heat stress.

Rise in temperature is one of the most firmly established forecasts, and the chances that this will take place have been estimated as very likely. The temperature changes projected for the Sahel during summer could mean that the average future temperature range would be completely outside the normal variation in summer temperatures experienced so far in the region (Battisti et al. 2009), a development that would severely challenge the ability of the agricultural system to adapt to these changes. Many crops (among them rice, wheat, sorghum) are very susceptible to heat stress if it occurs during the specific vegetation period.

The often disastrous effects of droughts and floods have been demonstrated frequently in recent times. Whether a specific event is linked to climate change or is just the expression of 'normal' climate variation

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is hard to prove or disprove scientifically, and will not be taken up here. Nevertheless, there is enough evidence to indicate that we must at least consider very concretely the possibility of such events becoming more frequent and think about possible precautionary actions.

The indirect effects of climate change could bring about large-scale eco-system changes, such as a shift in agricultural belts and the desertification of entire regions. What happens if the most favorable regions for coffee production move to higher altitudes? Such effects would have far-reaching consequence because they would entail the need to restructure the economies of entire regions.



Endangered rural infrastructure: risks may be higher in the future (Songwe river, Tanzania).
Photo: Udo Höggel

2. What about variability and uncertainty?

It is very important to emphasise that especially at the regional level uncertainty about climate change is still very great and will probably remain so for quite some time. The global climate system, given all its interactions with economic and social processes, is highly complex and not yet fully understood. Detection of climate change signals at local level is hampered by the great variability of climate data. Consider, for

example, the annual precipitation data from Same Meteorological Station in North-East Tanzania.

Rainfall patterns show great variability in annual rainfall (see figure 1). Detailed analysis of seasonal rainfall shows that *Masika* season (long rainy season) rainfall has declined, whereas *Vuli* season (short rainy season) rainfall does not show a particular trend. However, there is no statistical significance in these trends (Figure 2, Enfors and Gordon, 2007). The frequency of dry spells during the planting season, on the other hand, increased significantly, almost doubling in intensity in twenty-five years. The frequency of heavy rainfall also increased, indicating a distributional change. Dry spells during the *Masika* rainy season

