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LEISA

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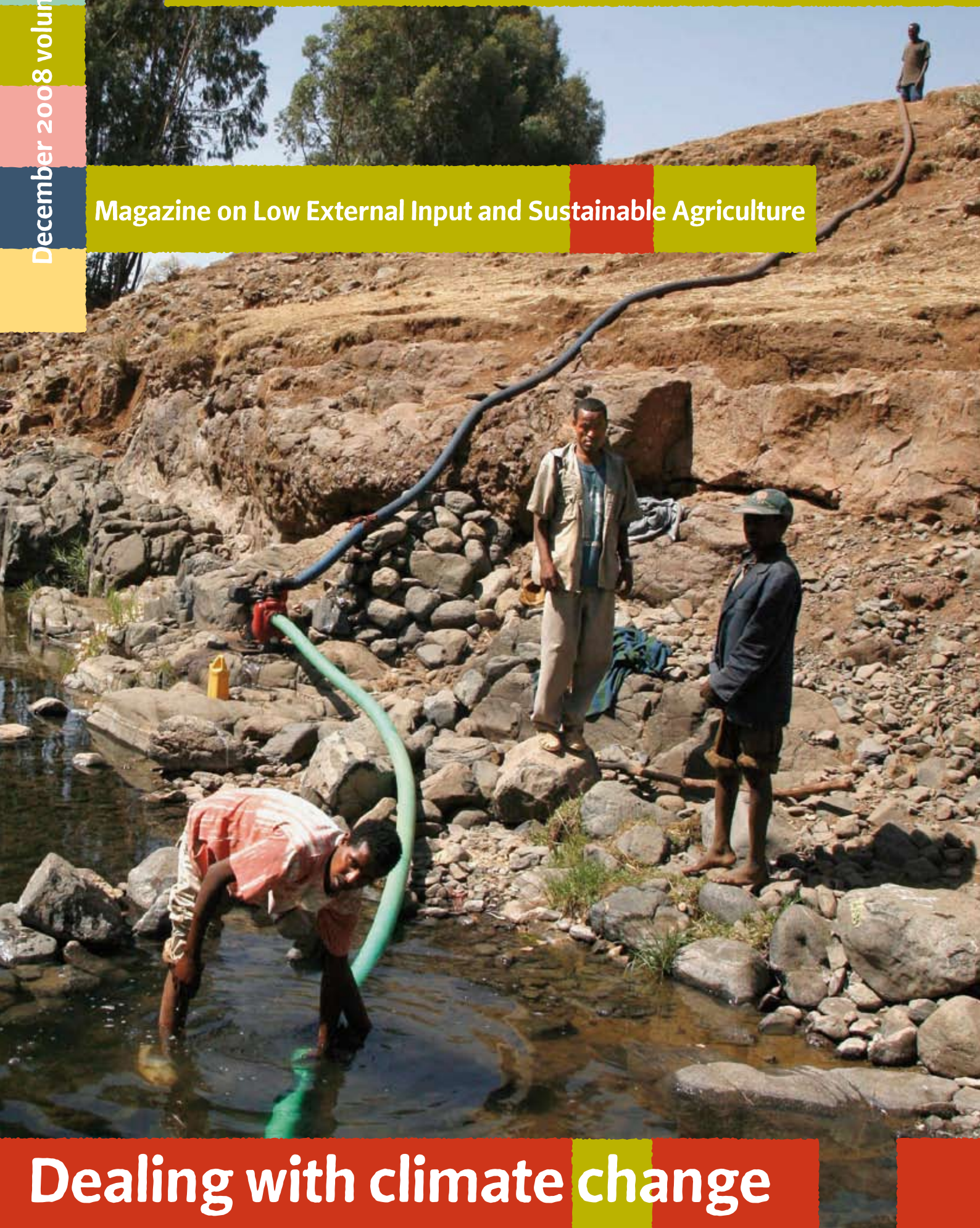

Dealing with climate change

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LEISA
Magazine on Low External Input and Sustainable Agriculture
December 2008 Volume 24 No. 4

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Cover photo
The Lake Tana Watershed project in Ethiopia focuses on mitigating and adapting to climate change. Here farmers connect a small water pump to the river as part of a small scale irrigation project to provide water for potatoes. Photo: Petterik Wiggers

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12 Farmers and sorghum in Nicaragua's northern region

Gilles Trouche, Henri Hocdé, Silvio Aguirre and Irma Ortega Sequeira

Farmers in northern Nicaragua have started growing short-cycle sorghum varieties, in response to changes in the weather. Sorghum is consequently losing its reputation as a "poor man's crop", as farmers showed an interest in improving their varieties. With researchers, they have been testing improved varieties from Africa, and then crossing local varieties with the most suitable African varieties. Some of these are now being registered and are in use. With good relationships established between farmers, researchers and extension workers, they are now looking into other ways they can improve cropping systems.

20 Using radio to share farmers' adaptation strategies

Blythe McKay

Information is vital when farmers are trying to adapt to changing weather and climate conditions. Radio is an effective way of reaching small-scale farmers with useful information, especially in rural areas. In Africa, a scriptwriting competition was launched to provide information about climate change. Fifteen winners were chosen, and their scripts circulated to radio stations across Africa for broadcast. Radio can also stimulate debate through radio drama, for example. In Nigeria, radio makers are currently preparing a long running radio drama that will tackle agricultural topics and climate change. The challenge is always making scripts that are entertaining to listen to, while also being informative.

LEISA is about Low External Input and Sustainable Agriculture. It is about the technical and social options open to farmers who seek to improve productivity and income in an ecologically sound way. LEISA is about the optimal use of local resources and natural processes and, if necessary, the safe and efficient use of external inputs. It is about the empowerment of male and female farmers and the communities who seek to build their future on the basis of their own knowledge, skills, values, culture and institutions. LEISA is also about participatory methodologies to strengthen the capacity of farmers and other actors to improve agriculture and adapt it to changing needs and conditions. LEISA seeks to combine indigenous and scientific knowledge, and to influence policy formulation to create an environment conducive for its further development. LEISA is a concept, an approach and a political message.

ILEIA is the Centre for Information on Low External Input and Sustainable Agriculture. ILEIA seeks to promote the adoption of LEISA through the LEISA magazines and other publications. It also maintains a specialised information database and an informative and interactive website on LEISA (**www.leisa.info**). The website provides access to many other sources of information on the development of sustainable agriculture.

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30 Farmers' perceptions lead to experimentation and learning

Paul Mapfumo, Regis Chikowo, Florence Mtambanengwe, Samuel Adjei-Nsiah, Freddy Baijukia, Ricardo Maria, Andrew Mvula and Ken Giller

Farmers' perceptions are an important entry point when adapting to climate change. In a project covering seven African countries, farmers were asked how they see climate change, and how vulnerable they are to it. "Learning centres" were set up in all

seven countries, to carry out participatory research in response to the issues identified. Farmers, realising the need to use new crop types and varieties, have been experimenting to improve soil fertility management. The "learning centres" show that coping with variability poses a greater challenge for small-scale farmers than previously thought. Farmers also need technical and institutional support services that allow innovation and enable communities to generate locally relevant adaptation strategies.

32 The potential of community managed forests for carbon trade

Ashish Tewari, Vishal Singh and Pushkin Phartiyal

The forests of the Himalayas store a lot of carbon. Under the Clean Development Mechanism proposed by the Kyoto Protocol, this carbon can be traded with industrialised countries. For communities who depend on, and manage their own forest resources, this is an opportunity to benefit from preserving their forests. But can communities benefit from carbon trading? In Uttarakhand State, India, members of local village forest councils were trained to measure how much carbon their forests store per year. The project made it clear that communities can use forests sustainably to support livelihoods and agricultural production, but that these forests still store considerable amounts of carbon annually. The village councils hope to develop these activities in the future and find more "buyers" for their carbon.

DEAR READERS

Everybody is talking about climate change. It is truly a global concern. It is in the newspapers, on the radio, and many books have already been published. You can read some key findings from recent reports on agriculture and climate change in this issue of LEISA Magazine. It is also useful to know what is being done, on a practical level, to combat its effects. So, we have put together some field experiences, to bring you ideas and insights from the small-scale farmers' perspective. Further reading can be found, as always, in the Sources section on p. 38.

Next year, 2009, marks 25 years that ILEIA has been publishing LEISA Magazine. On p. 19 you will find more details about the anniversary celebrations and how you can join in. We hope to publish some stories and reflections from you, looking back over the last 25 years, as well as looking forward, at the "Future of Family Farming". Look out for the logo which highlights jubilee related contributions.

In addition, we are now launching a new initiative, entitled Farming Matters. With this, we aim to describe the basic principles of LEISA, in easy to follow modules. Uniquely for such an educational tool, it will be developed over the internet, by a variety of contributors, perhaps including you! You can read more about it on p. 13.

Inside this issue you will also find a 2009 LEISA Magazine calendar. We hope that you like it and find it useful. This year we have received more articles for the magazine than ever, so would like to thank everybody who contributed. And finally, we would like to wish everyone a healthy and prosperous 2009.

The Editors

Photo: GEAG

Traditional knowledge plays a key role in a community's capacity to adapt to climate change.

Dealing with climate change

Editorial

"The rains these days are unpredictable… One year they start in November, another year in December, and then we have dry spells at the critical stages of crop growth…" All over the world, the observations of farmers like Emmanuel Luhanga seem to confirm the scientific evidence which shows that climate change is a fact, occurring at an alarming rate. The latest reports of the Intergovernmental Panel on Climate Change (IPCC) quote a 0.76° C increase in the world's average temperature in the last century, expecting temperatures to rise by 2° C by 2050. This is leading to rising sea levels, the disappearance of glaciers, and to drastic changes in rainfall patterns, affecting the production potential of rural areas.

Most rural areas have always experienced climate variability, and farmers have always had to cope with a degree of uncertainty in relation to the local weather. Detailed observations reveal that many of the effects attributed to climate change are in fact the result of deforestation or soil erosion, or take place because more people live in disaster-prone areas. But there is no doubt that farmers are facing a changing context, with rainfall and temperature patterns moving outside the regular variability ranges. This is already having a very strong impact. How do farmers perceive and deal with these changes? This was one of the core questions we had when putting this issue together. Are farmers prepared? What are the advantages of sustainable agriculture practices? And what is needed in terms of communications or global political decisions?

Vulnerability and resilience

While climate change is a global phenomenon, those living in rural areas in the tropics face greater risks. Their vulnerability depends on intrinsic factors such as the local topography or geology. But many other factors are involved, the combination of which determines a family's capacity to cope with stress and drastic changes. This can result in differences in vulnerability within a community, and even within one household. The knowledge a farmer has of climate issues, or how regularly and easily she can get information, such as weather forecasts, plays an important role. Equally important is the degree of control a farmer has over resources such as water or land and the possibilities this brings. Similarly, local "safety nets" (e.g. family members, local organisations, networks, institutional support, etc.) can provide help in case of need.

Perhaps the most important factor in terms of vulnerability is the fact that, in many areas in the tropics and subtropics, agro-ecosystems have dramatically deteriorated in recent decades. This is mainly due to changes in land use patterns: intensified agriculture, coupled with deforestation, soil degradation and erosion. It is to be expected that climate change will further accelerate the ongoing degradation processes, in many cases leading to a complete collapse. Systems with greater diversity, or which successfully integrate livestock, are often less vulnerable to sudden changes, and show higher levels of resilience. Sustainable agriculture practices which help soils retain higher quantities of water, for example, help withstand periods of drought.

Coping and adapting

Throughout history, farmers have always had to cope with the environment that surrounds them, gradually adapting to it. In the process they have developed specific farming systems which perform best in their given situation. Most small-scale farmers have to deal with insufficient resources, and many are trying to

grow crops in soils which are less fertile, or deal with recurrent pests and diseases. In many situations, farmers have to cope with policies which directly influence their production potential and resulting income (for example, policies which promote imports that bring the price of their products down). The speed in which the climate is changing and the resulting situations, whether a temporary dry period or a hurricane, only adds to the list of challenges and to the sense of urgency.

The magnitude of the problem, however, requires more than just a reactive response to change. Farmers need to be able to cope with a sudden flood, but it is better if they are prepared for it. Adaptation to climate change refers to a proactive approach: preparing in advance for what might come. It is not surprising that organisations like FAO, in the framework document prepared by their Interdepartmental Working Group on Climate Change, recommend many of the practices presented throughout the years in this magazine, as part of a continuous attempt to build resilience.

Adaptation requires technological efforts, both large scale (such as building river barriers to protect farms from floods) and at a farm level (such as irrigation facilities which make production less dependent on the rain). Adaptation can also refer to adopting "new" farming practices, such as vermicomposting, to improve soil organic matter content, which is basic yet essential in coping and adapting to climate change. Management skills are needed when opting for associated crops, mulching, or the different practices described by Shah and Ameta (p. 9), complementing traditional practices with "new" ideas. In addition, considering that most of these will not show results immediately, a long term planning process is necessary. Changes in producers' behaviour may also be necessary – as shown by those farmers in Nicaragua who now grow –and eat– sorghum instead of their traditional staple crop, maize (Trouche *et al.*, p. 12). Consumers will also need encouragement to change their behaviour (as awareness of our own "environmental footprint" grows). As Gurung and Bhandari (p. 6) show, an integrated approach which considers all technical aspects together with social and economic issues has a much higher rate of success.

Knowledge and information play a vital role in the process of building resilience. All processes need to build on local coping mechanisms, local innovations and local practices, in ways which enhance local capacities. Efficiency of such mechanisms is only increased with additional information such as weather forecasts. Fortunately, this is increasingly being recognised: Mapfumo *et al*. (p. 30) describe the advantages of their "learning centres", while Winarto *et al.* (p. 18) show how Climate Field Schools can contribute to an increased adaptive capacity.

Mitigation

Deforestation and soil erosion result in considerable quantities of carbon dioxide being released into the atmosphere, a total complemented by the production and use of fertilizers. The IPCC documents conclude that agriculture accounts for at least one quarter of all of the world's greenhouse gas emissions. There is now widespread evidence showing how farmers can help reduce these emissions by reducing the use of chemical fertilizers, minimising the use of fossil fuels, incorporating nitrogen into the soil, avoiding the loss of organic matter, and improving the use of manure (see Sources, p. 36). At the same time, farmers can help sequester carbon by restoring the natural vegetation where this is possible, avoiding deforestation, and efficiently managing their soils. As reported by the IPCC, Greenpeace and FAO, there is a large mitigation potential in agriculture, directly related to the implementation of sustainable agriculture practices.

Other reports, like the recently released International Assessment of Agricultural Knowledge, Science and Technology (IAASTD), show the need to change the way agriculture is understood and practised, and acknowledge the advantages of sustainable agriculture. Further efforts are needed so that the international community acknowledges the contribution of small-scale farmers. This recognition can come as part of what is now known as Payments for Ecological Services, or as part of the carbon trade mechanisms which are slowly becoming more common (Bayani, p. 34).

A global phenomenon

One of the major characteristics of climate change is the non-linear relationships it shows. Local emissions, in one part of the world, have global consequences, while avoiding deforestation in one area will not help stabilise that area's weather. At the same time, the impact of the many different farming practices (both positive and negative) may not be visible immediately. The articles in this issue show that, even if small and localised, the steps taken by small-scale farmers count, and are very important, both in terms of reducing the contribution of agriculture to climate change and in helping farms prepare for future changes. Most important is that all these efforts have many additional advantages, reflecting a truly win-win situation. Reducing the emission of greenhouse gases, increasing a farm's resilience and preparing for a future scenario, goes together with increasing (and more sustainable) yields, a more diverse production, healthier products, and higher incomes.

The articles in this issue also illustrate that farmers, and the organisations which support them, are going through a fast learning process. As part of this process, they are continuing to build on the resilience mechanisms developed over the years. This gives hope and is inspiring, as it shows that many things can be done that are well within the reach of farmers and agricultural institutions. These issues need to be addressed more systematically, in relation to the larger political, agricultural and environmental scenarios.

The current state of these larger realities must also be faced. The dominant trends in agriculture and the global economy are going entirely against the principles that underlie sustainable agriculture. In this larger context, sustainable small-scale family farming is a small, increasingly threatened "oasis of diversity" in a huge ecological desert. It will continue to suffer the negative economic and ecological consequences of the larger world around it, while it contributes more than its share in terms of rendering ecosystems services.

But there is change in the air. At a time of food, fuel and financial crises, a new debate is emerging across the world about the future of agriculture. What type of agriculture do we need? Do we need more and more monocropping systems, with higher yields and profits? Such systems may sound rational from a macro-economic point of view, but they exclude millions of small producers and have little to offer when it comes to facing the challenges of climate change. Or do we need to foster an agriculture that is inclusive, multifunctional, and built on principles of resilience that are crucial in the process of adapting to climate change? Can there be a balance between these two types of agriculture? Dear readers, we leave you with this question and hope that you will find inspiration in this issue of LEISA Magazine to deal with climate change, in your own, diverse ways!

■

An integrated approach to climate

It is now apparent that dealing with climate change is unavoidable. Nepal's temperature is rising faster than the global average, and rainfall is becoming unpredictable. Many communities are struggling to cope. Experience from a three-year project indicates that adapting to climate change requires an integrated approach, including socio-economic development, environmental conservation and disaster risk reduction. By focusing on a watershed, each element, such as livestock, infrastructure or education, could be addressed effectively.

Gehendra Bahadur Gurung and Dinanath Bhandari

Climate change is already being felt, and its effects are expected to continue and to increase. In Nepal, the effects of climate change are seen in many ways: the country's glaciers are retreating, and the discharges of snow-fed rivers have fluctuated. Rising temperatures are having a positive impact on agriculture in some areas: farmers in the high altitude areas can now comfortably grow two crops per year (rice and barley). But increasing agricultural production in these areas is threatening the local biodiversity and affecting forests. And as most farmers rely on the monsoon rains for production, climate change, particularly the changes in rainfall patterns, is only making agriculture more difficult. In addition, rural communities are increasingly vulnerable to climate-induced hazards, such as landslides and floods. For different reasons, poor rural communities seem particularly vulnerable to climate change, requiring support in order to successfully adapt to the quick changes they are experiencing.

Adapting to change

Between 2005 and 2007, Practical Action Nepal carried out a project called "Increasing the resilience of poor communities to adapt to the impacts of climate change". This was implemented in partnership with local communities and ECOSCENTRE (Ecological Services Centre), a local non-governmental organisation. The communities played a key role in mobilising local resources. ECOSCENTRE provided training programmes and technical advice (especially on agriculture), and supplied some inputs. The involvement of a local NGO was meant to help sustain all activities after the main project has ended.

The district of Chitwan, in central Nepal, and within it the Jugedi Khola watershed, was selected for the project because of the perceived severity of climate-induced disasters, and the local communities' vulnerability. This area's climate is sub-tropical, with temperatures ranging between 18 and 32°C, and with an average annual rainfall of 2000 mm. Agriculture and livestock keeping are the mainstay of the majority of its people. However, only a third of all households produce sufficient food grains to meet their needs throughout the year. All other households have to purchase food.

One of the project's first activities was to carry out a vulnerability context analysis. We asked villagers to rank those aspects which determine vulnerability, considering the environment, and also the social and economic context. All of them mentioned landslides and floods as major hazards, and easily linked these to a changing climate (see Box). As part of this analysis, we were able to see that villagers were already following a number of coping strategies, preferring short term strategies, or those which give immediate relief. Due to a lack of resources, and also because of a limited understanding of the long term effect of climate change, most villagers had not planned long-term actions.

