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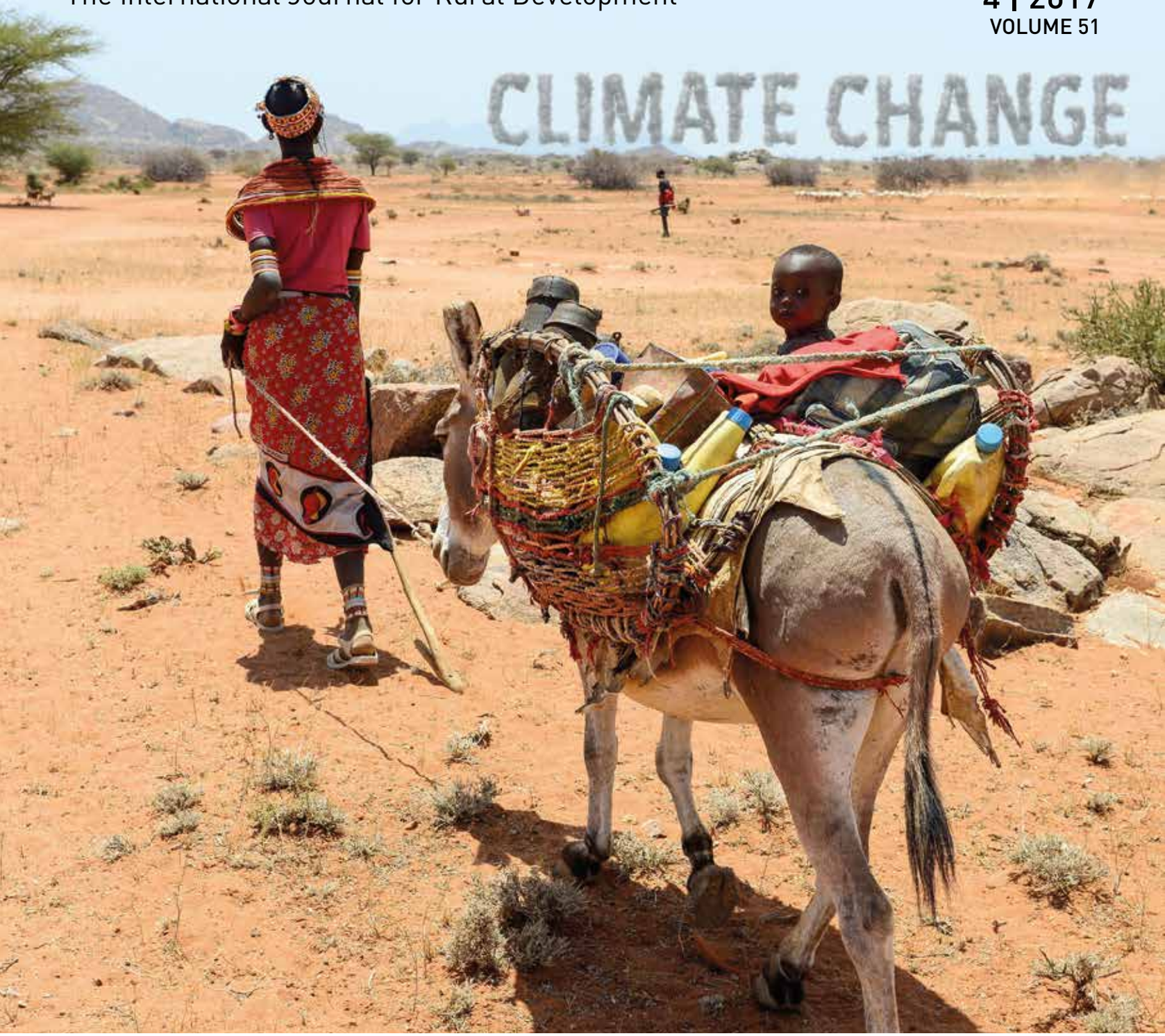

AGRICULTURE AND CLIMATE CHANGE
Where do we stand?

MIGRATION
Can development co-operation help reduce international labour migration?

SMARTPHONE APPS
New prospects for research and monitoring

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DEAR READER,

It's just a few days before the Old Year draws to a close, making room, as always, for a new start. And this is just the right moment for us to present our readers with something new as well. You will certainly have had a mild surprise when you received this edition of Rural 21 in the post – what about the familiar red bar with the white lettering, which after all has been our journal's trademark for more than five decades? We had lengthy debates on whether we could simply do away with the "face" of Rural 21 after such a long time. And we arrived at the conclusion that you, our faithful readers, will indeed appreciate such a change – for as the German poet Johann Wolfgang von Goethe noted towards the end of the 18th century: "Life belongs to the living, and he who lives must be prepared for changes."

If you have a bit of time between Christmas and New Year's Eve to take a closer look at the journal, you will notice that the change above all applies to its outer appearance. For us, it was important to give Rural 21 a fresher look and a clear structure that encourages reading and makes things easier to digest. What has not changed is our endeavour to provide readers with well-researched contributions. Instead of hastily compiled snippets of information, Rural 21 will continue to supply in-depth analyses of pressing issues and topics of high importance concerning rural regions with accounts written by experts in fields relating to development co-operation who will share their experience with you. It is always the aim of our journal to reflect the latest debates on rural development and present you with an added value for your day-to-day activities.

Our team of editors will also continue to provide you with the latest news and developments concerning the rural world, new science and research results, our partners' projects as well as exciting and inspiring print and online publications at our Website www.rural21.com. Here, you will also find brief accounts and analyses of events at the recent World Climate Summit COP 23 in Bonn, Germany, complementing this edition.

We hope you like the new Rural 21 design and look forward to your feedback.

Wishing you and your families a peaceful festive season and a happy and a prosperous New Year,

Sincerely yours,

Silvia Richter

Photo: Jörg Böthling

NEWS

Photo: UNDP

FOCUS

INTERNATIONAL PLATFORM

SCIENTIFIC WORLD

Photo: Thomas Daum

CLIMATE ACTION IN AGRICULTURE DISCUSSED AT COP 23

A wide range of topics surrounding climate and agriculture were discussed in an official side event at COP 23 in Bonn, Germany. Representatives from countries, organisations and businesses across the world came together to focus on the transformation required in the agricultural sector.

In 2015, public finance to support mitigation of and adaptation to climate change peaked at 437 billion US dollars. On average, however, only two-and-a-half per cent of this money goes into agriculture. Given the threat climate change poses to food security, it is crucial to provide more financial support for agriculture to undergo a fundamental transformation, according to Margarita Astralaga, Director of the Climate Change Division at the International Fund for Agricultural Development (IFAD). Astralaga explained her organisation's efforts to raise more finance for climate mitigation and adaptation measures at an event held on the fringe of the World Climate Summit in Bonn.

"Agriculture Advantage: The case for climate action in agriculture" was hosted by seven organisations and institutions, including IFAD and the German Development Institute (DIE), and organised by a further twelve, among them CGIAR, the Climate Policy Initiative and the World Agroforestry Centre. The week-long event covered areas ranging from climate-smart agriculture through private-sector climate actions and policy engagements to breeding and water issues.

The agricultural sector urgently needs more money for climate mitigation and adaptation measures.

Photo: Thomas Hug/FAO

KEEPING AN EYE ON WOMEN

Astralaga reported on her organisation's Adaptation for Smallholder Agriculture Programme, which runs 42 projects in 41 countries with a financial volume of USD 300 million (see also page 13). ASAP has set in place programmes reaching 6.6 million farmers. It has increased water availability for nearly 180,000 households and launched actions to avoid and/or sequester 30 million tonnes of CO_2 emissions by 2034. The programme applies a systemic approach integrating aspects such as nutrition and gender. "For example, we have observed that violence decreases if women are empowered and work in the fields themselves," Astralaga explained. "At the same time, their involvement has proven to ensure better nutrition." One ASAP target is to have three million women adopting sustainable and climate-resilient practices by 2025.

Around two thirds of the world's 600 million livestock farmers are women. However, Sophia Huyer, Gender and Social Inclusion Leader in the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), pointed out that at local level, the majority of women were only using land together with men or after the men were finished with their work. This also contributed to an increasing gap between men and women regarding climate information. Women working the land later than men needed different weather forecasts from those of the men.

Huyer maintained that gender had to be mainstreamed in the climate and agriculture debate. "We are still at a point where women's access to areas like credit, knowledge or land is poorer than men's," she noted. "There could be a huge increase in productivity if this gap were closed, although that requires strong steps to be taken." Women's decision-making power had to be raised at all levels. More involvement in community groups gave them better control of their income, increased productivity and decreased the workload. Women also needed to be involved more in non-traditional activities, including various levels of the value chain, as agro dealers or providers of tractor services.

Nitrous oxide is a greenhouse gas (GHG) with around 300 times the warming power of carbon dioxide. More than half of the amount in the atmosphere is emitted by the soil, while the rest comes from the oceans. Nitrogen originating from nitrogen-rich fertilisers is dissolved in the groundwater and ends up in the sea, where microbial action combines it with oxygen. According to Luis Felipe Arauz Cavallini, Costa Rica's Minister of Agriculture and Livestock, nitrous oxide coming from agriculture represents nitrogen that has not contributed to productivity.

Cavallini reported that several GHG mitigation strategies had been introduced in Costa Rica, including live fences, rational grazing and improved pastures. Most CO_2 emissions could be offset by trees. Good fertilisation practises were being employed in coffee growing, which was also combined with agroforestry. Further mitigation elements included solid waste management, residual water treatment and gasification of farm waste to produce energy.

GRASPING DIVERSITY

Outlining a farmer-based approach to climate action in agriculture, Ishmael Sunga, CEO of the South African Confederation of Agricultural Unions, noted that engaging farmers in discussions on climate had to be based on an understanding of their needs. "Finance programmes often miss the point here and set out from the assumption that farmers are all the same. But they are heterogeneous," Sunga ex-

plained. "And a farmer is only a part of the whole, the community, so we have to grasp what the overall situation is like. Other parts of this whole could be more important." Aspects like diversity, levels of education or appreciation of science needed to be taken into account. "When we talk about investment, our considering necessary action for the farmers is not enough. They themselves have to demand an enabling environment," Sunga concluded.

Mike Gardner

COAL IS STILL KING IN SUB-SAHARAN AFRICA

A COP 23 side event hosted by the German Development Institute in Bonn, Germany, looked at the situation of sub-Saharan Africa with regard to climate change mitigation.

At the COP 23 Climate Summit, governments got together to advance the implementation of the 2015 Paris Agreement committing parties to limit global warming to well below two degrees Celsius to avoid irreversible climate change. Using up all known and probable energy reserves would result in around 15,000 gigatons of CO_2. The carbon budget of 800 gigatons of CO_2 stated in the Agreement is referred to by various institutions to be necessary for a two-thirds probability of reaching the Paris goal. The 1.5 degree limit called for by representatives of Pacific island nations already affected by sea-level rise would stand a 50 per cent chance of being reached with the 800 gigaton carbon budget. The panel discussion "Climate Change Mitigation in Sub-Sahara Africa" focused on the continent's increasing reliance on carbon-intensive energy sources to meet poverty eradication requirements. The event was organised by the Mercator Research Institute on Global Commons and Climate Change (MCC), RWI Essen, The Environment for Development Initiative and GIGA Hamburg.

One of the chief sources of pollutants in sub-Saharan Africa is charcoal, which is in widespread use for household energy. Coal has assumed a key role in the Republic of South Africa, where the state-owned energy corporation ESKOM operates the Medupi power station. Medupi already ranks fourth among coal-fired plants world-wide, although ESKOM's giant Kusile power station, set for completion in 2018, bids fair to become the largest coal-fired power station ever built.

"Trade unions in South Africa are in opposition to phasing out coal-fired power stations, although renewables would also hold jobs," Neoka Naidoo reported in Bonn. Naidoo, a Climate and Energy Policy Communicator and member of the Cape Town-based Project 90 by 2030, which campaigns for a low-carbon society, maintained that there were other groups in South Africa that also had vested interests in retaining coal.

Ottmar Edenhofer of the MCC noted in Bonn that renewables need not automatically lead to a phase-out of coal-fired power generating. The real limiting factor for CO_2 emissions was not the actual amounts of carbon dioxide emitted but the carbon price. Carbon pricing could penalise the use of coal, oil and gas through devaluation while incentivising renewables and generating revenue that could in turn contribute to meeting the demand for infrastructure. "Sub-Sahara Africa is facing the challenge of an overuse of commons and an underprovision of public infrastructure," Edenhofer maintained.

Youba Sokona, Vice-Chair of the International Panel on Climate Change (IPCC) and top official of the Africa Renewable Energy Initiative (AREI), emphasised Africa's unique position, given that a basic infrastructure was not in place in the continent. "This enables it to explore new approaches and stay disconnected from classical ones," Sokona maintained. "It would be a big mistake to focus on adaptation and mitigation. Rather, we should start with a development agenda aiming at making it sustainable and climate compatible." Referring to sub-Saharan's household energy system's reliance on charcoal, Sokona noted that a transition to liquefied petroleum gas could be an option, although LPG was currently not affordable for small households and required a transportation and infrastructure basis.

Gerrit Hansen of Germanwatch stressed the importance of energy access in Africa. Hansen agreed that energy considerations should be based on a sustainable energy approach, which was also favourable for Africa because building up a new energy system transition was the key issue, not transition. However, she cautioned that despite their advantages in terms of achieving Sustainable Development Goals, renewables could also be very damaging.

Jann Lay of GIGA noted that energy infrastructure had to take Africa's huge diversity into account. Nigeria, for example, was one of the countries in the region that did have an energy infrastructure. Lower to middle income groups of society were largely not on a path to decarbonisation, especially in South Africa. Compared to what Lay referred to as the spectacular success of mobiles in the continent, energy technology was lagging behind. This, he maintained, was also due to missing markets.

Mike Gardner,
Journalist in Bonn/ Germany

Still under construction. Medupi Power Station outside Lephalale, Limpopo Province, South Africa.

Photo: Kevin Sutherland/laif

AGRICULTURE AND CLIMATE CHANGE – WHERE DO WE STAND?

At a side event during the recent UN Climate Conference at Bonn (COP 23), Martin Frick, Senior Director for Policy and Programme Coordination, UNFCCC, said "agriculture is the Cinderella in climate discussions. At the moment she is peeling potatoes in the kitchen but very soon she could be the Princess at the ball." Is this true or merely the optimistic perspective of a professional committed to agriculture and climate change?

By Rupa Mukerji

Agriculture has been one of the most complex topics in climate negotiations. It has all the features of a tricky problem: climate change affects agriculture in all parts of the world but with very different impacts; food security, livelihoods and trade are key sovereign interests that all parties seek to protect; agriculture policies are closely linked and affected by other international agreements particularly related to trade and subsidies; and agriculture is central to adaptation and mitigation but with a high degree of specificity, making standardisation and measurement difficult.

The United Nations Framework Convention on Climate Change (UNFCCC), signed by 197 nations, has protection of food security at its centre. Article 2 of the Convention states that its ultimate objective is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, noting that "Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner".

Agriculture and agriculture-driven land use change contribute around 17 per cent of global greenhouse gas emissions. Agricultural production causes 70 per cent of the deforestation globally but also employs 70 to 80 per cent of the population in developing countries through smallholder farming. Many mitigation options, such as biofuels and re/afforestation, are intimately linked to agriculture.

Despite this significance, there has been little progress in the climate negotiations related to agriculture over the years. With the move to Nationally Determined Contributions (NDCs) to mitigate the factors causing climate change under the Paris Agreement, many countries now see the agriculture sector as central to their own climate strategies. But before delving into this, it is important to understand the factors and concerns that have impeded actions thus far.

AGRICULTURE IN THE CLIMATE NEGOTIATIONS

Until fairly recently, climate negotiations have focused mainly on the mitigation potential of agriculture. They have been shaped by the 'Common But Differentiated Responsibilities' (CBDR), where mitigation responsibilities of nations are based on a combination of historical emissions, current capabilities to contribute to mitigation and development needs. In the negotiations, therefore, each country has tried to protect its key national interests, including agriculture, given its centrality in national food security, economy, trade and employment.

Large exporters of agricultural produce have been concerned about the potential impact of climate agreements on the competitiveness of their exports. Simulation studies on trade flow adjustments due to changing production and prices indicate that with climate change, growing populations and changing diets, agricultural imports of developing countries may double until 2050. Exporting nations fear that mitigation measures could become non-tariff trade barriers imposing restrictions on high emissions agricultural products. They fear for

Photo: Jörg Böthling

their patents and intellectual property rights when it comes to adaptation and related technology transfer.

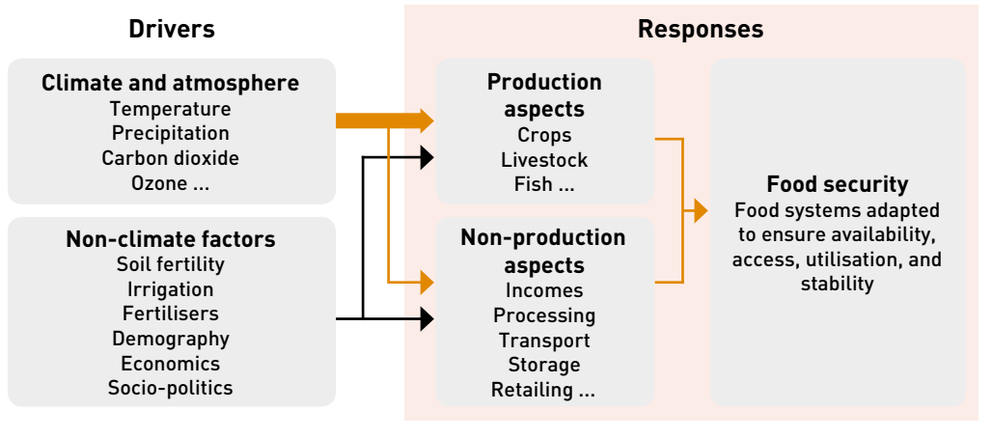
Highly populated countries such as India are very anxious that food security of their populations is ensured. Sub-Saharan Africa and South Asia are two regions where agriculture is highly vulnerable to even small changes in temperature and rainfall. India has been emphasising the centrality of food security and resisting all efforts to include agriculture in mitigation actions.The African nations are also deeply concerned about food security and the climate vulnerability of their agriculture sector. They have however strongly advocated for a focus on the adaptation needs of the sector leading to this issue coming centre-stage in recent years. Several Latin American countries have supported mitigation measures in agriculture while also addressing adaptation and food security concerns. They have been the pioneers in developing Nationally Appropriate Mitigation Actions or NAMAs in the agriculture sector.

The different stakes in the agriculture sector also arise from differences within the sector regarding climate change impacts. A rising temperature will benefit agriculture in the mid-to-high latitudes, while agriculture in the low latitudes will be adversely affected even with small increases in temperatures. North America and the Russian Federation are likely to gain significant amounts of arable land thanks to global warming by 2080, while sub-Saharan Africa will lose a substantial amount (nine per cent) of its arable land.

Agriculture-related negotiations are further complicated by the fact that bioenergy and land-based mitigation measures, such as afforestation and reforestation, compete for land and that this trade-off is expected to intensify in the coming years. Rising demand for food and energy in turn leads to conversion of land for agriculture, causing further emissions. This is why the landscape approach is increasingly used to analyse the aggregated impacts across multiple sectors and sub-sectors. Total greenhouse gas emissions from livestock supply chains represent about 14 per cent of global emissions. It is clear that plant based diets have a lower carbon footprint, nevertheless this topic has remained a taboo in climate negotiations due to its impact on individual lifestyle choices.

Subsidies play an important role in agriculture. The Green Box subsidies in particular include environmental aspects, and planting low emission crops should ideally qualify for such subsidies. However, this is a highly contested domain, as current recipients seek to protect their interests.

Climate and non-climate related drivers of changes in food systems



Source: IPCC, 2014

WHAT DOES SCIENCE TELL US?

The fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) looked at agriculture as part of food systems, taking into account the impact of climate change on production as well as non-production aspects, such as processing, transport, storage and retailing.

The AR5 concluded that all aspects of food security are potentially affected by climate change, including food access, utilisation, and price stability. Effects of climate change on crop and terrestrial food production are already seen in several regions of the world. In the future, negative impacts will be more common than positive ones, and climate trends are also affecting the quantum and distribution of aquatic species. Large negative sensitivity of crop yields to extreme daytime temperatures is seen at around 30° C. While temperature trends are important for determining impacts on crop yields at sub-continental to global scales, at individual country or smaller scales, precipitation projections are important but have greater uncertainty for assessing future impacts.

Whereas enhanced CO_2 levels in the atmosphere have a stimulatory effect on plants, in most cases, the damaging effects of elevated concentrations of tropospheric ozone (O_3) are equally high on crop yields. Changes in climate and CO_2 concentration will also enhance the distribution of invasive weeds. For the major crops (wheat, rice and maize) in tropical and temperate regions, climate change without adaptation will negatively impact production for local temperature increases of 2° C or more, although individual locations may benefit. Projected impacts vary across crops, regions, and adaptation scenarios.

Synthesising the results from over 1,000 modelling studies, the IPCC AR5 assessed that about 10 per cent of projections for the period 2030–2049 show yield gains of more than 10 per cent while another 10 per cent of projections show yield losses of more than 25 per cent, compared to the late 20th century. These include projections for different emission scenarios, for tropical and temperate regions, with and without adaptation. Relatively few studies have considered impacts on cropping systems for scenarios where global mean temperatures increase by 4° C or more. The IPCC graph on page 8 shows data for five timeframes in the near and long term, using data from 1,090 model projections for a 20-year period. The changes in crop yields are relative to late twentieth-century levels, and data for each timeframe add up to 100 per cent. The graph shows that while in the near term (2030) models show yield reduction and gains to an equal extent, in the longer term, the negative impacts are predominant.

In 2007, the IPCC's fourth assessment report had concluded that the impacts of climate change would be particularly complex for groups with lower adaptive capacity, in particular smallholder and subsistence farmers, pastoralists and artisanal fisherfolk, typically located in the South. Developing countries are therefore understandably most concerned about their food security and their adaptive capacities.

The emissions from agriculture are much higher in developing countries and continue to rise, while they are declining in developed

countries. Over the period of 2001–2011, annual emissions from developing countries increased by 14 per cent according to the UN Food and Agriculture Organization (FAO), while the emissions from agriculture in developed countries decreased by 3 per cent. Over the longer time horizon of 1990 to 2011, agriculture emissions increased by 37 per cent in developing countries and decreased by 20 per cent in developed countries. Asian countries account for 44 per cent of all agriculture emissions (ibid).