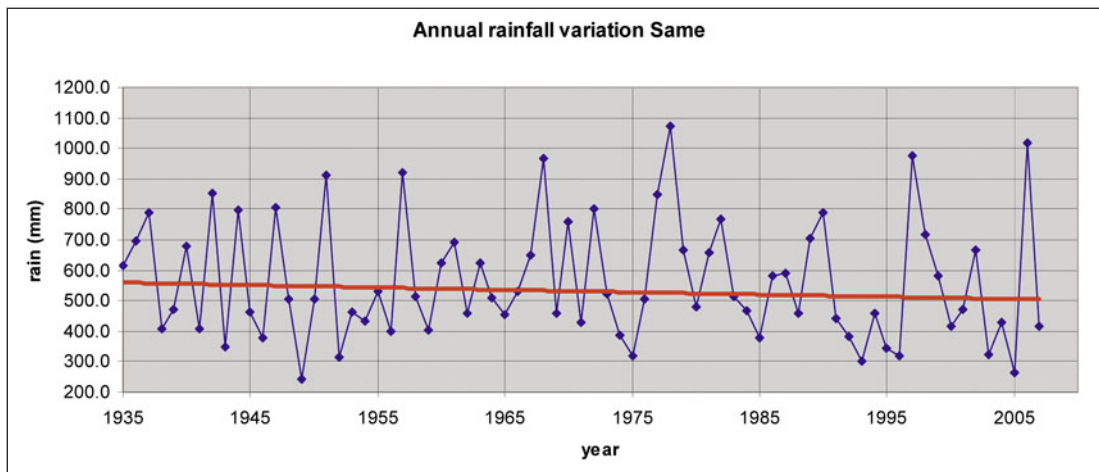


Figure 1: Project report ESAPP

Source: Ngana, 2010

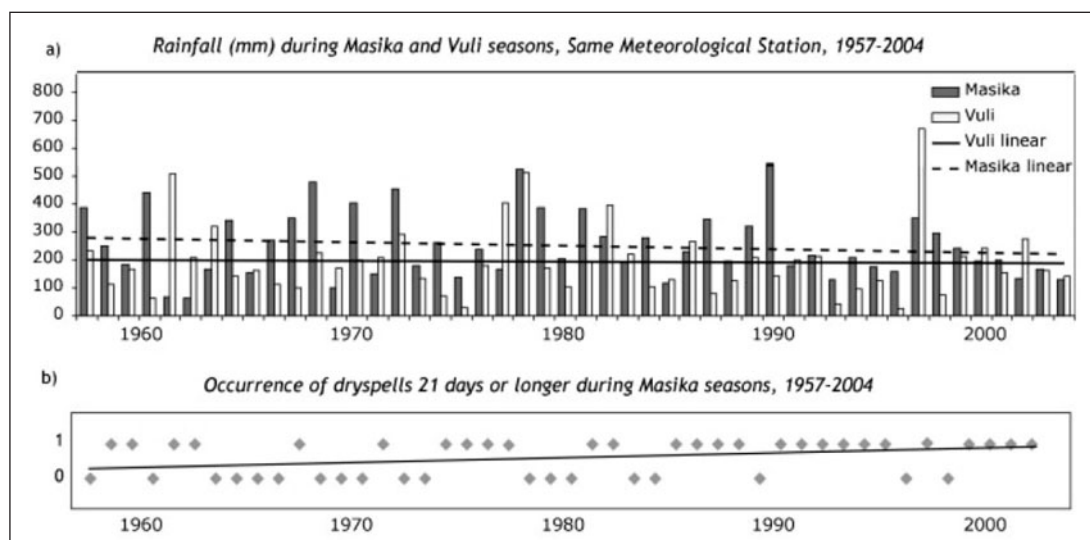


Figure 2: Seasonal rainfall trend and occurrence of dry spells

Source: Enfors and Gordon, 2007

have a very negative impact on yields, a reason why farmers perceive that there is less rain today. (Enfors and Gordon, 2007).

Interestingly and puzzlingly, climate change scenarios (<http://country-profiles.geog.ox.ac.uk/>) based on global models are predicting more precipitation for Tanzania but also indicate that seasonal changes are complex and heavy rainfall is expected to increase further, implying less favourable distribution of rainfall.

The question therefore arises: to what exactly must agriculture adapt? And within which time horizon must this adaptation take place? Looking at the great variation in annual rainfall patterns, the regular occurrence of drought years, the trend towards more extreme rain events and trends in temperature increase (evident also from the local meteorological data), it is obvious that the strategy must be to increase the resilience of local communities to withstand climate variation and climate change and that both objectives require action in the same direction.

3. Coping strategies and adaptation

It is obvious that climate change trends are only one additional factor that threatens local livelihoods. Population growth, increased water consumption for all kinds of economic activities, declining land availability and degradation of soils and vegetation are other

factors that local communities have to cope with, independent of climate change. Often these changes are faster and have a more far-reaching effect than climate change, at least in the short term. AGRA (Alliance for a Green Revolution in Africa) has, for instance, found that land suitability for major crops will be largely unchanged in six important African countries (Kagwanja, 2010), implying that existing constraints to productivity increases need to be addressed continuously.

One of our partnership projects discussed community perceptions of climate change and the available meteorological data. The locally perceived indicators of climate change were reduction in rainfall, increase in temperature, water scarcity, shifts in rainy seasons, frequent famines, and increased plant and animal diseases. A large overlap between findings from research and public perceptions was found.

The project also identified a number of coping strategies already used by local households (Table 3).

But the project also identified actions that can be implemented by the government, such as completing a water reservoir under construction in order to assure safe and reliable water for livestock and other domestic uses.

Promotion of water harvesting techniques at household level (Pachute et al. 2009) and planting drought-

Attribute	Yes (%)	No (%)
Buying food as a strategy	78	21
Selling livestock to buy food	78	21
Planting drought-tolerant varieties	59	40
Planting early-maturing varieties	40	59
Storage of more food	53	46
Move livestock to areas with pasture and water	34	65

Table 3: Household Coping strategies (%)

Source: Ngana 2010

resistant crops such as millet, sorghum, cassava and sunflower are other important measures to increase food security in the area. The village government services should ensure that the extension officers, including veterinary officers, provide technical support to livestock keepers.

Adaptation to climate change will involve in many instances a large range of activities aiming at dealing with the risk of climate change in an integrated manner and well linked to development goals in a given context.