Our initial analysis identified different coping strategies, all of which helped us define our intervention process. For example, when an irrigation canal was destroyed by floods, villagers tried to repair it with their own resources, without relying on new skills or external resources. But if traditional technologies or practices repeatedly fail, villagers follow a different strategy: changing these practices, or incorporating external ideas. In some areas, rice has been replaced by maize or by other crops. Livelihoods do not change, as villagers continue farming, but they incorporate new skills, techniques or resources. When this is not enough, villagers opt for other activities, such as skilled or unskilled wage jobs. In other cases, they diversify their income generating activities by sowing high value cash crops, or by encroaching on the locally available natural resources (such as the forest). Only when these coping strategies prove not to be enough, do villagers migrate, either temporarily or permanently.

An integrated approach

Our project tried to address the communities' coping strategies, as short-term activities, but also looked at their long-term adaptation activities. As climate change affects all aspects of human life, we felt the need for an integrated approach. This meant taking the ecosystem into account, as well as the social and economic aspects which shape local livelihoods. Considering the area's topography, we felt we could benefit from a watershed-based approach, as a particularly relevant

Local perceptions and vulnerability

During recent decades, people in Chitwan have experienced hotter summers, while winters are shortening. Ninety eight percent of all villagers recognise changes in the climate, while 95 percent mention drought and erratic rainfall patterns as the main indicators of this change. Villagers have witnessed an increasing number of floods. Although many see human activities as reasons behind this (such as deforestation, or the cultivation of marginal lands due to an increasing population), villagers feel that the erratic rainfall patterns are equally responsible. The destruction of land by floods and landslides, and subsequent declining land productivity, compels people to occupy forest areas, cultivate steeper land and look for alternative means of living.

Our analysis suggested that poor people are more vulnerable, as they rely heavily on the ecosystem and on its natural resources. They also lack assets and access to resources, and institutional support is weak. Vulnerability is determined by the area's topography and geology (as factors which, for example, contribute to landslides), as well as by the socio-economic activities taking place. Deforestation, shifting cultivation, over-grazing or other practices weaken the ecosystem, making it even more vulnerable.

strategy in mountainous areas. We then agreed to an integrated approach which considered agriculture and livestock development; water resources management; forest, land and soil conservation; the diversification of incomes and livelihoods; the rehabilitation of local infrastructure; awareness and education; and institutional development. We aimed to reduce vulnerability by identifying locally affordable risk reduction measures, and at the same time developing adaptive capacities. Our ultimate objective was to develop the local communities' capacities to cope and adapt to climate change by building resilience and diversifying their livelihood options.

Agriculture and livestock development
As a basic coping strategy, farmers have been looking for crops that thrive under erratic rainfall conditions. Some of them replaced their rice by maize, not expecting high yields, but rather so that land would not remain fallow. Most farmers, however, wanted a source of income, looking for crops that do well and have a good market value. Banana and vegetables were seen as better options: local people were encouraged, trained and supported to produce cash crops for the market. Training courses were also given in livestock health management. The trained individuals will then provide services to local people in livestock health care. In addition, villagers have been able to sell their surplus milk and vegetables for additional income. With more income generating activities, villagers have become more resilient.

Water resources management
A more intensive agriculture needs an improved water management system. But the changes in rainfall patterns have also affected irrigation. Landslides and flash floods have destroyed the irrigation channels and affected the water discharge into the streams. The streambeds have risen because of deposition of debris, making water inaccessible for irrigation. Where appropriate, farmers have tried to use alternative techniques, such as wooden conveyers or lifting water by pumps for irrigation. When discussed with the communities, one of their priorities was to rehabilitate the irrigation channels. Thanks to the rehabilitation of six irrigation canals, benefiting over 30 hectares of land, farmers can now grow three crops a year. This is in an area where, previously, they could hardly grow one crop (rice), with uncertain harvests. This helped households to increase the total crop production in the area, thereby helping in terms of food security and income generation.

Forest, land and soil conservation
More than 8 hectares of land were destroyed by landslides and flooding in 2006. One of the communities' requests was therefore to protect their land from potential floods and landslides. Gabion wire boxes were filled up with rocks and laid down on the riverbanks to divert the stream flow away during the flood time. This helped protect the intakes of irrigation channels, land and houses located at vulnerable sites. Some of these, however, were destroyed by the floods and buried by the debris. Later interventions tried to put check dams in upstream micro-catchments. This, together with plantation and forest management, aimed to reduce the deepening of gullies, the occurrence of landslides, and the flow of debris.

Plantations have been established on both community and private lands. The preferred trees include fodder, timber and fruit species. The community members have also promoted grass species for reducing soil erosion. A community managed forest nursery was established to produce seedlings which are suitable to the local environment and economy. Communities have now formed Forest User Groups to manage the forest. They have controlled the illegal intrusion of outsiders who collect forest products.

Photo: Practical Action Nepal

The construction of check dams and other infrastructure goes hand in hand with awareness-raising, institutional development and the diversification of incomes.

Diversifying incomes and livelihoods
Farmers' first priority is to seek opportunities to make their existing livelihoods, like agriculture, more resilient. The second priority is to seek alternative livelihoods, like additional income generation activities. Goat raising, vegetable cultivation and fruit farming are some of the activities which make agriculture more resilient, while at the same time help diversify livelihood options, and thus reduce the potential risks coming from climate change. Starting new enterprises, such as selling milk and vegetables to the local market, has also resulted in a good source of income. The project looked at the link between the communities and the external market, and provided specific training, with various results. One of the trainees, for example, was able to establish a "service centre", from which villagers receive regular services (especially in terms of livestock health, feed, seeds and selected inputs). At the same time, the same person helps villagers sell their products to outside middlemen, increasing their income.

Reconstruction of local infrastructure
Intensive rains and landslides also destroy local infrastructure such as bridges, canals, trails or community buildings. Communities need to be prepared for such events, considering all possibilities at the time of planning, construction and rehabilitation of the

local infrastructure. Although the communities in the project area still need to repair a number of roads and buildings, we started with a local bridge at a strategic location. This bridge now allows villagers (and in particular students) access during heavy rains, while plans for future repairs are also being considered.

Awareness and education to local people and school students
Local communities are not fully aware of the wide impact of climate change. When talking about climate change, most think of the local environment, and not about a worldwide phenomenon with lasting consequences. We therefore organised a number of awareness-raising activities, among which we included slide shows, focus group discussions and educational visits, especially targeting young students. We also prepared a documentary, and helped set up a meteorological station, where students take records of temperature and rainfall. Information materials on climate change and on its global and local impacts, such as booklets and posters, were also produced and disseminated.

Photo: Practical Action Nepal

Meetings with all villagers helped define the intervention process.

Institutional development
Having noticed the changes in the climate, villagers have taken individual action. But local organisations do not always seem ready for the challenge. Considering the importance of co-ordinated action, the project also looked at these institutions, and at the opportunities they can bring. A Climate Change Impacts and Disaster Management Group (CCIDMG) was set up in the project area, to prepare plans, raise money for specific activities, and co-ordinate the response of all villagers. This group was recently registered at the District Administration Office. Its activities started with the election of an executive committee, with representatives who were trained in administrative and financial management. The group co-ordinates with the local government and with external service providers, helping villagers to access resources and services. Most importantly, the group has prepared a watershed management plan, pooling the necessary skills and resources and aiming at an increased resilience.

Increasing awareness for building resilience

The most studied impact of climate change in Nepal is the disappearance of glaciers and the formation of new glacial lakes. But global climate change is having a much wider impact at a village level, and there is not always sufficient information available about landslides, floods or about cold and heat waves. Also lacking are studies on the impact of climate change on agriculture or biodiversity. This is linked to the low awareness level we found among the professionals who are working in government and non-government organisations in the field.

Rural communities are already experiencing the impacts of climate change, and most are trying their best to adapt. Being based on the villagers' interests and motivations, as well as on their skills and knowledge, their coping strategies are a good starting point. But local efforts frequently have a short-term focus. Additional efforts are therefore needed to successfully adapt to change in the long term. These need to minimise an area's vulnerability, and help build resilience.

In order to help communities build resilience, a single sector or programme approach does not work. Adaptation to climate change should therefore be integrated, multi-dimensional and multi-sectoral. The experience from this project suggests that the climate change adaptation approach should include a diverse range of conservation and development activities, including strategies for disaster risk reduction. The approaches might be promoted as "Integrated Conservation and Development Approach" or "livelihood strategy approach", with the ultimate goal of sustainable development. In a given location, the severity of the impact on different sectors could be at different levels. It is therefore suggested that the most affected sector should be taken as the entry point on which the integrated programme should be developed and promoted. ■

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Photo: Seva Mandir

Farmers access seeds through seed banks, without depending on external agencies.

Adapting to change with a blend of traditional and improved practices

In Dhala, farmers have been blending traditional and "improved" farming practices to adapt to the changes in climate they are experiencing. By including practices like mulching, new seeds or vermicomposting in their agricultural systems, yields have improved. This has also shown how NGOs can assist communities in the dryland areas to reduce their vulnerability to climate change.

Ronak Shah and Niranjan Ameta

As a result of climate change, agriculture in the world's drylands is being seriously threatened by rising temperatures, changes in rainfall patterns, or the increase of drought. This is directly linked to reduced soil productivity, and to a higher incidence of pests and diseases. Food security is an increasingly important issue for the rural communities who rely on agriculture to meet their subsistence needs. Adaptation to climate change is thus a major concern. Several efforts are underway to identify approaches and measures to reduce the vulnerability of rural communities to its impact. This article presents one of these efforts: the combination of traditional and "improved" practices, as facilitated by Seva Mandir, an Indian NGO.

Traditional adaptation

Dhala is a beautiful tribal settlement found in the mountainous region of Udaipur, in southern Rajasthan (a state in north-western India). This region has a low and highly erratic rainfall pattern, with periods of drought almost every three years. Most farming households own less than two hectares of largely fragmented land. Farming is primarily rainfed, as irrigation systems are poorly developed. By the end of the previous century, farmers in Dhala, like those in the other rural and tribal communities in Udaipur, were facing many difficulties, like land degradation, low water availability, a lack of knowledge and resources to invest in improving their agriculture. As a result, they had low yields and low incomes.

Climate variation is common and quite a natural phenomenon in the drylands of Udaipur. Farming systems in the region have consistently had to adapt to these variations. Farmers in Dhala, for example, have adapted by regularly adjusting their farming practices. In this process, various simple, resource-efficient and locally apt practices evolved on the basis of their experience, trials, resources and skills. Many of these practices, like those which follow below, are now essential components of the local agriculture systems.

Intercropping or mixed cropping

Intercropping refers to two or more crops grown at the same time in the same field. In Dhala, farmers grow maize together with various legume crops like chickpeas, black gram (*Phaseolus mungo*) or *sismum* (*Sesamum indicum*). Intercropping is done in different combinations: one row of maize and one of legumes, or one row of maize and two of legumes and again one row of maize. Selection of a particular combination depends on soil conditions, the topography and the specific requirements of the farmer. These different

combinations reduce the risk of crop failure in a bad monsoon; if maize production is affected, farmers can rely on legumes, with a lower water requirement, for earning. In addition, intercropping allows households to use their land optimally by taking different crops at one time. Legumes, for example, fix high quantities of nitrogen, supporting the growth of the maize plants, while also reducing the presence of pests and diseases.

Green manuring
The use of chemical fertilizers has been favoured in recent years, through governmental subsidies and by other external factors. In Dhala, however, the traditional practice of green manuring is still widespread. Green manuring involves the cultivation of Sunn hemp (*Crotalaria juncea*), a forage or leguminous crop with a high nitrogen content. This crop is grown during the monsoon in the fields that will later be used for wheat or other cash crops. The plants are cut before flowering and are incorporated into the soil, improving soil fertility and structure. To some extent, the practice also controls pests, diseases and weeds in winter crops. Farmers in Dhala have mentioned that the yields of wheat are quite good in those fields where hemp was grown. Many of them are in favour of this practice. The major constraint is the need to dedicate land (and energy) for the cultivation of Sunn hemp during the monsoon, which is the main cropping season.

Mulching
The optimal use of available water is a top priority for the farmers in this area. Mulching is used to reduce evaporation, as well as to prevent soil erosion. Mulching enhances water infiltration, and helps prevent the topsoil being washed away by high winds or water run-off. In Dhala, mulching is used when growing tuber crops like turmeric (*Curcuma longa*) or ginger (*Zingiber officinale*). Fields are covered with the leaves of *khakhra* (*Butea monosperma*) after sowing, and these are left until the plant grows. This practice has also generated an additional use of *khakhra*, an abundantly available local tree species which can also be considered as a green manure.

Introducing "improved" agricultural practices

Seva Mandir is a development organisation which has been working with more than 600 rural and tribal communities in Udaipur for the last 40 years. Its various programmes include development of natural resources, health, education, women and child, and the local institutions. For almost two decades the organisation has been working in Dhala, during which time various development interventions have taken place in the village. During the first half of the current decade, we implemented an integrated watershed development programme with the purpose of improving the productivity of the land and water resources. We were also interested in helping farmers cope with an erratic rainfall and frequent droughts. In the process, we promoted various "improved" agricultural practices, involving both rainfed and irrigated farming.

Improved seeds
Agriculture in Dhala needs to withstand the impact of low rainfall and frequent droughts. Moreover, the availability of irrigation water in sufficient quantities is definitely a luxury for the villagers. Hence, most farmers either restrain from growing crops which require more water, like wheat, or spend ample resources on irrigation. In order to address these concerns, we promoted crop varieties which mature early and are drought-tolerant. The introduction of these "improved" seeds started with two farmers in 2006, and is expected to reach around 60 families this coming year.

Vermicomposting
This is a widely accepted organic practice used in dryland agriculture. It is used to improve the nutrient content and water holding capacity of the soil. Its preparation involves composting cattle dung with biomass like neem leaves or fodder residue, and using worms to decompose it all. This practice was also introduced three years ago, and now more than one hundred farmers have adopted it.

Crop diversification
Depending on only one or two kinds of crops considerably increases the vulnerability of farming households. Crop failure can easily increase food insecurity, especially for small-scale and marginal farmers. The diversification of crops in Dhala intended to help farmers secure an income, as well as food, even in the case of extreme events. As part of this process, farmers were encouraged to cultivate vegetables on small sections of their fields, and to plant saplings on their individual wastelands (as areas which are otherwise only used to provide fodder for livestock).

Seed banks
Selective breeding, and collecting seeds for planting in the coming year, are age-old traditions in our country. Nevertheless,

Photo: Seva Mandir

Local practices are combined with new ideas, but only after trying them out on a small scale.

the development of a centralised seed supply system and the proliferation of hybrid seeds have considerably eroded these practices over the last three to four decades, increasing farmers' dependence on external agencies. A seed bank is an attempt to revive the old system of seed availability at a local level, in a refined way. With the support of Seva Mandir, a seed bank started in Dhala two years ago, grouping the 17 farmers who received new seeds of wheat and gram. At the moment, this bank has 45 members, who have also started storing maize seeds.

Response from the community

For centuries, farmers in Dhala have followed many traditional, locally apt and sustainable agricultural practices, most of which are now well integrated into their farming systems. The adaptation of new practices has been gradual over the last few years, with approximately half of all farming families now trying at least one of these practices. The results from these new practices have been encouraging.

For instance, the introduced wheat seeds require watering only twice during the whole season, in comparison to the five or six times that are normally needed. More importantly, the productivity of this "improved" wheat is almost the same as that of the old varieties. This means that the money spent on pumping water (an average of Rs 1200 per acre) is a net saving. In addition, farmers are giving one and half times the seeds received from Seva Mandir to their seed bank, storing them for the coming year. The community is thus becoming less dependent on external seeds.

Regarding vermicompost, the families who have been trying this out have been able to obtain considerable quantities of compost (approximately 1300 quintals among all involved households), all of which is being used in their vegetable plots and farmlands. By diversifying the crops grown to include food crops, vegetables and fruits, more food is available during the year. This has also possibly lessened the need for physical labour.

Certainly, the adoption of improved practices has not meant a divergence from old wisdom, and Seva Mandir has never intended to do that. Farmers comprehend their old practices very well, and they are most certain to accept new practices only after a satisfactory assessment. Farmers in Dhala took both groups of practices to be complementary. Accordingly, once persuaded of the benefits, farmers effectively and appropriately started to integrate the new practices with their tested old techniques.

A plausible approach for climate change adaption

The different interventions in Dhala were planned to address the village's livelihood difficulties by increasing the productivity of local agriculture. This, as the results show, is progressing reasonably well, and will meet the expectations substantially. Adaptation to climate change was not an expected outcome. Seen in terms of climate change, however, the interventions clearly reflect many adaptation measures, both in terms of "coping" in the short run, and as a long term adaptation for building resilience.

The experience in Dhala has shown a plausible approach to community-based climate change adaptation. Recent climate change debates, which increasingly focus on the need to adapt, are pushing for approaches that can simultaneously meet development needs and help in adapting to the change. A few years ago, adaptation to climate change was considered to be a totally separate activity, and adaptation measures were not seen to be part of the on-going development programmes. However, evidence has shown now that adaptation cannot be separated from the current development agendas, and it is necessary to look for ways to approach both challenges together.

It is recognised that dryland agricultural systems in villages like Dhala are used to climate variations, and show enough resilience to withstand the impacts of change. Traditional knowledge, and the farming practices based on it, are a vital ingredient in the current need to adapt to climate change. Nonetheless, we are all witnessing that the pace of climate change is much faster than the natural climate variations, and the impacts are expected to be more severe. Local agriculture systems are already facing difficulties because of climate change, and old methods might not be sufficient to withstand the impacts. Gradual adaptation to variation will not be a viable alternative, and farmers will have to prepare themselves for drastic changes in advance.

The idea of blending traditional and "improved" agriculture practices, as it is happening in Dhala, has shown a way for reducing the gap between vulnerability and the resilient capacity of the existing systems. On the basis of their own judgement and needs, farmers in Dhala are blending different old and new practices, with positive results: "This year we could sow seeds late and rain has been near to average, yet still our maize fields are almost ready for harvest (which is earlier than usual) and the yield will be more than what we used to get..." In the near future, farming systems in Dhala will have different combinations of old agriculture practices, like intercropping and mulching, and new practices, like vermicompost and improved seeds, being used. We believe that such blending will increase the adaptation capacity of local systems. The blending will also reduce the buffer period. The system will need to acclimatise to the changes, and at the same time, it will have the advantage of the modern knowledge on impacts and risks of climatic variations.

The way ahead

Recognising that drylands are highly vulnerable to the effects of climate change, Seva Mandir is now planning to promote different adaptation measures among other partner communities throughout the region. The approach followed in Dhala has shown us a way forward. The organisation has worked with around 80 communities on agricultural development, in all cases working together with the village *samuh* (a membership-based local organisation). Seva Mandir also firmly believes that bottom-up approaches are most suitable for development as they are closer to communities, and increase the sustainability of interventions. Hence, efforts shall always be underway to identify other trends emerging locally that can provide approaches for climate change adaptation.

■

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Farmers and sorghum in Nicaragua's

In some regions of Nicaragua, sorghum used to be the poor man's crop. In recent years, more farmers are growing sorghum, instead of maize, in response to changes in the local climate. A participatory plant breeding programme was set up, looking to improve the sorghum varieties grown. Some varieties have now been registered. With scientists and farmers now working together, further activities are planned, such as selecting suitable bean and maize varieties.