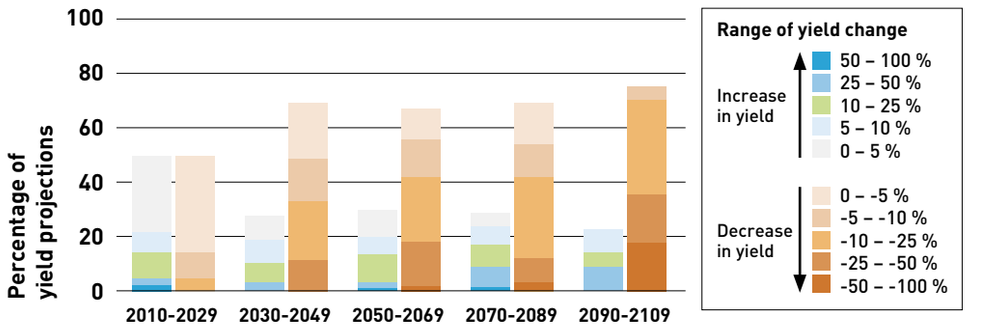
Agriculture and forestry are the sectors that can take atmospheric CO_2 and convert it into carbohydrates and oxygen through photosynthesis. Increasing soil organic matter can be a significant sink, but there is considerable uncertainty about the carbon capture potential of different soils and its permanence (also see article on pages 17-19). Nevertheless, according to the UNFCCC, the global technical mitigation potential of agriculture (excluding fossil fuel offsets from biomass) is estimated to be 5.5 – 6 Gt CO_2e (Carbon dioxide equivalent) per year by 2030. About 30 per cent of this potential can be achieved in developed countries and 70 per cent in developing countries.

IMPACT OF THE PARIS AGREEMENT

After the collapse of the climate negotiations at the Climate Summit in Copenhagen, Denmark, in 2009, where countries felt decisions were taken in a non-transparent, top-down manner, a concerted effort was made to rethink the architecture of the UNFCCC agreement. The 2015 Paris Agreement moves away from globally determined mitigation targets for countries to bottom-up nationally determined contributions (NDCs) to a global emission reduction goal. Each country is expected to indicate its own contribution to the global goal of keeping average global temperature increase 'well below 2 degrees Celsius' by 2100.

Agriculture now features in the NDCs and the national adaption plans of several countries (also see article on pages 9-11), while the Paris Agreement itself has little reference to agriculture. About 90 per cent of the NDCs include adaptation and have agriculture as a priority sector for action, and about 80 per cent indicate their mitigation commitments in the agriculture sector. While this is a great turnaround many challenges still lie ahead – the NDCs provide few details about mitigation actions in the agriculture sector. Measurement and permanence of soil carbon sequestration is a challenge. Most NDCs have focused on the production aspects and not on the entire food system, where mitigation potentials are high. For example, only Rwanda has included reduction of food wastes, which accounts for about eight per cent of global greenhouse gas emissions, in its NDC. Some of the most effective mitigation measures, such as letting land lie fallow to regenerate, are not affordable by farmers in most countries, especially in developing countries where subsidies and other public investment in agriculture are lacking.

Projected changes in crop yields, 2010 – 2109



Source: IPCC, 2014

Concerns about the climate-induced risks to agriculture are driving collective global action. The Subsidiary Body for Scientific and Technological Advice (SBSTA) of the UNFCCC has identified four priority areas for further work:

1. developing early warning systems in relation to extreme weather events;
2. assessing risk and vulnerability of agricultural systems to different climate change scenarios;
3. identifying agriculture adaptation measures; and
4. identifying and assessing agricultural practices and technologies to enhance productivity sustainably.

Rapid progress on these topics is expected in the coming months leading up to the next meeting of the SBSTA in May 2018.

THE WAY FORWARD

The Marrakech Partnership for Global Climate Action is an initiative launched during COP 22 last year. It seeks to catalyse and support climate action by countries and other stakeholders during the important period of 2017–2020, when deep climate actions are needed. The Partnership's priorities are co-operation between organisations, initiatives and coalitions, inter alia, on the interaction between climate action and the Sustainable Development Goals (SDGs). It promoted high-level engagement to help advance SDGs 2 (zero hunger) and 11 (sustainable cities and communities) at the recent COP 23 in Bonn, Germany, and will do so for SDGs 12 (responsible production and consumption), 8 (decent work and economic growth) and 9 (industry, innovation and infrastructure) at COP 24.

> *"The AR5 concluded that all aspects of food security are potentially affected by climate change."*

A range of multi-stakeholder actions to address mitigation and adaptation needs in the agriculture sector are being implemented. They include private sector actors with large stakes in the sustainability of agriculture and food systems. While the negotiations for formally binding international regulations have been slow and painful, the shift towards voluntary commitments and carbon standards is important and can be a major driver of change, provided consumers reward the early adopters.

Rupa Mukerji is Co-head of Advisory Services at HELVETAS Swiss Intercooperation and a lead author for the 5th Assessment Report of the IPCC, working group II focusing on Vulnerability, Impacts and Adaptation. She has about 25 years of practical development experience and a background in natural sciences and management.
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For a list of references, see online version of this article at: **www.rural21.com**

A touch of Fiji at the COP23 opening ceremony.
Photo: UNFCCC

HOW TO SUPPORT COUNTRIES TO ACHIEVE THEIR NDCS

Since 2013, the (Intended) Nationally Determined Contributions – (I)NDCs – have been playing a crucial role in international climate diplomacy. Our author looks at the process from the INDCs to the NDCs and describes how the UN Food and Agriculture Organization (FAO) supports the countries in implementing them and which stance the international community took in this respect at the latest climate conference.

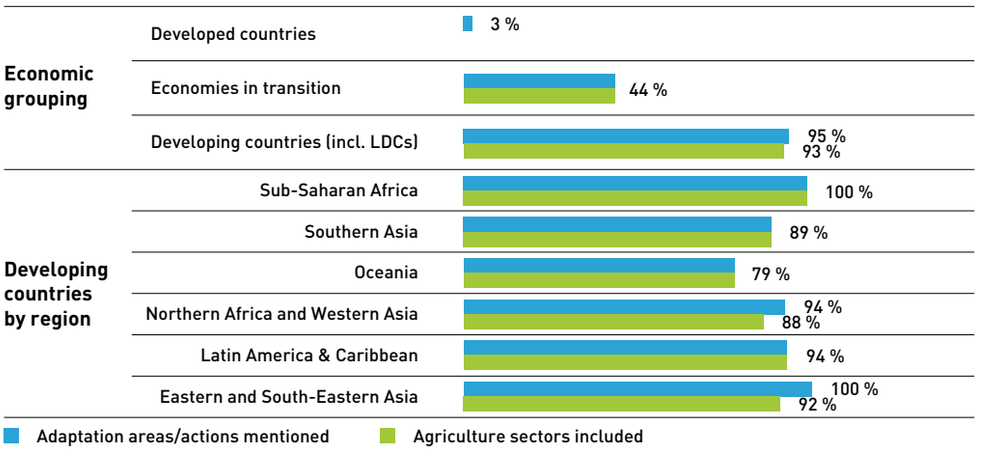
By Julia Wolf

The 19th meeting of the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) in Warsaw, Poland in November 2013 paved the way for a radical change in international climate policy. Whereas previous conferences had always negotiated globally determined targets to address climate change, COP 19 had now invited "all Parties to initiate or intensify domestic preparations for their Intended Nationally Determined Contributions (INDCs) towards achieving the objective of the Convention, as set out in its Article 2". 'Parties', as Countries are called in the context of the UNFCCC convention, were given leeway to ensure that their climate change mitigation and adaptation objectives were nationally appropriate. Such flexibility gave developing countries scope to base their plans, including their National Adaptation Plans (NAPs; see Box on page 10), on their specific adaptation and mitigation needs. Each INDC would reflect a country's ambition to reduce emissions, taking into account its domestic circumstances and capabilities. Two years later, in December 2015, 196 Parties came together at COP 21 in Paris, France and decided to transform their development trajectories towards sustainable development, aiming at limiting warming to 1.5 to 2 degrees Celsius above pre-industrial levels. Parties also agreed to a long-term goal for adaptation – to increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not "threaten" food production.

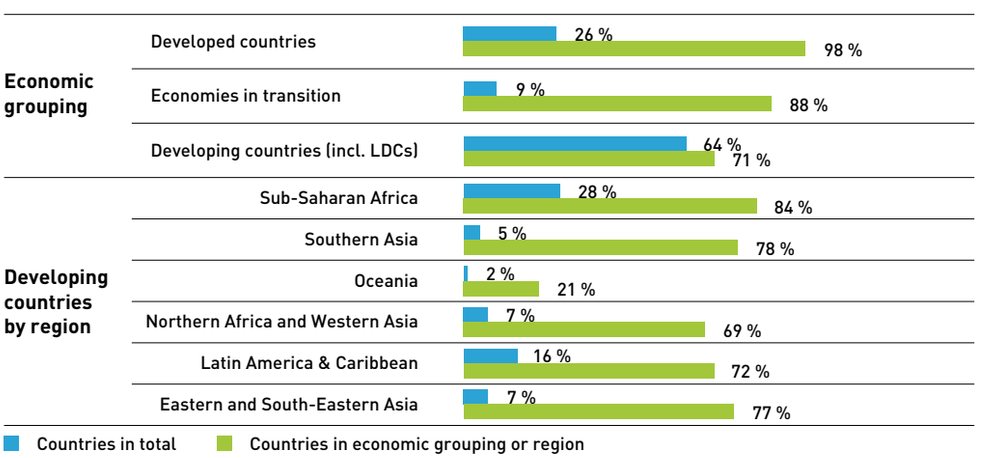
> The ultimate objective of this Convention ... is to achieve ... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.
>
> UNFCC, Article 2

The INDCs pitched before COP 21 were the trust building elements of showing countries' commitments towards a new development pathway addressing climate change from a domestic and "bottom-up" perspective. The Paris Agreement, referred to as "historic", entered into force on the 4th November 2016, having reached the necessary threshold of signatory countries. To date, 170 of the 197 Parties to the Convention have ratified the Paris Agreement. It turned the INDCs into NDCs – Nationally Determined Contributions, for those countries that had ratified their NDCs nationally. Now, every five years, each country submits its own climate change provisions to the UNFCCC Secretariat, which assesses them and establishes the overall climate benefit. In addition, it includes them in an "NDC Registry" for public scrutiny on the website. The notion behind this is that if the targets are not determined top-down, but are nationally owned and planned for, it is more likely that they will be met.

Percentage of countries that include adaptation sections and that refer to agriculture sectors in adaptation



Percentage of developing countries indicating mitigation targets and/or actions in agriculture and/ or LULUCF by economic grouping and region



The next round of NDCs (new or updated) are requested to be submitted by 2020. Hence through NDCs, increased ambition and action will be formulated in and communicated by countries, which will be assessed by the global stocktaking, starting with the 2018 facilitative dialogues (which at COP 23 was renamed the Talanoa dialogue under the Fijian COP Presidency).

AGRICULTURAL SECTOR IS KEY

Agriculture sectors feature prominently both in the INDCs and the NDCs. A 2016 FAO report found that the 98 per cent of countries (131 out of 134) that include priority areas for adaptation and/or adaptation actions mention the agriculture sectors (which, according to the FAO definition, covers crops, livestock, forestry, fisheries and aquaculture), including 93 per cent of developing countries (see upper Figure). Of these countries, 97 per cent referred to crops and livestock, 89 per cent to forests, and 64 per cent to fisheries and aquaculture.

When describing their mitigation contributions, agriculture and land use, land-use change and forestry (LULUCF) are considered by 89 per cent of countries (168 out of 189). Here, the agriculture sector includes emissions from enteric fermentation, manure management, rice cultivation, prescribed burning of savannahs and grassland, and soils, while emissions related to forest and other land use are covered under LULUCF. The mitigation potential of agriculture and LULUCF is prominently acknowledged by developing countries in all regions and by all economic groupings. Actions put forward by countries in agriculture focus on cropland, livestock and grazing management. For LULUCF, the actions mentioned by countries can be grouped under forest management and restoration, afforestation/reforestation and reducing deforestation. The lower Figure provides an overview of countries that cover mitigation in agriculture. For example, 16 per cent of countries that refer to agriculture are from Latin America and the Caribbean (LAC). Within LAC, 72 per cent refer to agriculture under mitigation in their INDCs and NDCs.

NATIONAL ADAPTATION PLANS

National Adaptation Plans (NAPs) are a core vehicle to deliver on adaptation priorities, and towards achieving countries' Nationally Determined Contributions (NDCs). The NAPs process was established under the Cancún Adaptation Framework in 2010, enabling Parties to the UNFCCC to identify medium- and long-term adaptation needs and to develop and implement strategies and programmes to address them. NAPs can build upon the National Adaptation Programmes of Action (NAPAs), established in 2001, to tackle least developed countries' urgent and immediate needs to adapt to climate change. Many developing countries consider adaptation as their main priority because of the significant impacts climate change is expected to have on national development, sustainability and security and to address key Sustainable Development Goals under Agenda 2030.

LEVERAGING SYNERGIES – SUPPORT FOR NDC IMPLEMENTATION

The fact that a total of 116 countries refer to the agriculture sectors with regard to both **adaptation** and **mitigation** is indicative of the potential to leverage adaptation-mitigation synergies. In accordance with the NDCs, countries will take the lead in NDC implementation for transformative climate action in the agricultural sectors, but the international community must support them in doing so. Well-targeted interventions in the agricultural sectors are uniquely able to deliver adaptation and mitigation benefits, as well as economic, environmental and social co-benefits – often simultaneously.

The 23rd meeting of the Conference of Parties (COP) of the UNFCCC in November 2017 in Bonn concluded with a landmark decision, "Koronivia joint work on agriculture", to address agriculture and food security in the international climate negotiations. It requests the two Subsidiary Bodies for Technical and Scientific Advice and for Implementation (SBSTA and SBI) of the UNFCCC to work together on issues related to agriculture, taking into consideration the vulnerabilities of the sector to climate change and approaches towards food security. The items mentioned in the decision cover many of the most promising areas for action, including soil, livestock,

nutrient and water management as well as the assessment of adaptation, socio-economic and food security dimensions.

FAO is already working with over 40 countries on both adaptation and mitigation related capacity building efforts to identify the priorities and step up from design to implementation, also with regard to leveraging climate finance. One example is the **Integrating Agriculture in National Adaptation Plans Programme (NAP-Ag)**. It is supported by the German Federal Ministry for the Environment (BMUB) through its International Climate Initiative (ICI) with 17 million US dollars as a multi-year initiative to support eleven countries in identifying climate adaptation measures for agricultural sectors and integrating them into relevant national planning and budgeting processes. The programme is being jointly implemented with the United Nations Development Programme (UNDP) and FAO. Thus the programme facilitates adaptation planning in countries in designing, prioritising and implementing adaptation across sectors via the NAPs and in alignment with the targets set out under the NDCs.

On a global scale, FAO has established **a Thematic Working Group on Agriculture, Food Security and Land Use** under the **NDC Partnership** (see page 12). The working group seeks to facilitate a peer-to-peer network for countries and international organisations to exchange and consult regarding knowledge, experiences and needs on climate change impacts and challenges in the agricultural sectors. It pursues the overall aim of supporting the implementation of NDCs related to agriculture, food security and land use, and strives to explore opportunities of transformational change and paradigm shift in the agricultural sectors. At COP 23, Germany's Development Ministry (BMZ) pledged one million euros to support this Technical Working Group.

FAO also started to develop a **knowledge exchange platform for the agricultural sectors** to enhance pre and post 2020 action and ambition addressing agriculture and food security under a changing climate and in their NDCs. The hub will provide information facilitating access to knowledge, tools and partners supporting climate action in the agricultural sectors. At COP 23, Germany also announced additional finance for FAO to the tune of 0.5 million euros from the German Federal Ministry of Agriculture (BMEL) to support the platform. As a result, a network of countries will increase and enhance knowledge and lessons learned to pursue a climate resilience pathway of agricultural sectors by using the platform.

FAO is working closely with countries, UNFCCC and partners by providing technical input, tools and mechanisms in support of the COP 23 decision referred to as "Koronivia joint work on agriculture".

FOCAL ISSUES: THE EXAMPLE OF EASTERN AFRICA

FAO is working on a paper series of regional NDC analysis with focus on agriculture and food security. At COP 23, the organisation launched the analysis for Eastern Africa in this context. It showed that all 18 countries in Eastern Africa highlight the key climate-related hazards, impacts, vulnerabilities and the adaptation measures and actions relevant to the agriculture and LULUCF sector. Most countries report on observed and projected changes in meteorological variables, namely fluctuations in mean annual and seasonal land surface air temperature, changes in precipitation intensity and variability of rainfall regimes. Droughts and floods are referred to as major observed and projected climate-related hazards. Countries further report on how climate change exacerbates already existing vulnerabilities, such as economic dependence on agriculture sectors, poverty and low human development. Countries report on observed effects of past and recent climate trends, as well as on projected impacts mainly on human health and life incidence, agricultural productive assets and livelihoods and human settlements and infrastructure.

Plans and projects regarding afforestation, reforestation and avoiding deforestation are mentioned by 34 per cent of countries as strategies for adapting to climate change.

Photo: Jörg Böthling

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For references and links to the FAO publications, see online version of this article at: **www.rural21.com**

THE NDC EXPLORER

In a joint project, scientists of the German Development Institute (DIE), the African Centre for Technology Studies (ACTS) and the Stockholm Environment Institute (SEI) have analysed all submitted Nationally Determined Contributions (NDCs). Based on the results, and in co-operation with the UNFCCC secretariat, they have developed a publicly accessible database concentrating all the information. Broken down into 60 subcategories in the areas of "mitigation", "adaptation", "finance and support", "planning and process" and "broader picture", the ambitions and priorities of the individual countries can be scrutinised in detail with the NDC Explorer. **https://klimalog.die-gdi.de/ndc**

CLIMATE ACTION – TIME TO WALK THE TALK

What is next after the Paris Agreement? Signed by 196 countries, this historic accord to stop global warming and create a low carbon and resilient world creates a whole new challenge: how do countries achieve these goals before our planet hits a point of no return? Finding the answer to this question is exactly why the NDC Partnership was born.

By Pablo Vieira

Different from the 1997 climate accord known as the Kyoto Protocol, the 2015 Paris Agreement on climate change now has almost every country in the world on board. At the heart of this diplomatic success are the Nationally Determined Contributions (NDCs) which every nation in the agreement must create to outline its specific plans to fight climate change and prepare for the inevitable challenges it presents. The harsh realities of climate change are requiring nations to find creative and collaborative solutions, and, for the first time, they have agreed to develop strategies that build from their own national contexts, challenges and opportunities to achieve a common outcome: to keep global warming below two degrees Celsius.

But now these commitments must turn into action. That is why the NDC Partnership was launched at COP 22 in Marrakech, in November 2016, the first United Nations Climate Conference following approval of the Paris Agreement. The Partnership aims to enhance co-operation so that countries have access to the technical knowledge, capacity building and financial support they need to achieve large-scale climate and sustainable development goals as quickly and effectively as possible, and continue to scale up their ambitions to attain the goals of the Paris Agreement.

Co-chaired by the governments of Germany and Morocco, the Partnership brings together developing and developed nations with international institutions and non-state actors to promote transformative changes. After one year of work, we have among our members 62 countries spanning five regions of the world and nine institutions that include UN agencies and multilateral development banks. The breadth and depth of the Partnership underscores how seriously the world is taking this call to action – and acknowledges that no-one will solve the crisis of anthropogenic climate change alone.

No single country has all the answers. But in our work with country partners, we are beginning to see, and support, the emergence of successful and scalable approaches. Countries like Colombia, Vietnam, Mali and Pakistan have established or are gearing up to establish climate targets for their ministries and local governments. Uganda is using the country's NDC to ensure that budget requests from all ministries undergo a screening for climate responsiveness and are in alignment with national plans. Kenya is using its revised Climate Change Action Plan to ensure that climate is integrated across its economy. These are just a small sample of the steps we are seeing taken world-wide as momentum continues to build.

The steering committee of the NDC Partnership.

Photo: NDC Partnership

The Partnership supports a growing community of learning that aims to help countries share promising practices with one another and find support from the significant array of resources that continue to be rolled out. For example, three online Navigators launched by the Partnership help users access national and international climate data, funding sources, tools, guides and technical support. The Partnership is a facilitator, supporting multi-stakeholder engagement across governments, regions and the global South to improve co-ordination and enhance responsiveness and efficiency.

Like the NDCs themselves, our work is country-driven. In-country technical assistance is provided based on an individual government's requests and needs: once requested by a member nation, partners come together to produce a partnership plan under the leadership of the government to support NDC implementation in ways that ensure a coherent approach, aligning development and climate action, enhancing NDC integration into national planning and promoting long-term solutions for adapting to the effects of climate change.

Advancing both mitigation and adaptation strategies is critical for success. Efforts to fight further damage from anthropogenic climate change are just as important as being able to respond to its inevitable effects. The agricultural sector is one area where these parallel objectives can be seen particularly well. While agriculture and water supply currently represent the top priority of adaptation measures identified by countries in their NDCs, agriculture mitigation measures are also present in the plans of 120 countries out of the 162 that have submitted NDCs to the UN Framework Convention on Climate Change (UNFCCC).

Countries have come together for a shared purpose: to create new pathways for growth that are low-carbon, environmentally sustainable and resilient. Through the Paris Agreement, they can do this in a way that allows for national ownership in alignment with economic and development goals. In Paris, countries committed to this direction. Now, they must walk the talk, and we are here to support the process.

Pablo Vieira is Global Director of the NDC Partnership Support Unit based in Washington, USA. From 2013-2016 he was Deputy Minister of Environment and Sustainable Development in Colombia.

For more information: www.ndcpartnership.org

CHANNELLING CLIMATE FINANCE FOR ADAPTATION IN AGRICULTURE

Smallholder farming systems are particularly vulnerable to climate impacts. This is where the Adaptation for Smallholder Agriculture Programme (ASAP) run by the International Fund for Agricultural Development comes in. ASAP projects are aimed to make rural development more resilient to climate change, also through measures directly benefiting farmers.

By Christopher Paul Neglia

The International Fund for Agricultural Development's (IFAD) foray into programming climate finance began in 2004. Engagement in this area increased substantially after the organisation's adoption of its Climate Change Strategy in 2011. It was around this time that an unmet demand for climate adaptation was identified among IFAD member countries. In order to close this gap, IFAD established a trust fund, financed by a group of donors (Belgium, Canada, Finland, Flanders, France, Netherlands, Norway, South Korea, Sweden, Switzerland and the United Kingdom) who were interested in supporting more innovative projects in response to the particular vulnerabilities of smallholder farming systems to climate impacts. This rationale led IFAD to become one of the first multilateral institutions to channel climate finance for adaptation in agriculture.

ASAP works in 41 low-income and middle-income countries, using climate finance to make rural development programmes more climate-resilient. The programme has a financial volume of 300 million US dollars, making it the largest global financing source for smallholder adaptation. Much of it goes directly to the 6.6 million farmers it benefits and to farmer-led adaptation, through financing a diverse set of approaches and actions that support local decision-making processes and community organisation initiatives to improve their ability to cope with climate change.