4. What are the consequences for extension services?

What does this mean for extension services? The theses formulated in this final section are intended to stimulate further reflection.

Adaptation means dealing with uncertainty: Climate variability is a problem that affects farmers concretely and it is one that they must deal with. The brief example above makes it obvious that neither reviews of meteorological data, climate forecasts nor local perceptions alone can prevent the need to act within a context of uncertainty.

The uncertainty created by climate variability is already a key problem for extension services, since it renders the timing and content of their advice more difficult (Speranza I., 2010) Extension approaches that foster learning processes (Gabathuler et. al., 2009) will become even more important, since climate change impacts are highly contextual and require a profound understanding of patterns of variations and trends and uncertainties involved.



Adaptation of local systems in a environment of high variability: fishermen moving their boat to another lake (Tanzania). Photo: Udo Höggel

Agriculture has always been about adaptation: CDE's experience with extension services (Gabathuler et al., forthcoming) has shown that very often these services still operate explicitly or implicitly on a model of one-way communication, i.e. mainly transferring knowledge from research and formal education to farmers. But adaptation to climate change and climate variability will make local knowledge even more important. On a mission in India aimed at preparing an adaptation project, a farmer told my colleague 'we farmers of India have been adapting to climate for centuries! This is nothing new' (Udo Hoeggel, personal communication). Adaptation strategies will have to be designed in close cooperation with land-users and will need to be very well adapted to local conditions and prevailing risks.

Vulnerability and adaptive capacity: Among the many concepts related to climate change, vulnerability and adaptive capacity are probably the ones that extension staff should become familiar with. Climate change is another risk factor for farmers, as is climate variability or the risk of pests. These risks need to be managed. If vulnerability can be reduced, then the potential damage is smaller. Farmers have always managed risks and reduced vulnerability through the choice of crops, diversification, planting calendar, irrigation, and so on.

The more capacity households have to adapt, the better. Adaptive capacity can be influenced by a wide range of factors. Functioning extension services themselves can become very important elements of adaptive capacity. They can support systems in providing timely information, for instance on weather and extreme events and insurance schemes for crops, but also support the building of social relations to deal with conflicts and tensions between groups (farmers, nomads, ethnic groups), that arise due to climate change and other factors.

Extension services can take over the role of facilitating dialogue between those who have access to climate data and forecasts and those who possess first-hand experience in a local context with the aspirations of the local actors and their strategies for coping with uncertainty.

No regret strategies: As already pointed out, most potential adaptation measures will not be promoted based on adaptation needs alone. Uncertainty and climate variation will often call for the application of so called 'no-regret' strategies. This means tackling already existing problems, for which the causes and solutions are often already known.

It is impossible to provide a full list of adaptation measures, but among the measures most frequently cited are:

Farm level:

- Soil and water conservation, saving and harvesting (resilience to water stress)
- New irrigation schemes and adaptation of existing ones
- Diversification of income (off and on-farm)
- Choice of crop and livestock breeds
- Agronomic practices
- Using weather and climate forecasts
- Using agricultural insurance schemes

Government and private sector:

- Research (crop drought resistance, pest resistance, suitability of crops for changing ecosystems)
- Strengthening farmers' capacities to reduce risk or make optimal use of climate variability.
- Developing insurance systems
- Irrigation systems
- Investment in resilient rural development and agricultural production in general
- Support of institutions at different levels in order to adapt policies and practices to changing climate risks and climate variability

In most of these activities, extension systems potentially have a role to play. Improving extension systems can thus be an important contribution to increasing adaptive capacity to climate change.

The need to support a multi-stakeholder process: Climate change has impacts that affect whole watersheds and communities. Examples are the reduction of melt water available for irrigation systems, degradation of communal grazing areas or increased competition for land and water caused by immigrant nomads from regions affected by drought. Such chal-

lenges require action at regional level. Adaptation and strengthening of rules regulating land use will become necessary, increasing the need for coordination between different actors. Stronger collective action will be required, going in many cases beyond what traditional coping mechanisms can deliver. Increasingly, extension services will be involved in such processes, requiring skills and methodologies for organizational development and negotiation processes. From this perspective, not only the development of value chains or improvement of production methods but also organization of collective action for climate-resilient land management will be needed. (Gabathuler et. al., forthcoming).

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