Adaptation in Agriculture

Potentials, Challenges and Experiences from Implementation

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

Published by:
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Friedrich-Ebert-Allee 36 + 40
53113 Bonn
T +49 228 44 60-0
F +49 228 4460-17 66

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany
T +49 61 96 79-0
F +49 61 96 79-11 15

E info@giz.de
I www.giz.de

Sector project Sustainable Agriculture (NAREN)

Responsible/Contact:
Julian Andersen, julian.andersen@giz.de

Authors:
Andreas Wilkes (UNIQUE forestry and land use GmbH)
Katalin Solymosi (UNIQUE forestry and land use GmbH)

Design/layout:
Ira Olaleye, Eschborn

Photo credits/sources:
Title image: ©GIZ/Daniel Brombacher; Pg. 24, 25: ©GIZ ICCAS; Pg. 26: © Flickr, creative commons, © Terrence Franklyn, Sarah Boyd, Christabelle Andrews (Grenada), www.flickr.com/photos/sarahboyd/15630735529, is licensed under CC BY 2.0; Pg. 28: ©GIZ 'Strengthening drought resilience in the arid and semi-arid lowlands of Ethiopia'; Pg. 30, 31: ©GIZ 'Adaptation of agriculture to climate change in northern Namibia'; Pg. 33, left: Flickr, creative commons, © Rémi Kahane, GlobalHort. Benin, July 2011, www.flickr.com/photos/globalhort/6836233694/in/album-72157629585045489, is licensed under CC BY 2.0; Pg. 33, right: Flickr, creative commons, © jbdodane, www.flickr.com/photos/jbdodane/10628839534, is licensed under CC BY 2.0; Pg. 34: Benin. Photo: Flickr, creative commons, © Rikolto (Vredeseilanden), www.flickr.com/photos/vredeseilanden/2247595211, is licensed under CC BY 2.0; Pg. 35 – 37: ©GIZ CAADP-Climate; Pg. 39: © GIZ 'Adaptation to climate change in the West Bank': Pg. 43, 45: ©GIZ FOR-CC;
Pg. 48 – 49: ©GIZ CCCPIR

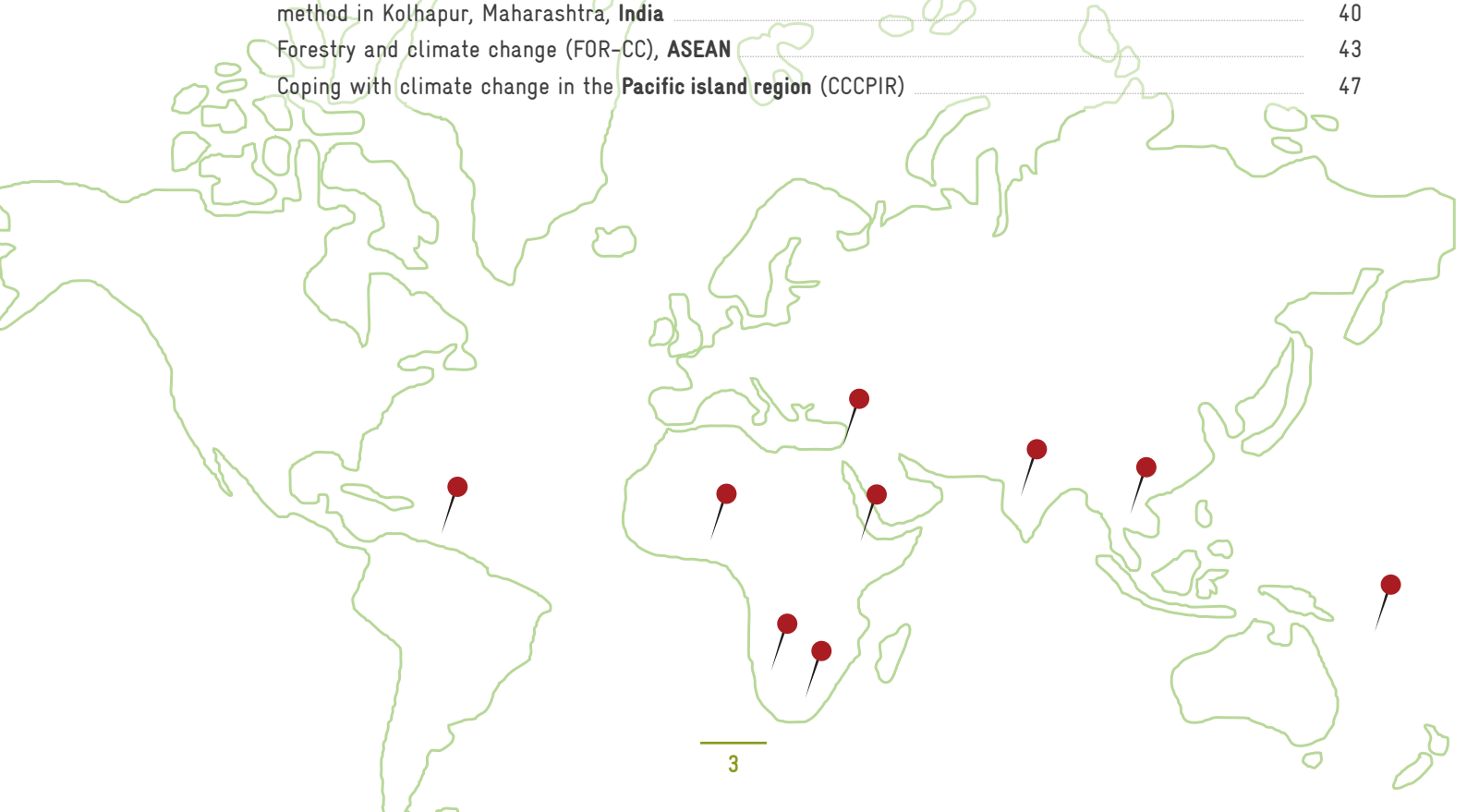
Printed on 100 % recycled paper, certified to FSC standards.