TAKING LOCAL VULNERABILITIES INTO ACCOUNT

The first generation of ASAP projects have sought to promote resilient rural development interventions, which are framed by prospective climate risks. For instance, the Livestock and Pasture Development Programme (LPDP) in Tajikistan is concerned with raising the capacity of Pasture Users' Unions (PUUs) to develop and implement climate-risk management community plans. These plans respond to pastoralists' observed changes in the climate, such as greater heat stress during the summer months, and increased snowmelt leading to mudslides and river floods in spring. The climate-risk management plans lead to the re-zoning of production enclaves that are more suitable in light of changing climate trends.

Similarly, in the Southern Provinces of Mozambique, where livestock-raising represents a lifeline for resource-constrained pastoralists, the Pro-Poor Value Chain Development Project (PROSUL) is drilling boreholes to increase the number of watering points for herds, while also supplying water for domestic use and community vegetable gardens. Increased water availability thanks to the multifunctional boreholes has reduced the amount of time needed for women to collect and transport water, leading to improved household food and nutrition security.

In both projects, local vulnerabilities are accounted for based on changes in temperature and rainfall and how these factors are expected to influence pastures and livestock. However, the design stage planning has gone beyond climate risk analysis, and expanded its scope to factor in associated economic and social risks as well. Consequently, these projects are supporting enhanced veterinary services to reduce herd mortality rates, and private entrepreneurs that source livestock input supply are also engaged in value chain development.

In terms of support for climate-resilient agricultural practices, the Fostering Agricultural Productivity Project (PAPAM) in Mali has contributed to the protection of five lowlands areas and 17 villages' groves through stone lines and reforestation. PAPAM has also supported the development of 20 market gardens, benefiting up to 1,600 women. One of ASAP's general goal is to have three million women applying sustainable and climate-resilient practices by 2025.

Armando Simando in Mabalane, Gaza Province in south-western Mozambique. The cattle farmer highlights the need to have reliable veterinary services in the area.

Photo: Clarissa Baldin/IFAD

ON TRACK TOWARDS A CLIMATE-RESILIENCE BUSINESS MODEL

The above-mentioned suite of interventions reflect a 'multiple benefits' approach that is gaining attention within the IFAD business model. Indeed, the Fund's adaptation projects have been expressly designed to deliver ancillary economic and social benefits. This initiative to integrate climate change considerations into rural development has been given a boost as a result of ASAP.

Going forward, the ASAP instrument will transition from a model whereby a subset of projects focus on building climate resilience to one in which all IFAD projects undertake vulnerability analyses that account for climate risks, among others. As IFAD institutionalises its experiences programming climate finance, it will seek to tap resources from public sources such as the Green Climate Fund, as well as private financial institutions, to leverage sufficient resources to advance its transition to a climate-resilience business model.

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A farmer at work in a maize field in India.

Photo: Michelle DeFreese/CIMMYT

CLIMATE-SMART AGRICULTURE – WHAT IS IT?

CSA – today, any programme addressing the future viability of agriculture that does not contain this acronym for "Climate-Smart Agriculture" would be quite inconceivable. But what exactly does the term refer to, and in what way does the concept differ from that of sustainable agriculture? Showing examples from Colombia, Niger and India, our author demonstrates what CSA means in practice and explains why the term "agriculture" does not do justice to the broader framing of the context.

By Bruce Campbell

Hundreds of local and international organisations have adopted the concept of Climate-Smart Agriculture (CSA). However, as with many newly-proposed concepts, there are different interpretations and contestations. CSA is by no means perfect for what it needs to cover in the urgent and complex area of climate action in agriculture and food systems, but it is a useful shorthand.

Many of us interpret CSA as an approach rather than as a concrete practice or technology. As Leslie Lipper and co-authors write in Nature Climate Change, "CSA is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change". There are many other terms related to agricultural development, but CSA is novel in its focus on a range of climate actions. The concept was conceived by the United Nations Food and Agriculture Organization (FAO) in 2010 in response to the need to transform agricultural development to the challenges of climate change.

Realising a food secure world has always been difficult, but it will become even more challenging under a changing climate. According to the Intergovernmental Panel on Climate Change (IPCC), a temperature increase of 2° C could affect agricultural yields by 15 per cent with current farming practices, while the FAO states that 60 per cent more food is needed by 2050 to meet the growing demand. In addition, food systems are responsible for up to a third of greenhouse gas emissions, so these must be mitigated to limit global warming. Climate-Smart Agriculture is an approach to address these challenges in an inclusive manner.

THE THREE PILLARS OF CSA

In essence, CSA interventions seek to achieve three outcomes: (a) sustainably increasing agricultural productivity and incomes; (b) adapting and building resilience to climate change; and (c) reducing and/or removing greenhouse gases emissions, where possible. Many have interpreted these as the components that would need to be found in a particular agricultural practice or technology, such as in conservation agriculture and agroforestry. We have a somewhat different framing. The overall objective of CSA is to support efforts, from local to global levels, for sustainably using agricultural systems to achieve food and nutrition security for all people at all times, integrating necessary adaptation and capturing potential mitigation. The three pillars above are then the goals to achieve that objective.

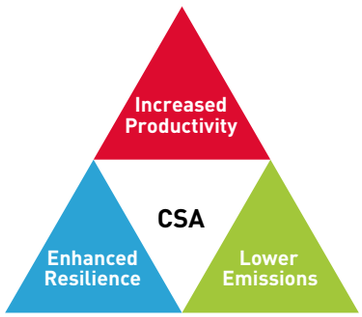
What do we need to do to achieve those three inter-related goals? Action may involve agroforestry in one location, but crop-livestock systems in another. It may involve index-based insurance, better input markets and wheat farming elsewhere. The focus is on the goals, not on any particular practice that needs to be labelled climate-smart. And we need to recognise the trade-offs that may arise amongst the goals.

In focusing on the goals, we would hope to move away from the situation where particular technologies and practices are "sold" and "promoted" – we want to move away from silver bullets. Unfortunately, this is not the case in current practice, as we see multiple forms of climate-smartness being promoted: climate-smart potatoes, climate-smart landscapes, climate-smart villages, climate-smart rice, climate-smart livestock production, etc. We concur with Todd Rosenstock from the World Agroforestry Centre (ICRAF) when he says that a technology can be climate-smart in many places but is unlikely to be climate-smart everywhere. Let's not go to a farm, farmer, landscape or country with a climate-smart solution, but rather start from the farmers and local stakeholders to understand their needs, and work together towards the local and global goals. We should focus on the processes needed to achieve the goals. As Lipper and co-authors suggest, these may include promoting co-ordinated actions by farmers, researchers, private sector, civil society and policy-makers; building evidence of what works in specific contexts with particular types of farmers; increasing local institutional effectiveness to support agriculture; fostering coherence between climate and agricultural policies; and linking climate and agricultural financing. This gets CSA into the real business of development in the era of climate change, rather than pushing particular technologies.

WHAT DISTINGUISHES CSA FROM SUSTAINABLE AGRICULTURE?

We think this is simply answered. CSA is merely sustainable agriculture with a strong focus on the climate dimensions. CSA ideas will make sustainable agriculture even more sustainable! This will occur by, for example, focusing on climate advisories for farmers (where appropriate!), scaling up weather-based index insurance (where appropriate!), and/or mobilising climate finance for the benefits of farmers and farming (where appropriate!). If sustainable agriculture completely embraces the emerging ideas in CSA, there will be no reason for the CSA concept to continue – climate concerns will be completely mainstreamed into sustainable agriculture.

The three pillars of Climate-Smart Agriculture



While CSA pursues similar goals to other approaches – food security and sustainable development – CSA distinguishes itself in three ways. First of all, CSA systematically integrates climate change into the planning and development of agricultural systems. While many approaches to sustainable agriculture consider resilience and reduction of greenhouse gas emission as beneficial side effects, CSA takes them as starting points. Secondly, to achieve the three outcomes of productivity, adaptation and mitigation, CSA emphasises the synergies and trade-offs between interventions at different levels. This is important, because interventions can have beneficial socio-ecological effects at farm level, but detrimental effects at landscape or community level. To identify optimal interventions and assist farmers and decision-makers, CSA projects need to deploy prioritisation tools to identify trade-offs and synergies between options. Thirdly, CSA attracts new funding to agricultural development, as it focuses explicitly on climate change. With the need for climate change adaptation and mitigation, a myriad of climate funds has appeared, such as the Least Developed Countries Fund, the Global Environment Facility Trust Fund and the Green Climate Fund.

CSA IN PRACTICE: EXAMPLES FROM COLOMBIA, NIGER AND INDIA

To illustrate how CSA can be applied to an institution, in women's empowerment and an agronomic technique alike, three examples are shared from Colombia, Niger and India. The first example is the establishment of the Local Technical Agroclimatic Committees (LTACs) in Colombia. The Colombian Ministry of Agriculture and Rural Development set up these committees with support from several research institutes in 2015, to make farmers more resilient to the increasing climate variability. In these committees, representatives from gov-

Members of a Local Technical Agroclimatic Committee in Montería, Colombia.

Photo: José Luis Urrea/CCAFS

ernment, civil society, meteorological services and farmers meet regularly to discuss climate forecasts and formulate practical agronomic recommendations. These recommendations are distributed to farmers through regional and national bulletins, so that they can make informed decisions on what varieties to plant, when to sow and how to manage water and other inputs. With the five LTACs more than 150,000 farmers were already receiving tailored agroclimatic advisory services. The establishment of the LTACs followed a typical CSA approach and contributes to the three CSA outcomes, as it enables farmers and policy-makers to increase productivity, decrease greenhouse gas emissions by optimising fertiliser application, and adapt to changing climates.

The second example comes from Niger. Agriculture in Niger is characterised by its hostile environment, with annual rainfall lower than 600 mm and temperatures surpassing 30° C for months on end. Despite these harsh conditions, 80 per cent of Nigeriens depend on farming for their livelihood, which makes them very vulnerable to climate variability. Particularly women and their children often face malnutrition, as they are assigned marginal lands to cultivate. In response to both problems, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) trained over 10,000 women in Niger to reclaim degraded lands. Women learn restorative cultivation techniques, such as the use of zai-pits, which are dug in hardened soil and filled with manure to concentrate nutrients and water for seeds once the rainy season starts. They were also assisted in negotiating for the long-term right to cultivate common marginal lands. These efforts to empower women to reclaim marginal lands increased productivity and carbon sequestration in soils, and strengthened the resilience of women to face climate variability.

> *A technology can be climate-smart in many places but is unlikely to be climate-smart everywhere.*

The third example from India shows how a technique from conservation agriculture can be deployed as a CSA intervention. The International Maize and Wheat Improvement Centre (CIMMYT) and several research partners tested different combinations of tillage, crop establishment and residue management in a rice-wheat rotation in the Indo-Gangetic Plains of India. The researchers found that the fields without tillage led to a higher productivity of both rice and wheat after four years, and that the soil organic carbon content increased over the years. With a higher organic carbon content, carbon dioxide is sequestered and soils become more resilient to floods and droughts. To demonstrate these benefits, CIMMYT deployed the zero-tillage and accompanying conservation agriculture techniques at one of its test fields in the India state of Bihar. Representatives of the government of Bihar, seeking methods to increase the climate resilience of its farmers, visited the test fields and decided to promote the zero-tillage rice-wheat rotations as an official policy. While this production system was conceived as a conservation agriculture technique, it contributes to CSA outcomes, and was deployed throughout the state of Bihar to increase the resilience of farmers to climate stresses.

Nigerien women sowing okra seeds in the zai-pits.

Photo: ICRISAT

As such, these three examples show that there is a great overlap between the objectives and methods of approaches to sustainable agriculture, but that CSA distinguishes itself with its focus on climate change.

A BROAD FRAMING OF CSA

There are many different interpretations of CSA – this is alluded to above in relation to the focus on technologies and practices as opposed to an approach to agricultural development under climate change. The term "agriculture" in CSA is perhaps unfortunate, as we should be also focusing on broader food system issues, value chains, policy issues and crucial services (such as climate-informed advisories, insurance and credit). Technologies and practices, however, tend to get the most attention in many discussions on CSA. Furthermore, CSA often concentrates on the farm and farmers rather than on some of the higher level landscape issues that need to be considered. We would posit we need a broad framing of what is to be considered under CSA – anything that helps deliver on the three objectives (pillars). CSA can therefore be understood as an approach promoting agricultural development in response to the challenges of climate change adaptation and mitigation, ultimately aiming to improve the livelihoods of people. CSA has gained considerable traction since 2010, with participants ranging from local farmers to global organisations. However, as the interest in CSA practices grows, it becomes increasingly important to monitor and evaluate results and interpret them in their site-specific context. Only in this manner can CSA contribute to the livelihoods of people around the world, in co-operation with the other approaches to sustainable agriculture.

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A healthy soil contains a myriad of living organisms.

Photos: Georgina Smith/CIAT

THE ROLE OF SOIL CARBON IN MITIGATING CLIMATE CHANGE – LOST CAUSE OR TRIPLE-WIN?

Carbon is the major building block of soil organic matter. And this in turn forms the basis of soil fertility. In this article, our author explains just how closely soil fertility and climate change are linked, the role that the former French Minister of Agriculture's „4 pour 1,000" (4 per 1,000) initiative can play in the context, and what all this means for food security und resilience of small farmers.

By Rolf Sommer

What distinguishes soil from "dirt" is its biology and functionality. A healthy soil contains a myriad of different bacteria, fungi, insects, earthworms and other organisms. Thriving, these consume and produce organic material – humus, or as scientists say, soil organic matter. Humus is what determines a soil's fertility and resilience to a large extent. It can persist in a soil for decades, centuries or even millennia, but it is basically in constant turnover – humus being decomposed and lost as carbon dioxide (CO_2), and new humus being formed. Soils rich in humus can absorb and hold more water, and are usually more productive than soils that have been degraded.

Most of such soil degradation is caused by people and agricultural land use. Degraded soils are often associated with (physical) erosion, unprotected topsoil being washed away by rainstorms and leaving behind barren land. However, in Africa, loss of soil organic matter contributes significantly to soil degradation, which is evident for instance when rangelands are no longer lush and green, or crops don't grow as well as they used to, producing meagre crop yields. This so-called biological or chemical soil degradation is also anthropogenic. Decades of unsustainable land management practices in Africa have rendered many formerly productive soils infertile. Many of the African soils are very old and weathered to start with, and nutrients have been leached over the years. Soil fertility, productivity and soil organic matter are tightly interlinked in these cases.

A HUGE POTENTIAL

What does this have to do with soil carbon and climate change? First of all, needless to say, carbon (C) is the major building block of organic matter. This means that when we talk soil organic matter we talk soil (organic) carbon at the same time. Globally, soils contain a lot of carbon: about 1,500 gigatons (Gt), or billion tons, to a depth of 1 m and 2,400 Gt to 2 m. This is three times the amount of carbon that we currently find as CO_2 in the atmosphere (~830 Gt C), at least four times the amount of all biomass on our planet (~400–600 Gt C), and 240 times the current annual fossil fuel emission (~10 Gt C). Given this massive stock, if we were able to increase the net soil C storage globally only a little bit each

year, this would represent a substantial C sink! The potential of the soil to sequester carbon can lessen the intensity of climate change and become a critical mitigation measure, if it is well leveraged. However, as yet, this potential is not well enough tapped.

At least since states agreed the Kyoto Protocol in 1997, combating climate change by reducing net greenhouse gas emissions has been high on the agenda. CO_2 is by far the biggest contributor to these emissions.

THE 4 PER MILLE INITIATIVE – A REALISTIC VENTURE?

What is the potential to sink carbon in soils? Our most recent, optimistic rates (0.9–1.85 Gt C) range between 9–18 per cent of all annual emissions caused by fossil fuel burning. Other scientists are even more optimistic: Two years ago, French scientists defined the aspirational goal to mop up a significant share of all newly emitted CO_2 through soil organic carbon sequestration and halt the annual increase in atmospheric CO_2. To achieve this, the C-stock of the top 40 cm of all soils (~820 Gt) would have to increase by approximately 4 per mille (0.4 %) each year, equal to 3.5 Gt of carbon sequestered. Hence the name of this initiative: 4 per 1,000 (which also budgets-in concurrent natural sinks – oceans – and measures, namely reducing emissions from land use change – deforestation – to zero). It was launched by the French Minister of Agriculture at the 2015 United Nations Climate Change Conference in Paris, and without doubt, has since gained tremendous momentum and global interest.

Not to be misunderstood from the start: 4 per mille is a game-changing initiative and deserves our full support. But, as is often the case, the devil lies in the details.

First of all, not all soils on this planet are the same, and soils are exposed to different climates and land uses. Carbon stocks in soils depend on how much organic matter is added to the soil each year, e.g. by retaining crop residues or adding compost, and how much is lost by microbial breakdown of humus, which is a factor of climate, land use and soil properties. To increase soil carbon, either organic inputs need to be augmented or humus breakdown reduced. But soils under pristine forests, for instance, may have reached an equilibrium, i.e. they cannot easily be hoodwinked into sequestering more carbon; management options to do so are limited or absent. This applies similarly to high latitude grassland or tundra soils. Focusing on annual cropland soils therefore seems a good entry point to address the issue.

Yet our research, carried out together with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in Western Kenya, shows that traditional farming practices like tilling the land have contributed to original carbon losses from the soil of 50–70 per cent in the last 30 to 100 years. While such losses illustrate a key challenge for the global community – that soil management is a major factor in whether our soils can sequester more carbon or not – they also show there is potential to "win back" carbon, if land use practices are changed and improved (see Box above).

> On current agricultural land, mitigation and adaptation interaction can be mutually re-enforcing, particularly for improving resilience to increased climate variability under climate change. Many mitigation practices implemented locally for soil carbon sequestration will increase the ability of soils to hold soil moisture and to better withstand erosion and will enrich ecosystem biodiversity by establishing more diversified cropping systems, and may also help cropping systems to better withstand droughts and floods, both of which are projected to increase in frequency and severity under a future warmer climate.
>
> Rosenzweig and Tubiello, 2007

Second, even if we all agreed to implement practices that increase carbon in the soil, adoption of such management practices would take time. In other words, not all soils can be turned into carbon sinks tomorrow.

Third, a multitude of studies around the world show that increases in soil carbon over time are slow. In fact, the rate at which carbon can be requested usually slows down and even ceases altogether at some point – often 20 to 30 years after adoption of improved management practices. It is therefore reasonable to assume that the potential for soil carbon sequestration has its limits.

Fourth, the dilemma of a moving target and top-down calculations: unfortunately, greenhouse gas emissions are still on the rise. What constitutes a 4 per mille goal today may have to be bumped up to 5 per mille tomorrow to keep pace with the increases in emissions. Then, soils do not automatically sequester these amounts because the top-down calculated budget demands it. While it is reasonable to find out what a hypothetical increase of global carbon stocks by a certain amount or percentage each year would mean in terms of climate change mitigation, this needs to be backed by bottom-up estimates of sequestration amounts, taking into account the various site-specific factors – such as whether farmers will adopt them and what the incentive would be – as not all soils are the same, and the farmers are the ones that will need to implement changes.

Therefore, it is not surprising that the 4 per mille initiative has been criticised for largely simplifying the issue of carbon sequestration potentials and setting unreasonable aspirations.

CIAT LONG-TERM TRIALS IN KENYA

Since 2004, the International Center for Tropical Agriculture (CIAT) has maintained two long-term trials in Western Kenya in which the impacts of improved land management practices on the yields of maize and soil fertility are tested. These experiments are very valuable, as trials of this kind conducted long-term in Africa are hard to find, and as it takes longer time spans to be able to evaluate how sustainable certain management practices really are. Two cropping systems – Integrated Soil Fertility Management and Conservation Agriculture – are being tested. Both have in common that organic matter is retained or brought back to the soils to sustain long-term soil fertility.

Results indicate that, depending on the amount of organic matter recycled, soils under these systems can mitigate the emission of between 0.25 and 0.7 tonnes of carbon per hectare and year. That sounds little but is enough to offset the amount of carbon emitted by one economy return flight ticket from Nairobi to New York.

HOW TO MEASURE SOIL CARBON

Unfortunately for book-keeping, nature is complex. Soil carbon is no exception. It varies significantly over space and time. Hence, it is not a trivial task to determine carbon in soils and its increase over time, large-scale. This is why scientists are working hard to find easy-to-measure and cheap indicators. While repeated actual soil sampling and lab-based carbon analysis may be the gold standard, indirect measures, such as the infrared spectra of soil properties, that are fast and cheap(er) to measure, or using satellite imagery to derive soil carbon status, can speed up this process of book-keeping.

Mathematical computer models can be leveraged to describe biophysical processes of carbon dynamics in soils, determining further potential to sequester carbon in soils.

Or, as David Powlson from Rothamsted Research in the UK put it: "The point we are making is that the rate of carbon accumulation in soil that is suggested, 0.4 per cent per year every year for 20 years, is almost certainly unattainable … It would therefore be unwise for policy-makers to rely on this rate of carbon sequestration across the globe. … However, no-one wishes to criticise the positive and laudable aims of the initiative."

In conclusion: despite all the simplifications, the 4 per mille initiative puts soil organic carbon sequestration as a means to mitigate climate change on the global agenda – where it belongs!

EVERY LITTLE BIT HELPS!

Even if we scale down expectations and move back to sequestration estimates that seem more reasonable and in line with previous estimates (e.g. that of Smith et al, 2008), the mitigation effect will be significant. Our 9-18 per cent estimates could help us make agriculture carbon neutral, as direct emissions from agriculture (excluding deforestation) add approximately this percentage of greenhouse gases to the global balance. Even a lower mitigation target by C sequestration in soils would be worth the effort, because there are no other silver bullet solutions lining up right now that could carry the bulk. Hence every little bit helps mitigate harmful emissions! And, this is only banking on climate change mitigation through soil carbon sequestration. For a centre like CIAT, food security and resilience of smallholder farmers in the tropics is a number one priority. Climate change mitigation is "only" a co-benefit. As outlined at the beginning of this article, the alarming loss of soil fertility is the real issue at hand. Smallholder farmers will benefit the most, and most immediately, by improving their natural resource basis (soils).

But farmers in developing countries are often resource-constrained, and forced to intensify their production, frequently depleting the fertility of their soils in the process. Sequestering carbon and receiving associated payments for this environmental service could help them make the shift a reality. It often takes very little to help farmers adopt more sustainable (and climate change mitigating!) measures, if they are provided with adequate information about the benefits of the shift. For example, microcredit schemes allow farmers to buy the right inputs, such as improved seeds, fertiliser, lime, etc., at the onset of the season, when cash is usually scarce. Providing the right tools (e.g. a shallow weeding tool that reduces tillage intensity and helps protect soils, or something as simple as a wheelbarrow to move compost) can catalyse adoption of practices such as conservation agriculture or integrated soil fertility management. Provision of crop insurance against drought allows farmers to adopt otherwise risky investments in sustainable intensification. In other words, a payment for an environmental service does not need to be a major income-generator, but only has to be big enough to catalyse change.

Bringing organic matter and hence carbon back into the depleted soils of the tropics addresses three climate-relevant issues: increased crop productivity, enhanced farming system resilience, and climate change mitigation. Such triple wins are hard to find in the development arena. Let us seize the opportunity!