Gilles Trouche, Henri Hocdé, Silvio Aguirre and Irma Ortega Sequeira

Back in 2002, a study carried out by different organisations in Madriz, a district in northern Nicaragua, showed that more and more farmers were growing sorghum instead of the main staple crop, maize. Farmers were also willing to talk about growing and eating sorghum, while only a few years ago this would have been equal to admitting they were very poor. The study showed that a large percentage of farmers now grow white-grain short-cycle sorghum varieties (locally known as *sorgo tortillero*), in addition to those growing the daylength-sensitive varieties (or *millón*) that are now restricted to the less fertile fields.

Most farmers remember when these changes started (the first major drought experienced in 1972), and therefore relate the change in their cropping systems to the changes they see in the weather. They also reported that these changes have mainly taken place without the help of the government's extension services, or without involving NGO programmes. As sorghum was not a major national staple crop, most governmental development programmes focused on the production of maize or beans. But farmers feel that sorghum is a major crop in terms of food security, and therefore expressed their interest in improving the varieties they grow.

Photo: Gilles Trouche

Clotilde Soto Vargas, a farmer from Musuli, Palacanguina, selecting some of the best *tortillero* plants in her field.

Participatory plant breeding

Responding to this, CIRAD (a French agricultural research centre), INTA (Nicaragua's national agricultural research institute), and CIPRES (a local NGO), began implementing a participatory plant breeding programme. Running from 2002 until 2008, it is part of a larger project covering several countries in Central America. The programme focused on diversifying and improving the sorghum varieties so as to match the needs of resource-poor farmers in the dry areas. The research team involved breeders, farmers and extension workers. First they considered the introduction of improved inbred lines or varieties from Africa, representing a wide genetic diversity. Farmers tried them out in their fields and evaluated their agronomic performances and also their culinary qualities. Secondly, crosses were then made between the local varieties and those of African origin with complementary traits. The aim was to develop progenies which would better satisfy the local farmers' requirements.

As a result of this process, farmers now grow new varieties of *tortillero* and *millón* sorghum presenting higher and more stable yields and other quality traits. One was officially registered in 2007 by a smallholder's co-operative, and is now being disseminated in the area covering the south of Honduras and the north of Nicaragua. Known as 'Blanco Tortillero', this variety was originally developed in Burkina Faso, giving excellent results in the low-input cropping systems (see Box). Another new variety highly praised by farmers is 'Coludo Nevado'. At least 10 other lines derived from the crosses formerly mentioned, are currently in the final evaluation stages before being released.

One of the most important results observed is the formation of a core group of farmer-breeders. All of them are capable of selecting plants and progenies, of evaluating varieties with their own criteria, and taking decisions together with researchers and NGO extensionists. A large number of men and women, both

New varieties

Tortillero sorghum 'Blanco Tortillero'

- Improved line developed in Burkina Faso for drought and low soil fertility conditions.
- Excellent combination of earliness, adaptation and yield stability in conditions of abiotic stress (drought or high rainfall, low soil fertility) and grain quality.
- Registered in Nicaragua in 2007 by the co-operative COSENUP R.L. with the technical support of CIPRES, INTA and CIRAD and the financial support of FDN Norway and ACSUR Spain.
- Is now being diffused in the north of Nicaragua and south of Honduras.

Millón sorghum 'Coludo Nevado'

- Daylength-sensitive landrace from Sudan.
- Drought-tolerant and high ratooning capacity after the dry season.
- Good productivity in the maize-sorghum intercropped systems and excellent grain quality for making *tortillas.*
- Rapid adoption in the dry hillsides in the north of Nicaragua.

New *tortillero* and *millón* lines derived from crosses with African progenitors

- Plant types responding better to the farmers' preferences.
- Higher grain yield and forage quality.

young and old, are involved in these participatory breeding activities, at different steps. According to a female farmer in the village of San Lucas, "This is the first time that I see researchers interested in improving our *millón*, the crop which for a very long time has been our insurance against risk." Many of them are now also involved in evaluating and selecting new progenies of maize and beans, and plan to be further involved in managing trials for new varieties of sisal (*Agave sisalana*) and vegetables.

Strengthening farmer innovation systems

Farmers and technicians are also working together to improve soil fertility and ensure better and more stable yields within the existing sorghum cropping systems. Long-term agronomic trials on agro-ecological techniques have been designed and are being managed locally. These trials are looking at crop associations, locally-produced organic fertilizers and green manures. They mainly focus on techniques derived from the experience of some innovative farmers, with some adjustment. One of these is ratooning in the second cropping season. Ratooning is a technique where a crop is cut down to its base, leaving the roots and allowing new shoots to develop. In sorghum, this technique helps in getting a relatively stable grain and fodder production, even in cases of severe drought (as happened in 2006) or excessive rainfall (as in 2007). Research is currently being done in order to optimise this practice, looking at the best date and stem height for cutting the plants. The team is also interested in the development and selection of lines with better ratooning ability.

Perceptions and motivations

Farmers involved in this work are improving their yields and grain quality while adapting to a changing context. They are not part of a project developed around climate change, but their perceptions on climate change are reflected in the criteria they use for selecting new varieties. Climate change is not seen in terms of major disasters (floods, hurricanes, drought), but rather as increased uncertainty: some years bring excessive rainfall, while others are very dry, with a great irregularity within and between the two annual rain seasons. Farmers are interested in crops which ensure production in all climatic conditions. Breeding new varieties through a participatory and decentralised approach is a way for farmers to deal with uncertainty, and for anticipating climatic change. In short, they are looking for flexibility in their cropping systems; they do not want very specialised cultivars, preferring varieties able to produce in any weather conditions.

As everywhere in the world, farmers in this region want to avoid risk. They are interested in a healthy and productive system, and thus do not want to return to the farming systems of the past. Since 1972, farmers have actively and independently been changing their cropping systems, through the large scale adoption of *tortillero* varieties complementing the *millón* varieties. From 2002, the development of efficient links between the scientists and farmer organisations has allowed them to increase the diversity of the available varieties, to improve the productivity of their cropping systems, and thus to refine their responses to the climate changes. ■

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FARMING MATTERS

Help us develop a new educational series on LEISA principles

ILEIA has started to develop a new educational series that will make LEISA principles and practices more understandable. It is called Farming Matters. Eventually, Farming Matters will be published as a series of modules to help educators and field workers explain better why to practise more sustainable agriculture, and to put it into a wider perspective.

Before we publish the series on paper, however, we will make it available on-line as it develops. Our hope is that we can partly develop the series on-line, seeking input from LEISA practitioners and readers around the world to make sure that the guide will be relevant to people in the field. Besides this, field testing and access to the on-going developments will be made available on CD-ROM to readers without access to the internet.

The global version of Farming Matters will be developed in English first, though many partners in the LEISA network may eventually develop their own more regionally focused versions in different languages.

Farming Matters approach: learning

We will explain the main principles behind LEISA, give ideas on how to explain scientific concepts (with examples, illustrations and clear definitions), and remind about the wider context of farming (for example, looking at cultural, economic and political factors in addition to the ecological principles). References will be made to both local and scientific knowledge. Finally, rather than giving recipes to solve problems, Farming Matters will keep asking questions, to get people to reflect on the principles within their own situation.

Look for notices about Farming Matters on the LEISA website (http://www.leisa.info) in the New Year!

More information for better planning

Rural communities have been adapting to a changing environment for a long time. But the scale of adaptation has to increase as a result of climate change. The Sakai project, implemented in Kenya, shows how important weather and climate information is when adapting to climate change. Cropping calendars were used to put this information alongside traditional knowledge. Farmers then used them in planning their farming systems, including the use of relevant "external" techniques such as improved seed varieties and drip irrigation systems.

Cynthia Brenda Awuor

Many parts of Kenya are already experiencing unpredictable weather, with more frequent droughts, floods, and strong winds (particularly at the coast). Kenya, like many other countries, is particularly vulnerable to climate change. It relies on rain-fed agriculture and on other activities that are highly weather-sensitive; it suffers water scarcity, and many of its natural resources are degrading. Rapid population growth, inadequate basic infrastructure, and weakening social institutions and safety nets only increases its vulnerability, threatening to undo decades of poverty reduction and development achievements. This article presents the experience of a Kenyan community that is reducing its vulnerability to drought, as a first step towards increasing food security and reducing poverty.

Setting up a pilot project

The pilot project presented here is part of a regional project on "Integrating Vulnerability and Adaptation to Climate Change into Sustainable Development Policy Planning and Implementation in Southern and Eastern Africa" (ACCESA). This is funded by the Global Environment Facility (GEF) through the United Nations Environment Programme (UNEP), and the Governments of the Netherlands and Norway. It is being implemented by the local community, together with the Centre for Science and Technology Innovations (CSTI), and the Arid Lands Resource Management Project (ALRMP). Its main objectives include increasing household food security, reducing poverty, and facilitating the integration of climate change adaptation into policies related to disaster management and to the sustainable development of arid and semi-arid lands in Kenya.

Starting in 2006, this project is being implemented in Sakai, a sub-location in the Kisau division of Makueni, a district in Kenya's Eastern province. Sakai covers an area of approximately 24.5 km^2 and has a population of about 4800 persons, who mainly conduct small-scale, rain-fed agriculture and livestock rearing. This area was chosen because it is very vulnerable to drought, it has local institutions and organisational structures in place, and the community was willing to actively participate.

Local knowledge and information

About three-quarters of Sakai residents were aware of indigenous or traditional methods of forecasting rainfall, including the use of weather indicators. More than 40 percent of all households get weather information from traditional sources, including traditional weather forecasters (members of the community who determine whether the rain will fall or not by observing the behaviour of certain birds or insects). Of these, about one third use this information for seed selection, for deciding when to till, terrace and repair agricultural land, or for planting. At the same time, 88 percent of the respondents receive weather information from other sources, including radio, television, newspapers and agricultural extension officers.

But while traditional sources of weather information have been useful, and are widely accepted among the community, the villagers noted that they do not provide sufficient information to help them plan their activities in the long run. Considering that knowledge and information is directly related to vulnerability, the project therefore decided to fill this gap by complementing traditional weather information with scientific weather forecasts.

The project team has been "downscaling" scientific weather forecasts for the sub-location, and communicating this information in agricultural terms. Downscaling involves conducting meteorological weather forecasting and seasonal weather predictions at the sub location, to generate more accurate figures for expected temperature and rainfall. By doing so the team has been able to provide accurate weather predictions for the sub-location – especially when compared to the provincial weather forecasts provided by the Kenya Meteorological Department. For a large geographical area, they only classify the expected rains as "above normal", "normal" or "below normal". In parallel, community members were trained on the use of seasonal weather information. For example, they have been trained on how to interpret provincial weather forecasts provided by the Kenya Meteorological Department. This includes the specific range of rainfall quantities expected under "above normal", "normal" and "below normal" rains. In addition, community members have been trained on suitable agricultural and land management activities that they could undertake under different seasonal weather predictions. This looks at types of crops to plant during "above normal and normal rains" as well as drought resistant crops and seed varieties to plant under "below normal" rainfall quantities. Based on downscaled seasonal weather forecasts, villagers have been regularly provided with information detailing the expected dates of the onset and cessation of rain, duration and amount of expected rainfall, suitable crop and seed varieties for a given season, and dates for land preparation and sowing.

The team used various channels of communication. These included several meetings with the local administration or *"barazas"*, notices in local newspapers, as well as radio programmes run at the beginning of each rainy season by the local radio station hosted in partnership with the Arid Lands Resource Management Project Team in Makueni. A special activity was the preparation of "cropping calendars". These incorporate traditional knowledge on weather and farming practices, outlining suitable agricultural activities to be undertaken during the rainy and dry seasons. A "cropping calendar" also highlights the importance of preparing the land early, selecting appropriate seeds, and conserving livestock feed. It provides guidelines for planting that take into consideration possible rainfall scenarios under different soil types. It provides information on appropriate crop types, seed varieties, planting dates, as well as depth and spacing of seeds. In addition, we also prepared guidelines on land preparation, application of manure, pest and disease control, weeding, crop rotation, grain selection, packaging, storage and transportation.

Photo: Cynthia Awuor

Community meetings such as this one, held in August 2008, were vital for the preparation of the "cropping calendars".

This information has been useful for farmers. They use it to decide when to prepare their land, the crop varieties they will grow in a given season (in view of expected quantity and duration of rainfall), and good land and crop management practices that will help them improve their agricultural yields. All villagers agree that the use of information has contributed to improved yields during the last four cropping seasons. According to one of the farmers, Boniface Kimeu, the results have been very positive. He was provided with 2 kg of good quality, drought-tolerant maize seeds bought by the project. He used knowledge and skills gained through training, as well as weather information provided, and planted them. He harvested 50 kg of maize at the end of the long rainy season in 2007. Out of his harvest, he selected 6 kg of good quality seeds and planted them during the short season of the same year. Out of this, he harvested 400 kg of maize.

Other activities

In addition to the interpretation, packaging and timely communication of weather forecasts, other project interventions include training community members on appropriate agricultural and animal husbandry practices. The project also runs training courses on identification, retrieval, selection, bulking and storage of good quality seeds, pest control, post harvest storage and management. Demonstration sites were established with 40 families, helping to show the benefits of using weather information in agricultural planning, as well as the use of specific agricultural practices.

Many of the Sakai villagers have been participating in farmer-to-farmer trainings, and distributing good quality seeds from their farms to other farmers in the area. The farmer-to-farmer training sessions are conducted twice a year before and during each rainy season. Each farmer trains two neighbours. As a result, we estimate that more than 600 farmers have been trained so far. Thanks to the Arid Lands Resource Management Project, much of the work carried out in Sakai has been replicated in the nearby divisions of Kibwezi, Tulimani and Kalawa.

Furthermore, to enhance year-round availability and accessibility of water, the project helped to build two sand dams, namely *Kwa Dison* and *Kwa Ndeto*. These are designed to form a partial barrier across a river or stream, which traps sand and water as it flows. Sand dams are suitable for the area because they conserve water that the community can use during dry seasons. Since the completion of the first sand dam in mid 2007, community members have appreciated the benefits of such efforts, especially in terms of access to water. This water has so far been used for domestic purposes, and for the cultivation of kitchen gardens. Future plans include the drilling of shallow wells and establishment of drip irrigation systems in the area. The project is also strengthening small-scale micro-finance institutions in the area to help diversify the community's economic base and increase access to credit.

A wider outreach

One of the project's main interests is to regularly update its website, showcasing the many activities and results. In addition, the team has prepared several papers based on the project's experience, presenting them at various national and international meetings. Project partners have also prepared and distributed a project brochure and a video documentary. Plans are underway to use the video documentary as a tool for further awareness creation, peer learning, as well as in further policy engagement. Policy briefs will also be produced. They will highlight the importance of integrating climate change adaptation into sustainable development policy planning and implementation, and will draw on lessons from the pilot project.

In terms of policy engagement, the project actively involved many authorities and decision makers, such as representatives of the District Food Security Group and the District Environmental Committee. It also met with representatives of the Ministries of Environment, Agriculture, Social Services, Water, Planning and National Development and Finance. Integration of climate change adaptation into national policies, however, has been a major challenge. The team faced different constraints, especially in terms of knowledge and application of appropriate tools and methods. Another challenge is the lengthy process of policy review, together with external factors that affect policy change, such as political interests or the prevailing economic priorities.

Fortunately, the Kenyan government recognises that climate change is a challenge to national development, and is committed to action. The Arid Lands Resource Management Project helped by including climate change adaptation in the National Disaster Management Policy, currently under review. A draft of the document has been tabled in Kenya's parliament, with the results of the deliberations expected soon. A National Climate Change Office is being set up, and will be charged with the task of formulating a national climate change strategy on adaptation and mitigation. This office is expected to consider the lessons drawn from the Sakai pilot project's experience. Our next task is to contribute to this office's success. We plan to do this by comparing the experience in Sakai with that of the other areas where the project is now being replicated. This will help build a body of knowledge on the application and adaptation of diverse tools and methods in community based adaptation to climate change and policy integration.

■

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Climate Field Schools in Indonesia: Improv

Following the successful Farmer Field School approach, experimental Climate Field Schools were set up in Indonesia. These aim to increase farmers' knowledge on the climate and improve their response to it. Climate is another reason for building up resilience in farming systems, and this was built into the CFS curriculum. Farmers are now more aware of how to use climate information in managing their soil, water and crop resources for best effects.

Yunita T. Winarto, Kees Stigter, Esti Anantasari and Siti Nur Hidayah

Farmers have always responded to climatic variability, particularly to changes in rainfall, by adapting their practices throughout the season. This involves adapting their choice of crops, crop varieties, planting and other cultural measures, while at the same time managing and manipulating the soil, water and microclimate where possible. Climate change complicates this so-called "response farming", but it does not change the principles of the approach.

Photo: Esti Anantasari

Farmers in Gunung Kidul look at the changes in crop growth as part of their analysis.

One way forward is to improve coping strategies to increase farm resilience within the limits set by the environment. Response farming could be improved through better weather forecasting and planning. The best example in the agro-meteorological literature is found in pilot projects set up by the National Meteorological and Hydrological Service in Mali, West Africa. Here, information is regularly received from farmers' fields; forecasts and advisories are then disseminated throughout the growing season. This makes it easier for farmers to respond and adapt. In Indonesia, however, farmers we spoke to in this study generally found official rain forecasts and predictions of little use, because they are not sufficiently downscaled. Farmers were more interested in making their own observations, and acting on them.

Using climate information

The idea of improving extension support to response farming led to the development of Climate Field Schools (CFSs) in Indonesia. In 2005-2006, an experimental CFS was set up in Indramayu, West Java to increase farmers' knowledge on using climate information in their decision making. The collaboration included the Indonesian Ministry of Agriculture, the Asian Disaster Preparedness Center (in Bangkok), the Indonesian Agency for Meteorology and Geophysics, and the University of Agriculture in Bogor.

Indramayu was the site chosen because of its confusing variations in water availability. Farmers live in lowland areas and cultivate rice as their staple crop. They have developed diverse agricultural systems in response to the different water regimes: full technical irrigation, partial technical irrigation, and rainfed agro-ecosystems. Accordingly, rice planting varies from one to three growing seasons per year.

In 2007, a second CFS was established by government extension in a contrasting setting in central Java: Gunung Kidul. An active farmers' group existed there already, some of whom had previously attended a Farmer Field School, which offered promising follow-up possibilities. Farmers in Gunung Kidul live in dry rainfed hilly areas and cultivate multiple cropping systems the whole year round where water allows. But rice can only be planted once a year. The CFS lasted almost five months, with twenty farmers attending twelve meetings in that time. Besides sessions on climate and water regimes, farmers experimented with local practices of dry multiple cropping of rice, corn, cassava, sorghum, tobacco and vegetables. In particular, as rice is a one-season crop here, participants set out to improve water management through establishing ridges in the rice fields.

Since May 2007, the research team of the Academy Professorship Indonesia in Social Sciences & Humanities for Gadjah Mada University's Graduate School (Yogyakarta), carried out ethnographic fieldwork in Gunung Kidul. The team observed the CFS, the participants' local knowledge and practices, their interpretation of the school's teaching, and responses to the climate. The authors participated in discussing alumni farmers' questions over several days in December 2007 and May 2008.

Climate change and forecasting problems

Across the whole of Indonesia, "climate change" is real. Rainy seasons on the islands of Java and Bali, for example, start later and stop earlier, while the amount of rain remains roughly the same, resulting in higher rainfall intensities. An important issue that has emerged is the need to improve farmers' capacity to use climate forecasts and other agrometeorological information in their activities. For instance, farmers in Indramayu are finding it difficult to determine an appropriate planting time for rice under the changing conditions of the rainy seasons.

