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Agriculture + Rural Development Network

# Information Flash No. 2

# ADAPTATION TO CLIMATE CHANGE: CHALLENGES FOR SMALL-SCALE AGRICULTURE

## 1. Introduction

Small-scale agriculture is already being impacted by climate change and climate variability and will continue to be so in the future. Changes in the amount and frequency of precipitation, in temperature levels, and in seasonal patterns are among the parameters that will influence production systems.

Major production parameters in agriculture include elements of complex natural systems (such as water cycles and the temperature regime). Farmers have always had to manage uncertainties and adapt to changes. However, agricultural practices and knowledge were developed to deal with uncertainties within the limited range in which they usually occurred.

## 2. The Need to Adapt to a New Challenge

Observed and projected climate changes are expected to severely impact agriculture, especially in tropical and subtropical areas. Developing countries are expected to be hit hardest. It is especially resource-poor farmers who are least able to adapt to longer periods of drought, more intensive rainfall patterns, increased heat stress and the consequences of soil degradation.

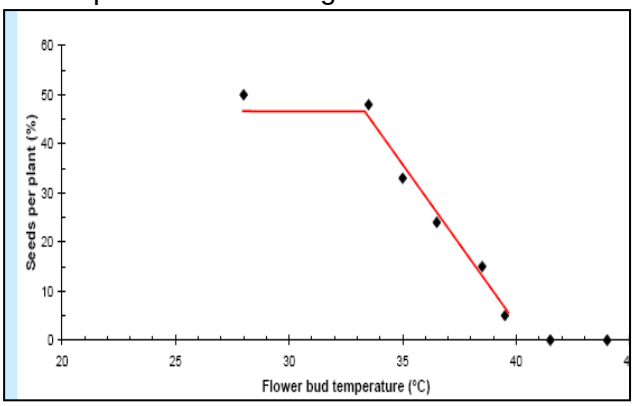


**Figure 1.** Losses of groundnut seeds per plant as a result of increasing ambient temperature. Source: Stern N. 2006.

Such changes can be quite dramatic. One example is the effect of heat stress. Figure 1 shows the sensitivity of groundnut crops in India to gradually increasing ambient temperature. While the crop tolerates a certain increase in ambient temperature, its productivity (seeds per plant) diminishes rapidly once the temperature rises beyond a certain threshold. The likelihood of such extreme temperature events is increasing due to climate change, and they threaten to directly affect agricultural production and food security.

Hence there exists a real threat to the foundations of livelihood and food security systems in the small-scale agricultural sector. The challenge is to identify this threat, assess it and develop targeted adaptation measures.

## 3. Strengthening the Potential for Adaptation and Disaster Risk Reduction (DRR)

Small-scale farmers in many least developed countries are observing significant changes within the agricultural production system. Uncertainty is assuming a new dimension and the time available for autonomous adaptation is short. This element of urgency is

reinforced by the need to increase global agricultural output in the coming decades. It is in the area of identifying changes and supporting adaptation where development cooperation should support the small-scale agricultural sector.

- An important first step towards adaptation is to identify **potential impacts** that are likely to affect small-scale agriculture. This requires scientific and technical information as well as local knowledge, and these need to be combined.
- Having identified potential changes, development cooperation can assist the small-scale agricultural sector in identifying potential **vulnerabilities** to climate change impacts. Vulnerability can be defined in various ways, but three key factors are important: exposure, sensitivity and adaptive capacity.

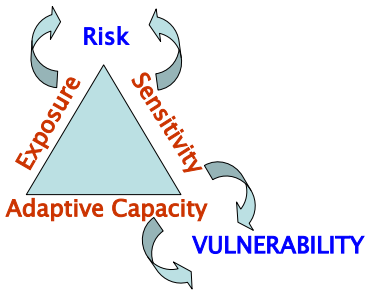


**Figure 2.** Elements of vulnerability.

Figure 2 illustrates a concept that is useful in assessing the level of **vulnerability** of farms to climate change impacts:
A farm may be **exposed** to climate change impacts because its land is located in a flood-prone lowland area. It may also be **sensitive** because it grows crops that are easily destroyed by flooding. Such a farm is at high risk due to the combination of high exposure and high sensitivity; nonetheless, it might not be overly **vulnerable** to climate change impacts if it has **adaptive capacity** and applies flood defence mechanisms as an adaptive measure. Alternatively, the farmer might also decide to switch to flood-tolerant crops, which would reduce sensitivity and thus make the farm less vulnerable.

- Sustainable agricultural practices, especially land management practices, can contribute significantly to reducing the **risk of disaster**. For example, land stabilisation techniques such as contour bunds coupled with contour planting reduce the risks of flooding and landslides. At the same time they contribute to maintaining the agricultural production potential. Sustainable land management techniques thus combine the effects of disaster risk reduction and support of agricultural production.

Agricultural planning must take account of climate change by specifically addressing these questions. This is where development cooperation can assist partners. The SDC Climate and DRR Check could be a good entry point.

Sources:
SDC Climate and DRR Check
http://www.sdc-climateandenvironment.net/en/Home_Who_we_are/SDC_Climate_DRR_Check_Training/Handbook_and_tool_downloads
National Adaptation Programms of Action and National Communication (usually the best starting point)
http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.php
http://unfccc.int/national_reports/non-annex_i_natcom/items/2716.php
UNDP country profiles (interpretation of climate data for 52 countries
http://country-profiles.geog.ox.ac.uk
General information on adaptation:
http://www.eldis.org/go/topics/dossiers/climate-change-adaptation
CRISTAL - tool for community scale vulnerability assessment:
http://www.iisd.org/cristaltool/download.aspx

## 4. Adaptation measures

In the absence of information, adaptation will continue to be prone to uncertainty. Adaptation measures must be broad and prophylactic in nature and must make use of any

available technical information and local knowledge. The overall objective is to reduce vulnerability and increase resilience.