While covering only about 3 per cent of the Earth's land area, peatlands hold roughly between 20 and 25 per cent of the world's soil organic carbon stock.

Photo: Berthold Steinhilber/laif

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For a list of references, see online version of this article at: **www.rural21.com**

WHAT CAN ORGANIC FARMING CONTRIBUTE?

Are organic farming systems more climate friendly and climate resilient than conventional ones? And does this make them suitable to maintain global food security in changing climate conditions? Our authors believe that this is the case. However, they say that in assessing mitigation and adaptation potential, one should not only look at production aspects, and make a case for a food systems perspective.

By Adrian Muller, Markus Steffens, Hans-Martin Krause, Lin Bautze, Matthias Meier and Sibylle Stöckli

Organic farming offers several ways to mitigate climate change when compared to conventional agriculture:

First, organic farming, through its key practices of organic fertiliser use and crop rotations with forage legumes, tends to increase soil organic carbon levels resulting in carbon sequestration. This contributes to climate change mitigation, as it absorbs CO_2 from the atmosphere and stores the additional carbon in the soil. However, depending on soil type and climatic conditions, this process usually comes to a halt after some decades, when soil organic carbon levels have reached a new equilibrium and soils are thus saturated with respect to organic carbon contents. Furthermore, this storage of organic carbon is reversible and the carbon can again be released into the atmosphere as carbon dioxide when switching to unsustainable practices.

Second, organic farming does not use mineral fertilisers. Thus, the emissions from industrial fertiliser production are avoided. In contrast to carbon sequestration, this is a permanent mitigation benefit that can be realised every year anew.

Third, organic farming generally has higher nitrogen use efficiencies and lower nitrogen use levels than conventional agriculture. This results in correspondingly lower emissions of the potent greenhouse gas nitrous oxide from fertilised soils, which is another straightforward and permanent mitigation benefit.

Fourth, organic farming tends to work with lower stocking densities of animals with respect to the land area available for grazing and feed production. These lower animal numbers go along with lower direct animal-related greenhouse gas emissions per farm, smaller manure quantities, and correspondingly reduced methane and nitrous oxide emissions from manure management.

In these aspects, we have a clear mitigation benefit from organic farming. However, all these strategies closely link to extensive production systems with lower outputs. Thus, the lower output in these systems may lead to so-called "leakage" of emissions if the missing produce is just sourced from elsewhere, with corresponding emissions occurring there. In this case, relocation rather than net reduction of emissions would take place. Hence, the danger prevails that the reduced emissions from these systems will come at the expense of leakage, unless complementary changes on the consumption side are realised as well. This aspect is reflected by the fact that many studies find organic farming to have higher emissions than conventional farming if related to the output rather than to the farmed land area. Framed differently, the yield gap between organic and conventional agriculture is central here and puts the aggregated mitigation potential of organic farming into perspective.

MITIGATION IS IMPORTANT, BUT ADAPTATION POTENTIAL CARRIES MORE WEIGHT

However, mitigation is by far not the only and most important topic when it comes to climate change and agriculture. In fact, adaptation to climate change is much more important for the individual farmer and for food security. The livelihoods of hundreds of millions of people directly depend on successful climate change adaptation practices and strategies in agriculture. Organic farming shows considerable potential for successful adaptation related to soils. Soils under organic farming generally show a higher soil quality, characterised by higher organic matter contents, more active and diverse (micro)organisms, and better soil structure. Such fertile and healthy soils support stable production. Furthermore, the physical characteristics of soils under organic management lead to generally higher water infiltration and water holding capacity. This results in an increased resilience in the face of extreme weather events such as droughts and heavy rains. Such enhanced capacity to regulate the soil water cycle is central for successful adaptation in agriculture, as such extreme events are projected to increase in frequency and strength with ongoing climate change. In consequence, yields may be more stable in organic farming, thus contributing to more resilient livelihoods.

Another key aspect suggesting a considerable potential for successful adaptation in organic farming is diversity. Organic farms show a higher diversity of crop varieties, animal breeds and often also semi-natural habitats, which supports resilience against adverse impacts of climate change and provides the basis for intact ecosystem services provision, such as biological pest control. This is important in the context of climate change, as it is expected that pest and disease pressure will increase in many regions. Furthermore, new plant pests and diseases facilitated by trade, management intensification and climate change will have an impact on agricultural productivity. Organic farming with its high diversity of habitats, species and management practices is able to show high resilience in respect to pests and diseases. The tendency to work with locally adapted varieties further works in the direction of in-

Soils after heavy rain under organic (left) and conventional management – thanks to the better soil structure, organic agriculture is better able to deal with extreme events, which are likely to increase in frequency with climate change.

Photos: Research Institute of Organic Agriculture FiBL

creased resilience against the adverse effects of climate change.

One important element of adaptation strategies is precise and concrete local information on the impact of climate change, for example regarding crop suitability, or risk assessment for pests and disease outbreaks. Especially for organic farmers such an "early warning system" can be highly relevant, as they have no quick-fix method to tackle pests with pesticides. Moreover, organic farming is knowledge-intensive, and organic farmers particularly depend on being knowledgeable about their land, soil, ecosystems and biodiversity situation and its changes and development. They are thus likely to be particularly sensitive to changes, allowing them to react early and well-prepared.

A LOT OF STAYING POWER IS NEEDED

There are thus many indications of an improved performance of organic farming in the face of climate change impacts. Research efforts steadily increase, but review work to gain more aggregated and robust knowledge on this is still scarce, which is due to the fact that measuring successful adaptation is much more complex than measuring successful mitigation. Successful adaptation is only visible after several years or even a few decades. This would require long-term commitments of international research funding, which is seldom possible in the current research context with its rather short-term visions between three and five years maximum. The situation is different for mitigation achievements such as avoided greenhouse gas emissions, which can already be assessed on an annual basis.

Unlike for mitigation, where indicators per unit of output are used for communication, it often makes less sense to link adaptation services to the product quantity only. To a substantial degree, adaptation indicator performance is linked to agricultural area, farm, household or regional level. Thus, the yield gap is only of secondary importance for this.

On the contrary, one could even argue that more extensive systems such as organic farming, where farmers crop larger areas with lower yields but better adaptation prospects, provide more resilient livelihoods for the whole community than intensive conventional production. Furthermore, organic farming systems allow for a number of further environmental, economic and social co-benefits. These include reduced eco-toxicity, lower energy use and lower eutrophication potential per area, or reduced input costs and consequently higher profitability, for example.

LIVELIHOOD STRATEGIES

Organic farming can thus be seen as an overall strategy for sustainable livelihoods beyond the benefits for climate change mitigation and adaptation. Reduced input costs and higher profitability, for example, directly work towards an improved livelihood basis. These benefits do not relate to climate change adaptation only, but contribute to sustainable livelihood strategies in the face of many other challenges, such as demographic change, lack of employment opportunities or migration. Along this line of thought, the importance of the yield gap also dwindles. It is one aspect among many others for a sustainable livelihood strategy, while it can dominate results when focusing on the climate change mitigation potential per unit of product.

We emphasise that by this discussion we do not want to posit that low or high yields do not make a difference. The aim of the discussion is to put the role of yields of agricultural production systems and yield differences between such in a wider context and to highlight that they are only one important indicator among many others. All other aspects, such as inputs, being equal, higher yields are usually clearly better for the farmer as they directly relate to higher revenues – unless oversupply results from high yields on many farms, thus

resulting in corresponding drops in prices on the market.

THE FOOD SYSTEMS PERSPECTIVE

Despite the advantages of organic farming regarding climate change and livelihood strategies, the challenge of leakage of production still remains. Therefore, we need to ultimately adopt a food systems perspective to discuss the role of organic farming in climate change mitigation and adaptation. On a food systems level, food security is provided by supplying enough products to meet the demand (thereby for once neglecting the central aspect of adequate distribution and access to food). If production falls short due to lower yields, the solution does not necessarily lie in yield increases at all costs. We could rather focus on reducing the demand. In our current food system, working on demand is best possible along two lines. First, there is the option to reduce consumption of animal products and correspondingly reduce demand for concentrate feed from croplands that is in competition with direct human nutrition. Second, it is possible to reduce demand via reduced food wastage, given that about a third of today's production is wasted or lost. Working on these aspects of demand can result in lowering the demand to a level that easily can be met with lower yields.

We emphasise that this discussion is geared to an aggregated view in the context of increasing incomes, growing middle-classes also in low-income countries, and correspondingly increasing demand for animal products in a "business-as-usual" projection. We are aware that there are many contexts where this discussion would be downright cynical, where demand reduction is no option. Albeit, there too, reducing post-harvest and storage losses may often contribute to improvements and works similarly to demand reductions. This is all the more important in the context of climate change, where yield forecasts report much lower increases than realised in the past, down to stalling or even decreasing yields for key crops such as rice, wheat or maize. In such a context, the yield gap may even narrow, given the indications that organic farming performs particularly well regarding adaptation to the threats of climate change.

COMBINING THE BEST OUT OF ALL SYSTEMS

So, what does this all mean? It means, first, that climate change mitigation potentials in organic farming are real but should not be overestimated. Second, mitigation should not be addressed by focusing on the production side only. It is a central topic to be discussed on a food systems level where demand patterns are essential, too. Third, it means that organic farming is a promising strategy for climate change adaptation. There too, though, a mere focus on climate change is too simplistic. Organic farming is a sustainable livelihood strategy that has promising effects along a broad number of indicators where climate change adaptation relates to a subset only. Fourth, it means that in all this, organic farming may serve as a blueprint for sustainable agriculture, also contributing to improving non-organic approaches. The debate should not result in quarrels on which production system may be better or worse regarding climate change mitigation and adaptation. It should rather identify where the strengths and promising practices of each production system lie and how these may be transferred to and implemented in other contexts, to the benefit of all stakeholders.

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TOOLS FOR RISK ASSESSMENT

Tackling risks arising from climate change, environmental degradation and natural hazards in an integrated manner is one of the greatest challenges of today – notably in development co-operation. These risks significantly influence the resilience of systems and communities thereby often threatening the poorest disproportionally. There are several tools to integrate climate, environment and disaster risk reduction (DRR) aspects into development co-operation to safeguard development achievements. One such tool is the **Climate, Environment and Disaster Risk Reduction Integration Guidance – CEDRIG**. It helps development and humanitarian actors to reflect whether existing and planned strategies, programmes and projects are at risk from climate change, environmental degradation and natural hazards, as well as whether these interventions could further exacerbate these challenges.

The guidance is composed of three modules: CEDRIG *Light* will help you to decide whether a detailed risk and impact assessment must be conducted or not. It is proposed to be conducted individually or by involving only a few relevant stakeholders for maximum two hours. In case of a 'yes', CEDRIG *Strategic* will help you to analyse strategies and programmes, while CEDRIG *Operational* will be applied for projects. Both are proposed to be conducted in a participatory manner by organising a workshop with all relevant stakeholders. Its duration can vary from 1.5 to 3 days depending upon the scope, interest and availability of the participants and whether a (recommended) field visit is feasible. The end result of the analysis will include concrete identified measures to improve the strategy, programme or project along with respective actions and indicators to monitor their implementation.

CEDRIG offers the possibility to invite the workshop participants (and others) to access each application and thus to create a team. It further allows storing documents including pictures. An offline version of CEDRIG is available that allows to use CEDRIG while not being connected to the Internet. The content can then be easily transferred into the online version. Currently CEDRIG is available in English, French and Spanish – a Russian version is under development.

The Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL) was designed to help users design activities that support climate adaptation (i.e. adaptation to climate variability and change) at the community level. It helps them to identify and prioritise climate risks that their projects might address. CRiSTAL seeks to systematically assess the impacts of a project on some of the local determinants of vulnerability and exposure, so that project planners and managers can design activities that foster climate adaptation. The tool is available in English, French and Spanish.
More information: www.cedrig.org; www.iisd.org/cristaltool

A coffee producer in Nepal.
Photo: HELVETAS Swiss Intercooperation

HOW TO CONSIDER CLIMATE RISKS IN MARKET SYSTEMS

Changes in climate conditions can lead to shifts within a market system – with both negative and positive effects for the individual stakeholders und sub-sectors. Helvetas Swiss Intercooperation has developed a Guideline designed to systematically establish corresponding climate risks. Our author presents initial hands-on experiences from Nepal and Madagascar.

By Nicole Clot*

Already today, climate change, in the form of extreme events, seasonal variability with too much rain or lack of rainfall combined with high temperature, is a harsh reality for millions of farmers who have to cope with degraded and weakened natural resource systems. They often lack knowledge about potential options for adapting their production systems and have limited assets and risk-taking capacity to access and use technologies and financial services. However, opportunities are also emerging where farmers can suddenly grow crops that they could not grow in the past. It is therefore important to apply a climate risk and vulnerability approach in natural resource-based market systems and hence take proactive and planned rather than reactive action, including identifying emerging opportunities.

For this reason, Helvetas Swiss Intercooperation started to systematically address climate risks in its market system projects and has recently developed the Guideline "Assessing Climate Risks and Vulnerabilities in Market Systems" (see Box on page 24). The Guideline shall help (small-scale) businesses, private and public, in better understanding climate risks and opportunities in their sub-sector, identifying where emerging market opportunities exist and developing a comprehensive climate risk management approach as part of the enterprise. To maintain a viable sub-sector, all market actors have to understand the importance of including climate adaptation and disaster risk management in the perceived or foreseen changes in their sphere of influence and responsibility. The proposed measures should be environmentally, socially and economically sound in order to justify the investments of different market actors.

Currently, the Guideline has been applied by Helvetas in various sub-sectors in Nepal (coffee, banana, sweet organs, walnuts, macadamia, medicinal and aromatic plants, riverbed vegetables and charcoal) and Madagascar (cacao and cotton jointly with Lima bean and *Artemisia annua*). In the following section, we share some results.

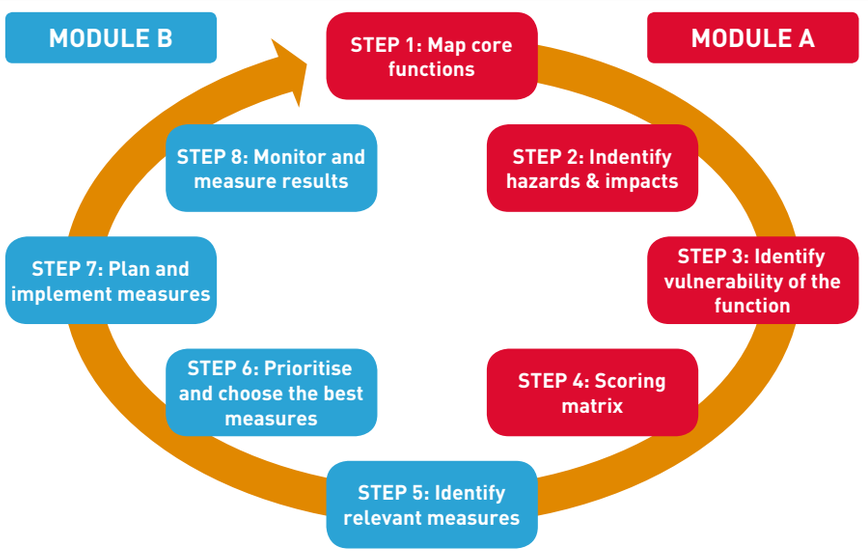
SHIFTING COFFEE CULTIVATION BOUNDARIES IN NEPAL

The Asian Highland region has been warming at greater than global average rates, and projections indicate continuing increases in temperatures by two to four degrees Celsius into the 2050s. Despite much regional variation and uncertainty regarding rising temperatures and associated changes in precipitation and evaporation, these climatic changes will lead to shifts in production areas and hence to changes in agricultural practice among small-scale farmers. According to the risk assessment conducted with three different stakeholder groups (members of a coffee co-operative, representatives of a district coffee cooperative union and the coffee promotion team of Helvetas) and complemented with scientific information, coffee production is adversely affected by rising temperatures linked with increasing

THE GUIDELINE IN A NUTSHELL

The Guideline "Assessing Climate Risks and Vulnerabilities in Market Systems" builds on existing approaches (i.e. risk assessment tools such as the Community-based Risk Screening Tool, Adaptation & Livelihoods – CRiSTAL or the Climate, Environment Disaster Risk Integration Guidance – CEDRIG (see page 22)) as well as approaches related to market systems development. It seeks to orientate and support practitioners by bringing in a risk and vulnerability perspective in market systems and identifying the most climate-resilient sub-sectors in a given context. It consists of a series of eight steps, structured according to Module A and Module B.

8-Step approach towards risk-resilient sub-sectors



Source: HELVETAS Swiss Intercooperation 2016

Module A launches an analysis of the wider and broader market system that contains the core functions of a system (Step 1). This is then followed by a detailed risk assessment of current and potential hazards (Step 2). Step 3 involves an analysis of the different functions and their vulnerability to current and potential climate risks. And finally, the most resilient sub-sectors to climate change are identified based on a scoring matrix in Step 4. With the support of Module B, the most appropriate measures for adapting to climate change and managing disaster risks for a specific sub-sector are identified (Step 5), resulting in a concrete action plan (sustainability matrix) where role and responsibility for short- and long-term measures are defined (Step 7). And finally, Step 8 supports practitioners in elaborating result chains for monitoring and measuring the results.

humidity and a decrease in precipitation as well as increased occurrence of fungal diseases and insect infestations and increased drought during the dry season due to a decrease in precipitation in that season. The results of the risk assessment are in line with farmers' observations reporting decreasing quality of green bean caused by higher temperatures and humidity at lower altitudes.

The analysis further revealed that not only the production but also other core and support functions such as pulping, storage and seedling production are affected by climate risks. Based on the main impacts identified for each market function, possible adaptation and disaster risk management options were identified (see Table). For the final measures selected, jointly with stakeholders, an Action Plan (sustainability matrix) has been developed defining each actor's role in the system, i.e. who will do it (implementation responsibility) and who will pay for it (financial responsibility). The Action Plan reflects a good mixture of short-term and longer-term measures which require more incremental and transformative changes such as varietal research or a shift to higher altitude, implying that coffee production below 1,000 metres above sea level may no longer be appropriate in Nepal.

Short-term measures such as intercropping, promotion of proper shade trees as well as moisture management were also identified. Based on these proposals, different actors have initiated the implementation of concrete measures and facilitated further discussions to prepare the farmers to these changing climatic conditions and hence to become more climate-resilient.

Interestingly enough, the findings from Nepal are in line with a recent study conducted on coffee production in Latin America where even under an intermediate emission scenario (the so-called RCP or Representative Concentration Pathway, 4.5), the total for suitable land for coffee production is expected to fall by 73 per cent by 2050 compared to 1950–2010.

A RELATIVELY RESILIENT COCOA SUB-SECTOR IN MADAGASCAR

Cocoa dominates the area around the Sambirano River in northwest Madagascar, delivering weekly incomes for more than 30,000 farmers. The region is characterised by a microclimate ideal for cocoa with hardly any chemical additives that is purchased by well-known chocolatiers. However, despite the area under cultivation having almost doubled during the last decade, yield has dropped, one of the reasons for this being climate change. Helvetas has applied the Guideline in its cocoa project, which is funded by the Lindt Cocoa Foundation as part of the Lindt & Sprüngli Farming Program.

The application of the Guideline, which included focus group discussions with farmers and interviews with state and private actors, complemented by secondary data, revealed that the changing of seasons (i.e. longer dry seasons and shorter rainy seasons, with both more accentuated) is regarded as a major hazard. Not only has it already had an impact, but it will further exacerbate other prioritised hazards such as flooding, cyclones, droughts, fungal diseases and insects. The application has shown that these hydro-meteorological phenomena affect not only production but also other core functions within the market system such as drying and transport. The continuing trend of increasing mean and maximum temperatures could significantly enhance future drought stress and hence become a limiting production factor. Since the introduction of cocoa as a cash crop, the increased groundwater level has been one of the reasons why cocoa plants in the region endure a dry season that exceeds by far the tolerance level of three months with less than 100 mm rainfall.

Alongside the Helvetas interventions which already contribute to climate resilience (e.g. sharing knowledge of biological treatment of recently emerged pests in the training modules, introduction of rain-resistant drying infrastructure), adaptation and disaster risk management measures are included in the training modules for cocoa producers to enhance the farmers' climate adaptation capacity and raise their awareness concerning ecosystem services of forests and natural resources. While Helvetas supports the development and realisation of these training modules, trainers of local partners (i.e. operators/exporters and supporting institutions) carry them out.

The application of the Guideline resulted in the discovery of mutual influences between climate risks and unexploited potentials of market systems that can now be addressed in a more comprehensive manner. For example, reforestation of hills or systematic shade tree management decrease future climate risks and can be combined with strategies of integrated pest management, alternative incomes based on timber or non-timber products or the valorisation of carbon storage in compensation projects. Other identified measures are related to local weather stations and warning systems, sewerage, phyto-sanitary studies, weather and pest-resilient stocking methods, research on climate-resilient cocoa varieties and shade trees.

> Climate change is the greatest and widest-ranging market failure ever seen, as in most markets, the effect of this market dysfunction falls most on those least able to take action to escape its consequences
>
> The Stern Report

In sum, while climate does affect the different functions of the cocoa system, the analysis revealed that cocoa is still more climate resilient compared to other local products, i.e. rice that is mainly cultivated in subsistence. Even though far from replacing the functions of primary forests, cocoa in agroforestry can also serve as an important climate regulator. The application facilitated the findings of combining adaptation, mitigation and development goals. Such a comprehensive multi-benefit approach is key for sustainable development and in line with current initiatives on sustainable cocoa.

Nepal: Climate adaptation and disaster risk management options according to market functions

Climate risk relevant market functions (see STEP 1 in figure)		Relevant climate risks (see STEP 2 in figure)	Remarks on impacts	Adaptation to climate change and disaster risk management measures
Core	Production	Increased temperature; decreased precipitation and drought; increased humidity; fungal diseases; insect infestation	Reduced yield per plant; increased mortality of plants; lower quality of fresh cherries Shift in production area: shifting altitudinal belt; overall expected reduction in production area	• Varietal selection and research • Intercropping • Proper shade tree management/shade tree plantation • Moisture management/rainwater harvesting • Altitude shift (above 1,000 meters)
	Pulping	Increased temperature; increased humidity; fungal diseases	Changed processing management; decreased fermentation duration, increased threat of fungal diseases (mould)	• Improved pulping facilities such as clean water for washing • Improved drying system with clean drying yard: drying table • Appropriate storage facility (i.e. well ventilated room, prevent dampness and odour)
	Storage	Increased temperature; increased humidity; fungal diseases	Increased threat of fungal diseases (mould)	• Appropriate storage facility (i.e. well ventilated room, prevent dampness and odour)
Support	Seedling production	Increased temperature; decreased precipitation and drought; increased humidity; fungal diseases; insect infestation	Increased mortality of seedlings	• Priority to onsite nursery development • Shift in altitude (above 1,000 meters)

Source: HELVETAS Swiss Intercooperation 2017

ADJUSTABLE TO LOCAL CONTEXTS

The application of the Guideline confirms that a sound understanding of the causes and effects of climate change is required to facilitate long-term viability of agricultural sub-sectors and to identify innovative and efficient adaptation and risk management solutions. Risk and vulnerability assessments are the first crucial steps towards a better understanding of the local context. In the case of Nepal, where various sub-sectors have been assessed, climate impacts vary from sub-sector to sub-sector within the same region. This confirms once more that there is no one size fits all approach when it comes to adaptation to climate change, and hence sound risk assessment is key to identifying future interventions. And it underlines the importance of carefully monitoring adaptation measures in order to see what works and what does not and hence to make necessary adjustments (adaptive learning). This also gives space for identifying good practices and measures that are suitable for scaling up new measures or assessing whether new strategies need to be included. Different actors have different stakes in the market system, but rely on each other's performance. This requires all the actors to review their role, their possible contributions and their necessary actions towards concentrated efforts to climate change adaptation and risk management.