Eschborn/Bonn 2018

Druckerei bitte FSC-Logo einfügen

Druckerei bitte Carbon Neutral Logo einfügen

Contents



Abbreviations

AFCC	ASEAN Multi-Sectoral Framework on Climate Change: Agriculture and Forestry towards Food Security
ASEAN	Association of Southeast Asian Nations
ASEC	ASEAN Secretariat
ATWGARD	ASEAN Technical Working Group on Agricultural Research and Development
AU	African Union
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMZ	German Federal Ministry for Economic Cooperation and Development
CA	Conservation agriculture
CAADP	Comprehensive Africa Agriculture Development Programme
CapDip	Capacity Building and Dissemination Programme
CARDI	Cambodian Agricultural Research and Development Institute
CCCPIR	Coping with climate change in the Pacific island region
CO_2	Carbon dioxide
CRN	ASEAN Climate Resilience Network
CSA	Climate-smart agriculture
EKF	Energy and Climate Fund
FAO	Food and Agriculture Organization of the United Nations
FOR-CC	Forestry and climate change in ASEAN member states
GERRI	Grenada Ecological Resilience Research Institute
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
ICCAS	Integrated climate change adaptation strategies in Grenada
IICA	Inter-American Institute for Cooperation on Agriculture
IPCC	Intergovernmental Panel on Climate Change
NABARD	National Bank for Agriculture and Rural Development
NAIP	National agriculture investment plan
NAP	National adaptation plan
NAPA	National adaptation programme of action
NDC	Nationally determined contribution
NEPAD	New Partnership for Africa's Development
NPCA	NEPAD Planning and Coordinating Agency
PACC	Adapting agriculture to climate change in northern Benin
PIA	People in Action
RISE	Response-inducing sustainability evaluation tool
SDSSSKL	Shri Datta Shetkari Sahakari Sakhar Karkhana Ltd
SSI	Sustainable Sugarcane Initiative
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UPNRM	Umbrella Programme for Natural Resource Management

Acknowledgements

This report was written by Andreas Wilkes and Katalin Solymosi (UNIQUE forestry and land use GmbH) with inputs from many GIZ colleagues in Eschborn (Antonia Bosse, Dieter Nill, Stephanie Heiland and Christian Weidner) and others working on the projects described in the case studies (Joanna Akritidu, Imelda Bacudo, Christopher Bartlett, Joachim Becker, Maria Carciumaru, Sonja Esche, Sylvestre Fandohan, Ntaba Francis, Daniel Gerecke, Miriam Heidtmann, Birgit Mayer, Tobias Mohn, Peter Müller, Dorothe Nett, Dieter Rothenberger, Hanna Sabass, Alexander Schoening, Elisabeth van Akker and Kristine Villagracia). Photographs were provided by the project staff, with the exception of the last photo in the CAADP Climate case study (UNclimatechange via flickr).

Introductory note

The Paris Climate Agreement of December 2015 represents an unprecedented turning point in international climate and development policy. The legally binding and universal agreement contains commitments for all 196 states and has been widely recognized since the official signing ceremony in New York, April 2016, which subsequently came into force on November 4th, 2016.

To achieve the goals of the Paris Climate Agreement, global GHG emissions are to be reduced to net zero in the second half of the century (so-called GHG neutrality). Furthermore, adaptation to climate change is given equal political weight with the reduction of GHG emissions.

At the center of the climate agreement are the national climate targets (Nationally Determined Contributions, NDCs). With the NDCs, countries show what and how they plan to contribute to GHG reduction and adaptation. According to an FAO study, the agricultural sector is included in over 90 per cent of NDCs. About 86 per cent of developing countries and 88 per cent of emerging economies have set reduction targets for agriculture and/or land use, land use change and forestry in their NDCs. More than 90 per cent of the developing countries that have formulated adaptation targets in their NDCs refer to agriculture (in Sub-Sahara Africa,100 per cent).