Many Javanese farmers know about *pranata mangsa*, a world-view based on the Javanese lunar cyclical calendar (the position of stars). The Gunung Kidul farmers depend on this cosmology, as well as observations of the environment, to work out their planting schedule. These farmers are now confused and worried that the guidance they receive from *pranata mangsa* and local observations, built up over time, is no longer of much use. Observations that used to indicate the start of the rainy season are, for example, falling leaves, singing birds or noisy insects.

ing "response farming" to climate change

However, similar to experiences common now in the African drylands, false starts to the rainy season and unusual dry spells are now being experienced.

In Gunung Kidul, farmers practising rainfed agriculture are interested in understanding the causes of climate change better and hearing about the basic processes behind it. However, the experimental CFS did not delve into this deeply enough. During our follow-up meetings, we tried to explain in simple terms what global warming means and its most likely causes. We then looked at what the consequences are for the atmospheric circulations that determine weather and climate. We emphasised that the trend of climate change is not going away, that larger numbers of more, and more serious, extreme events have already occurred and will occur more frequently in the future. This goes against the farmers' long built-up cyclical cosmological knowledge.

Climate change another entry point

If anything became clear to us in our interactions with farmers, it is that climate change is just another reason for building up resilience in farmers livelihoods. Soil and water management, pests and diseases, crop choices and their adaptations, are examples of related issues the farmers in Gunung Kidul wanted to discuss with us. This means that ultimately only the complete livelihood approach counts for Farmer –or Climate– Field Schools.

CFSs and soil & water management

Climate change means that farmers need to adapt to the changes in opportunities for harvesting water, as well as taking measures to prevent water logging and flooding of their fields. In addition to field planning, using responses to forecasts and actual behaviour of the rainy season, a complete understanding of in-field water harvesting principles is highly important. In Indramayu, farmers requested that future CFSs deal more with these latter issues. In Gunung Kidul, farmers' core issues were to have a better understanding about preventing field water losses, as well as taking on-farm rainfall measurements.

Improving soil management

Farmers have their own ways of classifying soils according to types, colours, and the combination of both (e.g. light white lime, light red lime, heavy black clay, and light black clay). Related to the increased water runoff problems, they learned in the CFS that this runoff is more severe in light lime than in heavy clay soils. However, farmers perceived that heavy soils are suffering more from water runoff. We reasoned that with such differences in arguments, other factors must be involved. We suggested that slope and soil surface characteristics had a greater influence on soil loss and water runoff, than other soil properties that determine infiltration. Soil surface characteristics include state of tillage, surface cover and other obstacles to water flow.

Building up organic matter was also taught as being an important aspect of soil improvement, for example, not burning fields, nor removing falling leaves or other biomass. We further discussed how contaminated soil gets "cleaner" after applying an organic approach, and whether and how inorganic fertilizer may be combined with organic fertilizer in the long run. We found that it was particularly important to include knowledge on root systems in soil and water management. Crops' root systems can react to availability of water, availability of fertilizers and competition from intercrops, including trees, depending on the soil horizons they can use.

During the Climate Field School, farmers compared yields in field experiments. Since ridges showed a positive effect in harvesting rainwater, farmers in Gunung Kidul implemented the extensionists' advice to build in-field ridges to preserve water.

CFSs and pests & disease

Prior to the CFS, farmers did not know the relationship between pest populations and the microclimate. On the basis of their observations and experiences in the school and follow-up, all the farmers were convinced that the less rainfall there is, the more insect pests there are. Under less than normal rainfall, chilli and vegetables are attacked in particular.

Photo: Esti Anantasari

Climate Field Schools help farmers observe and compare. Farmers in Gunung Kidul recommended ridges in dry-rice fields intercropped with maize.

In India, a new development for fighting pests and diseases, using warnings from operational agro-meteorological services via the Indian Meteorological Department, will soon begin. This is seen to be very important because changes in rainfall patterns result in shifting pest and disease problems.

CFSs and choice of crops

Farmers adapt more often and faster than is often assumed. Crop choice is a dynamic practice on most soils and has to be even more so under a changing climate. Prior to the CFS, farmers at the two sites were already growing crops suitable to seasonal climatic conditions. However, despite much local knowledge, the farmers are feeling insecure. To increase their farms' resilience, much better advice is needed on a variety of matters: which crops to grow; in which rotation; on which soils; under which soil conditions with respect to fertilizer history; water use efficiency potential; soil depth and aeration, as well as presently changing rainfall patterns. Farmers need help to do this more efficiently and to disseminate results beyond the local trials. In the CFS, their knowledge was enriched and strengthened by the teachings and observations. Farmers' presentations in meetings and during our field visits showed the great knowledge they had acquired on suitable crops and the adaptations needed to respond to changing conditions in weather patterns and market developments.

Farmer observations to respond better to climate change

In terms of climate change anticipation, farmers are good observers and experimenters. They already do adapt but could adapt even more, if they link their own experience to the results of such organised experiments. They are not in the habit, however, of taking notes of their own experiences and observations. In the present unanticipated climate variability, they should regularly write down the particulars of each season to document the changes that are occurring. An argument

Photo: Kees Stigter

Hedgerow intercropping design on sloping land at the World Agroforestry Centre's experimental fields in Machakos, Kenya.

frequently used by the farmers of Gunung Kidul themselves was that documentation is an aspect they miss, when compared to better organised societies. We mentioned examples of some traditional societies, where information on changes in plant, tree and crop phenology (cyclic and seasonal natural phenomena in relation to climate, plant and animal life) had actually been preserved. If documented, these examples could then be more actively gathered and disseminated through Climate (and other) Field Schools.

CFSs go beyond farmers' empirical methods by bringing in experiences from elsewhere, from science and through participatory experiments. Recent discussions in Indonesia looked into how to move away from its dependence on rice. It was proposed that new cropping systems should be tested on-farm in a participatory approach, under the presently changing climatic conditions. As shown by Indramayu and Gunung Kidul, Climate Field Schools can play an important role in such a process.

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Call for articles

June 2009, Vol. 25.2
Rural Entrepreneurship

Families who farm on small areas of land find it increasingly hard to survive on farming alone. Farming may provide at least part of a family's needs for food, but farmers also need cash: their children are going to school, or they incur medical expenses. The problem they all face is that opportunities for off-farm employment in rural areas are limited. Migration to urban centres in search of work is a very widespread strategy. Whenever possible, people seek work as construction or agricultural labourers closer to home. Those who show motivation and interest, and who have some resources to invest, engage in rural entrepreneurship. They may be running a shop or a small agri-processing business.

In several areas new and different opportunities have emerged. Access to markets (and to market information) has improved, new opportunities have been created for selling organic "regional products", sometimes directly to the consumers. In other cases, initiatives have been taken to pay farmers for their ecosystems services. In mountainous regions and other areas with tourism potential, farmers have moved into (eco-) tourism. This has meant developing managerial and other skills needed for running home-based enterprises.

This issue of the magazine will focus on how farmers are finding other sources of income, taking opportunities which complement their farming systems, and contributing to an improved quality of rural life. How have traditional and less traditional types of rural entrepreneurship contributed to stronger local economies, and how have they contributed ecologically and socially?

Articles must be submitted by March 1st, 2009, to Jorge Chavez-Tafur, editor, at j.chavez-tafur@ileia.nl

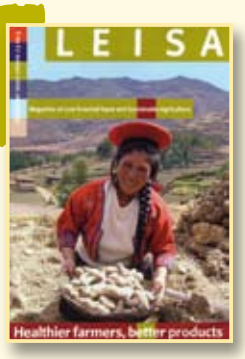
Vol 25.3
Gender and food sovereignty
Deadline: 1st June, 2009.

Vol 25.4
Sustaining the gains
Deadline: 1st September, 2009.

L E I S A

Next year it will be 25 years since the first LEISA Magazine (then called ILEIA Newsletter) appeared. We would like to celebrate this jubilee year together with you, the readers of the magazine. To do so, we need your input!

25 years of LEISA Magazine
Wanted: your experiences



Do you know of a groundbreaking initiative that was covered in LEISA Magazine several years ago and which deserves a follow-up? Then we would very much like to hear from you. What happened since the article was written? What went well and what went wrong? What surprise discoveries have been made along the way? What has been the long-term impact of the initiative? Send us an outline of around three hundred words, explaining why this particular initiative deserves to be highlighted. We will select the most interesting ones and request the authors to develop their outlines into an article for the magazine. It does not necessarily have to be an example of something that is still successful now. Lessons can also be learned from experiences or projects which did not work out as intended. Those of you who send in the most insightful stories about "groundbreaking initiatives revisited", will be invited to our conference on the Future of Family Farming, which will take place in the Netherlands at the end of 2009.

"Inspired by LEISA Magazine"

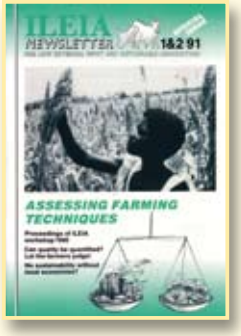
We are also looking for examples of information from LEISA Magazine being put to use. Were you inspired after reading about the field workers in China who shared their experiences with pest control and did you decide that you wanted to try this for yourself? Did you read about SRI (System of Rice Intensification) and have you since been able to raise farmers' interest to try this method on their own farms? Do you think other readers should know about your initiative? Send us a brief outline, again of around three hundred words. We will select the most interesting ones for publication, and invite authors of the most inspiring stories to our conference.

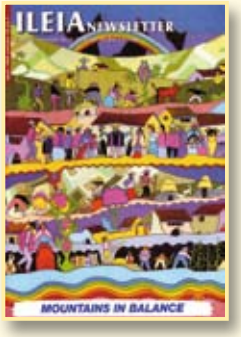
How to go about it

Your leads, stories and outlines are welcome from December 15, 2008 to March 1, 2009 – we will celebrate our jubilee in all of next year's issues. But the earlier you send them, the better. You can send them in through e-mail (jubilee@ileia.nl) or regular mail (see p. 2). As of January 1, 2009 our website will provide you with more information. Future issues of LEISA Magazine will keep you updated on our jubilee activities.

Edith van Walsum

Edith van Walsum
Director, ILEIA, Centre for Information on Low External Input and Sustainable Agriculture





Using radio to share farmers' adap

Farm Radio International recently held a script-writing competition on the topic of adapting to climate change. Working together with different partners, the fifteen winners' scripts were distributed to over 500 radio organisations across sub-Saharan Africa. These are now being broadcast, bringing accurate and engaging information about climate change and adaptation strategies to rural farmers all over Africa.

Blythe McKay

Only when farmers can understand the negative effects of climate change and its impacts can they prepare for and adapt to them. While many farmers are already coping with varying climatic conditions, the weather is becoming less predictable, and some of their strategies may no longer work. Effective communication approaches are critical to help farmers adapt to climate change.

Radio is an effective way of reaching small-scale farmers throughout Africa, where rural farmers are among the most vulnerable to climate change. The challenge for radio broadcasters is to give relevant climate change messages and to ensure that their audience can understand them. Radio programmes can encourage communities to assess local problems and identify local solutions, while also providing listeners with other useful information such as weather forecasts.

Extract from script by Kwabena Agyei, from Classic FM, Techiman, Ghana

"Mangoes to the rescue: A local response to climate change"

Mr. Agyei Boahen: Hi, you two. How is life treating you?
Benedict and Joyce: (together) Fine, Nana!
Benedict: We're just worried about the rapid changes we are witnessing with the weather and the environment.
Nana Boahen: Sure, I am worried too. Erratic rainfall patterns, too much heat, disappearance of the forest cover with its animals and plants, drying up of streams and rivers, loss of soil fertility and more erosion – these all lead to low crop yields. It wasn't like this when I started farming forty years ago.
Joyce: Hmmm! Then farming was not as costly as today.
Nana Boahen: True. But I have noticed something in one of my farms that I think can be tried and replicated elsewhere. Obviously, it is not a one-stop answer to global warming, but it can help as a local initiative.
Benedict: What is it?
Nana Boahen: About six years ago I planted some maize and garden eggs in a portion of my farm where I have 10 mango trees, spaced about 50 metres apart and covering a large area. I noticed that the leaves of the other plants were greener and bore bigger fruits.

Plenty of research in Africa focuses on testing methods for farmers to adapt to climate change. Some research looks at the traditional approaches farmers have relied on for centuries,

Anthony Lwanga, the Station Manager of the Kagadi-Kibaale Com

while other projects test new methods. The thousands of radio organisations across Africa can play an important role in publicising research results and transforming them into programmes that their audiences can understand and use. Also, by interviewing local farmers, radio organisations can pass on information about how different communities adapt to droughts, improve soil fertility, or select which crops to grow.

Scriptwriting competition

To encourage African radio broadcasters and producers to research and write innovative radio scripts about farmers' strategies for coping with climate change, Farm Radio International and the Technical Centre for Agricultural and Rural Cooperation (CTA) launched a scriptwriting competition in November 2007. Four months later, the competition had received 51 script submissions from 20 countries across sub-Saharan Africa. An international panel of seven judges reviewed the scripts, selecting the top 15 winners. Following on the success of Farm Radio International's first radio scriptwriting competition in 2006 –on the Millennium Development Goals– this initiative aimed to strengthen the capacity of rural radio broadcasters in Africa to provide relevant information to farmers.

Photo: Blythe McKay

mmunity Radio (KKCR) interviews rural farmers in western Uganda.

Jean-Paul Ntezimana from Radio Salus in Rwanda won the grand prize, with his script on managing rainwater to prevent soil erosion and provide water for crops. This is an important adaptation practice for farmers who face extremely heavy rains on some occasions and droughts on others. Other winners covered topics including the importance of manure for increasing soil fertility, water-conserving irrigation practices, drought-tolerant rice, preventing deforestation, and livestock management.

The 15 winning scriptwriters worked for several weeks with Farm Radio International's managing editor, using the feedback received from the judges, to improve and finalise their scripts. The finished products were published in French and English and distributed to over 500 radio organisations across sub-Saharan Africa. All scripts are also available on the website of Farm Radio International. In addition, the UN's Food and Agriculture Organization (FAO) supported the audio productions of two of the best scripts, in time for World Food Day (October 16, 2008).

Radio drama on climate change

Another interesting idea currently underway is the development of a radio drama to strengthen farmers' capacity to adapt to climate change. One of these projects is focused in four states in northern Nigeria: Kaduna, Katsina, Kano and Borno. The initiative is led by the African Radio Drama Association (ARDA) in partnership with Farm Radio International, the Canadian University of Guelph and the Women Farmers Advancement Network (WOFAN). With the help of farmer-led focus groups to shape content, a twenty-six episode radio drama called *In kidi ya chanza* ("When the drum beat changes you must change your dance steps") is being produced in Hausa and Kanuri languages. The drama will be broadcast weekly by six radio stations over a period of six months starting in early 2009.

The drama focuses on four agricultural topics:

- general climate change indicators based on farmers' observations;
- the reduction in water available for rainfed crops, livestock and human use – successful adaptations include diversifying the number of crops planted to reduce risk of crop failure, as well as using household grey-water to irrigate vegetables in home gardens;
- the implications of climate change for livestock – adaptation measures include improving livestock feed availability; and
- the loss of trees and shrubs – adaptation measures include planting of barrier hedges along contours to reduce soil erosion and provide fuelwood.

Radio drama is a popular format that resonates with Africa's oral narrative traditions. Drama, music, story-telling and proverbs are central to traditional education and information sharing in African culture. Drama imitates real life, is entertaining and can be used to demonstrate actions for comparisons and consequences. It can objectively portray, through multi-dimensional characters, models of responsibility, community leadership and ideal behaviour. Radio drama can attract and keep listeners' attention. It can also motivate them to imitate the actions of their favourite characters. Radio soap operas are particularly successful because of the slowly evolving nature of their plots as well as the gradual building up and subtle integration of the topics and messages over time.

Challenging topic

One thing that was clear from these projects is that writing about climate change for radio is challenging. Creating a factually accurate yet entertaining or engaging message is perhaps the most challenging aspect of all. The key to writing for radio is to write in a simple and clear language, as if you are talking to one person. Messages need to be communicated in such a way that people from different backgrounds can understand a difficult topic like climate change. When talking about farmers' situations, getting farmers' voices on the air is essential to help them understand the issues enough to make relevant adaptations. Although it is still too early to evaluate the results of this competition, surveys completed by 90 of Farm Radio International's network of radio broadcasters over the last two years indicate that on average broadcasters use half of the scripts in a package, and 82 percent adapt and translate them into local languages. Each script is broadcast at least twice. ■

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For the list of winners and the full winning scripts, go to Farm Radio International's website at http://www.farmradio.org/english/radio-scripts and look at Package 84.

Livestock and climate

Livestock rearing contributes to climate change, but at the same time it brings many benefits to small-scale farmers. Do these benefits outweigh the disadvantages in terms of greenhouse gas emissions? And how can these emissions be reduced?

Reducing greenhouse gas emissions from livestock

Akke van der Zijpp, Professor of Animal Production Systems, Wageningen University, the Netherlands.

Livestock was never really mentioned in the climate debate until 2007, when the Food and Agriculture Organisation (FAO) reported that livestock keeping produces 18 percent of all greenhouse gases. Since then, we have realised that livestock keeping is a cause of climate change, but is also affected by it. The chairman of the Intergovernmental Panel on Climate Change suggested that people should eat less meat. I do not think that that is feasible: for most people in developing countries, meat is a welcome part of the diet; and in rich countries only small groups of people voluntarily eat less meat. Thus, we have to look at strategies to reduce the impact of meat production on the climate. We do this by looking at the different sources of greenhouse gases in the livestock chain

A main source of the greenhouse gases related to livestock production is poor land use, like deforestation and overgrazing. This is responsible for more than one-third of the greenhouse gases produced by livestock. In Burkina Faso, land degradation as a result of free roaming cattle is common: land becomes unproductive with little organic matter. In pilot plots, it was clear that live fencing, controlled grazing, water harvesting and manure use could double the production of grains and cattle, with few inputs. Wide adoption of such practices is slow, unfortunately.

Managing manure

Another major source of all greenhouse gases from cattle is manure. This produces about a third of the 18 percent quoted by FAO. Reduction is possible if small-scale farmers could collect manure in time, process it properly, and incorporate it in the soil just before planting the crop. However, it is mostly women who manage manure, who are often heavily overworked. With more time, they could manage the manure much better. For example, fermenting manure into biogas reduces fuel wood collection time, deforestation and provides slurry for manure. But installations are expensive. Farmer groups may develop common biogas plants to reduce costs.

A quarter of the greenhouse gases comes from animals themselves, mainly from cows, sheep and goats, because of the bacteria in their stomach. A solution could be to change to mainly keeping pigs and chickens, which have different guts. That might be emotionally difficult for farmers: farmers who migrate, and have to leave their cattle behind, will start rearing the same species again. I come from a cattle keeping family, and I cannot imagine our family would change to pigs. Yet, chickens are a real alternative, particularly for poorer farmers: they are more efficient in turning grains into meat than cattle, and investments are affordable.

Seven percent of the greenhouse gases produced by livestock comes from fodder: this includes fertilizer used for production, and deforestation particularly for concentrate production. The remedy is again to use the land that you have more efficiently. There are experiments with no-till systems that produce less greenhouse gas – although fertilizer is needed there. Finally, one percent of greenhouse gases in the livestock sector comes from transport.

Another way of reducing greenhouse gas is changing cattle's diet. Relatively more concentrated than rough feed increases production of milk and meat, while greenhouse gas emissions remain about the same. For this reason, there is much to say for intensification of cattle keeping. Yet, getting concentrated feed is not always easy for small farmers, and in countries like India, managing free-roaming cattle is culturally sensitive. In such situations it is difficult to provide protein-rich feeds to cattle.