Many measures are part of good agricultural practices and are considered as 'no-regret' measures. In general these are versatile and resilient technologies aimed at sustainable land management.

1. Keep intact or improve soil cover. Vulnerability is reduced by reducing soil erosion.
2. Improving soil fertility. Vulnerability is reduced as the production potential is maintained or enhanced.
3. Establish water harvesting structures. Vulnerability is reduced as (1) water is not lost through runoff, (2) the flood risk is reduced, and (3) soil is protected from being washed away by excessive runoff.
4. Consider future choice of plant breeds carefully. Past breeding efforts, both in plants and in animals, have focused mainly on production. This has severely reduced genetic variability, an important factor in managing uncertainty. While improved breeds do offer improved production potential, locally bred plants and animals, although they may be less productive, offer greater production security in the face of uncertain precipitation and temperature patterns.
5. Support the revitalisation of extension services based on the principles of community participation and participatory technology development (PTD)

Sources: WOCAT 2007, Liniger et al. 2011, Gabathuler et al. 2011
A presentation of WOCAT at the Forum SLM in 2009 can be found at:
http://www.cde.unibe.ch/Research/pdf/Forum_slm_2009/7-ForumSLM_WOCAT_GS.pdf

Other measures are not considered 'no-regret', i.e. they imply additional costs. These measures are considered exclusively in response to specific projected impacts of climate change:

6. Consider changing crops. For example, replacing maize with millet may reduce vulnerability to temperature rises, as most strains of the latter are more heat tolerant than the former.
7. Consider altering cropping areas.
8. Consider investing in intensified agricultural research, both for livestock and for crops.
9. Adjust land use planning to expected climate changes.
10. Support the development of alternative sources of income.

**Table 1.** Examples of adaptation measures

| **Adaptation measure** | **Example** |
|---|---|
| Share losses | Social networks, local relief systems, insurance systems |
| Modify the threat (increase adaptive capacity) | Protection work (dams), plan agricultural operations according to forecast information, promotion of soil and water conservation measures, terracing |
| Prevent impact | Change plant breed, increase irrigation (but: consider increased groundwater offtake), use forecast information |
| Change Use | Changes in crops, change in land use systems |
| Information | Generate and share data and information, apply cell phone networks and alert systems |
| Change location | Relocation of economic activities, improved land use planning |
| Research | Apply new technologies (e.g. drought-resistant varieties) |
| Behavioural change | Education, information, regulation |
| Bear losses | When adaptation costs are too high, farmers may decide to endure the impact to a certain extent |

Adapted from: OECD 2009.

## References

IAASTD [International Assessment of Agricultural Knowledge, Science and Technology for Development]. 2009. Agriculture at a Crossroads. Global Report. Washington, D.C.: Island Press.
IPCC [Intergovernmental Panel on Climate Change]. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.
Gabathuler Ernst, Felicitas Bachmann, Andreas Klaey. 2011. Reshaping Rural Development. Learning for Sustainability (LforS). An integrative and learning based advisory approach for extension with small-scale farmer.
Liniger, H.P, R. Mekdaschi Studer, C. Hauert, and M. Gurtner. 2011. Sustainable Land Management in Practice – Guidelines and Best Practices for Sub-Saharan Africa. TerrAfrica, World Overview of Conservation Approaches and Technologies (WOCAT) and Food and Agriculture Organization of the United Nations (FAO). http://www.wocat.net/en/knowledge-base/documentation-analysis/recent-publications.html
OECD [Organisation for Economic Cooperation and Development]. 2009. Integrating Climate Change Adaptation into Development Co-operation.
WOCAT [World Overview of Conservation Approaches and Technologies]. 2007. where the land is greener – case studies and analysis of soil and water conservation initiatives worldwide. Editors: Hanspeter Liniger and William Critchley. http://www.wocat.net/en/knowledge-base/documentation-analysis/global-overview-book.html

## Links to some short videos on adaptation and climate resilient agriculture:

**Video trailer of "greener land, bluer water" by Nicole Harari and Hanspeter Liniger**
http://www.wocat.net/en/news-events/global-news/article/video-trailer-greener-land-bluer-water.html?tx_ttnews%5BbackPid%5D=1&cHash=8527d00cc4993cd1a1da6015ae01762a

**Uganda: Supporting climate-resilient sustainable land management practices**
http://www.youtube.com/watch?v=6QC7S7XmhmM
Supporting climate-resilient sustainable land management practices in Uganda: an example by the National Agricultural Advisory Services (NAADS), a new programme of the government of Uganda put in place to increase the efficiency and effectiveness of agricultural extension services.

**Smart Farming in India**
http://www.youtube.com/watch?v=TRXZfRKxrs4&NR=1
A film showing how farmers in India can overcome drought by using new water harvesting and farming techniques to conserve water and soil and thus produce more food and empower their community. To read more about food and water security visit http://knowledge.allianz.com/en/

The next Information Flash will focus on mitigation.

Authors: Udo Hoeggel, Markus Giger, Centre for Development and Environment (CDE), 2011
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