Here, the Guideline can make an important contribution. Experience so far has demonstrated that it represents an effective, simple and low-cost instrument for single use and/or comparative purposes (i.e. same sub-sectors in different regions, different sub-sectors in the same region). Practitioners can apply and adjust it to their local contexts and needs; and it can help them approach development issues systematically and balance economic, social, political and ecological demands in a sustainable way.

* With inputs from Jürg Merz, Andrea Wynistorf, Lea Eymann and Annick Vollmar.

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For further information and links to the programmes, see: **www.rural21.com**

RESILIENCE-BUILDING – EASIER SAID THAN DONE

With view to climate change, raising the resilience of rural households and local communities is becoming ever more important. Practising Climate-Smart Agriculture and establishing early warning systems are two elements employed in this context. However, limitations quickly become clear in practical implementation. Taking experiences from the Concern-led „Building Resilience in Chad and Sudan" programme, our authors reports on success factors and obstacles.

By Cecilia Benda and Anastasia Marshak

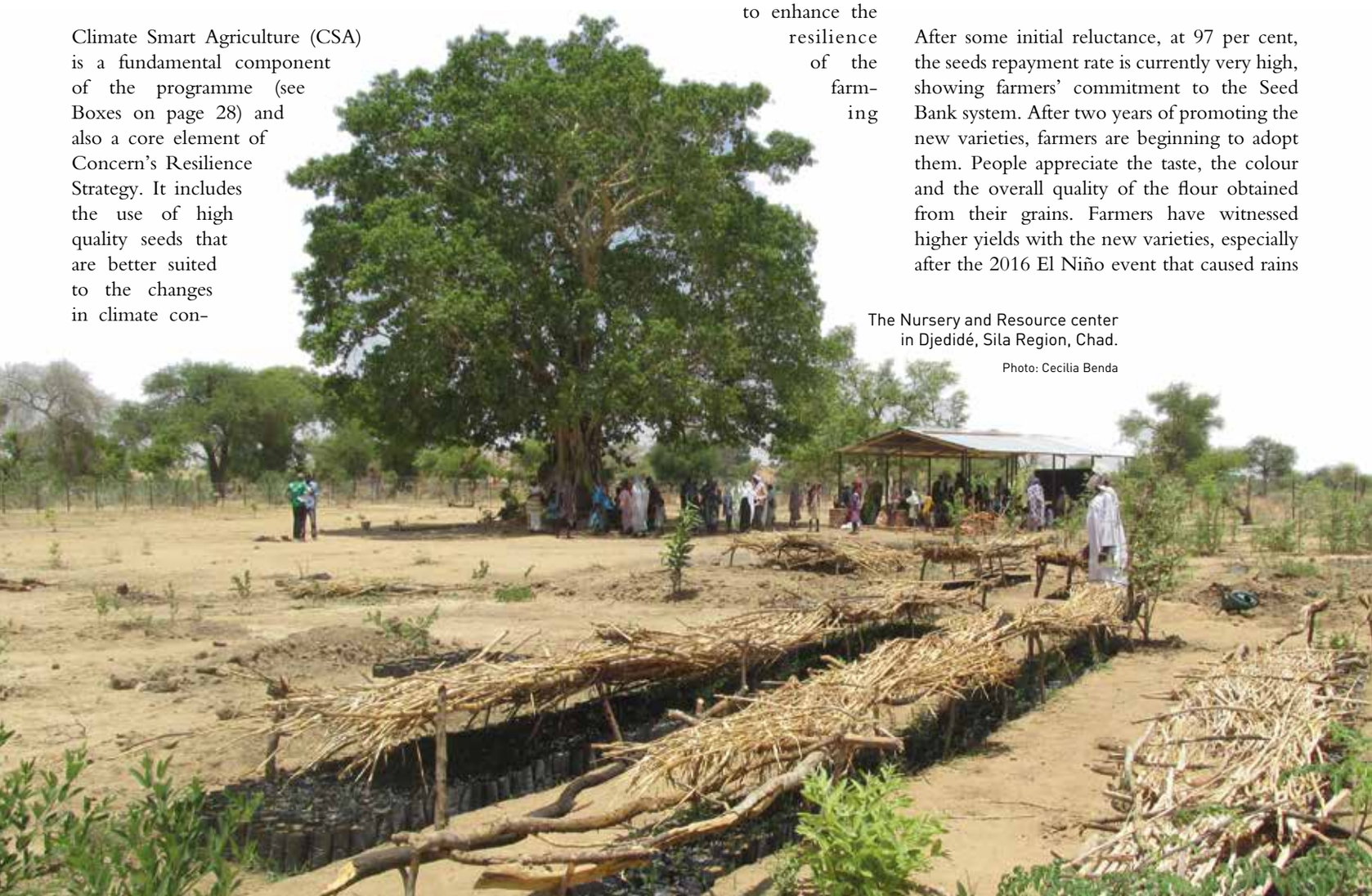
Increasing erratic climate patterns, a rise in temperatures and more frequent extreme weather events have been witnessed throughout the Sahel. Boosting the region's capacity to respond to such changes is vital to enhancing food security and household and community resilience to the effects of climate change. In order to adapt the food production systems to these trends and make them less vulnerable to the impact of climate change, Concern Worldwide launched the Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) programme in Chad and Sudan.

DROUGHT-RESISTANT VARIETIES IN WEST DARFUR

Climate Smart Agriculture (CSA) is a fundamental component of the programme (see Boxes on page 28) and also a core element of Concern's Resilience Strategy. It includes the use of high quality seeds that are better suited to the changes in climate conditions. Within the programme, Concern has been partnering with the Sudan Agricultural Research Corporation since 2015 in order to promote and increase access to two drought-tolerant and quick-maturing varieties of millet and sorghum, Ashana and Butana respectively. These varieties mature in 70 days only compared to between 90 and 120 days with traditional varieties. A seed bank system was established in Bangadeed community and through it, 50 farmers were provided with Butana and Ashana mother seeds to have them test and multiply seeds for further distribution. Farmers were sensitised to the importance of growing varieties that are adapted to the changing climate and having a range of different crops in the farm to enhance the resilience of the farming system. Trainings on seeds multiplication and cooking demonstrations were organised to make people familiar with the taste and texture of the new varieties. After the first season, farmers brought back a certain amount of seeds to the seed bank to ensure that other farmers could benefit from further distributions. The following season, Concern bought Ashana and Butana seeds from the seed bank and distributed them to vulnerable farmers in other villages at seed fairs. This approach was deemed successful for timely procurement and suited to stimulate local economy.

Good acceptance thanks to visible success

After some initial reluctance, at 97 per cent, the seeds repayment rate is currently very high, showing farmers' commitment to the Seed Bank system. After two years of promoting the new varieties, farmers are beginning to adopt them. People appreciate the taste, the colour and the overall quality of the flour obtained from their grains. Farmers have witnessed higher yields with the new varieties, especially after the 2016 El Niño event that caused rains



The Nursery and Resource center in Djedidé, Sila Region, Chad.

Photo: Cecilia Benda

to stop earlier. Only those who used improved seeds managed to have a decent harvest, whereas local varieties failed almost completely. Having recently increased their cereals production, farmers feel more food secure. They reported a longer period during which they had enough food at home. Many households even managed to sell surplus production.

Thanks to the awareness creating activities, sorghum has seen a surge in popularity, and the revived interest is promoting household diet diversification. Having become aware of the new varieties, many people from other villages have visited the seed bank to request seeds, and those unable to pay have managed to exchange grains for seeds. Butana and Ashana grains have started to appear in nearby markets, although in small quantities given the limited supply. Still, they fetch high prices and are sold very quickly as their popularity grows.

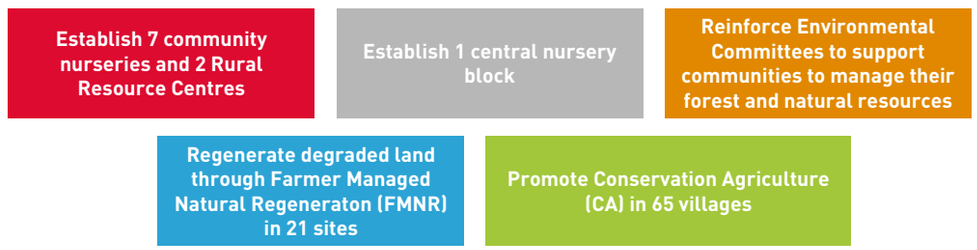
Future steps

Farmers often rely on "normal" grains bought in the market rather than on high quality seeds for planting. The programme is currently working to obtain quality certification for seeds produced by farmers, and to develop a packaging system for seeds with appropriate logos, batch and certification numbers. This will improve visibility and provide quality assurance to farmers, thus encouraging them to obtain improved seeds, along with expanding access to market channels, like local agro-dealers and traders. The seed bank committee will also undergo further capacity building on business management to improve its capacities to run the business in a sustainable manner. These are all regarded as necessary steps to capitalise on what has been achieved so far to ensure that positive results on food security and access to high quality seeds for resource-poor households can be sustained in future.

AGROFORESTRY SYSTEMS FOR CHAD'S SILA REGION

Concern has worked in the Sila region in eastern Chad since 2007 with emergency responses as a consequence of the Darfur conflict and food insecurity crises. After a fragile calm had returned to the region, in 2012, Concern began to address causes of food insecurity and malnutrition with the Community Resilience to Acute Malnutrition programme integrating Health and Nutrition, WASH (Water, Sanitation, Hygiene), Food Security, Disaster Risk Reduction and Gender. Since 2015, the BRACED programme has continued to promote resilience and has reinforced the Climate-Smart Agriculture component to adapt to the on-going trend of erratic rainfall patterns, increase in temperatures and land degradation across the region. For this purpose, a partnership has been entered with the World Agroforestry Centre (ICRAF). Trees are perennial "crops" which, once established, have better chances to withstand erratic rainfall and yearly climatic variations compared to annual crops, thus promoting more stable productions and diversified incomes from the sale of their produces. Agroforestry is therefore considered part of Climate-Smart Agriculture (CSA).

CSA and agroforestry activities in the BRACED programme in Chad



In Chad, the CSA interventions that mainly focused on agroforestry and Conservation Agriculture (CA) have covered 65 villages (see Figure). ICRAF's technical know-how has been drawn on e.g. to establish nurseries, Concern's staff and community members have been trained on agroforestry techniques, and access has been increased to improved trees' genetic materials (e.g. trees with increased pests and diseases resistance, or reduced periods before starting to produce fruits) and for the domestication of indigenous trees species already adapted to the local environment. A wide range of exotic and indigenous fruit trees were raised in community nurseries, including: moringa; Citrus spp.; mango, guava; papaya; *Balanites aegyptiaca*; *Ziziphus mauritiana*, tamarind, Acacia spp. and marula tree. Community nurseries produced over 5,000 trees seedlings in the first year. They were purchased by Concern and distributed to community members.

> Community resilience is the ability of all vulnerable households or individuals that make up a community, to anticipate, respond to, cope with, and recover from the effects of shocks, and to adapt to stresses in a timely and effective manner without compromising their long-term prospects of moving out of poverty.
>
> Core definition of Community Resilience for Concern

Initial successes

The tangible benefits that agroforestry can bring to vulnerable households are yet to materialise, as trees are still young and have not started producing yet. Nonetheless, some quick wins have already emerged. For example, moringa has been promoted, a fast-growing tree producing highly nutritious seeds and leaves within less than one year of planting. The "Arboloos" initiative foresaw one moringa per household where fruit trees were planted on closed latrines as part of the CLTS (Community-Led Total Sanitation) approach with the aim to combine sanitation and nutrition outcomes. Cooking demonstrations were carried out with care groups to promote moringa consumption, and now women have started to prepare meals with moringa leaves. Farmer Managed Natural Regeneration (FMNR), an agroforestry practice promoting the protection and regeneration of trees on the farm, is also spreading quickly amongst farmers, who are starting to realise the value of trees in terms of biomass and firewood.

To make the measures sustainable, BRACED worked with local innovators and lead farmers, recognised experts in farming, with a good capacity to teach others and willing to take risks by embarking on new practices, also called early adopters. Having them involved in trainings and participatory on-farm research trials is promoting knowledge transfer and inspiring other farmers to try and adopt innovative technologies, thus ensuring continuation of activities after BRACED.

The water challenge

However, the main challenge for ensuring the success of agroforestry is water. Farmers constantly cite access to water as a limiting factor for their ability to continue or expand agrofor-

estry, and investments need to be considered in water infrastructure, such as improved wells or rainwater harvesting systems. Concern has established protected wells at each community nursery and is currently working on promoting other water infrastructures.

Communities have raised worries about the financial sustainability of the community nurseries, and for this reason, a value chain and market survey will be conducted to identify opportunities for income generation, thus motivating communities to become self-sufficient. Chad has no specific policy on agroforestry, and the lack of institutional knowledge greatly limits the resources allocated for promoting it across the country. Dialogue with relevant public institutions has been initiated to ensure that agroforestry will be included in future environmental and agricultural policies and also to reduce local-level barriers to its implementation. More advocacy work will be needed to achieve these objectives.

ENHANCING THE ADAPTIVE AND ABSORPTIVE CAPACITIES OF HOUSEHOLDS

Exposing farmers to climate-smart agriculture practices like agroforestry enhances their **adaptive capacities**, or their ability to adapt existing systems to better cope with future shocks and stresses, by providing new tools and innovative technologies to mitigate risks of climate change. **Absorptive capacities**, "the ability to 'absorb' or cope with a shock when it happens", usually through better anticipation, preparedness, and reduction of vulnerability to that specific shock, are being encouraged as well through increased and diversified productions and alternative income opportunities derived from the sales of agricultural surplus and trees products.

ABOUT BRACED AND BRICS

The BRACED programme, funded by the Department for International Development (DFID) of the UK government, aims to build the resilience of more than five million vulnerable people against climate extremes and disasters. The programme comprises 108 organisations forming 15 consortia that implement 15 projects across 13 countries in the Sahel, East Africa and Asia. Amongst the BRACED consortia, the BRICS (Building Resilience in Chad and Sudan) programme is led by Concern in partnership with ICRAF (World Agroforestry Center) in Chad, the Feinstein International Center of Tufts University in both Chad and Sudan and the Almassar Charity Organisation as a sub-partner in Sudan.

EARLY WARNING SYSTEMS IN CHAD: FORECASTING FOOD SECURITY

Early warning is a key component in eliciting and informing a timely response to a drought to protect lives and livelihoods before they are threatened. To that end, since 2012, the Feinstein International Center has been working with Concern Worldwide to develop and test a model that uses local and historical rainfall in the Kimiti Department in Chad to predict future crop production, which is linked to food security. Our modelling approach borrows from the field of machine learning using historical remote sensing rainfall data (data obtained from satellites for the local region from 2000–2016). We combine this with crop productivity data provided by the Kimiti Department's government agriculture services for the planting period (June–September) to predict future millet productivity (kg/ha). We use millet as the indicator crop in the model because it is the main cereal crop in Kimiti.

The model looks at the amount and distribution of rainfall throughout the five main growth phases of millet because the requirements for water, nutrients, and sun vary during each phase. In addition, it uses a moving start date to account for the large variation in sowing time based on the timing of the first rains. Remote sensing data is particularly valuable because it is available in real time and hence can provide an initial prediction of harvest quality a few months in advance of official national predictions. The millet productivity data, in turn, can serve as a proxy of food security because most households depend primarily on rain-fed agriculture and have limited access to agricultural inputs. We argue that in a context where, according to our survey results, 89 per cent of the population are directly or indirectly reliant on agriculture for food or income, and the majority of the population (75 per cent) consume what they grow and have limited alternative employment opportunities, cereal crop production can serve as an appropriate proxy for food availability and potential access.

While we have seen some success with the model, some limitations remain.

- When developing models, the more data you have the more accurate your model is. Forecasting models therefore require hundreds or thousands of data points. In this case the more years of rainfall and crop production data we have, the more accurate the model can be. Currently we have only 14 years of data. To address this, we used a statistical technique called repeated cross-validation, which allowed us to create "new" data points and increase our total number of observations. As we continue to add data annually, the information should become more accurate and precise.
- The model does not apply to all households. For example, households who have access to market gardens or cereal plots near the seasonal rivers would be less affected by rainfall deficits. Pastoralists, who mostly rely on markets for cereals, are less impacted by local production shocks, although a production deficit would affect supply and prices.

While we are improving technical aspects of the model, it has to be borne in mind that the political and economic context in which the model operates plays an important role in the interpretation of and responsiveness to the prediction. The model must be useful to a wide range of potential users, including local communities and decision-makers at the departmental, regional, and national level, in order to elicit an appropriate response to a potential emergency.

The model was registered as an official source to inform the 'Cadre Harmonisé' (CH), a regional framework aimed to prevent food crisis by quickly identifying affected populations and proffering appropriate measures to improve their food and nutrition security. The CH uses food and nutrition security outcome indicators, corroborated by relevant contributing factors, to establish where the food and nutrition insecure areas are within the Sahel and West African Countries.

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DROUGHT CYCLE MANAGEMENT FOR BUILDING RESILIENCE AND FOOD SECURITY

With global climate change progressing rapidly, droughts are predicted to increase in frequency, duration and severity. To combat the impacts, adequate vulnerability assessments, early warning-systems, and efficient disaster relief must be combined with the long-term investment in drought mitigation and adaptation. In the following article, our authors describe what such drought cycle management could look like.

By Michael Brüntrup and Daniel Tsegai

Based on various characteristics such as severity, duration, spatial extent, loss of life, economic loss, social effect and long-term impacts, several studies find that drought is the most far-reaching of all natural disasters. In the context of poverty and food insecurity as well as political instability, drought and its associated impacts is responsible for more deaths and displacement of people than any other natural disaster. The adverse impacts of drought are particularly serious for the poorest and most vulnerable in the drylands of developing countries whose economy relies on rain-fed agriculture and pastoralism.

The channels through which drought affects these vurnerable households are multifaceted and complex: they include lack of water for people and livestock, pasture and crops, energy, food availability and the rise in food prices, loss of lives and livelihoods, and assets. They fuel local conflicts around natural resources. And, while it is contested whether it leads to or amplifies larger conflicts and mass migration in the short run, there can be no doubt that in the long run, an increase in the frequency and severity of droughts would do exactly that.

ESSENTIALLY NATURAL, SOCIALLY CONSTRUCTED

The reasons for the emergence of droughts are essentially natural – droughts have accompanied humankind from the very beginning and have been conceptualised one of the apocalyptic riders. As humans have increasingly shaped their environment however, drought risk has at least in part been socially constructed. Deforestation, forest fires, overgrazing, soil mining, land and vegetation degradation and water mismanagement lead to increased susceptibility to droughts, foster the drying of soils and water runs, overexploitation of groundwater reservoirs and, in sum, reduce the resilience of the landscape and of people along with the natural resources they depend on. In addition, the creeping and multi-faceted nature of droughts, often concentrated in rural areas, coupled with the lack of systematic recording of drought impacts does contribute to its reduced political and economic visibility and this in turn reduces the willingness to address underlying risks.

In the coming decades, drought is projected to increase in severity, frequency, duration and spatial extent, at the same time as the world's land areas are expected to be drier overall in the 21st century. This will have severe consequences for people in poor countries and particularly in rural areas with arid and semi-arid lands which are extremely susceptible to droughts. It may be noted that recent simulations show that even the food security of developed countries may be threatened by droughts if they hit various large global production areas – such as United States and China for maize – simultaneously, which has never happened in historical times but becomes a possibility under climate change.

While the general process of economic development helps to alleviate the negative effects of droughts, this route is (too) long for developing countries, and will not be enough. Economic development itself can be compromised by intense and frequent droughts, and certainly local development is at risk. In addition, the effectiveness and efficiency of ad hoc drought management approaches – only coming into action with emergency measures when drought strikes – are low and long-term impacts are often not, or cannot be, considered.

Thus, proactive approaches are needed to increase the resilience of people, ecosystems and societies against droughts. In developing countries, food security should be at the core of national drought policies and a strong driving force in the fight against drought at all levels.

DROUGHT RESILIENCE, PREPAREDNESS AND CYCLE MANAGEMENT

The implementation of national drought policies based on the principles of risk reduction can mitigate the impacts of droughts. Such principles and their implications for action are spelt out in international voluntary agreements such as the Hyogo and the Sendai frameworks for disaster risk reduction and the seminal 2013 High-level Meeting on National Drought Policy. Based on these various international frameworks, the following "three key pillars" of drought risk reduction can be specified:

1. Implement drought monitoring and early warning systems.
2. Assess drought vulnerability and risk.
3. Implement measures to limit impacts of drought and better respond to drought.

These pillars can help countries prepare better for, respond to and recover from drought by reducing exposure and vulnerability to drought, increasing resilience, and transferring and shar-

ing drought risks. They have to be translated into national drought policies according to the specific needs, conditions and vulnerabilities, priorities and options of a country.

Drought is a complex, recurrent and slow-onset phenomenon. Unlike other natural disasters, such as floods and earthquakes, it takes long to realise that a drought – length, severity and extent – is in the making with implications for action to limit the impacts. As with all disasters, the disaster-free times should be used to build up resilience, while interventions during the drought times must be special in as far as they have to respond as early as possible, with due consideration of the quality (certainty) of the early warning systems and the evolving drought conditions. Yet, drought interventions should also be designed and implemented in a way to prepare for the next cycle. This leads to the concept of drought cycle management (see Figure) where proactive and reactive measures are interdependent and function in an integrated manner.

A comprehensive list of policy areas required to tackle food insecurity in drought-prone areas is shown in the table on page 31. Many sectors are involved: water, land and other natural resources, agriculture and food trade, social security, economic development and infrastructure, to name only a few. Other domains, such as energy and health, may also be heavily affected by droughts and require good preparedness plans and management.