All in all, for small-scale farmers it is wisest to manage available land and cattle to use locally available means (such as trees, bushes, fields and available fertilizer) for intensification of cattle keeping, in combination with efficient species such as pigs and chickens and use of biogas. In that way they can both deal with climate change, and contribute to mitigation of the negative impact on the climate.

Akke van der Zijpp. E-mail: akke.vanderzijpp@wur.nl

Join the debate

change: Two views

Our last topic, "Subsidised fertilizer", provoked many reactions. In our digital newsletter, E-LEISA, this discussion is summarised for you. To subscribe to this newsletter, go to E-LEISA on the homepage of the *LEISA Magazine.*

Integrated local systems for mitigating climate change

Nitya Ghotge, Director, ANTHRA Pune, India.

Global demand for livestock products is expected to double during the first half of this century, as a result of the growing human population, and its growing affluence. Over the same period, we expect big changes in the global climate. Climate change is one of the most serious long-term challenges facing farmers and livestock owners around the globe today.

If livestock are effectively integrated into ecological agricultural systems, the benefits are many and various: returning valuable biomass to the soil improves water retention, and reduces risks posed by sudden periods of drought. Recycling carbon to the soil in this way closes the carbon cycle. By encouraging the use of local breeds of livestock, greenhouse gas emissions are reduced. Growing crops which require less water will reduce the need for fuel and energy-driven irrigation systems. Similarly, encouraging locally grown fodder crops, which are integrated into farming systems, will reduce transportation costs and aid carbon sequestration. By using local markets, transportation costs and carbon foot prints are reduced.

The major pollutants from industrial livestock rearing systems are accumulated animal wastes, antibiotics and hormones, chemicals from tanneries, and pesticides used to spray feed. Besides this, groundwater is exploited for growing fodder crops. These, in turn, are grown on extensive tracts of land, thereby diminishing agro-biodiversity. It may also increase phosphorus and nitrogen contamination which can have negative effects on marine ecosystems.

Energy

The social and environmental value of local, small-scale livestock production systems can far outweigh any negative consequences. This is mainly through the energy they produce. For example, in terms of traction and draft animal power, the use of livestock reduces the need for fossil fuels.

Methane, generated from animal waste, is a far more potent greenhouse gas than carbon dioxide. It can, however, provide cooking fuel (biogas) for rural households. This has multiple benefits. A gas which would have contributed to global warming and climate change, is then efficiently transformed into useful domestic energy. This in turn implies that rural households will make fewer demands on fossil fuel energy, as their energy needs get taken care of at the local level. If these energy solutions can be properly designed and promoted, the demand for fuel wood could be reduced. This may in turn allow for greater carbon sequestration in reforested areas.

Integrating livestock into a farm system can reduce the use of chemical fertilizers by recycling animal wastes into farm yard manure. Another way to reduce demand for chemical fertilizers is by recycling the slurry from biogas plants into local agriculture. This also enhances soils. Local systems also effectively utilise crop residues and plant by-products, thereby reducing the demands on land.

Ecological agriculture and endogenous systems, with livestock as an integrated component, have the potential to mitigate some of the adverse effects of climate change. Livestock are a key component in small-scale farming systems. Farmers need only to take small steps to adapt management practices to benefit fully, while also contributing to climate change mitigation.

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Adaptive agriculture in flood affected areas

Eastern Uttar Pradesh, in the foothills of the Nepal Himalayas, has been prone to floods for centuries. In the last 60 years, however, their frequency has increased dramatically. People living in the region have slowly developed ways to cope with the floods. These adaptive measures had not been documented until now. A booklet has recently been produced detailing adaptive agricultural practices in this specialised region.

Shiraz A. Wajih

Photo: GEAG

Scenes such as this are not unusual in eastern Uttar Pradesh, where extreme floods are becoming more commonplace and cause much suffering.

Although the geography of the eastern Uttar Pradesh region makes the area naturally sensitive to floods, rainfall patterns and the nature of these floods have changed. While there have been changes in natural factors, like deforestation and land degradation, it has been observed that agro-climatic situations are altering. Such changes in climate have caused severe damage and people's lives have been affected. Data is available which indicates a direct linkage with climate change (e.g rainfall, dry spells, floods). Significant changes include: increasing frequency of flash floods; dry spells during floods; flood timings (longer, delayed or early); increased duration and area of water-logging; and changes in time, volume, and pattern of rainfall.

There has also been a significant change in the monsoon period. While August-September was the usual period of floods twenty years ago, at present it is unpredictable. In 2007, there were heavy rains in July causing sudden flooding. In 2008, rains began at the end of May. Heavy rainfall throughout June and July caused floods for which people were ill prepared, and had very little time to respond. Consequently there was considerable loss of life and property.

Eastern Uttar Pradesh is largely dependent on agriculture. The area receives an average of 1200-1400 mm of rainfall per year, with adequate availability of groundwater. Land holdings are quite fragmented with more than 80 percent of farmers having less than one hectare of land. Therefore the main effect of floods and now climate change is on agriculture, and agriculture-based livelihoods. The geo-climatic and livelihood situation of the area means that people depending on agriculture are very sensitive and vulnerable to changes in climate.

Documenting adaptive agriculture

Government and development organisations' initiatives to cope with floods have been relief oriented, and short-term. People living in the area have integrated floods into their lifestyles and have developed ways and means to get over their flood problems. Some farmers' practices are traditional, while others have evolved over a period of time, generally in response to local agro-climatic changes. Today, such capability to adapt is seen as extremely important in dealing with problems related to climate change.

However, adaptive practices have largely remained confined to the respective local areas, and have not been documented for wider dissemination, use and benefit. In response to this, efforts were made by a consortium of 20 NGOs in eastern Uttar Pradesh to compile agricultural knowledge and practices which have helped communities develop their adaptive capacities in response to floods. The objective of compiling these practices was to share these local and traditional flood responsive measures with more people. It is hoped that this will help to build and strengthen people's adaptive capabilities in tackling disasters like floods, thereby mitigating their impacts.

June - August	August - October	December - June
Preparedness/ preventive	**Living with floods**	**Recovery or rehabilitative**
Early planted crops	**Crops which withstand floods**	**Post-flood crops**
Early and short duration paddy, maize, watermelon, okra, pointed gourd.	Paddy, guava, bamboo, lotus.	Late sowing paddy alfalfa, mustard, coriander, Arkil pea.

Strategies for coping with floods during the growing season.

One hundred practices were documented, all of which are time tested and have especially helped small-scale and women farmers in the area. Fieldwork took place between April 2006 and November 2007. After holding a writeshop and getting various feedback, a booklet in Hindi was published in January 2008, describing all 100 practices. Forty-three of the practices have been translated into English and also published in a booklet. (Both booklets are downloadable from http://www.geagindia.org.) Forty practices were video documented for the benefit of illiterate farmers. The target users are farmers and facilitators (be they government, NGO, or from academic institutions) who are working directly with farmers. There has already been much interest in the manual: we have received several requests for it from donors, academic institutions, NGOs and government agencies.

Livelihood resilience

The development and adaptation of practices has not only helped reduce the impact of climate change-induced floods, but also considerably helped secure people's livelihoods. Where adaptive activities are practiced more intensively, the easier it becomes for the people to return to their normal lives once the floods recede. It has been observed that people's livelihood resilience depends a great deal on how well the community uses the available resources in its adaptive strategies. Generally, and in the particular context of agriculture, it has been observed that people's livelihood resilience and their adaptive capacities are inter-dependent. The major factors helping people develop their adaptive capacities in agriculture, as observed during the study, can be grouped as follows:

a. Intensification. Though the floods cause a dramatic effect, people are still able to recover some harvest or income because of crop intensification and related activities. For example, people grow hemp and vegetables like okra with sugar cane. Farmers also have established grain and seed banks, and engage in vegetable growing, fish culture, fodder production, or livestock rearing.

b. Diversification. The flood-affected region is richly bio-diverse. People adapt with the help of a diversity of crop varieties, trees, plants, grass and animals besides the diversity in people's knowledge, skills, experiences and enterprises. The landless are able to make a living from small animals. When silt and sand spreads over paddy fields, people learn to grow watermelons, gourds and other vegetables and fruits.

c. Value addition. Local women's groups are engaged in processing activities to add value to paddy, milk, sugar cane or vegetables. The possibilities are immense, but due to lack of resources and information, the initiatives by farmers remain incompletely harnessed as yet.

d. Indigenous technical knowledge. Various adaptive practices in agriculture have a strong element of indigenous knowledge. Without any organised mechanism of developing and imparting technical know-how for people to survive in floods and other climate change induced situations, it is people's knowledge which has helped them to adapt and survive.

e. Marketing. Markets are an important factor in adaptation. Although farmers are able to sell products made from sugar cane or milk, as well as vegetables, or fish, they do not get an appropriate price for their products.

f. Crop cycle management. To cope with the flooding, farmers have adapted the crop cycle so as to reduce crop losses (see figure). The main strategies are: pre-flood cultivation (so farmers can harvest before the floods); cropping with floods (crops which grow well even in floods); and post-flood cultivation (planting late varieties or those which withstand waterlogging).

Such practices either evolve spontaneously (independently by farmers) or in agricultural universities or NGOs. The knowledge behind some practices is the outcome of a synergy between farmers' indigenous knowledge and technological know-how. Even if the practice or technology is "imported", the practice style is often innovative, according to local conditions (farmers land holding, flood area, needs or other crops). The adoption of any of these practices is generally needs-based, with farmers in the most adverse situations more likely to adopt. During the documentation process, it was also noted that people's adaptive capacities are affected by other factors, including:

- The state of natural resources in the area.
- The livelihood system and opportunities at the local level.
- Income generating opportunities in the nearby areas.
- Basic physical infrastructures, services and facilities (like roads, housing, drinking water) at the local level.
- The area's socio-economic and gender sensitivities.
- Access to information and know-how.
- The existence of social networks in the community, as well as formal sector organisations like banks, government departments, or voluntary organisations.

As such, in order for people to deal better with floods and their changing character, one of the ways is to build people's adaptive capabilities through raising their awareness, knowledge and capacities to earn a living through a selection of appropriate crops and techniques.

Finding other ideas

Sri Shambhu Sharan Nishad of Thakurnagar village, Gorakhpur District, has four acres of land, located near the Sarua lake, which is annually affected by floods. In October 2006, on an officially organised tour to Madhubani in Bihar, he learnt about the 'Turanta' paddy being cultivated in the flood-affected areas there. It was not just the paddy's ability to tolerate water that impressed Shambhu Sharan Nishad, but also that it was fast growing. He decided to cultivate 'Turanta' the next season in his own fields. In June 2007, he sowed this paddy, albeit only on half an acre for want of seeds. Then on 30 July, the floods came and along with other rivers, the Sarua lake swelled and all nearby fields were inundated. When the water receded after 15 days, Shambhu found that there were no negative effects on the 'Turanta' crop. On the contrary, new shoots had emerged from the sides of the plants. The paddy continued to thrive and in time it was harvested. From a mere half an acre, he got a yield of seven quintal (700 kg). Encouraged by this, other farmers from the nearby villages too are now keen to plant this rice variety.

It is clear that people living in flood stressed zones have their own traditional practices and knowledge that help them to cope effectively. But such knowledge is not given importance by people such as policy makers, or agricultural scientists. Documentation efforts such as this one can assist in making adaptive practices more widely known and valued.
More broadly, research and extension needs to continue supporting adaptive agriculture. Support at the policy level is also needed, with flood disasters being placed at the centre of development planning and execution. While the farmers of eastern Uttar Pradesh have already come a long way in adapting to the changing climate, their innovativeness, knowledge and skills, as well as external support that has enabled them to do this, will all continue to be essential for them to keep adapting in an uncertain future. ■

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Cultivating resilience: Lessons from the

Coastal communities are particularly vulnerable to climate change. They are affected by changes in sea-level and wave height, as well as changes in weather patterns. Some families with home gardens were better able to recover from the tsunami in Sri Lanka than others. Such resilience often depended on how well the home gardens were protected by trees. However, strong community networks and related support, was also found to be very important for families recovering from this disaster.

Melissa Harvey and Sathis Wijewardane

The 2004 Indian Ocean tsunami severely impacted the coastal zones of Sri Lanka, causing considerable erosion, damage to infrastructure and salinisation of soil and water sources. It affected about 28 000 coastal home gardens. Gardens were flooded with salt water, and crops, trees, infrastructure and equipment were lost. In May 2005, discussions and visits to around 30 growers in Matara, Hambantota and Ampara districts, southern Sri Lanka, found some clear features of cultivation and income systems that affected resistance to the impact of the tsunami and their ability to recover (resilience). Most of the growers visited had gardens of half a hectare or less, which were within walking distance of their home. The gardens provided a significant source of food and/or income for the household, and the cultivated land had been affected by the tsunami. As well as features that affected the physical resilience of plots, economic, livelihood and social factors also had significant influence on home garden households' resilience.

Photo: Melissa Harvey

Production restarted soon after the tsunami in gardens like this one that had living fences.

Protection from trees

Before the tsunami hit, there was little evidence that the communities knew that trees would protect them. After the disaster, they clearly appreciated the positive effect of having trees there. Many households mentioned the protection provided by living fences as a mitigating factor to the tsunami's impact. Indeed, trees proved vital for resilience in home gardens affected by the tsunami. This can be highlighted by the difference in impact on two neighbouring plots. One was protected by a living fence, with tree and shrub crops growing in the garden. The neighbouring household, which was growing only a large crop of pumpkins and had little surrounding tree cover, was severely damaged, with all infrastructure and crops lost.

Trees grown as part of a home garden system not only offer protection, but are also a significant source of income. Coconut palms (*Cocos nucifera*) were one of the few crops to widely survive the tsunami impact. Coconut palms grow abundantly along the coast and are a key feature in many home plots. They are superbly adapted to coastal conditions, being salt and drought tolerant and with flexible trunks, which absorb the energy of wind and waves. Households that had lost other crops were still able to gain an income from coconuts.

During the discussions in 2005, there was mixed local knowledge about agro-ecological home gardens. Some people had misconceptions about approaches. For example, some people thought that having too many trees would compete with vegetable crops, whilst other groups had a good understanding of the benefits of ecological approaches. However, even some who did understand the benefits of such approaches didn't always use them, citing labour or financial reasons.

While it appeared that none of the growers had used resilience as a conscious factor when planning their gardens, those gardens where local knowledge and cultivation practices were used proved to have better resilience. Although traditional approaches such as crop combinations are still useful, there is definitely scope for introducing new practices that could improve the systems. For example, few growers practiced composting, or had a lot of knowledge about pest and disease control methods.

Livelihood diversification

Diversification of income generating activities and off-farm employment is widely recognised as an integral part of rural livelihoods. Indeed, it was found to be a very important feature in the growers' ability to recover after the tsunami. Many growers had off-farm employment as well as their home garden, such as office work or contracted farm labour. Others were engaged in non-land based agricultural activities, such as coir processing (coconut fibre), mushroom cultivation or seedling production. Householders with diversified sources of income continued to gain some earnings following the tsunami. Many jobs, such as office work, had not been severely affected. Non-land based, and non-seasonal agricultural activities, such as mushroom and seedling cultivation could be re-established quite easily, and were not so dependent on the season or land quality.

Community support is vital

The role of community groups and networks was crucial to a household's capacity to re-organise their activities following the tsunami. Many community groups had formed strong networks for support, joint activities and accessing resources, which helped them to resume cultivation even without external aid. After the tsunami, many communities worked together in formal and informal groups to make land rehabilitation and cultivation possible, for instance, clearing land, accessing inputs and applying for assistance. Of the communities visited that had re-formed their community-based organisations following the tsunami, they had all re-started, or had put considerable effort and motivation into re-starting cultivation and working out the challenges for themselves. This included applying for assistance as a group, replanting shared gardens, and having soil tests done collectively to find out if the land was ready for cultivation. They were aware that they had a greater capacity and better chance of being responded to as a group than as individuals. This emphasises the value of supporting communities and networks in development and rehabilitation, and the implementation of interventions that do not undermine the capacity and strength of community groups, institutions and networks.

Family and friendship networks also played a vital role in the rehabilitation of livelihoods for many households. Some growers replanted their crops on the strength of loans from family or friends and without any NGO or government aid towards rebuilding agriculture. Further, many households demonstrated remarkable personal motivation and innovation to resume cultivation without any external aid, for example planting trial plots to test for soil and crop suitability.

Psychosocial issues

Psychosocial issues can have a significant impact on households' resilience in relation to any livelihood, including agriculture. Such issues, including lack of motivation and depression, were a considerable constraint to some households' capacity to resume their livelihoods after the tsunami. Many people had lost family members and were in mourning. Many were also living in temporary accommodation and in a situation of great uncertainty. This posed practical constraints to starting cultivation again, such as lack of land, as well as psychological issues. Agricultural and other livelihood activities have a strong potential role in the improvement of psychosocial wellbeing, as well as income. Several examples were found where support and training for home gardens and coir processing was introduced with the primary aim of providing activities and community-building to lift people's spirits, with the improvement of livelihood options being only a secondary outcome. Longer term studies following the tsunami found that time was also a crucial factor in people's resilience, with many households reaching a stage that they could begin to rebuild their livelihoods a year or more after the impact.

The impact of development on resilience

The economic effects of long term development efforts had a considerable impact on the resilience of growers. Before the 1970s, agrochemicals were not widely used. Most growers produced their own seed for crops. Green Revolution approaches, including chemical pesticides and fertilizers and new crop varieties, were introduced in the 1970s, and have in many cases resulted in higher yields. However, several of the growers in Sri Lanka found that the profit is similar in both systems – the higher yield from using fertilizers and new varieties is offset by greater spending on inputs. In the lower income districts of Hambantota and Ampara, high spending on inputs caused considerable debt problems. Several households that had borrowed money to buy inputs at the start of the season, lost not only all their crops, but also the investment in inputs.

In the wealthier Matara district, the cost of labour, which had been pushed up by wages offered by the local garment industry, was identified as a major constraint to agricultural production. It was also a reason for using less labour intensive approaches (such as using fertilizer and pesticides) instead of more labour intensive approaches. This clearly highlights the complexity of agronomic systems and the links between resilience and the influence of different resources and markets.

Sharing insights

The results of the insights gathered have been disseminated to the University of Ruhuna, to NGOs working in Sri Lanka and to other groups working on disasters and resilience. It is hoped that the findings will contribute to an information booklet on gardening for resilience to climate change as part of Garden Organic's series of free booklets on organic agriculture in the tropics. (Garden Organic is the U.K.'s leading organic growing charity.)

In terms of what we can learn from this analysis about how to promote home gardens that are resilient to the impacts of climate change, five key points can be drawn:

- The impact of having trees along with other crops improves resilience by acting as a physical barrier to high speed waves or wind, but are also a more resilient crop in themselves, providing a reliable source of food and income.
- Diverse livelihood options can contribute to the resilience of home growers, by providing alternative income if crops fail. Opportunities could be enhanced through training.
- Strong cohesive communities are resilient in themselves, even in the absence of external aid. In order to build resilience, development and rehabilitation interventions should build on existing local institutions such as community groups, or local businesses.
- There is a limit to people's capacities to adapt and recover, which can be based on the level of psychological or material impact they have experienced during a disaster. It is thus crucial that adaptation or rehabilitation approaches can identify the level of capacity and provide appropriate support for basic needs, as well as longer term livelihood support.
- The impacts of development found in this study demonstrate the importance of considering the specific economic and social context when looking at resilience and adaptation to climate change.

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Partnerships for sustainability

In 2002, the beer brewer Heineken got together with the Agrarische Unie and farmers in Flevoland, the Netherlands. Together they wanted to explore the possibilities of sustainable barley production. Each of the three partners had their own interests, but also had shared aims. Focusing on soil fertility as essential for developing resilience and sustainability, the partners are still working together.

Chris Koopmans and Marleen Zanen

The Netherlands, with fertile soils and a moderate climate, is not the first place where you would expect farmers to worry about climate change and resilience. However, it is generally accepted that climate change will have an impact on agriculture in the future. Failure to adapt might affect farm yields, biodiversity and profitability. Sustainable farming systems that are resilient to changing environmental conditions are essential to cover these future challenges. Sustained soil fertility is a key part of such systems, and will help to manage these challenges. With intensive crop rotations, the use of heavy machinery which causes soil compaction, and tightening of regulations, arable farmers in the Netherlands are willing to invest in resilience through building soil fertility.

At the Louis Bolk Institute we work on building resilient farming systems with an organic and sustainable agricultural focus. With our participatory research and extension activities we want to find practical solutions and provide direction for new policy issues which will benefit society. The results of our work are translated into improvements for the agricultural sector. For example, we are involved in a project called Skylark, which accompanies 60 farmers and 10 companies from the food industry to develop sustainable and resilient farming systems in the province of Flevoland.

Working in partnership

In 2002 the beer brewer Heineken initiated this project, together with the Agrarische Unie (a Dutch company supplying seeds and fertilizers) and ten farmers in Flevoland. Together they wanted to explore the possibilities of sustainable barley cultivation and examine what sustainable agricultural production involves in general. While sustainable raw materials were important for Heineken, the Agrarische Unie and the farmers realised they had to become more active to survive in a competitive market place. With the current production methods it would become more and more difficult to maintain yields without increasing inputs even more. The Unie realised that they needed to change from selling inputs and buying grains to becoming independent advisers. For the farmers, sustainability means not only ideals but also an income; including the question of whether a son or daughter will take over the farm in 20 years time. Heineken was able and willing to follow a participatory approach, putting the farmer and his crop rotation in the centre of the approach.

In 2003 the Louis Bolk Institute, along two other organisations, became involved as advisers in exploring sustainable barley production. Initially, just ten farmers were involved in the project. In 2006, building on successes achieved over the previous three years, 50 new farmers joined the project. Farmers saw the need to learn together and from each other. Working together in a wide production chain opened their eyes to new perspectives. Right from the beginning it was clear that a sustainable production could not be limited to a barley crop alone, but that other industries buying from the farms should be involved if a truly sustainable production at the farm level was to be created. In 2006 the Skylark foundation was created, including not only the farmers but also other industrial partners such as Cargill and McCain.

In the project an environment is created in which arable farmers can work effectively and with pleasure on the sustainability of their business. The joint focus on the farmer's crop rotation and his strategy towards a sustainable production environment is central. The farmer himself has a leading role and his sustainability strategy serves as a basis for activities. Based on a long-term vision, an annual farm plan is developed, indicating sustainable practices at the farm level and also indicating the farmers' choices about rotation, use of fertilizers, and soil fertility practices.

Photo: Louis Bolk Institute

Working on soil fertility and structure can improve the sustainability of yields. This well-established onion root is 7 cm deep.

Planning for sustainability

Ten indicators for sustainable agriculture, accepted by the food industry, and underpinned with a limited number of measurements, now highlight the changes made. The set of indicators includes nutrients, crop protection, energy and water on the input side of a farm. On the output side, indicators include product value, local economy, human capital and biodiversity. Soil fertility and soil preservation are considered as the essential basis for development towards resilience and sustainability.

Together with the farmers, a set of 27 baseline measurements was selected for the ten indicators. Based on these measurements and an informal discussion with all participants individually, each participant formulates their annual farm plan and ideas as to how sustainability could be incorporated into their business. The concrete result of these annual discussions is a list of elements that need special attention, as well as activities which work towards sustainability in the following year.

The challenge is achieving a good balance between the different indicators. For example, an activity good for nutrient management might not be positive in terms of the indicator for product value (e.g. increased cost). Therefore activities need to be planned carefully and seen within the context of all ten indicators. In practice, widening a crop rotation from 1:3 to 1:6 crops, means not only improving soil structure, but also lessening the chance of diseases. It will also improve the water holding capacity, and reduce the need for irrigation. For many farmers the relationship between economic sustainability, crop rotation and soil fertility is of the essence. It is difficult to change the crop rotation for improving soil fertility in the future, without being able to estimate the financial consequences properly.

During the whole process the question arises as to how to translate sustainability requirements into tools that can allow us to understand what is happening, and then develop management practices that work at the farm level. With this in mind, we developed a set of tools for translating the main indicators of sustainability into management practices to build resilience at farm level. Some tools were developed for looking at soil fertility, as this is essential for building resilience and having the capacity to adapt to climate change.

Tools

To build resilience and make farmers more aware about how their cropping systems and management is affecting their farming system, a training course on soil fertility was offered to all participating farmers. In this practical field course farmers learned how to visually assess their soil quality, how to optimise soil fertility, how to recognise the effects of crop rotation or soil tillage, the importance and effects of using green manures, crop residues, or other organic materials. For all participants this meant developing their insight into and answers to the following questions, specifically for their own farm: How can you look at your soil? What can you see in your soil? What does this tell you about your farming practices? What does it imply for your farm management? How can you overcome negative effects or improve the positive effects of management on soil fertility? An essential process in the course was moving from visualising the soil and understanding the processes, to making the steps towards actual management practices. These practices are preferably discussed by a group of farmers so that farmer-to-farmer learning can take place.

A second tool we used is a soil scan. In a visit to the farmers involved, the quality of their soil was assessed individually. The soil scan includes a visual soil assessment as well as a minimum set of relatively simple soil chemical and physical characteristics. With this scan, developments in the soil over the years are visualised and form a basis for improving the whole farming system.

In addition to standard laboratory analysis which focuses mainly on nutrients for the next growing season, we evaluated the living soil activity based on a laboratory respiration test. This test, indicating the respiratory activity of the soil life community, also indicates the power of a soil to withstand interruption or adapt to changing environmental conditions. With a more active and diverse soil community, a farming system is also able to withstand environmental changes and suppress soil diseases better, for instance.

At the farm level a very important and useful tool is the computer model called NDICEA. Besides input-output balances used in the project at the farm level to be able to reduce fertilizer inputs, the model gives insight into how to improve crop rotations, reduce nutrient losses, and build long-term soil fertility. It combines a user-friendly interface with rather complex calculations. It was tested over more than ten years within the European context but has also been successfully applied as study material in Pakistan and the U.S.A. Combining application at individual farms and discussing results in groups with an adviser seems the most promising approach.

What are the results?

Before the start of the project, most participants had never had a close look at their soils. During the project, participants became more aware of the fact that a fertile soil is the basis for a resilient and healthy farming system. As one of the participants said: "The most important vitamin for the soil is vitamin A: attention! Dig a hole, take a closer look, feel and assess the situation of your soil and use this easily accessible knowledge as a basis for management practices." During the course of the project other wholesalers and processors became curious and are now participating in the project. They also encourage their farmers to produce in a more sustainable way. Some of the farmers have now switched to organic growing systems.

Another important factor was the open exchange of knowledge and ideas between the different stakeholders. The fact that the whole project was initiated by one of the companies buying their products increased the awareness that sustainability and resilience are important for the future.

Within any multi-stakeholder process, an important factor for success is the participants' increased ability and willingness to work on their own initiative, and take greater responsibility. Participants learn from each other and learn together. The advisers play a key role in facilitating this process and keep challenging the participants.

It is a challenge to transform all indicators into concrete actions at the farm level. Soil fertility, product value and crop protection are indicators farmers pick up and are excited about. We still have a way to go to turn biodiversity and human capital, for instance, into concrete actions on most of the farms.

Sustainability in the industry part of the chain also remains a challenge. Depending on the company we have local, national or international players. From this, ideas vary widely about whether to expand the number of growers, or the willingness to compensate farmers for sustainability. To work on this we have started discussion groups, bringing farmers and the industry together on a specific crop, discussing and exploring the challenges in creating a truly sustainable chain for the produce.

Lessons learned for resilience

Tools like the visual soil scan increased the awareness and problem solving capacities of farmers and have resulted in a more conscious soil management that is able to build resilience. Farmers observed that with more attention and improved soils, crops can tolerate certain conditions better: more and more of the Skylark farmers' irrigation installations are out of work. Others say their crops do better, resulting in more quality products even after an extremely wet period. ■

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Farmers' perceptions lead to experimen

"Learning centres" in seven African countries are identifying opportunities for adaptation, based on farmers' perceptions of climatic changes. Together, researchers, farmers and extension agents are experimenting with crop varieties and soil fertility improvements. Results so far highlight that adapting to climate change is not just about technical options, but access to markets, credit or information is also necessary.

Paul Mapfumo, Regis Chikowo, Florence Mtambanengwe, Samuel Adjei-Nsiah, Freddy Baijukya, Ricardo Maria, Andrew Mvula and Ken Giller

For decades, small-scale farmers across Africa have struggled to maintain food security for their families. With few alternatives available for sustaining their livelihoods, it is questionable whether the coping mechanisms that have evolved have contributed to the resilience of the farming and livelihood systems. In the face of external pressures, it is apparent that the systems are virtually at rock bottom and farmers are entangled in intricate poverty traps. The emerging evidence of climate change, coupled with increased climate variability, points to a dire need to develop local communities' capacities to cope with this extra pressure.

Under the Climate Change Adaptation in Africa programme, a study was initiated in 2007, to work with smallholder farmers on identifying and using improved farming technologies to adapt to climate change and variability. A parallel aim was to strengthen the capacity of individuals and institutions to conduct related research. The study is being undertaken in seven countries: Uganda and Tanzania in East Africa, Ghana and Mali in West Africa, and Mozambique, Zambia and Zimbabwe in Southern Africa. The sites represent Africa's major climatic zones, with rainfall ranging from about 600 mm per year in the maize dominated crop-livestock systems of Zimbabwe, to 2200 mm per year in the banana-based systems of Tanzania. Land holdings range from less than 1 ha in Ghana to more than 10 ha in southern Mali.

Summary of farmers' perceptions of the indicators and causes of climate change across different regions in Africa.

Indicators: Increased drought incidences • Unpredictable wind movements • Changes in seasonal temperatures (very hot summers and very cold winters) • Prolonged winter seasons • Marked delays in on-set of rainy seasons • Disappearance of wetlands and declining water reservoirs

Causes: Deforestation • Poor farming practices destroying soils and water resources • The rise of industries, towns and cities • Increasing incidences of wild fires • Lack of respect of traditional cultural values (e.g. cutting down of sacred trees) • Unexplained natural forces

We started by focusing on farmers' perceptions of climate change and asking who is vulnerable and how. The next phase was participatory experimentation. This aims at promoting interactive learning among different partners, and testing alternative farming practices that farmers could use to adapt to climate change and variability. This was done mainly through establishing "learning centres" in each country.

Farmers' current understanding of the "threat"

There are diverse and mixed views about the causes and indicators of climate change across and within communities in Africa, despite the evidence of a general awareness (see Box). At a local level, a wide range of indicators for predicting wet and drought seasons were identified. For example, farmers believed that cold winters indicate a drought, while hot summers signify good rains. In addition, farmers identified specific environmental changes that they had observed. In Wenchi, Ghana, farmers listed the following observed changes:

- reduction in soil fertility levels
- reduction in yields of major staples such as yam and maize
- disappearance of cocoa as a major cash crop
- disappearance of the forest and wildlife
- changes in rainfall pattern
- proliferation of disease and insect pests
- proliferation of obnoxious weeds, e.g. spear grass

Farmers' own responses to these changes included planting different (early maturing) crops, planting earlier and using more agro-chemicals.

Learning with farmers to identify opportunities for change

Since 2007, an inter-disciplinary team of researchers, extension and agricultural input suppliers worked with farmers to identify interventions which could help them minimise vulnerability to climate change. Farmer discussion groups were formed, facilitated by local leaders and extension personnel. Local leaders and farmer representatives had participated in earlier climate change awareness workshops with district policy makers: what they had heard and learnt there helped to invigorate the community-level discussion workshops. Farmers and stakeholders discussed topical issues and challenges that emerged, which then formed the basis for further interventions and participatory action research.

Across all study sites, the major challenge shared by communities was poor and declining soil fertility. Although this may sound counter-intuitive when addressing issues of climate change and variability, it has long been recognised that poor soil fertility is the overriding constraint to the efficient use of available water by crops. A common objective in all communities was to achieve high crop yields in favourable seasons, and to intensify productivity. Integrated Soil Fertility Management (ISFM) was therefore used as a key entry point. We defined this as: "A combination of a proven set of concepts, principles and practices on the efficient use of available organic and inorganic resources… in maintaining or improving soil fertility leading to sustainable crop production for household food and income security, and enhanced livelihoods."

As part of the project activities, "learning centres" have been established in each of the participating communities. Participatory trials are being carried out there in collaboration with the farmers. These "learning centres" will contribute to creating a more effective context for discussing issues related to climate change, thereby building the adaptive capabilities of these farmers. The "learning centres" integrate local, conventional and emerging knowledge, in testing different ISFM technologies, such as effects of planting dates, or alternative crop types and varieties as prioritised by communities. Strategically located fields were used to test the technologies best suited to the circumstances of specific farmer groups (e.g. by gender, available resources or social clubs). Agricultural input companies are also involved in the "learning centres", responding to farmers'

tation and learning

demands for alternatives and working with researchers to develop new options for fertilizer management. Farmers are interested in using the available organic nutrient resources (including nitrogen-fixing legumes) in combination with the small amounts of mineral fertilizers they can afford.

Emerging opportunities for communities to adapt

Results from the participatory experiments are beginning to appear. One evident change is that farmers are interested in different crop types and varieties. Some are now demanding new crops and varieties, while others are seeking to revert back to traditional crops (or cultivars they used long ago). Lack of seed within communities is still a major challenge. Similarly, suitable crop types and varieties are difficult to find on local markets as agricultural input suppliers have tended to lag behind. Farmers are slowly moving away from some of the traditional cropping practices. Women farmers in southern Africa are proving to be the custodians of legume seeds and cereal cultivars that had previously been discontinued by dominant seed companies.

Farmers are aware of the increasing variability in climate, but it was apparent that they are not yet able to respond to it adequately. For example, extreme events of floods and droughts within the same season give small-scale farmers little opportunity to recover or respond. There is apparently little emphasis on building medium- to long-term adaptive measures because of limited information and knowledge about the implications of the observed trends. Current strategies to adapt have tended to intensify land degradation. Examples include the encroachment of cropping and livestock grazing into fragile environments such as highly erodible soils and aquatic environments.

Learning experiences from the different countries suggests that the impacts of climate variability among African communities are highly differentiated according to land tenure, traditional beliefs, resource availability and gender. However, this provides opportunities for developing adaptation mechanisms directed at specific vulnerable groups:

- In Wenchi district, Ghana, farming is dominated by immigrants who use their agricultural produce as payment for land leased from the landlords, who expect annual payment regardless of whether it has been a good growing season. Short-term climate variations then pose a major threat to the security of tenure for the immigrant farmers.
- In parts of central Mozambique, tradition does not allow for farmers to grow pearl millet (due to bird problems), despite its apparent superiority over maize in terms of drought tolerance. Selection and testing of drought-tolerant maize varieties was one of the key priorities to emerge, together with education of farmers and local leaders on the need for alternative crop types such as sorghum and millets.
- In Zimbabwe, farmers in previously maize-dominated high rainfall zones have begun experimenting with sorghum, millet and drought-tolerant maize. Early planting was identified as a major adaptive strategy, but some farmers, notably women-headed households, cannot meet this challenge due to other demands on their labour.
- Increasing frequency of seasonal floods has led participating farmers in Tanzania to demand technical and institutional support so that they can begin producing rice. In dry years, a major source of vulnerability is the increase in transmission of cattle diseases due to the congregation of large numbers of cattle at water holes.

Photo: Paul Mapfumo

With increasing awareness of changing climatic conditions, farmers are keen to look for ways to adapt their systems to cope with this extra burden. "Learning centres" provide a good opportunity for all parties to meet and discuss.

These adaptation strategies must not be used in isolation. For instance, the use of early maturing crop varieties must be accompanied by other crop management practices such as crop rotations or the use of cover crops. This, however, requires additional institutional support, such as credit, access to both input and output markets and information. This will enable farmers to increase and sustain their productivity and production in the wake of changing climatic conditions. Migrant farmers are more vulnerable to the adverse effects of climate change than native farmers, because the majority of them do not have secure access to land. Their adaptive capacity is also low, due to low levels of human, financial, institutional and technical capabilities as well as limited access to markets.

"Learning centres" are currently at different stages of implementation, and experimentation is continuing. By involving a variety of partners in the learning, testing and adapting processes, relationships improve and farmers are exposed to new opportunities. However, the increasing costs of household fuels and agricultural inputs, coupled with low prices of agricultural produce, and limited off-farm livelihood opportunities, continues to pose major threats in building the capacity of farming communities to adapt to climate change and variability. ■

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The potential of community managed

The "Kyoto: Think Global Act Local" initiative is an international project. It was set up to assess the potential for communities such as those in the state of Uttarakhand, India, to benefit from carbon trading. Members of village forest councils were trained to measure how much carbon their forests store per year. They are now looking for more "buyers" for their carbon, while continuing to manage their forests sustainably.

Ashish Tewari, Vishal Singh and Pushkin Phartiyal

Every year, about 8 billion tonnes of carbon are released into the atmosphere, contributing to global warming and climate change. According to some estimates, around one quarter of this is due to deforestation. This also means the loss of forests which could store carbon. Conservation of forests is therefore an important strategy for dealing with climate change. Forests are a much cheaper and easier way to store carbon than industrial capture and storage.

But the capture and storage of carbon by existing forests, (a process known as carbon sequestration) is not eligible for carbon trade under the Kyoto Protocol. This is mainly because it is difficult to accurately measure and verify carbon gains. Under the Kyoto Protocol, only afforestation (plantation on land where forests did not exist) and reforestation activities (plantation on land which was cleared before 1990) are eligible for carbon trade. However, avoiding deforestation by conserving forests is a more effective solution to the atmospheric rise of carbon dioxide. An existing mature forest in the Himalayan region, for example, stores approximately 200 to 300 tonnes of carbon per hectare. While plantations would bind carbon rapidly, they may take 40-50 years to accumulate such an amount.

Think global , act local

The "Kyoto: Think Global Act Local" initiative, financed by the Netherlands Ministry for Development Co-operation, involved research teams in eastern and western Africa, and in the Himalayas. The aim of this project was to assess the potential for communities involved in sustainable forest management in developing countries, to benefit from the Clean Development Mechanism and carbon trading. It also aimed to explore the value of community-based forestry management as a climate adaptation strategy. Measurements were made over a five year period, at 26 sites, spread over seven countries, aiming to demonstrate the increase in carbon stocks that result from such management.

Carbon trading

The Kyoto Protocol commits industrialised countries to reduce their emissions of greenhouse gasses. Through the system known as Clean Development Mechanism (CDM), a project to reduce emissions can be set up in a developing country, and the carbon "saved" there can then be "credited" (expressed as carbon dioxide equivalents). Developed countries are entitled to purchase these credits as a way of meeting their own obligations. The resulting trade in carbon credits is intended to encourage investments in various emission-reducing technologies.