It is necessary to build flexibility into such concepts. Droughts are slowly creeping phenomena whose (accumulated) impacts not only depend on precipitation but also on water storage, access and consumption, as well as on specific target systems. Thus, it is difficult to determine when exactly they start and end, especially as there is no universal definition of drought. Smallholders and poor consumers may be affected earlier than commercial farmers and the wealthy. While waiting to see how drought conditions evolve, "no- or low-regret" measures have to be taken early on for various target systems and groups, which can be adjusted according to the best available and updated information and risk scenarios. For instance, food stocks can be built up through local storage or international purchases, including by the private sector. This requires reliable data on future crop availability and demand. Water can be used for irrigation to overcome dry spells or short-term droughts but may have to be reduced to the most essential uses during longer droughts if water reservoirs become depleted. Vaccination and livestock reduction campaigns can be set in motion early on to avoid price collapse; and social safety programmes can be scaled up during drought periods, providing cash or food depending on food market conditions (see also articles on pages 32–33 and 34–35).

Special treatment may be required for particularly vulnerable groups of drought-affected people and ecosystems. For example, specific strategies are often necessary for pastoralists who very often live in particularly drought-vulnerable arid areas. Pastoralism has in fact often been the best traditional adaptation strategy in these regions. In more recent times, the flexibility in time and space as well as livelihood options for pastoralists have been shrinking. New trends such as population growth, education, or changes in income sources and consumption habits have pushed for further structural changes. In these settings, improving the resilience of pastoralists against drought requires maintaining a particularly difficult balance between keeping up traditional ways of life and the economy and the shift to alternative livelihoods. Also, women are often affected by drought in ways substantially different from men.

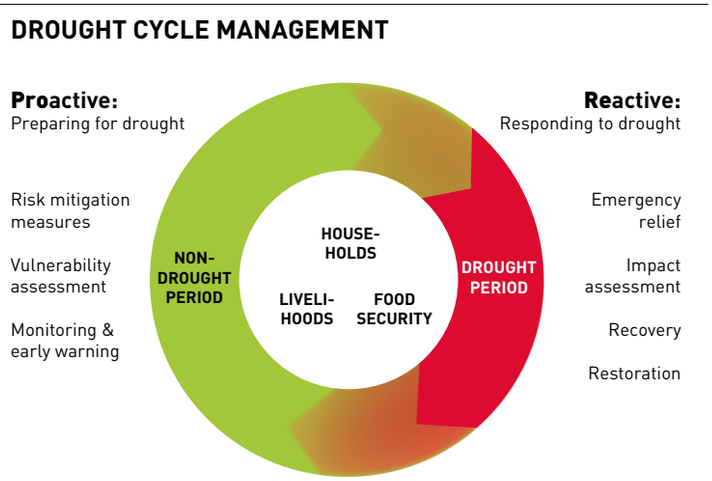
Pastoralists often live in particularly drought-vulnerable arid areas and need special treatment.

Photo: Jörg Böthling

POLICY COHERENCE AND CO-ORDINATION

Policy coherence and coordination for drought resilience is particularly important and at the same time difficult to achieve because it touches upon many dimensions: sectors, various decision-making levels, time, socio-economic and technological transitions, etc. Bottom-up solutions to drought resilience are preferable because they are more compatible with aspirations and local knowledge (particularly for pastoralists), but all too often, they face limitations. Economic diversification away from

Conceptual framework: drought risk management cycle



Source: Authors

Role of key policy domains/ sectors for building up food-security enhancing drought resilience during drought and non-drought times

Policy domain	Non-drought period	Drought period
Early warning systems/ knowledge management	• Risk assessment • Vulnerability assessment • Drought planning • Knowledge dissemination	• Ongoing impact assessment • Monitoring and evaluation of mitigation and emergency measures
Water/ landscape	• Landscape/ watershed management, water harvesting and conservation on- and off-farm • Water storage • (Water-saving) irrigation • Water contingency planning	• Contingency execution (drinking and livestock first)
Agriculture	• Drought resilience breeding • Cropping system adjustment (new crops) • Fostering livestock markets • Seed (emergency) stocks • Managing pastoralism and crop/ livestock integration	• Irrigation or stop according to drought severity and outlook • Livestock vaccination and reduction • Protecting key animals, recovery • Seed distribution (recovery)
Finance	• Crop and livestock (weather) insurance • Savings • Cash transfer facilities	• Ease disbursements • Use for emergency cash transfers (private and public)
Social protection	• Establishing social security systems	• Scaling up to drought-affected populations, cash or in kind
Food markets	• Fostering food crop markets (integration, storage, commercial linkages, ...) • Establishing food price monitoring systems	• Facilitating commercial food inflows • Situation-sensitive regional food aid
General economic development	• Income diversification • Migration as income diversification measure • Infrastructure (transport, storage, telecommunication, etc.) • Contingency planning	• Infrastructure-building as part of emergency aid and reconstruction (cash/ food for work)

Source: Authors' compilation, based on Duguma et al. (in press)

income sources reliant on rainfall is extremely difficult in some rural areas, particularly in the often sparsely populated drought-sensitive arid and semi-arid areas. Not least, there are trade-offs, for example, drought-resilience versus optimisation under normal conditions; investment into production versus resilience-enhancing infrastructure; self-reliance of food production (for normal years) versus establishing food markets (during droughts); or specialisation gains (plus securing measures such as insurance or savings) versus resilience through diversification.

Implementing multi-sectoral drought policies should particularly consider the following:

- In the optimal case, there should be a general framework for disaster risk management, where specific actions against droughts, based on specific needs and characteristics, are identified. For weather-induced disasters (floods), close co-ordination with drought policies is sometimes worthwhile. Whether a standalone or embedded into a larger disaster management strategy, a strong and comprehensive co-ordinating institution is indispensable for drought management in order to enhance co-operation among the various levels of governments, development partners and non-governmental organisations.
- Drought risk management approaches must be integrated into both long-term development measures and humanitarian responses. This requires a clear understanding – by all stakeholders – of short-term disaster relief activities as well as long-term development measures towards resilience-building at community, sub-national and national levels and across many sectors. Regional and international issues should be explicitly considered. A mix of bottom-up resilience approaches that brings the concerns of farmers, civil society and grassroots together with the top-down measures (including national policy) would be optimal, the latter having to support the former (principle of subsidiarity). The Ending Drought Emergency programme in Kenya is an example of such an approach.
- Effective communication among relevant stakeholders is important for the efficient and proper functioning of early warning systems for drought. This should be tailored to long-term drought resilience and preparedness planning, better targeting and proactive action. This also has to extend to strong monitoring and evaluation and knowledge-management of drought resilience efforts and achievements.
- Flexibility of funding (contingency planning) and programmes must be built into development budgets. This means that development programmes can switch to "emergency modus" and fund emergency measures if drought is declared. Flexibility is also required within the on-going programmes. For example, the Productive Safety Net Programme (PSNP) in Ethiopia temporarily expanded during drought periods in many cases (see article on pages 32–33).
- Building the capacity of individuals, institutions and organisations, especially at the local level, is decisive to process and use, as well as to efficiently mobilise and absorb, resources.

In this way, droughts can become a "connector" and an opportunity for strengthened collaboration among many sectors, levels and actors.

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MAKE SOCIAL PROTECTION SCHEMES WORK FOR DROUGHT RESILIENCE: LESSONS FROM ETHIOPIA'S PSNP

During the last decade social protection instruments have gained popularity among policy responses to drought. Several governments in sub-Saharan Africa have integrated cash transfer and public works schemes into their strategies for food security and disaster risk management. Looking at Ethiopia's Productive Safety Net Programme (PSNP), one of the largest programmes of this kind in the region, our author examines which structural bottlenecks have to be removed for social protection schemes to contribute to drought resilience in the long term.

By Mesay K. Duguma

As part of Ethiopia's food security programme, the Productive Safety Net Programme (PSNP) was launched by the Ethiopian government and a group of its development partners in the year 2005. The programme targets the food-insecure population in chronically food-insecure rural districts and aims to bridge food gaps, prevent asset depletion at household level and create assets at community level. For this reason, the PSNP is primarily designed to provide predictable support (food or cash) to households with predictable needs – those households that are chronically food-insecure. In its major component, which covers approximately 80 per cent of the programme participants, it targets healthy and able-bodied adults to carry out public works; as part of its smaller component, vulnerable clients who have no other means of support, including the disabled and elderly, receive unconditional food and/or cash transfers. Besides the standard components, the PSNP comprises risk financing and contingency funds at the regional and district levels that are to be used to expand coverage in the case of drought emergencies. Therefore, both through its public work component and risk financing and contingency funds, PSNP seeks to provide a platform for drought risk management practices and resilience building at household and community level.

A wide range of literature exists regarding the role of social protection in reducing chronic poverty and vulnerability to disasters as well as in facilitating long-term investment in human and physical capital. But is this confirmed by experience on the ground? According to Devereux et al. (2008), Headey et al. (2012) and Jones et al. (2010) experience in Ethiopia shows that productive safety nets can make a valuable contribution to protecting assets against "distress sales" for food and non-food needs, improving household food security, raising household incomes and enhancing resilience. But other findings suggest quite the opposite. Béné, Devereux and Sabates-Wheeler (2012) found that the positive achievements of the programme were rather shallow as regards guaranteeing complete protection of its beneficiaries from the impacts of severe shocks. Similarly, Anderson et al. (2011) did not find evidence that PSNP protected households' livestock in times of climate or economic difficulties/shock, while Gilligan et al. (2009) documented that PSNP had little impact on participants on average, due in part to transfer levels that were far below programme targets.

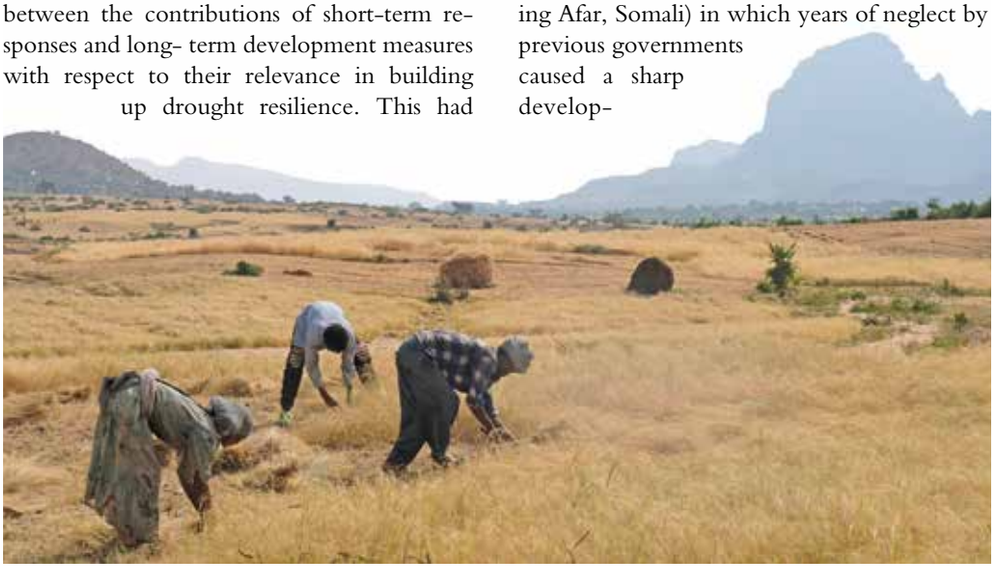
REASONS FOR POOR PERFORMANCE

In order to identify the factors responsible for the poor performance found in the studies, interviews were conducted with federal and sub-national level government stakeholders in Ethiopia. They revealed the following constraining factors that had undermined the impact of PSNP for drought resilience over the years:

Lack of common understanding on the concept of "drought resilience". Some stakeholders lacked clarity in distinguishing between the contributions of short-term responses and long- term development measures with respect to their relevance in building up drought resilience. This had weakened the focus on proactive and long-term measures within PSNP which are useful in building the internal capacity of poor rural people who frequently deal with the negative impact of droughts.

Inadequate co-ordination and harmonisation. The implementation of the programme suffered from weak co-ordination among government stakeholders at federal, regional and lower levels due to the lack of a clear mandate (role and responsibility) of stakeholders. In addition to this aspect, the contingency fund and risk financing of PSNP has been poorly integrated in the overall Disaster Risk Management (DRM) framework. As a result of this, there was weak harmonisation of PSNP activities with early warning information to ensure early action which depends on fast and timely utilisation of the contingency fund.

Decentralisation and capacity gap. The study identified organisational, technological and financial capacity gaps at multiple levels. This has been more pronounced in pastoral and emerging regions of the country (including Afar, Somali) in which years of neglect by previous governments caused a sharp develop-



Farmers producing teff in Mekelle region in Northern Ethiopia.

Photo: Michael Brüntrup

Since 2005, the Productive Safety Net Programme (PSNP) has provided assistance to more than 7 million people, with annual transfers averaging 300 million US dollars. According to the 2014 Program Implementation Manual (PIM), the estimated maximum annual programme caseload till 2020 will be 10 million clients/ beneficiaries, consisting of 8.3 million chronically food insecure individuals and with the capacity to support an additional 1.7 million transitory beneficiaries if need exists. The programme is currently operational in six regions in the country including Tigray, Amhara, Oromia, SNNPR, Afar and Somali.

ment imbalance with the rest of the country. For instance, lack of skilled man power for design and supervision of land rehabilitation technologies under public works, shortage of other resources (equipment including vehicles) and poor public infrastructures remain serious problems in Afar region. By the time of the interview, it was reported that the region owned only two trucks to distribute emergency forage (obtained through aid) to all the districts in the region. As a result, field experts were unable to reach remote districts in time.

Poor quality of public works under PSNP. Field visits to Chifra *wereda* (the Amharic word for district) of Afar region confirmed that poor quality land rehabilitation structures built under the public works have further exacerbated land degradation and slowed down regeneration of vegetation. Much of the problem was caused by lack of technical expert advice prior to designing and building structures.

Shortage of funding for complementary livelihood components. While donors' contributions to PSNP's core programme components have been quite substantial, complementary livelihood programmes such as the Household Asset Building Programme (HABP) have generally received little finance for their implementation. In light of such facts, it has to be stressed that relying solely on regular transfers made through PSNP may not go beyond fulfilling the immediate food needs of households for short-term survival.

"Silo thinking" and limited knowledge and political will regarding a 'multi-sectoral' approach. All government stakeholders interviewed note limited knowledge of multi-sectoral approaches at district and lower level. Furthermore, lack of political will among implementers has been slowing the process. "Silo thinking" among stakeholders is to blame for PSNP within the Agriculture sector having enjoyed weak linkage with the other sectors, including the health and disaster management. This has hampered progress in terms of synergic relationships with other drought resilience initiatives under the responsibility of various line ministries.

Weak monitoring, follow-up and knowledge management. There have been reports from stakeholders that some promising results of pilot drought resilience projects by NGOs were not adequately documented and never scaled up, which hampers the sharing of knowledge and skills among stakeholders.

WHAT DOES THIS MEAN FOR THE FUTURE?

Poverty and inequality are two of the root causes of vulnerability to the impacts of droughts. This is why many of the actions needed to mitigate these impacts require long-term and proactive development interventions. Taking into account the special role that can be played by social protection schemes and the above-mentioned experiences, the following policy implications are drawn to make Ethiopia's PSNP – and safety net programmes in general – work better for drought resilience.

Awareness-raising. Policy-makers should build awareness on drought risk management and the role of PSNP for enhanced drought resilience at all levels, from community to global. These may include use of mass media to create awareness on drought, its multi-sectoral impact as well as its wider implications for national and regional peace and stability. Gatherings for payments could be used to sensitise beneficiaries on drought issues. The linkages of PSNP with other sectors could also be further communicated to develop new, location-specific ideas about raising drought resilience beyond the standard programme.

Better communication. Communication should be improved among donors/NGOs and a government institution, which is decisive for efficient and proper functioning of social protection schemes, drought early warning systems and tailored long-term drought resilience programmes. A regional or national independent platform must be established that consolidates the early warning information on droughts from various sources. This can be in a form of a consortium of various governments, NGOs, research institutions with high profile expertise and reputation.

Mobilising resources. The capacity of individuals, institutions and organisations to use and mobilise resources must be improved. Especially, skill and technology transfer for local PSNP implementers has to be strengthened, the internal capacity of PSNP districts needs to be enhanced. For instance, this would include expanding banking options and complementary business trainings for farmers so that they are able to invest in various sectors (also outside of agriculture) in their community. This could also be used as a source of employment and a buffer in disaster periods.

Quality infrastructure. If social protection schemes are to serve their purpose as long-term development approaches in building drought resilience, then it is important to create and maintain quality infrastructures. Therefore, ensuring the active participation of the most vulnerable group is imperative. In other words, adequate grassroots level community participation from planning to implementation and evaluation should be strengthened. Furthermore, both technical and local human capacity development should be enhanced through learning and experience sharing platforms with the assistance of development partners.

Co-ordination. The impacts of drought are multi-faceted, and its management requires strong multi-sectoral collaboration. Therefore, a robust and comprehensive institution is essential to enhance co-ordination among governments, development partners and non-governmental organisations in carrying out long-term activities towards drought resilience. Thus it is necessary to establish a strong co-ordination unit with solid authority and clear accountability to oversee the coordination of drought resilience activities among sectors.

Knowledge management. Strong monitoring and knowledge management is vital for effective follow-up, reporting and documentation of drought resilience efforts and achievements. Thus it is important to facilitate the exchange of information among PSNP stakeholders and those in the NGO sectors who implemented drought resilience initiatives. This must be accompanied by documentation of lessons learned and scale-up of best practices.

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For a list of references, see online version of this article at: **www.rural21.com**

BUILDING RESILIENT LIVELIHOODS THROUGH ECONOMIC EMPOWERMENT – AN EXAMPLE FROM MALAWI

One of the objectives of cash transfers is to improve household income to meet basic needs. Adding economic empowerment interventions to existing cash transfer programmes has the potential to reduce vulnerability and build the resilience of households in extreme poverty by creating assets, supporting income diversification and promoting financial inclusion – an example from Malawi.

Training group in Kanduku II village, Mwanza District.

Photo: Martin Ihm

By Martin Ihm, Twapashagha Twea and Dalitso Kalimba

The most common understanding of resilience among academics and practitioners is the ability to endure, recover and adapt to stresses, shocks and changes. Households and communities are considered resilient when they can meet their basic needs in a sustainable manner without external support during times of stress or disaster. Researchers have identified many factors that contribute to resilience building of households – among these are income and access to food, access to financial services, ownership of assets such as livestock, and access to basic services like health and education. In the humanitarian and development sector there are many programmes that focus on building the resilience of households and communities, including social protection programmes that provide livelihood support.

LIMITED SCOPE OF CASH TRANSFERS

In Malawi, one of the poorest countries in the world, chronic poverty, food insecurity and high vulnerability to disasters are widespread. About 70 per cent of Malawian households live below the international poverty line of 1.90 US dollars per day. Despite some improvements in recent years, poverty levels and the vulnerability of rural households remain high. Livelihood options and the resources available to rural households are limited. Most poor rural households earn their livelihood through farming or farm labour, but agriculture is seasonal and rain-fed, making it prone to climate-related shocks, such as floods and droughts, which are becoming more frequent and intense.

The Government of Malawi uses different social protection instruments to address chronic poverty and vulnerability. One such instrument is the Social Cash Transfer Programme (SCTP), which has been in place since 2006 and provides a monthly transfer to households that are both ultra-poor and labour-constrained. These households are unable to meet the most basic urgent needs (food and essential non-food items) and have a household member ratio of 'not fit to work' to 'fit to work' of more than 3:1 ('unfit' if below 19/above 64 years of age or with chronic illness/disability, or otherwise unable to work). Currently, the SCTP reaches around 167,000 households in 18 districts. Impact evaluations indicate that the programme has enhanced the living standards of beneficiaries considerably. However,

as the value of the social cash transfer is less than 20 per cent of household consumption needs, the scope for beneficiaries to invest in livelihood strategies that reduce poverty and increase resilience is limited. International empirical evidence on cash transfer programmes suggests that complementary livelihood interventions can strengthen the impact of cash transfers, increasing resilience and reducing poverty. One successful and often-replicated approach comes from the Bangladesh Rural Advancement Committee (BRAC). The BRAC approach complements regular transfers of cash or food for the ultra-poor with economic empowerment interventions, such as skills training, financial inclusion through savings and formal bank accounts, healthcare support and advice, a one-time grant of productive assets, and the facilitation of social integration.

COMBINING CASH TRANSFERS WITH ECONOMIC EMPOWERMENT INTERVENTIONS

In 2016, building on the success of the current Social Cash Transfer Programme, the Government of Malawi, with the support of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the COMSIP Cooperative Union, piloted an economic empowerment project for social cash transfer beneficiaries. The pilot looked at how to better address ultra-poverty and vulnerability using the available social protection instruments. In addition to the regular social cash transfer payments, which allow beneficiaries to meet consumption and other basic needs, the pilot provided a package of economic empowerment interventions, such as training on group formation, financial literacy, business skills and agriculture. It also offered once-off seed capital for productive investment. The purpose of the training was to encourage beneficiaries to form savings groups, develop and set up income generating activities, and engage in individual and group businesses. The financial resources required to overcome capital constraints with regard to productive investments or to start a small business were provided by way of once-off seed capital equivalent to the annual aggregate of social cash transfer payments.

The German Development Institute (DIE) evaluated the pilot project and conducted qualitative and quantitative surveys. The first results show that most of the 557 beneficiary households, of which 70 per cent are female-headed, have increased their asset base by investing a large part of their seed capital in small livestock, having in mind the savings and income-generating functions of livestock. Other parts of the seed capital were invested in improving housing quality in order to enhance living conditions and health.

> **Economic empowerment** refers to processes where poor people gain greater control over resources and life choices beyond immediate survival needs. Economic empowerment can be facilitated by enhancing knowledge and skills, increasing possibilities to access financial resources and assets and strengthening self-organisation with regard to economic activities.

In addition, some of the qualitative findings suggest that the trainings, in combination with the seed capital, contributed to income diversification by strengthening existing businesses and promoting the development of new income generating activities (mostly non-farming activities in the area of small trading and processing). The trainings also increased financial literacy among beneficiaries and led to the formation of savings and loan groups, which provide group members with access to microcredit. However, loans from savings groups are primarily used for consumption and meeting basic needs (e.g. for food and clothes), and less often for productive purposes (e.g. to purchase business inputs or farm implements). It would be desirable to enhance the usage of loans for productive investments and business creation. This could be achieved through the provision of intense group or household coaching for income-generating activities.

> *“Households and communities are considered resilient when they can meet their basic needs in a sustainable manner without external support during times of stress or disaster.”*

The findings of the evaluation suggest that the interventions have positively contributed to building resilience. Many of the beneficiary households were able to improve their access to financial services, increase their livestock assets, and diversify their income sources. They also benefited from social integration into business and savings groups. Furthermore, the project, and in particular the provision of the seed capital, increased the likelihood and reduced the time needed by households to recover from the severe drought in southern Africa in 2016. Hence, the pilot project points out that combining protective cash transfers with a promotive package of additional cash for investments and human capacity building can be an effective way for the Government of Malawi to put ultra-poor households on a pathway out of poverty and vulnerability.

THE WAY FORWARD

However, it should be noted that the interaction of cash transfers with additional support programmes requires the coordination and harmonisation of efforts among different government and non-government actors at national and local levels. Furthermore, the provision of intense skills trainings for economic empowerment is challenging, as the government lacks resources – both human and financial. Regardless of these shortcomings, it is aware that the effectiveness of its social protection instruments can be enhanced with regard to resilience building and poverty reduction if protective social protection instruments are linked to economic empowerment interventions. As a result, the new Malawian National Social Support Programme, which is the operationalising and guiding document to the country´s social support policy, prioritises the promotion of resilient livelihoods. This will be achieved by connecting available social protection instruments that provide consumption support, like the Social Cash Transfer Programme and the Public Works Programme, to financial services, asset creation and skills development, while at the same time facilitating linkages and access to nutrition, health and education.

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For more information on the project, see online version of this article at: **www.rural21.com**

Less than ten per cent of the maize growers in Embu have opted for a weather index insurance.

Photo: Matin Qaim

WEATHER INDEX INSURANCE FOR SMALLHOLDER FARMERS – INSIGHTS FROM KENYA

Weather index insurance has often been hailed as a blessing for smallholder farmers to cope with climate shocks. These expectations were overblown. Generally, farmers' uptake of index insurance remains low. But this does not mean that there is no potential. Research from Kenya shows that better tailoring index insurance to smallholder conditions could increase uptake with significantly positive effects for agricultural development.

By Matin Qaim and Kenneth W. Sibiko

Climate change will affect agricultural production through higher mean temperatures and more frequent weather extremes. Smallholder farmers are particularly vulnerable to climate shocks. After severe weather events, small farm households often end up selling productive assets to smooth consumption. Frequent weather extremes are also associated with risk-avoidance strategies, such as low adoption of productivity-enhancing inputs and technologies. Thus, climate shocks can cause and perpetuate poverty traps. Agricultural insurance could help, but is literally non-existent in most developing countries due to various constraints.

Weather index insurance (WII) is a relatively new type of insurance that could help overcome some of the problems with traditional insurance schemes. Unlike indemnity-based crop insurance, where an insured farmer receives compensation for the verifiable loss at the end of the growing season, WII makes claim payments based on the realisation of an objectively measured weather variable (e.g. rainfall) that is correlated with production losses. Neither the insured farmer nor the insurer can easily manipulate rainfall measurements, which reduces issues of opportunistic behaviour. Also, in comparison to traditional insurance, WII is less expensive to administer, which can lead to more affordable insurance premiums and faster payout to farmers. Despite these potential benefits, uptake of WII by smallholder farmers is much lower than was initially anticipated. This gives rise to two questions. First, can smallholder farmers really benefit from WII? Second, if they can benefit, what are reasons for the low uptake of WII, and how could possible constraints be overcome? We have addressed these questions in a recent research project in Kenya.

AN INCENTIVE FOR MORE INPUTS

Commercial WII programmes in Kenya's agricultural sector have already been implemented for several years. The most widely known initiative is the Kilimo Salama Program of the Syngenta Foundation for Sustainable Agriculture. Kilimo Salama offers rainfall index insurance contracts against the risks of drought and excess rain. Insurance contracts are often (but not always) tied to the purchase of inputs – such as maize seeds and fertilisers – and provided to farmers through local input dealers.

If a farmer decides to purchase insurance, rainfall at the weather station closest to the farm is monitored for a specified period of time. If, during this period, rainfall remains below (or exceeds) a certain threshold, payout is triggered. The amount of payout depends on the concrete rainfall measure. The money is sent to farmers automatically through mobile money networks. If insurance is tied to the purchase of seeds, farmers have the option to only insure the first three weeks after planting. In that case, when drought or flooding occurs, quick insurance payout enables farmers to replant.

WII through Kilimo Salama is meant to provide new incentives to farmers and enable them to use more and better inputs. As low input intensity is one of the main reasons for the yield gaps observed in the African small-farm sector, higher input use is also expected to lead to higher yields and incomes.

ARE THE WII CONTRACTS REALLY EFFECTIVE?

To analyse whether the WII contracts result in increased input use and yield, we carried out a survey of around 400 maize farmers in Embu County in the eastern region of Kenya. The climate in Embu is characterised by erratic rainfall and frequent droughts. Embu is also one of the regions where Kilimo Salama was already launched as a pilot project back in 2009. Nevertheless, up till now, fewer than ten per cent of the maize farmers in Embu have purchased WII. Our survey included both, insured and uninsured farmers. We oversampled insured farmers to have a sufficient number of observations for robust impact analysis.

Regression models were used to estimate the effects of insurance uptake while controlling for other observed and unobserved factors that might also influence input intensity and crop productivity. The estimation results show that purchase of WII has led to a significant increase in farmers' use of high-quality seeds. Insurance uptake has also increased the use of fertilizer by 50 per cent and maize yields by 53 per cent. These are large effects that underline how much farmers' cropping decisions are influenced by weather risk. For resource-poor farmers without insurance, fears of financial loss and liquidity constraints in cases of droughts and floods are important factors explaining low input intensities. While insurance payouts do not fully compensate farmers for crop losses in bad weather years, our results suggest that WII can change farmers' incentives structures and contribute to higher crop productivity and income on average. Against this background, it is particularly surprising that WII uptake by smallholders remains so low.

HOW COULD INSURANCE UPTAKE BE INCREASED?

Further analysis of the data from Kenya shows that the relatively better-off farmers are more likely to purchase WII contracts than their poorer colleagues with lower access to markets and information. This is undesirable, as the poorest farmers are those that could benefit most from crop insurance. Obviously, Kilimo Salama and the particular design of the WII contracts are not yet sufficiently tailored to the needs and constraints of smallholder farmers. To better understand the constraints and examine whether changes in contract design could possibly lead to higher insurance uptake, we carried out a choice experiment with the same 400 farmers in Embu County. In this choice experiment, farmers were asked to choose between hypothetical WII options in which specific contract features were modified. The data reveal that farmers' mean willingness-to-pay for the existing WII contracts is 25 per cent lower than the actual premiums charged. Reducing the premiums could therefore contribute to increased insurance uptake, even though this may be difficult without jeopardising the Program's financial viability.

Another general problem with WII is that the rainfall measures at the weather stations are not identical to the actual rainfall at the farm locations, leading to so-called basis risk. Installing more weather stations, such that the average distance to each farm would be smaller, could reduce basis risk. Our estimates suggest that this would increase farmers' willingness-to-pay, but only slightly. Hence, the insurance provider needs to weigh the benefits of additional contract sales against the costs of maintaining additional weather stations. A more fundamental problem is that many farmers struggle with fully understanding the functioning of WII contracts and when exactly payouts are triggered. The resulting uncertainty undermines farmers' confidence and lowers their demand for insurance contracts. Better training could increase farmers' confidence and thus contribute to higher insurance uptake. Transparent provision of relevant rainfall measurements and thresholds – for instance through regular text messages sent via mobile phones – would also increase farmers' confidence and willingness-to-pay for WII.

Finally, the choice experiment suggests that offering contracts to farmer groups rather than individuals could be a promising avenue for wider insurance uptake. On the one hand, group contracts could help to reduce transaction costs. On the other hand, farmer groups can be important platforms for information exchange and mutual learning about complex innovations.

CONCLUSION

The results from our study are specific to one particular WII programme in Kenya. However, our findings are compatible with those from other studies, so that some broader conclusions are justified. In general, WII seems to be a promising mechanism that can help farmers to better cope with weather risks while avoiding many of the issues that have prevented indemnity-based crop insurance from gaining ground in the small-farm sector. But WII contracts are complex to understand and not yet sufficiently tailored to the needs and constraints of smallholders. More research and innovation is needed to improve the design and adapt the contracts to particular situations on the ground.

RISK INSURANCE – PROS AND CONS

A range of international initiatives are developing and promoting risk insurance. One example is the G7 climate risk insurance initiative InsuResilience, which aims to insure 400 million people in developing countries against climate-related risks by 2020. Although it is undisputed that such insurances can be an extremely helpful tool for farmers in affected areas, unwanted environmental and social side effects may arise as well if they have not been well thought through. This was recently pointed out by scientists at the Helmholtz Centre for Environmental Research. For example, they maintain that there is a risk of farmers in developing countries who traditionally grow a wide range of crops in their fields reverting to monocultures because the agricultural insurance is often linked to specific crops. The result is a decline in agricultural biodiversity, deterioration in soil quality and increased use of fertilisers and pesticides, which in turn raises the risk of water pollution. The scientists also refer to the weakening of networks of small farmers in developing countries as a risk. *sri*

More information: www.rural21.com
www.insuresilience.org

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Photo: Christophe Vander Eecken/laif

CAN DEVELOPMENT CO-OPERATION HELP REDUCE INTERNATIONAL LABOUR MIGRATION?

When asked what is to be done about the "refugee crisis", almost every politician will argue that development co-operation has to do more towards improving the situation in the regions of origin. And indeed, billions of euros are being allocated to the task of *"Fluchtursachenbekämpfung"*, i.e. combating the root causes of migration. Can development co-operation in general and rural development interventions in particular fulfil this expectation, and if so, how?

By Theo Rauch

Fluchtursachenbekämpfung is a controversial topic. Opposition parties argue that governments refer to the causes of migration to detract attention from their failure to manage the refugee crisis. Critics of development co-operation ask why so many people are still trying to find a future for themselves outside their home areas. Supporters of migration fear that Official Development Assistance (ODA) could be misused for building walls against migrants. Migration researchers object that more effective efforts to reduce poverty will even stimulate international migration as the very poor cannot afford to migrate. Some development co-operation practitioners fear that reorienting aid towards migration policy aims will just end up as another re-labelling exercise.

So, the question this article explores is whether and by what means development co-operation can mitigate the causes of migration. The focus here is on labour migration, rather than refugees, acknowledging that it is not always possible to clearly separate one from the other. Another focus is on interventions addressing the situation in regions of origin, rather than on those aiming at better migration management. And lastly, there is a certain focus on sub-Saharan Africa, as it is our neighbour continent that most of the funds are supposed to go to.

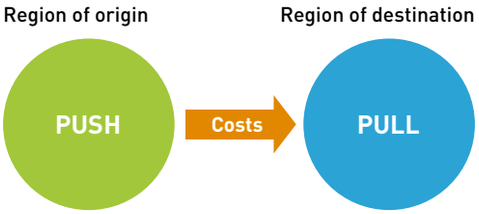
WHAT INFLUENCES LABOUR MIGRATION?

Migration theory tends to explain migration streams by distinguishing between **push factors** (conditions in the region of origin), **pull factors** (conditions in the region of destination) and **migration costs**. Although somewhat simplistic (see Figure on the right), this model can help structure the analysis of influencing factors. While *Fluchtursachenbekämpfung* relates to the push factors, migration costs also tend to play a role. Push factors for labour migration can be analysed from a macro- and a micro-perspective.

The push factors: jobless growth, ...

A macro-economic analysis of global labour markets indicates that the phenomenon of "job-less growth", well-known to most countries in the Global South, tends to foster migration in search of job opportunities. While economic globalisation has stimulated international trade and economic growth rates, it has failed to increase global employment, as it has been accompanied by labour-replacing technological progress. New jobs created by economic growth are matched by the destruction of jobs through automation. While this is a world-wide phenomenon, the impacts on different regions differ greatly. Less competitive regions are the losers. In sub-Saharan Africa, an additional 15 million young people reach working age each year, set against two million additional jobs. This mismatch has been observed even in periods of high economic growth rates of five to ten per cent per annum. The global nature of the mechanisms causing unemployment indicates that there are limitations for development co-operation when it comes to addressing the root causes of labour migration.

Migration theory



Looking at the micro-perspective, we see a corresponding picture. The majority of African families are securing their living through migration. More than 50 per cent of rural households and around 70 per cent of urban residents in sub-Saharan Africa are part of translocal livelihood systems, according to a recent analysis of a wide range of case studies by Malte Steinbrink and Hannah Niedenführ. For approximately 50 million rural-based African households, migration of at least one member, mostly young men, has become an economic necessity, as neither rural income sources in the home region nor incomes in the areas of destination can ensure a secure and decent living. So migration of young people is not merely an individual decision indicating a preference for an urban lifestyle. Rather, it forms a well-established part of rural-urban livelihood systems. Most of the migrants are temporary migrants, who maintain social, cultural and economic links to their home areas (see the article by Einhard Schmidt-Kallert in Rural 21 02/2016). Some migrate on a seasonal basis, some return once a year for festive seasons, some are circular migrants, and others migrate for a certain period of their lifecycle, intending to return after they have saved enough money to get married and establish a farmstead. Where migration has become a deeply rooted part of risk minimising livelihood systems, it will not be easy for development co-operation to provide sufficiently attractive alternatives.

... population growth, ...

Where too many young people are entering the labour market compared to available job opportunities, population growth cannot be ignored as a push factor. Indeed, sub-Saharan Africa still has a population growth rate of 2.5 per cent per year – far above that of other world regions. This figure, however, needs to be assessed in relation to the low population density of 45 people per sq. km (Germany: 230), which still leaves wide regions with underutilised resource potentials, but also with long distances to be overcome and correspondingly high costs for infrastructure development. The major obstacle to successfully addressing the high population growth rate within a short period is the underlying rationale of "demographic transition", according to which a reduction in the fertility rate tends to follow a reduction in the mortality rate with

a time lag of roughly one generation. This means that people are generally only prepared to reduce the number of children they have by means of birth control after they have seen for themselves that most of the children being born survive. Africa has only achieved a significant reduction in the mortality rate during the last decade (after a sharp interruption caused by HIV/ Aids in the 1990s). So, the reduction in fertility rates has started just recently. While family planning support can help speed up this process, there will be a delay until birth rates are affected due to the increasing number of women in the birth-giving age group. Thus, the scope for reducing migration via population policies is severely limited as well.

... environmental conditions

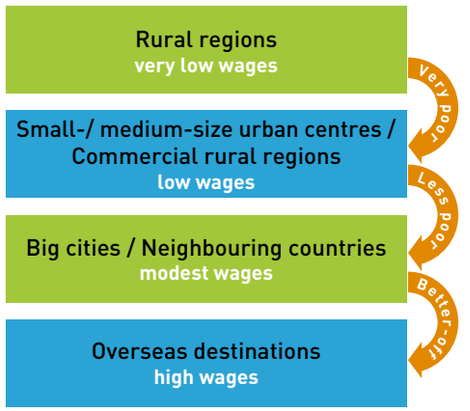
Another push factor is deteriorating environmental conditions such as climate change, soil deterioration or increasing water scarcity. In Africa's Sahel region, for instance, migration has become a widespread response to droughts and food crises. While environmental migration is frequently emphasised in support of climate policy, research results indicate that environmental push factors are usually only one among a whole set including agricultural markets or increasing scarcity of land. While effective climate change mitigation and adaptation policies are crucial to reducing migration pressure in the long run, their short-term impact on migration is limited.

Looking at these push factors in context, we can conclude that while development co-operation does relate to all of them, it clearly cannot easily influence most of them in the short run.

Role of migration costs reflected by migration cascade

Migration costs are an impeding factor in particular for long-distance international migration. There appears to be a clear correlation between the income levels of households and the distance of migration. In Nepal, for example, the poorest in a village look for jobs in rural areas, the less poor can afford to migrate to Kathmandu, the middle strata tend to establish migration networks to Indian destinations, while only migrants from the more well-to-do farm households manage to find jobs in the Arab Gulf states. So, the jobs on the construction sites in Qatar, considered terrible from our human rights perspective, are among the most attractive destinations for

Migration cascade



Nepali villagers. Such migration barriers only allow the comparatively better-off people to get to Europe. That is why some experts warn that more successful efforts towards poverty reduction might enable more people to venture on the costly journey to Europe – poverty reduction as a springboard for international migration.

This argument does not stand the test of a more in-depth analysis, however. In fact, migration often takes place in stages. Poor people from rural regions migrate to regional urban centres; people who have accumulated a bit of income and experience there may move on to big agglomerations. More advanced migrants from those cities may be able to afford the step to more prosperous countries, if competition from the new arrivals in urban labour markets or in informal service sectors becomes too stiff. Accordingly, there is an international hierarchy of destinations within the African migration pattern. While people from Burkina Faso may go to Ghana, Ghanaians tend to go to Nigeria, and Nigerians seek their fortune in South Africa or in Europe. So migration pressure from poor rural regions is passed on to better-off people in urban centres who have the capacity to migrate overseas. We can call this a migration cascade (see Figure). The resulting message for development policies is that by reducing the migration pressure at all levels, poverty reduction in the rural regions of origin can help reduce international migration.

WHAT HAS DEVELOPMENT CO-OPERATION CONTRIBUTED SO FAR?

First, we have to acknowledge that there is little statistical evidence for the impact of development co-operation interventions on migration. It is obvious that out-migration from rural areas has increased. But it is hard to say whether this is despite successful rural development efforts or due to neglect of rural areas during the past two decades or is even a result of rural interventions. The phenomenon of translocal rural-urban livelihoods is known from dynamic and from marginal rural regions. Ongoing efforts towards placing "jobs, jobs, jobs" at the top of the agenda of development co-operation with Africa indicate that past efforts were too limited or not very successful. The major achievements in reducing income poverty during the last five decades were made in countries like China and South Korea. They were based on macro-economic policies with minimum contribution from international development co-operation. Trade policies played a major role in the initial phases. Examples from Zambia and Nepal may indicate the potentials and limitations of rural development programmes in reducing out-migration from rural regions. In Zambia, significant donor-supported efforts were made towards rural development during the 1980s, with the aim of explicitly reducing out-migration in support of the Government's "go

> *"Rural development can reduce migration pressure. But only to a limited extent."*

back to the land" campaign. These efforts were followed by a clear trend of remigration to rural regions, which also resulted from a change in terms of trade between agricultural versus industrial products, i.e. a marked increase in producer and consumer prices for agricultural products. While trade policies provided necessary incentives for returning to the land, development programmes provided the opportunities and capabilities. In Nepalese hill areas, such programmes helped strengthen translocal livelihood systems by improving the income basis of migrants' wives through promoting horticulture rather than by seeking to offer local opportunities to the migrating men. This was a reflection of the limited natural resource potentials and high land pressure. The examples show that rural development interventions can improve income opportunities if accompanied by favourable market conditions for rural products. In doing so, they can reduce migration pressure among the rural poor but are unable to replace income from migration.

Taking the limitations of global labour markets and the phenomenon of "job-less growth" in Africa – in association with limited and mostly marginal income opportunities in non-agricultural sectors – into account, development co-operation needs to be aimed at reducing

migration pressures in rural and in urban regions. It has to focus on creating jobs and income opportunities, both for the youth and for all other job seekers. Broad-based, inclusive income generation is the key towards mitigating migration pressure. What can be done to contribute to that goal under the prevailing economic environment in African countries?

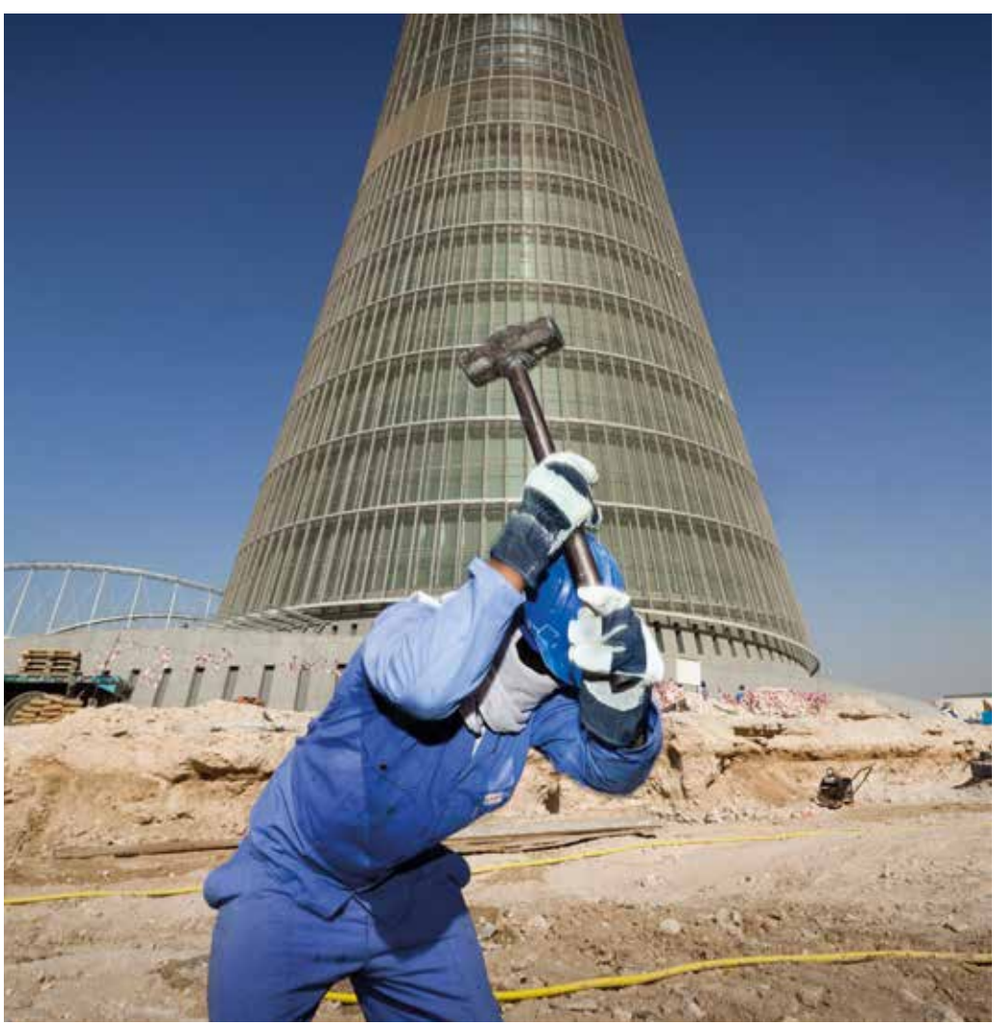
As development policies not only have the potential to reduce but also run the risk of intensifying migration pressure, the first set of recommendations follows the principles of doing no harm and leaving no one behind. Interventions need to avoid destroying jobs and income opportunities by avoiding labour-saving forms of technical progress. They have to avoid displacement of small-scale farmers or herders by large-scale land investors. They should avoid supporting the setting of inappropriate product-related standards that tend to exclude resource poor producers. They should not be guided by rural transformation models following the principle "grow or give way".