In the Himalayan region, the project aimed to explore the capacity of community forests in carbon storing. Its objective was to develop simple but reliable measurement methods that can be carried out by communities. By training communities to take measurements, costs are lowered. In India, activities were carried out in the mid elevations (1700-2100 m) of Kumaon Hills, in the state of Uttarakhand. This region, like much of the Indian Himalayas, is under constant pressure from the subsistence farming activities of the local population, resulting in fragile ecosystems. Livelihood choices are limited, and extreme weather events have further worsened the situation for the people of the Himalayan region. Traditional agriculture is heavily reliant on forests, needing a considerable amount of inputs from them. Forests provide a significant amount of fodder, sustaining a large livestock population. Leaf litter is also used to produce farmyard manure. It has been estimated that 2-15 hectares of forest area might be required to sustain the productivity of each hectare of cropland. The impact of climate change in the region is already having harsh and decisive consequences.

In Uttarakhand, the history of community participation in forest management goes back almost a century, when local people made collective efforts to protect their forests. The concept of managing the forest through community participation emerged in the mid-1920s following agitation against the British colonial government's control over forest resources. Van Panchayats (VPs), a village level forest council, emerged in Uttarakhand following the Van Panchayat Act in 1931, which allowed handing over management responsibility of designated community forests to the elected body of VPs. Most of the VPs were initiated on degraded sites under the control of the State Revenue Department. The VPs have been sustainably managing their forests for decades without any outside financial support. At present, Uttarakhand has 12 064 VPs, covering more than half a million hectares.

The project started in two VPs, Dhaili and Toli, and later extended to other VPs. The forest area they cover is found at an average altitude of 1850 m. Dhaili covers 60 hectares of forest,

and Toli a total of 103 ha. The forest is in good condition, and is dominated by chir pine (*Pinus roxburghii*) and banj oak (*Quercus leucotricophora*). Each village has about one thousand inhabitants, whose main source of income is working as daily labourers, and agriculture. The average income per family is close to the poverty line. Nearly all the families use fuelwood, with only 5 percent using gas. A family needs about 6-8 kg of dry fuelwood a day. Eighty-five percent of this is collected from the VP forests, 10 percent from trees on private lands, and 5 percent from government or reserved forest.

Five members of each VP, hereby referred to as field investigators, were selected on the basis of their willingness to participate and literacy level. The project then organised ten training sessions of two hours a day in using a GPS system for taking the coordinates and boundary marking of forests. This was followed by six additional sessions, where trainees were taught to take tree measurements in order to estimate the total biomass. Three one-day refresher trainings were given during the 2nd, 3rd and 4th year of the project.

Capacity enhancement and benefits

As a result, field level investigators learnt to use modern gadgets for biomass carbon measurement. They are now training other community members, thus hoping to lower the costs of these efforts. Aiming to see the effectiveness of the project's approach, an independent verification of carbon measuring techniques and carbon stock was conducted in Dhaili by scientists from the Kumaun University Nainital. The carbon data measured by the field level investigators varied by 5 to 11 percent from the data collected by independent verifiers.

The VP forests are sequestering carbon at the mean rate of around 3.3 tonnes per hectare per year. As the area of the Dhali VP is 60 hectares, it is sequestering a total of 186 tonnes of carbon annually. Average prices of carbon offsets range between US$ 5 to US$ 28 per tonne. Using the nominal rate of US$ 10 per tonne, the carbon stored in Dhaili is worth US$ 1860. Toli VP, with a total area of 103 hectares, is sequestering a total of 357.4 tonnes of carbon every year, worth US$ 3574. The situation in other VPs in Uttarakhand is similar.

Looking forward

This research has shown that communities can use forests sustainably to support livelihoods and agricultural production, but that these forests still store considerable amounts of carbon annually. Selling this carbon can provide a considerable income for the VPs. While they still only have small amounts to sell, they are now looking for alternative markets and "buyers". Community members and project staff are clear that this is just a research project for now, but it has shown that it is possible for community forests to sequester carbon, and that community members can measure it. Although the sale of carbon and flow of funds may take some time, they will not be discouraged.

The inclusion of forest conservation activities in international agreements and protocols will give incentives to the local population to get certified emission reductions for their efforts to conserve the forest. This would not only provide resources for sustainable livelihoods and improved lifestyles, but also encourage the marginalised people of the Himalayas to make a meaningful contribution to reducing global emissions and forest conservation. In the meantime, private carbon markets can be exploited. A federation of VPs has already submitted a proposal for claiming carbon credits in private markets. One of the project implementation organisations in Uttarakhand, the Central Himalayan Environment Association (CHEA), is now carrying out a small project, trying to further increase the carbon sequestration rates. A larger project is expected to help the local population develop new income generation activities.

Photo: CHEA

Field level investigators proved they can measure carbon sequestration accurately.

Encouraging signs are also coming from the government. The National Action Plan on Climate Change has recently been adopted by the Government of India, where "sustaining mountain ecosystems" is one of the priorities. This initiative also gives an opportunity to the villagers to conserve and manage their natural resources, and present their efforts with a sound scientific base. This could also lead to payment for ecosystem services through the National Accounting System (the transfer of funds from the central to the state governments). "We look forward to recognition of our conservation efforts, which have been followed traditionally by us. The state and central government have now realised our contribution to carbon sequestration. It is time that our efforts not only be appreciated in the books, but the community should also get tangible returns for it", says Gopal Singh, one of the project's field investigators.

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Malawi's initiatives in response to climate change

Malawi has recognised that climate change is an issue that needs tackling now. Adaptation and mitigation initiatives are already underway. Various government ministries are promoting tree planting or ensuring access to water. NGOs are promoting forestry and sustainable land use, while universities are working on biogas initiatives. Here, the choices facing Malawi are discussed – balancing the need to feed itself, against using this land for other purposes.

Edgar Kapiza Bayani

Photo: Joseph Phiri, EU/MPP

Several parties take an active role in tree planting in an effort to mitigate climate change. Robert Tauka, the EU/Micro-projects Programme Co-ordinator, launched a tree planting project.

Farmers in Malawi are already experiencing climate change. According to Emmanuel Luhanga, a farmer in the northern district of Rumphi: "The rains these days are unpredictable... One year they start in November, another year in December, and then we have dry spells at the critical stages of crop growth…" In general, farmers observe prolonged and more frequent droughts, changes in the overall rainfall distribution, more storms and other extreme weather events. While farmers have always been able to adapt to change, relying on their knowledge and expertise, it is clear that climate change poses new challenges.

All reports and analyses agree that countries in the tropics will be more affected by climate change than other regions. This seems to be especially true for Malawi, where a large percentage of the population works in agriculture, more than half of all farm families cultivate less than one hectare of land, and the national economy relies largely on agriculture. Due to population pressure, continuous cropping and monoculture is common, even on marginal lands. Soil structures are worsening, on top of losing nutrients and organic matter. Most farmers lack the resources needed to adapt to a changing context, or to integrate agronomic practices which may help them conserve water and soil.

Adapting to change

It is no surprise then that both the government and NGOs are working hard to promote strategies for adapting to climate change. As part of a comprehensive programme, the Ministry of Irrigation has seen a significant increase in its budget to ensure that dams are built for drinking water and irrigation. Since 2005, the government has been distributing treadle pumps, with each Member of Parliament receiving 400 pumps for distribution. At the same time, the International Maize and Wheat Improvement Center, CIMMYT, is breeding maize varieties for drought tolerance. Since 2005, the same organisation has also been promoting Conservation Agriculture, an approach to farming that increases the efficiency of rainfall and water use. Jeremoti Sikelo is one of 300 farmers who pioneered Conservation Agriculture in the central district of Nkhotakota since 2005. He has noticed greater water percolation in his field, as well as improvements in the structure of its soils. With better and more fertile soils, he has had higher yields.

Total Land Care (TLC) is another organisation complementing the government's efforts on climate change. The organisation is working with farmers in five different districts of Malawi, helping them adapt to the effects of climate change. TLC is an international NGO based in Malawi, operating also in Zambia, Tanzania and Mozambique, and working hand in hand with the University of Washington, U.S.A. Under the Management for Adaptation to Climate Change Project, TLC is promoting water harvesting, small scale irrigation, sustainable land use practices and forestry**.** Together with other organisations, it is providing farmers with treadle pumps and technical assistance to develop small scale irrigation schemes using gravity-fed water systems. TLC is also promoting the use of manures and agro-forestry technologies. With fertilizer prices soaring to record highs, the organisation encourages farmers to interplant their maize with some nitrogen fixing plants like *Tephrosia vogelii* and *Sesbania sesban*. Farmers are also being encouraged to use early maturing and drought tolerant varieties.

Malawi's contribution

While all farmers realise that the climate is changing, many of them don't know why. According to farmers like Mr. Luhanga, for example, the changes are an indication of the end of times. In contrast, government reports detail the role of greenhouse gases and, rarely for a developing country, also look at Malawi's role in the problem.

Like all other countries, Malawi bears some responsibility – even if this is very small in comparison. Documents prepared by the authorities, like the State of the Environment Report, published in 2002, look at the emission of greenhouse gases in the country, mentioning that this is increasing because of different reasons. Many farmers, for example, burn their crop residues when preparing the field for another season, a process that emits considerable quantities of methane. Different estimates show that the use of nitrogen for agriculture increased from less than 10 000 metric tonnes per year in 1966 to more than 50 000 tonnes at the end of the century. These figures do not take the country's fertilizer subsidy programme into account, which has resulted in a major increase in the use of fertilizers. And while forests used to cover more than half of the country's surface 30 years ago, this figure is down to 25 percent – basically as a

result of increased need for land for agricultural production. Made worse by weak enforcement of the existing environmental and conservation policies, deforestation is also caused by a growing demand for wood. The tobacco industry, for example, demands vast amounts of wood for leaf curing and building sheds, estimated at 1 million m^3 per year. Cities and towns demand large quantities of charcoal. Beer brewing, fish smoking, lime and brick production, all contribute to this increasing demand, and to higher emissions of carbon dioxide and other greenhouse gases. Just as important, however, is that deforestation is contributing to global warming by removing the possibility of storing carbon.

Mitigation

Realising that deforestation is a major source of greenhouse gases, organisations like Total Land Care also promote afforestation and the preservation of natural woodlands. At the same time, they aim to sensitise farmers about the importance of forests in managing climate change. To this effect, TLC put in place a policy that anyone benefiting from the organisation's irrigation strategy, should plant at least 100 trees along the stream banks. This policy goes together with the organisation's commitment to storing carbon in the soil, and to sequestering carbon by changing farm practices. Following a similar approach, the European Union's Micro Projects Programme has supported 17 afforestation projects in different parts of the country. This programme is also encouraging the use of cement blocks and Soil Stabilised Blocks (SSB) in construction projects, instead of red bricks. As red bricks are baked with firewood, they contribute to the demand for wood and to deforestation. To this effect, it has supported 54 building construction projects using cement blocks and 31 using SSBs.

For a second year running, the Department of Forestry, in the Ministry of Land and Natural Resources Management, is implementing a programme called Tree Planting for Carbon Sequestration. This programme started in 2007 and is working with at least one farmer in each of the 193 parliamentary constituencies of Malawi. The programme targets farmers who are willing to dedicate part of their land for trees. The government then provides tree seedlings and technical support. Farmers are then paid money in compensation for the land and the work they are doing in taking good care of the trees. The money is paid in phases after the programme assesses the establishment of the plantations and the tree survival rate.

The Clean Development Mechanism

The Clean Development Mechanism (CDM), set out in Article 12 of the Kyoto Protocol, has two aims: assisting non-industrialised countries in achieving sustainable development; and assisting industrialised countries in achieving compliance with their quantified emissions limitation and reduction commitments.

CDM is the only activity in which developing countries can participate in collective action for emissions reduction. If emissions are to be reduced while economies grow, more efficient technology needs to be introduced. The CDM aims to increase foreign investment in efficient technologies for emerging economies.

As developing countries are under no obligation to reduce greenhouse gases, there are two main sectors for CDM projects – energy and land use/land use change/forestry. In terms of land use and forests, there are many conditions in place for projects to be classified as CDM and gain the benefits. These include that projects must contribute to biodiversity conservation and sustainable use of natural resources, that projects must result in measurable emissions reduction, and that they must be in line with the sustainable development policy of the government hosting them.

In addition to efforts by NGOs and the government, national universities also can play a role. For example, the Mzuzu University's Energy Studies Department launched a biogas project with funding from the British Government. The Mzuzu University is the second state owned university located in the city of Mzuzu, in the northern region of Malawi. The project aims at helping the reduction of greenhouse gas emissions by capturing methane from organic wastes, including manures and slurries. In this way, biogas makes good use of methane and also provides an alternative to burning wood for fuel. More than 10 biogas plants are to be constructed by the project. The University's Energy Studies department is committed to making the most of the potential of anaerobic digestion to contribute to climate change, waste management and wider environmental objectives.

Benefiting from the CDM?

Whether by storing carbon, or as a major component of an effective adaptation strategy, the role of forests in facing the effects of climate change is enormous. Their importance seems even greater if we try to value them in monetary terms. Taking into account the potential advantages of the Clean Development Mechanism (see Box), there is little doubt that trees are worth more alive than they would be worth if burned (and sold as charcoal) or transformed into agricultural fields.

A major limitation is that not many small scale farmers in Malawi know that forests are valuable assets in mitigating climate change. The main concern which this country faces, however, is about food. An estimated 56 percent of the population has less than 1 hectare of land to use for all the family's needs. The challenge is to decide whether it is worthwhile to leave such a portion of land for forests or to grow food on it. The main limitation which a programme like the one started by the government faces, is land shortage. Farmers are expected to assign one hectare for trees, but few are able to. They need the land to produce food, while forests are a source of immediate income for many.

To better implement the Clean Development Mechanism in Malawi, the need to include poverty alleviation is paramount. An investment package is needed to encourage enterprises which do not exploit the environment. More carbon buyers and donors are needed if the Tree Planting for Carbon Sequestration programme in Malawi is to achieve meaningful results within a reasonable time. "We hope to court carbon buyers and other interested donors to have this programme continue in the longer term. Considering that land holding is a problem, bringing in other interventions like encouraging homestead tree planting in boundaries and educating the masses in other ways of reducing emissions is also vital", says Mr. Msiska, the Assistant Regional Forestry Officer for Malawi's northern region. Most importantly, society, including farmers, needs to be made more aware of the importance of trees in controlling climate change, through education and awareness-raising.

It has also to be borne in mind that, in Malawi, reliance on wood is continually threatened by non-sustainable exploitation of forest resources. Current policies do little to promote alternative fuels and building materials. Thus, despite the country planting millions of trees every tree-planting season, deforestation still remains a problem. The need for the Clean Development Mechanism to look into this fact is also equally important. ■

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Old methods for tackling new threats

Using different means to predict weather conditions, farmers in Uganda have always been able to prepare their farms accordingly. However, the effects of climate change are now being felt, and farmers are changing their practices to spread risk. This includes returning to traditional measures as well as adopting new technologies.

Photo: Ritah Lumala

On the basis of their own observations, farmers in Hoima District cover their banana plantations with dry grass to conserve soil and water.

Ritah Lumala

It is only 8.00 am, but Sarah Kasolo is already feeling the scorching heat. In the usually wet month of October, the sun is blazing over Bukona village, in Iganga District, in the east of Uganda. She sets off to tend her young maize shoots, saying "I hope the rains come soon". The 43-year-old mother of 16 has lived on the land all her life, but says she no longer understands it anymore, or the changing weather patterns. One thing she understands, though, is that her young maize shoots may wither due to lack of rainfall. At this time of the year twenty years ago, Mrs. Kasolo did not have to worry about the rains. The seasons have not shortened, but rather have become more unreliable.

While many believe that developed countries cause global warming, decisions taken about natural resources in developing countries can contribute to global warming. As such, it is now a global concern. On a daily basis, farmers are already seeing the effects, and finding ways to build resilience into their farming systems.

Farmers are well aware that trees and rain are interconnected. Trees protect against soil erosion, influence climate, and provide shade for humans and animals. Sarah Kasolo argues that cutting all available forests will not only deprive the future generation of rare plants and animals, but will also affect climatic conditions, leading to drought, wind storms and soil erosion. She confirms that rain starts on the forested lands. Referring to the nearby Mabira forest, she says "There is no dust in the forested lands. Instead these places are covered by cloud. Springs can only be found around forested areas." Mrs. Kasolo maintains that trees help retain moisture by shading the land from the sun and the wind. She also states that planting trees has influenced the weather in their locality.

Traditional means to predict the weather

Farmers in Uganda use different means to know the future and tackle future events, including divination and fortune-tellers who can predict the beginning and ending of rain. The farmers also practice astrology, basing farming calendars on lunar cycles. Furthermore, the physical appearance and conditions of both domestic and wild animals are important indicators of future events; for example, when a cow continuously moos and refuses to go out and graze, the dry season is believed to come soon. Flowering and fruiting trees are also used to predict weather conditions. Many rural farmers agree that these are reliable means of prediction, allowing them to prepare accordingly.

"The droughts have forced us to engage in indigenous methods of producing foods" says Mr. David Nkanda, a subsistence farmer in Kamuli District, in the east of Uganda, who is mobilising his community to cultivate drought-tolerant crops. He explains that crops like sorghum, cassava, sweet potatoes and legumes can grow with limited water. To minimise the risk of harvest failure, farmers are now growing many different crops and varieties, and they also hunt, fish, and gather wild food plants. They have also changed the timing of some activities (crop harvests, wild plant gathering, hunting and fishing), or changed the location, for example growing the same landrace in different places. They have made some changes to their lifestyle, resorting to wild foods in emergency situations; and exchanging food and other necessities through reciprocity, barter, or markets in times of need. These strategies for spreading risk and enhancing biodiversity have been adopted by many. Some farmers also spread risks across seasons – when a landrace does not work in one season, they go to the local market and exchange it with the variety that will grow well in their location.

Working with the environment

Recognising that increased productivity and efficiency are critical to economic growth, Africa 2000 Network, an independent Ugandan NGO, supports the commercialisation, dissemination, and widespread adoption of environmentally sound technologies. The organisation promotes low-cost but efficient technologies, food processing and the creation of viable farmers' associations. The organisation's principal goal is to reduce the rate of biodiversity loss through increased local, national, and regional natural resource management capacities. Key activities include the establishment of nature reserves, knowledge and skill development in soil and water conservation, bio-intensive gardening, soil fertility management, agro-forestry and animal husbandry, and sustainable forest use by local communities.

The rural farmers in Uganda, and other indigenous people in the world, are not blind followers of nature. They have attempted to understand the secrets of nature and avoid famine, drought and other problems by employing different strategies. They have tried to discover the unknown and the future by considering the reactions of plants, animals and the natural environment to both human induced change and natural change. The major goal of this effort is to maintain a positive relationship with the natural environment.

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E-mail: rlumala@africa2000network.org.ug ; http://www.panafrica2000network.org

Climpag, Climate impact on agriculture

http://www.fao.org/nr/climpag

FAO, Food and Agriculture Organization of the United Nations. Viale delle Terme di Caracalla, 00153 Rome, Italy. E-mail: fao-climate@fao.org

This section of the FAO website, put together by the Environment, Climate Change and Bioenergy Division, looks at the various aspects and interactions between weather, climate and agriculture in the general context of food security. It presents detailed information (such as rainfall maps or meteorological "real time" data), and also links to many different documents, such as the results of the "expert consultations" held in Rome in March 2008. There is also a section with "advice and warnings", which has a sub-section discussing the importance of communications to farmers, and "climate indicators", with information on risks and vulnerability. A separate section on "hotspots" describes areas where agricultural production or ecological processes are disrupted due to conflicts between environment and agriculture. Most sections include a set of methods and tools, with materials that can be downloaded for free.

Climate Change Adaptation in Africa

http://www.idrc.org/ccaa

IDRC, International Development Research Center. 250 Albert Street, P.O. Box 8500, Ottawa, Ontario, Canada K1G 3H9. E-mail: ccaa@idrc.ca

CCAA, the Climate Change Adaptation in Africa research and capacity development programme, aims to improve the capacity of African countries to adapt to climate change in ways that benefit the most vulnerable. It works to establish a self-sustained African body of expertise on adaptation that responds to the needs defined by African communities, decision makers and institutions. Its objective is to do this by strengthening the capacity of African stakeholders to contribute to adaptation to climate change; supporting adaptation by rural and urban people, particularly the most vulnerable, through action research. Apart from describing its activities, the site brings news and documents, grouped under four themes: communication and networking; education and training; monitoring and evaluation; and participatory action research.

Practical Action

http://www.practicalaction.org

The Schumacher Centre for Technology and Development. Bourton on Dunsmore, Rugby CV23 9QZ, U.K.
E-mail: practicalaction@practicalaction.org.uk

Practical Action believes that simple technologies can be used to challenge poverty. One of their programmes, "Coping with environment and conflict", aims to reduce poor people's vulnerability to disasters, considering that poverty, vulnerability and disasters are linked. As part of this programme they work with people to help them adapt to the effects of climate change. Their work has demonstrated that secure and sustainable livelihoods reduce both poverty and susceptibility to disasters. Projects supported in this programme include rainwater harvesting in Zimbabwe, the use of "crescent terraces" in Sudan, and the development of technologies in Bangladesh for growing food on flooded land. The website has lots of information about the more than 100 projects they implement, as well as the "Practical Answers" section where you can download technical briefs on adaptation to climate change, and send in technical questions.

Agrobiodiversity and Climate Change

http://www.agrobiodiversityplatform.org/climate_change

Platform for Agrobiodiversity Research (PAR), Bioversity International. Via dei Tre Denari 472/a, 00057 Maccarese (Fiumicino), Rome, Italy. E-mail: p.bordoni@cgiar.org

The Agrobiodiversity and Climate Change project aims to gather and make known information on the use of agrobiodiversity by communities facing climate change. Started in April 2008, this project was initially meant to run for one year, aiming to bring together information from rural communities, indigenous peoples and research workers on how they use agrobiodiversity to cope with climate change. The website gives you the opportunity to interact and discuss the project's topic, to find and share information on projects concerned with climate change and agrobiodiversity, and to check out related news and events. The project is actively seeking contributions from rural communities, indigenous peoples and research workers on how they use agrobiodiversity to cope with climate change. Contact them via the website or the e-mail address given here.

Tiempo Climate Cyberlibrary

http://www.tiempocyberclimate.org

Tiempo Editorial, P.O. Box 4260, Kamo, Whangarei 0141, New Zealand.
E-mail: tiempo.editorial@gmail.com

This site has a Climate Newswatch section and the Climate Portal. The first one is a weekly online magazine on climate and development, with news, special features and comments. It also brings short reports, interviews and links to many other organisations, together with podcasts and a series of regularly update blogs. The Climate Portal is a comprehensive source of information. It provides access to carefully selected documents, websites and other resources concerned with climate and sustainable development. It includes a long list of links to "interest groups", organisations and networks. The portal also provides access to the 3-monthly *Tiempo* bulletin (to which you can request a free subscription). The site is produced and maintained by the Stockholm Environment Institute (SEI), the International Institute for Environment and Development (IIED), and the Climatic Research Unit of the University of East Anglia.

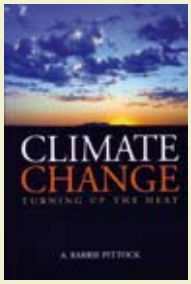
International Panel for Climate Change

http://www.ipcc.ch

IPCC Secretariat, c/o World Meteorological Organization. 7bis Avenue de la Paix, C.P. 2300, CH-1211 Geneva 2, Switzerland. E-mail: ipcc-sec@wmo.int

The IPCC is a scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP). It was established to provide decision-makers with an objective source of information about climate change. The IPCC does not conduct research, nor monitor climate related data. Its role is to objectively assess the latest scientific, technical and socio-economic literature relevant to understanding the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation. The IPCC provides reports at regular intervals, all of which are available on their website. The first Assessment Report of 1990, for example, played a decisive role in the establishments of the United Nations Framework Convention on Climate Change (UNFCCC). The IPCC Second Assessment Report of 1995 provided key inputs for the negotiations of the Kyoto Protocol in 1997, and the Third Assessment Report of 2001 as well as Special and Methodology Reports provided further information relevant for the development of the UNFCCC and the Kyoto Protocol. The latest is the Fourth Assessment Report, published in 2007.

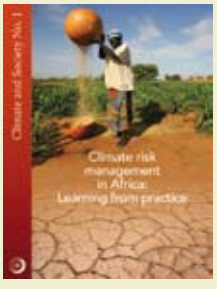
Climate change: Turning up the heat
by A. Barrie Pittock, 2005. ISBN 1-84407-300-9. Earthscan, 8-12 Camden High Street, London NW1 0JH, U.K.
This book provides a thorough and comprehensive look at climate change, reflecting the author's vast experience. Aiming to "sort fact from fiction", his analysis starts by looking at past climate changes, and then at possible future scenarios (considering, for example, the expected changes in crop yields or in sea levels). The author includes a chapter on adaptation, highlighting the need to enhance the adaptive capacity of many countries. Another chapter discusses why mitigation is needed, and how much is necessary.



The final chapters look at the international responses and at the need for further co-ordinated action, considering that "there is still hope of avoiding the worst consequences if we act now". It is written to be accessible to students and policy makers alike.

Gender: The missing component of the response to climate change by Yianna Lambrou and Grazia Piana, 2006. Gender and Population Division, Sustainable Development Department, FAO. Viale delle Terme di Caracalla, 00100, Rome, Italy. Downloadable from ftp://ftp.fao.org/docrep/fao/010/i0170e/i0170e00.pdf
Gender aspects have generally been neglected in international discussions and agreements on climate change. The authors see this as the result of a general preference for scientific and technological measures, rather than in policies which address behaviour and social differences. While poor people will face more difficulties in relation to climate change, women are generally more vulnerable to its impacts. In this brief report, the authors argue for the need to acknowledge gender differences, and the need to integrate gender in governments' and organisations' responses. On the basis of the key role which women have in development, these responses need to make sure that the effects of climate change do not further impoverish women.

Climate risk management in Africa: Learning from practice by Molly E. Hellmuth, Anne Moorhead, Madeleine C. Thomson, and Jim Williams (eds.), 2007. ISBN 978-0-9729252-3-5. The International Research Institute for Climate and Society (IRI), Columbia University, Lamont Campus, 61 Route 9W, Monell Building, Palisades, New York 10964-8000, U.S.A.
This is the first volume of the Climate and Society series, a programme of the International Research Institute for Climate and Society (IRI). The series is devoted to providing "authoritative and accessible" information on climate risk management research, practice and policy in support of sustainable development. It starts by looking at the strong relationship existing between climate and development, and at the need to incorporate climate information into the many development efforts taking place. The lessons presented at the end are backed by five case studies, all of which highlight the importance of integrating information into the decision-making frameworks, and the need to consider ICTs, the media and the local extension services. It is clearly written and will be useful for decision-makers and anyone working on climate change.

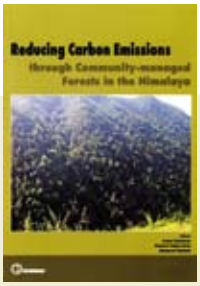


Adapting to climate change: How local experiences can shape the debate by Annelieke Douma and Danielle Hirsh, 2007. Briefing Paper, Both ENDS, Nieuwe Keizersgracht 45, 1018 VC Amsterdam, the Netherlands. Downloadable from http://www.bothends.org
This paper reviews the adaptation strategies of vulnerable communities, drawing on eight case studies prepared by local organisations working in Africa, Asia and South America (with full descriptions available on the internet). Presented as "the neglected aspect of climate change discussions", the report looks at the international framework for adaptation, and at the main issues behind it: funding, the necessary knowledge base, the capacities needed, and the existing local policies. The case studies provide different examples of adaptation strategies, and help the authors draw some key lessons and recommendations.

Indigenous and traditional peoples and climate change by Mirjam Macchi, 2008. Issues Paper, International Union for the Conservation of Nature, IUCN. Rue Mauverney 28, Gland, 1196 Switzerland. Downloadable from http://cmsdata.iucn.org/downloads/indigenous_peoples_climate_change.pdf
According to the IPCC's Fourth Assessment Report, communities who live in marginal lands and whose livelihoods are highly dependent on natural resources are among the most vulnerable to climate change. While many indigenous and traditional peoples fit in these categories, the potential impacts of climate change on their livelihood and cultures have not been looked at in detail. This report aims to fill this vacuum, focusing first on the treatment which these groups receive in the major climate change policy documents. It looks then at the social and biophysical factors which determine vulnerability, showing that climate change is already being felt in coastal areas, tropical forests and drylands. Recognising how traditional and indigenous peoples are already adapting to these changes, the report includes a series of recommendations, including topics for further research.

More than rain: Identifying sustainable pathways for climate adaptation and poverty reduction by Kirsten Ulsrud, Linda Sygna and Karen O'Brien, 2008. ISBN 978-8291923-09-3. Utviklingsfondet. Grensen 9 B, 0159 Oslo, Norway. Downloadable from http://www.utviklingsfondet.no/morethanrain
Utviklingsfondet, the Norwegian Development Fund, is an independent NGO that supports development projects through local partners. Focusing on enhancing people's capacity to use natural resources in a sustainable way, their work over the past 30 years has strengthened capacities to adapt, and reduced vulnerability climate change. They also now realise that the current situation presents many new challenges. The More than Rain project wanted to document their work so as to critically learn and improve the results for farmers and pastoralists. More specifically, their aim was to look at the integration of climate change adaptation in poverty reduction programmes, in ways that increase the capacity of individuals and communities to respond to climate variability and change. Looking in detail at communities in Nepal, Ethiopia and Nicaragua, the report presents some guiding principles for taking climate adaptation into account in poverty reduction efforts.

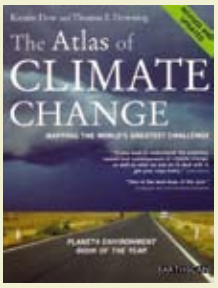
Reducing carbon emissions through community-managed forests in the Himalaya by Kamal Banskota, Bhaskar Singh Karky and Margaret Skutsch (eds.), 2007. ISBN 978-92-9115-058-8. International Centre for Integrated Mountain Development (ICIMOD), G.P.O. Box 3226, Khumaltar, Kathmandu, Nepal. E-mail: info@icimod.org
This book aims to generate awareness on the important role which community-managed forests can have in reducing carbon emissions and regulating climate change. It builds on the results of the "Think Global Act Local" research project, with case studies from India and Nepal. It looks at the Kyoto Protocol and the Clean Development Mechanism, discussing that they do not consider



forest management activities, or projects which avoid deforestation. There is also a chapter on carbon measurement. The book is useful for professionals, researchers, policy-makers and students, and especially anyone working in community forestry projects.

Climate change and food security: A framework document by the Inter-departmental Working Group on Climate Change, FAO, 2008. Vialle delle Terme di Caracalla, 00153 Rome, Italy. Downloadable from htpp://www.fao.org/climatechange/home/es
FAO's climate change activities are spread over all departments and cover all agricultural sectors. Since 1988, the Interdepartmental Working Group on Climate Change plays an important role co-ordinating these activities. One of its main objectives is to prepare documents, provide information, and "develop methodological approaches in the context of climate change". This report provides background information on the interrelationship between climate change and food security. In contrast to many other assessments which only look at the implications of climate change for agricultural production, this report tries to take a broader view and explores effects on food systems and food security. It looks at the possible disruptions or declines to food supplies, at the need to adjust consumption, and at the need to create "an eco-friendly energy economy". A separate section also discusses the advantages of Payments for Environmental Services.

The atlas of climate change: Mapping the world's greatest challenge
by Kirstin Dow and Thomas E. Downing, 2006. ISBN 978-1-84407-522-5. Earthscan, 8-12 Camden High Street, London NW1 0JH, U.K.
This is an easy to read, yet complete analysis of the major issues related to climate change. Highlighting the magnitude of the problem, the authors aim at a better understanding of the causes and consequences behind climate change, in a way that "will help us to avoid some of the threats, direct our efforts wisely, and find opportunities for meeting the challenges". With maps and diagrams, they present signs and evidence of change, and then examine the factors behind this change, including agriculture. After looking at the different threats (food insecurity, disrupted ecosystems, threatened water supplies), the last section looks at the international response, and at the steps which individuals can take. This book will be interesting to general readers, policy makers and practitioners.



Climate change: Impacts, vulnerabilities and adaptation in developing countries by the United Nations Framework Convention on Climate Change (UNFCCC), 2007. Climate Change Secretariat. Martin-Luther-King-Strasse 8, 53175 Bonn, Germany.
Drawing on material provided to the UNFCCC during three regional workshops, this book was produced "to highlight the concerns and needs of developing countries in adapting to the effects of climate change". It starts by showing why adaptation is needed, especially in developing countries, then looking at what is already being done. Separate sections examine the expected impact of climate change and vulnerability in Africa, Asia, Latin America and the small island states. This is followed by a detailed look at different strategies, considering both "reactive" and "anticipatory" responses to climate change. These include the integration of adaptation approaches into policy and planning, and work needed in capacity building, education and training, and public awareness. Its final chapter, "Looking forward", stresses the need for collaboration and co-operation between countries.

Regenerative 21st century farming: A solution to global warming
by Timothy LaSalle and Paul Hepperly, 2008. The Rodale Institute, 611 Siegfriedale Road, Kutztown, Pennsylvania, PA 19530-9320, U.S.A. Downloadable from http://www.rodaleinstitute.org/files/Rodale_Research_Paper-07_30_08.pdf
Based on a study carried out over almost 30 years, this 13 page report argues that an integrated approach to agriculture, using practices such as cover crops, composting and crop rotation, can reduce carbon dioxide in the atmosphere by pulling it from the air and storing it in the soil as carbon. This has the potential to substantially mitigate the impact of global warming – with no decrease in yields or profits. Considering that conventional agriculture contributes to at least 12 percent of the global greenhouse gas emissions, a change in agricultural practices will not only reduce these emissions, but also reduce the damage already made. The authors finish by calling for a "major paradigm shift" in the provision of incentives to farmers. They also ask that more consideration is given to this readily available solution to a major global problem.

Cool farming: Climate impacts of agriculture and mitigation potential by Jessica Bellarby, Bente Foereid, Astley Hastings and Pete Smith, 2008. Greenpeace. Ottho Heldringstraat 5, 1066 AZ Amsterdam, the Netherlands. Downloadable from http://www.greenpeace.org/international/press/reports/cool-farming-full-report
This report presents a very detailed analysis of agriculture's contribution to greenhouse gas emissions and global climate change. It looks at the direct and indirect emissions arising from agricultural production and land use changes, and also at the impact of intensive animal production and the increasing global demand for meat. The authors then look at the potential agriculture has for mitigating greenhouse gas emissions. They look at the restoration of natural vegetation and at the options that "sustainable management practices" provide, such as agroforestry, or a reduction of soil disturbance. Another important step is to reduce the reliance on fertilizers. "Taken together, these could change the position of agriculture from one of the largest greenhouse gas emitters to a much smaller source or even to [becoming] a net carbon sink".

Humanitarian implications of climate change
by Charles Ehrhart, Andrew Thow, Mark de Blois and Alyson Warhurst, 2008. Cooperative for Assistance and Relief Everywhere, Inc. (CARE). http://www.careclimatechange.org
The risk of disasters is increasing, with floods, cyclones, drought or other hazards becoming more frequent, more intense or less predictable. Based on research commissioned by the UN Office for the Coordination of Humanitarian Affairs and CARE, this document looks at the most likely implications of climate change in terms of humanitarian risk. Considering vulnerability as the main determinant of humanitarian risk, the authors map a series of "hotspots" with the objective of helping policy makers better understand the challenges, and help those involved adapt their response strategies to the realities of climate change. Their conclusion is that only a multi-pronged approach can counter the challenges posed; their recommendations are to act earlier, act wiser, and perhaps most important, not make things worse.

Conference brings farmers together from around the world

Over 400 farmers from 75 countries gathered in Matola, Mozambique, in October 2008, for the fifth general assembly of their global organisation, *La Vía Campesina*. The farmers analysed how the present world situation –struck with a "quadruple whammy" of the food crisis, energy crisis, climate crisis and financial crisis– is affecting their way of life.

Nico Bakker

Great effort has been made to make the messages of *La Vía Campesina* clearly visible throughout this conference. People are fully encouraged to participate, women are equally represented, and the organisers worked hard to make participants' meals from local food from the Mozambican farmers' organisations. Equally striking is that the conference is not dominated by formally trained specialists with a token farmer at the fringe of the meeting. This is a meeting of real farmers – specialists in their own right, who know very well what they are talking about. Here are some of their stories…

Climate change and marketing struggles

Alphonsine N'guba, from a farmers' organisation near Kinshasa, Democratic Republic of Congo, is pleased with the conference, especially the importance given to women. As she puts it: "You cannot talk about agriculture without talking about women." When Alphonsine is not busy organising, she works three pieces of land, producing a wide range of crops. Most of her produce is marketed through her co-operative, after setting aside the food needed for her family. She does not use chemical fertilizers anymore, as she found that they were destroying the soil, and are expensive. She has been observing that the weather seems to be hotter and the rains seem to be coming later, but falling with greater intensity, causing ever heavier floods.

While she struggles to "read" the new weather patterns in order to adapt her farming, Alphonsine considers the situation to be unfair as these changes, directly affecting her production, are caused by pollution not of her own doing. Nevertheless, her main problem is marketing, as Kinshasa is swamped by cheap imports, driving down prices – while farmers have high costs, because of poor infrastructure and being made to pay illegal "taxes".

Organic farmers are better off

Sago Indra is an organic farmer and organiser from West Sumatra, Indonesia. He says: "The first issue is to reclaim the land." He notes that ever larger amounts of land are being given to multinational companies by the Indonesian government, pushing farmers off their communal land and driving up land prices. Sago continues: "We feel the impact of the crises in Indonesia. For example, lamp oil is much more expensive now. Still, we organic farmers are better off than conventional farmers, who are becoming quite desperate. We produce food for our family, keeping costs low. We don't use agrochemicals, of which prices have increased by 50 to 150 percent in the last year. Also, we use local seeds, so we don't need to buy them." However, the changing weather is making it difficult to predict the rains: "If we have to rely on irrigation, our production costs will rise even further."

Photo: Cristina Machado

Farmers made themselves heard and shared their concerns with their counterparts at the *La Vía Campesina* conference.

Different farmers, same problems

Irène Anex from an organic co-operative in Geneva, Switzerland, is new to *La Vía Campesina*. In this conference, she notes that, despite all the differences between farmers and farm systems, "the problems are the same everywhere". Irène farms one hectare of rented land together with two colleagues, producing for 130 client members. Members volunteer on the farm and their membership fee covers the production costs. "Because of how we produce, our members' food costs did not increase that much. We produce in a less capital-intensive way than conventional farming, and whatever is produced is equally distributed." The energy needed for food production and distribution is also kept low as "we don't use chemical inputs, which require a lot of energy to produce, and members live nearby, keeping transport costs low".

Irène, Alphonsine and Sago all stress the importance of the *La Vía Campesina* conference, not only on a political level, but also to learn from others' experiences which might be adapted to their own situation. Alphonsine stresses the need for farmers to not lose their independence. For these and other reflections the conference served well. ■

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