TEN RULES FOR MIGRATION SENSITIVE INTERVENTIONS

Doing no harm is not enough, however. So what else needs to be done to promote inclusive job and income promotion taking the adverse competitive conditions of sub-Saharan countries into account? Ten rules have to be considered. **First and foremost**, jobs are only created by those investments that generate a positive net employment effect. Many private investments tend to destroy more jobs or income opportunities than they create. Investment promotion therefore needs to focus on new, innovative economic activities which replace imports or add processing steps to value chains rather than on replacing existing local activities. **Second**, economic opportunities have to be analysed with regard to the competitive environment. There are usually pro-poor, i.e. labour-intensive opportunities with a good chance of becoming competitive, although some effort may be required to identify them via a proper analysis of markets and local resources. **Third**, this calls for a thorough analysis of the – often underestimated – potentials of the poor in order to maximise their inclusion in the labour and commodity markets. **Fourth**, small-scale producers need to be organised in socially inclusive producer organisations to qualify for joint access to services and markets – a prerequisite for their access to income opportunities. **Fifth**, the promotion of appropriate technologies has to follow the guideline "as labour-intensive as possible while as efficient as necessary". Any promotion of "technical progress" per se will intensify migration pressure. On the other hand, productivity often needs to be increased in order to overcome labour bottlenecks or to become competitive. A tractor can replace 20 labourers in one case or help create 20 jobs in another. At any rate, the employment effect of technological change needs to be given the utmost attention. **Sixth**, trade policies need to be adjusted in order to protect promising labour-intensive trades. **Seventh**, land reforms have to ensure that poorer smallholders cannot be impelled to sell their land in the event of an emergency. **Eighth**, socially inclusive promotion of natural resource management – including soil rehabilitation and climate change adaptation – is essential to prevent environmental migration. **Ninth**, labour-intensive public work schemes for establishing and maintaining infrastructure should be promoted. This can help to improve seasonal job opportunities on a broad scale in the short run. **Last but not least**, skills development should focus on fields related to existing income opportunities. Training in other areas will stimulate rather than reduce migration.

The jobs on the construction sites in Qatar are among the most attractive destinations for migrant workers.

Photo: Michael Zunstein/VU/laif



We can conclude that rural development efforts can contribute to *Fluchtursachenbekämpfung* if oriented towards creating a positive net-employment effect within and outside agriculture and if accompanied by targeted trade policy adjustments. Such rural development contributions are necessary but will most likely not create sufficient jobs. This can only be achieved in a different global and national macro-policy environment.

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Traditional beehives in a tree.
Photo: Jörg Böthling

BEEKEEPING IN ETHIOPIA'S WHEATBELT – A WAY TOWARDS SUSTAINABLE AGRO-ECOSYSTEMS

With its Growth and Transformation Plan, Ethiopia's government has set itself the task of transforming subsistence agriculture to market production, with a special emphasis on supporting women and youth. What role could apiculture play in this regard?

By Susanne Dollmann, Diana Diekjürgen, Laura Kübke, Rebecca Younan and Sophia-Marie Zimmermann

Ethiopia, with a population of around 100 million people, is the second most populous country in Africa. Not only is it famous for its coffee and *injera* (sourdough-risen flatbread), Ethiopia is also the biggest honey producer in Africa and is ranked ninth in the world. The Ethiopian honey sector has a long tradition. National production of honey amounted to 50,800 tons in 2015/16. A total of 5.92 million beehives are found in 1.4 million households. However, it is estimated that the amount of honey being produced only accounts for ten per cent of the actual full potential.

The Government of Ethiopia aims to promote employment of women and youth as well as honey production in the country. Against this background, the Green Innovation Centre in Addis Ababa commissioned a study in order to identify possibilities and give recommendations concerning the enhancement of beekeeping in Arsi Zone in the Oromia Region (see Box on page 44). According to the country's Growth and Transformation Plan II (GTP II), the region is Ethiopia's wheatbelt, producing its highest crop yields. The aim of the study was to delineate ways to connect honey production and crop farming to increase sustainability. At the same time, opportunities for income generation and employment were to be identified, especially for women and youth, along the entire value chain of honey.

Research data was collected within two *woredas* (districts) in Arsi Zone: Lude-Hitosa and Arsi Robe. Various qualitative and participatory research tools (e.g. semi-structured interviews, focus-group discussions and transects) were applied to collect the required data.

CHALLENGES FOR BEES ARISING FROM AGRICULTURAL PRACTICES

Apart from extensive livestock production, Arsi Zone is characterised by a semi-intensive crop production focusing on wheat and teff (*Eragrostis tef*), which is the basis of Ethiopian staple food *injera*, as well as cereals like barley and maize. On the one hand, wheat and teff are predominantly grown on a partly mechanised basis and with a relatively high level of external inputs. On the other hand, crops and vegetables for daily life, like beans or tomatoes are cultivated with oxen ploughing, broadcast seeding and a low external input level. The average farm size amounts to 1.4 ha. The average harvest for wheat is 3-4 t/ha, which is comparable with the world's average yield.

The crop management found in Arsi Zone is multifaceted. Production increase is the main goal of the Ethiopian government's Growth and Transformation Plan II, where subsistence agriculture should be transformed to market production, stressing support of women and youth. However, this strategy goes along not only with monocultures but also with an increased usage of chemical pesticides – both major threats to bees.

WHY BEE-KEEPING REMAINS A SIDE-ACTIVITY

Although many interviewees showed interest in apiculture and honey production, knowl-

edge of the environmental and economic importance of bees, such as pollination services, was very limited. Nevertheless, most of the people were well aware of the nutritional value of honey and its additional benefits (e.g. use of honey as medicine or treatments).

In Ethiopia, all rural and urban land is under public ownership, and peasants only have user rights. They may not sell, exchange or pledge land. The government gives support to the apicultural sector by focusing on policies, extension services and the situation of small-scale farmers and by regulating land access to guarantee security for peasants against market forces. At the same time, critics underline the negative impacts of such land use, e.g. reduced investments, which is a consequence of the Ethiopian peasants' lack of land rights. However, no priority is given to beekeeping within the extension service in Arsi Zone, where the focus is clearly set on intensifying crop production. This described lack of infrastructure and of proper and essential equipment but also the short value chain of honey are additional factors why beekeeping is mainly, almost exclusively, seen as a side-activity among farmers. Alongside other factors, this explains the untapped potential of the honey production and lack of awareness concerning the importance of bees in the region.

VALUE CHAIN CHARACTERISTICS

There are three different types of beehives used in Arsi Zone (see Box). Most of the registered beekeepers (96.5 %) use traditional beehives, which are placed in trees (see photo on page 42). The traditional hives require low construction costs and minimal management, while at the same time having low productivity. The second type – the transitional hive – is also called the top-bar hive because its frames only have a top bar, and no sides or bottom bar. Many farmers and beekeepers in the two *woredas* know about this technique, but it is rarely used in practice mainly due to high investment costs, the advanced management level needed and missing tools. The modern hive is made of wood and contains various chambers and a composite cover with galvanised sheet metal.

31.4 per cent of the country's honey production originates from around three million beehives. Harvest per hive at national level ranges from 8.3 kg/year (traditional) to 18.3 kg/year (transitional) and finally 15.5 kg/year (modern hive). Based on our own research results, yields of 9 kg, 15.3 kg and 23.3 kg are reached respectively. Despite the high yields from modern hives in Arsi Zone, their number is still decreasing because of lack of proper processing instruments and management skills. In Oromia (the administrative region for Arsi Zone), 98.07 per cent of the beehives are traditional, 1.31 per cent are transitional and only 0.61 per cent are modern types. Our own calculations showed gross margins at farm gate per hive to be 388 Ethiopian Birr (ETB)/year for traditional hives, 676 ETB/year for transitional hives, and ETB 2 010 ETB/year for modern hives, with the highest investment costs at 4,300 ETB.

The value chain of bee products in Arsi Zone is short as products are limited to honey, beeswax and tej – a locally brewed honey wine. Around 50 per cent of the honey produced is consumed at home. Honey is most commonly stored in plastic bags, kettles or plastic containers and – if not used for home consumption – sold at farm gate. Wax is not extracted, and 82 per cent remains unprocessed at the farms. The lack of processing tools limits honey processing. Most of the honey produced in the selected *woredas* was not traded to surrounding towns like Ithaya or Asela or Addis Ababa. Despite this, some interviewees rated market access as generally good.

Women have a big portion of the beekeeping workload. They are responsible for cleaning around the beehives, feeding the bees (in the dry season), smoking the hives during harvesting and protecting the bees from predators. The catch of the colonies is exclusively reserved for men since this task is thought to be too risky for women. Since young people only have land access when organised in a co-operative, renting or sharing or through their families, their involvement in beekeeping is limited.

HOW APICULTURE AND AGRICULTURE INTERACT

The intensification of agriculture has left the landscape of Arsi Zone marked through deforestation, limited crop rotation and less wild vegetation, leading to a reduced variety of blossoms for the bees. Additionally, the usage of pesticides has increased in the last years. All beekeepers interviewed during the survey related the absconding of bees to the increased application of pesticides during the last three years. Here, the results of the survey reveal the existing potential of growing plants with additional benefits to bees as forage and for the farmers. The ones identified are: living fences

THREE TYPES OF BEEHIVES

Traditional hives are cylindrical, slightly over one metre in length and 20–40 cm in diameter. They are built from readily available natural materials like wood, bamboo, tree branches and barks, manure and clay (see photo on page 42). Made from local timber and plastered with clay, the **transitional hive** (top photo) normally holds between 27 and 33 top bars. The hive bodies or supers all have the same size and the same number of frames. While the bottom hive body is mainly used for reproduction (brood) and the queen, the upper ones are there for honey storage. The **modern hives** (bottom photo) are based on the assumption of Lorenzo Lorraine Langstroth (1810–1895; apiarist and creator of the modern Langstroth hive) that bees always leave the same space between the combs when building their hives. Depending on the availability of bee forage and the size of the bee colony, further boxes can be mounted on top of each other. For inspection or harvest purposes, the frames can be taken out individually without disturbing other combs or squashing bees. In comparison to traditional or transitional hives, modern hive management above all requires advanced knowledge and training.

The study was conducted by participants of the Centre for Rural Development/ Seminar für Ländliche Entwicklung (SLE) training course at Humboldt University Berlin. The research was commissioned by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)/ the Green Innovation Centre, based in Addis Ababa, as part of the "One World, No Hunger" Initiative of Germany's Federal Ministry for Economic Cooperation and Development (BMZ). A team of five junior consultants and their team leader in collaboration with five students from Ethiopia's Mekelle and Jimma Universities assessed the scope for apiculture and agriculture integration in Arsi Zone, which is one of the 18 zones within the Oromia Region, the largest region in Ethiopia. The complete study can be downloaded at: **www.sle-berlin.de/index.php/aktuelles/499-neue-ergebnisse-der-auslandsprojekte**

or edge strips (e.g. *Opuntia cylindrica*), intercropping plants (e.g. lentils or faba bean) or trees (e.g. *acacia* or *wanza* (*Cordia africana*)). More examples are listed in the full text study (see box).

ASSESSING THE POTENTIAL

A total transformation of Arsi Zone into a leading honey producing area is unrealistic (and, moreover, not in line with GTP II). This is related on the one hand to the agricultural practices relying on an increasing amount of agrochemical inputs, but also to deforestation and a lack of bee forage. On the other hand, the region's honey sector itself was identified as a rudimental value chain. However, further integration of beekeeping into the wider agricultural system could lead to positive synergy effects. Key potentials identified included plants serving multiple purposes in the farming system both as bee forage and to diversify the landscape, resulting in increased landscape resilience towards environmental hazards. An integrated system could strengthen crop rotation to decrease reliance on agrochemicals and increase soil fertility conservation. A system approach would benefit from a bee-friendly pesticide strategy.

Besides, most of the interviewed small-scale farmers possess basic knowledge on beekeeping practices and showed a keen interest in receiving training and gaining more knowledge in this field. The production and sale of honey could be a possible income-generating activity, especially for women and youths. Women were highly motivated and interested in getting involved in beekeeping or playing major roles in the sector. But a lack of specific trainings, practical and social barriers, limited market access and a low socio-economic status turned out to be main constraints. Therefore, trainings on beekeeping should be made more accessible, especially to women. The content should be developed based on specific knowledge gaps and needs and include basic training in business skills.

Gross margin calculations show that beekeeping can be a lucrative side activity supplementing other farming or income generating activities, but nevertheless requiring investments. Research and data collection revealed that, for various reasons, transitional hives are a good alternative to modern hives in the region. In general, transitional hives are moderately effective for managing honey bees, conducting hive inspection and shifting frames. The combination and division of colonies or moving the brood inside the hive was feasible for the beekeeper, and their yield was clearly higher than that of traditional hives.

Not only beekeepers, but also processors or other value chain actors might play a role in ensuring the market links for the honey products. Therefore, financing schemes or alternative approaches are necessary to allow beekeepers and other actors to take the risk of new practices. In addition to knowledge dissemination, the availability of necessary tools and suitable beekeeping material inputs would have to be addressed. Strengthening beekeeping youth co-operatives, facilitating access to land as well as knowledge sharing and improvement of market access for all beekeepers is necessary. Players along the value chain of honey should be enabled to connect more effectively, which results in mechanisms to ensure continuous quality of the products.

Any steps towards the integration of beekeeping will contribute to the improvement of the current farming system and its sustainability – environmentally, socially and economically. The diversification of crop rotation will preserve bee colonies and their pollination service for crop production. The decrease and technically improved application of agro-chemicals would not only be of economic value for the farmers; implementation of a bee-friendly pesticide strategy and integration of plants with additional benefits would balance the agricultural system. Hence, the landscape will benefit from these measures in the long run – and so will the bees and the people.

Crop diversity can help preserve bee colonies. A field in Arsi-Robe. Photos: Diana Diekjürgen

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For a list of references, see online version of this article at: **www.rural21.com**

THE POTENTIAL OF APPS TO STUDY SMALLHOLDER FARMING SYSTEMS AND MORE

Across the developing world, the rapid spread of mobile phones has led to a surge of mobile tools that allow users to access health, education and finance services. In agriculture, these tools can be used to obtain price data, weather reports and technical advice. While there is widespread consensus about the opportunities for economic growth and social empowerment that mobile tools offer users, one area has received limited attention so far: the potential to use mobile tools for research and for project monitoring and evaluation purposes.

By Thomas Daum, Regina Birner, Hannes Buchwald and Ansgar Gerlicher

During the last decade, mechanisation has received renewed interest among private actors, governments and development practitioners alike, especially in Africa. However, its intra-household effects are unclear. On the positive side, households using tractor services, for example, may be able to cultivate more land and achieve a higher yield. Yet, the expansion of land may increase the burden of labour for activities that are not yet mechanised, such as weeding and harvesting, which are often done by women and children. At the same time, activities that tend to be seen to more by males, such as land preparation, may be substituted by mechanisation services which are typically provided by male tractor operators. The potential changes of female time use may then alter the nutrition status of the household. So much for the hypotheses. To understand how mechanisation affects farm families in reality, we required data on time use and nutrition from different household members over an entire cropping season. For this purpose, we developed a picture-based smartphone app which allows respondents to record data themselves.

The smartphone app helped us obtain this data while also overcoming some of the challenges of existing time use research methods. Household surveys are cheap but prone to recall and social desirability biases. For example, one study found that men over-reported their contribution to household work by 70 per cent in the United States of America, a country where the concept of time plays a major role in society. Time-use diaries are an alternative but difficult to use if respondents cannot read or write and have no "modern" or clock-based concept of time. Given the lack of appropriate methods, reliable data on time use in smallholder farming systems is extremely scant, posing a challenge for researchers. Additionally, this makes it very difficult to prioritise and design good development programmes and to measure their effects.

Could mobile tools help researchers obtain more accurate data? After all, the rapid spread of mobile phones and tools in Africa suggests that rural populations are increasingly open to these technologies if they are well designed. Moreover, the more recent rise of smartphones now allows for the use of visual aids, which break down the text-barrier faced by low- and illiterate users. Many mobile tools have been severely criticised for this since it restricts their circulation to more well-off users who can also make better use of them. For researchers, this would be problematic as it can lead to selection bias.

SUITABLE FOR ILLITERATE USERS …

Therefore, we developed a smartphone application which allows respondents to record their daily activities only using pictures, so that even low- and illiterate users could participate (see Box on page 47). But still, would respondents understand how to use the app? And would they carefully record their daily activities?

To answer these questions, we conducted a study with 62 households in Zambia. These households ranged from families relying only on hand tools to households using tractor services to prepare their land. In each household, we gave the head, one spouse and either a boy or a girl a smartphone for three days at five fixed times during the 2016/2017 farming season. This allowed us to collect roughly 2,790 days of data on time use and nutrition during land preparation, planting, weeding, harvesting and processing. Our experience was that the participants generally found the use of the app exciting. One respondent found the app "easy to use and better than those questionnaires where you need to sit so long". Respondents also recorded their data with much discipline. Cleary, it was important to carefully introduce the app.

… AND WELL ADAPTED TO THE LOCAL SOCIO-CULTURAL CONTEXT

At village level, we placed particular emphasis on explaining why a smartphone app was used and how we selected the participating households. Otherwise, suspicions and tensions may have arisen. For example, one village was sceptical and at first believed that we were Satanists, a concern that we could overcome with careful explanation. At individual level, we found it crucial to carefully test the app and its illustrations. For example, one of our initial illustrations showed a person eating from a pot. This was not understood as eating

but as stealing, because people always eat together – and not directly out of the pot. We then had to change some of the illustrations by taking the local socio-cultural context more into account.

Training also played an important role. Respondents had no difficulties in understanding the app, but some were unfamiliar with using a touchscreen. So we allowed them to practise scrolling and touching first. In all cases, we trained the use of the app using some explanatory stories, such as the following: Mary goes weeding while carrying her baby, then she chats with a friend, then she eats some guavas. All users, ranging from 6 to 90 years, were able to use the app. Therefore, we concluded that smartphone apps can serve as a reliable, affordable and participatory tool for data collection in complex smallholder farming scenarios. So the app worked, but what about the result?

MECHANISATION – A HIGHER WORKLOAD FOR WOMEN AND CHILDREN?

As mentioned above, one of our research questions was whether agricultural mechanisation, especially during land preparation and when linked to the expansion of agricultural land, increases the work burden for women or children during weeding and processing times. Our early, as yet descriptive results suggest that this is not the case. In fact, we find that households using hand tools spend significantly more time on weeding than households that use animal or tractor services. The latter households expand their farm size, which results in a higher demand for weeding. However, they also use animals and/or herbicides for weeding. Furthermore, mechanisation may suppress weed growth. As a result, mechanisation does not increase female and children's time spent on weeding – the demand for weeding is compensated for by other technologies. In fact, our data shows that the time spent on weeding by females declines by nearly half, from around four to two-and-a-half hours a day.

FROM SPECIFIC EXTENSION SERVICES …

Although we focused specifically on time use and nutrition, we found a much larger untapped potential for the use of smartphone apps as a tool for data collection. Obviously, the activity set we used can be adapted. For example, a study focusing on livestock keepers could split our single "livestock activity" into several ones, such as herding, feeding, rearing, etc. Furthermore, the activity sets could be adapted to urban settings or to different occupations. Moreover, one could work with different "plug ins" besides the nutrition one which we adopted. For example, "plug-ins" could be designed to record data on fertiliser or pesticide use or the quality of extension and technical advice. Participants may also make videos or take photos that can be analysed by the researchers later on. The Makerere University in Uganda piloted a similar project that allows farmers and extension workers to take pictures to record the spread of the cassava mosaic disease.

Going some steps ahead, the built-in motion, environmental and position sensors of new smartphones provide a scope for further exploration. For example, position sensors could be used for geospatial studies focusing on land use changes, pastoralism, migration patterns or social movements and networks. Studies could combine (user-entered) data from mobile tools with remote-sensing data. Environmental sensors or an external weather station could be used to record weather data and thus link social and economic aspects of farming with the study of plant production. In addition, position sensors could be applied to validate agricultural plot-sizes, a crucial variable to calculate agricultural productivity which is often over- or underestimated in questionnaires. Sensors have the advantage that they can record data "en passant" without burdening the respondents.

… TO MONITORING AND EVALUATING DEVELOPMENT PROJECTS

The use of mobile tools may be a valuable opportunity not only for researchers but also for development practitioners. Instead of sending enumerators with pen and paper into the field, beneficiaries were able to record data themselves. The non-profit organisation Technoserve, for example, has already used an SMS tool ("Frontline Forms") to evaluate the impact of farmer training in Tanzania. Its tool is still text-based and thus difficult to use for

Does the workload for women increase with farm size? With the aid of the Time Tracker app, the working hours of each family member can be checked.

Photos: Hannes Buchwald

THE TIME TRACKER APP

The use of the app is straightforward. Participants click on the picture showing the activities they do (e.g. hoeing and carrying a baby) when they begin an activity. When they finish, they click on the picture again. This real-time recording rules out recall biases. We designed an additional "plug-in" for the activity of "eating". In this case, two windows open: the first one shows four differently filled plates, which allow quantities of food consumed to be recorded. The second one shows different food groups such as cereals, vegetables or fruits, which allow a recording of the diversity of food eaten. The smartphones used were blocked so that only the app could be used, which reduced the temptation to use the phones for other things besides data recording. It also enhanced the battery life to up to four days. The app has a second screen to crosscheck the data that was recorded and to correct potential mistakes. Both data recording and submission can be done offline. The collected data can be easily and quickly transferred from the smartphone to a laptop using a local Wi-Fi network. The app is open-source.

low- and non-literate users, but this shortcoming could be remedied using audio-elements and pictures. One could go some steps further and use mobile tools and apps not only for the evaluation, but also for the monitoring and management of development projects. The recording of data in real time would allow for quick adjustment and improvements to development projects once new opportunities or problems become visible. One should be careful, however, not to completely dismiss traditional ways to collect data in this context. Traditional data collection methods still have a lot to offer and are an important feedback mechanism. Specifically qualitative data collection methods are difficult to replace (and should not be replaced) because of their flexible and complex nature.

ETHICAL STANDARDS MUST NOT BE NEGLECTED

Clearly, some of the thoughts and ideas discussed above are easier to follow than others and should always be carefully weighed against existing data collection methods. Also, a number of them would need a strong focus on ethical standards, especially when private data such as GPS data are being employed. Additionally, smartphone penetration might still be too low in many areas to rely on mobile phones by respondents, which would lead to selection biases. So far, studies are likely to need to provide smartphones to the respondents. However, this may change in the next years given the recent and rapid rise of smartphones. Using them would then allow real "citizen science" studies.

In summary, the digital revolution does not only offer new development opportunities for users in developing countries, it also provides fascinating new pathways for researchers and development practitioners. Well-tailored mobile tools enable researchers to obtain highly valuable and accurate data – potentially in real time. Some of this data would be very difficult or impossible to collect using conventional data collection methods. Cleary, this benefits development practitioners. For them, access to accurate data is a key factor to design appropriate policies that allow increases in sustainable productivity on farms and reductions in hunger and poverty. This is also true for researchers: mobile tools and apps may allow them to tackle entirely new and so far neglected (but potentially crucial) fields of research. Many of these new fields may be transdisciplinary in nature. Overall, mobile tools and apps could enable us to get a much more nuanced understanding of complex smallholder farming systems in particular, and new and improved general insights into developing countries.

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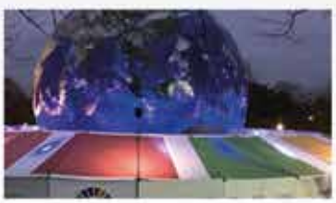

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A FORTNIGHTLY UPDATE ON RURAL DEVELOPMENT