In view of the global challenges, the German Federal Ministry for Economic Cooperation and Development (BMZ) has developed a framework for climate change and agriculture that must guide measures in German development cooperation. Climate change issues must be taken into account in all agricultural projects and concrete development measures for climate adaptation and mitigation are promoted and developed. With its efforts, BMZ support partner countries in implementing the agricultural components of the national climate targets (NDCs).

GIZ is implementing projects to adapt the agriculture sector to the effects of climate change and to enhance the climate resilience of rural livelihoods and land use systems worldwide. BMZ and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) are the principal agencies providing funding for adaptation projects in agriculture implemented by GIZ. All projects mentioned in this document were commissioned by either BMZ or BMU, with additional funding provided through the Energy and Climate Fund (EKF) jointly implemented by BMZ and BMU, except the CCCPIR project which receives funding from several external sources.

This publication is aimed at informing development specialists, scientists, climate change experts and the general public regarding GIZ approaches for climate adaptation projects in the agriculture sector. It showcases a selection of ongoing adaptation projects funded by the German Federal Government and implemented by the GIZ with partner countries.

GIZ – multi-level solutions to adapt to climate change in the agriculture sector

The effects of climate change are an increasing challenge for agricultural development around the world. Agriculture is one of the economic sectors most seriously affected by climate change, as it is highly dependent on weather conditions, such as temperature and rainfall. People depending on primary production for their livelihoods are most likely to suffer substantial economic loss, health consequences and the effects of environmental degradation amplified by climate change.

Even with a shift to a low-carbon economy, developing and newly industrialising countries will experience the impacts of climate change, such as extreme weather events and gradual changes in temperatures and precipitation. Under the Paris Agreement, adaptation is considered as important a goal as mitigation. The adaptation goal involves an undertaking by the international community to improve adaptive capacity, enhance resilience and reduce vulnerability to the consequences of climate change.

GIZ's support for adaptation in agriculture responds to the priorities of partner countries and builds the resilience of smallholder farmers to the effects of climate change through a multi-level approach from the local to the national level, building partners' capacities to understand adaptation needs and plan and implement adaptation measures in agriculture.

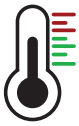
1 Introduction

Climate change, with its wide-ranging impacts, has become a major challenge for humanity, and the agriculture sector is highly prone to its adverse effects. Being dependent on weather conditions, it responds directly to changes in climate-relevant variables, such as temperature and rainfall. Agriculture has a history of responding to changing conditions, including climate as well as economic, social and political circumstances. However, the current rate of change – the increasing frequency and intensity of extreme climatic events and the overall rise in the global mean temperature – amplifies the risks faced by agricultural production and often exceeds the speed at which farmers are able to adapt.

Although the prevalence of hunger in the world has gradually been falling, the Food and Agriculture Organization of the United Nations (FAO) estimates that 789 million people were undernourished in 2014-2016, mostly in developing countries.[1] In addition, the world's population is projected to increase from 7.3 billion today to 9.8 billion in 2050.[2] Together with rising incomes and the changes in consumption patterns, FAO has estimated that there will need to be a 50 % increase in the total volume of food production by 2050.[3]

Across the world, crops and animals are adapting to the longer-term characteristics of weather conditions – known as 'climate conditions'. When changes in climate conditions occur in the short term, crops and animals are impacted. Compared to pre-industrial levels, the global mean temperature is likely to increase by between 0.3 °C and 0.7 °C in the coming two decades and may rise by as much as 5.4 °C by the end of the century.[4] Crop yields may decline, affecting farmers' incomes and food security, especially for rural people and the poor.

Climate change has direct effects on agriculture in several ways:[5]



- **Effects of rising temperatures:** While some crops in cooler climate regions may benefit from small degrees of warming, crop yields in tropical and temperate regions may decrease as average temperatures reach 2 °C above historical levels. High temperatures during flowering can result in lower grain yield per plant. They can increase water stress and may lead to plants wilting. Heat stress can also affect livestock, causing them to reduce their food intake, grow more slowly and become less productive. Extreme heat may even cause death. Changing temperature trends affect the timing and duration of cropping seasons: some tree crops and horticultural crops have been observed to flower earlier, but this may increase frost risks in temperate regions. This could mean that some crops are no longer suited to being grown in certain regions.

- **Effects of water stress and waterlogging:** Crops can suffer from both lack of water and excessive water. Long droughts and flooding can lead to total crop failure, and high moisture levels can result in poor harvest quality. In irrigated systems, where the water supply is managed, changes in temperature tend to be more important than changes in rainfall, but only about 22 % of the world's farmland is

1 FAO, IFAD, UNICEF, WFP and WHO. 2017. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

2 United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248, New York, USA.

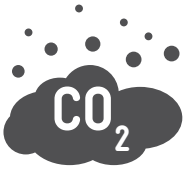
3 FAO (2017), *The Future of Food and Agriculture: Trends and Challenges*, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

4 IPCC (2013), 'Technical Summary', in *Climate Change 2013: The Physical Science Basis*, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, USA.

5 IPCC (2014 a), 'Food security and food production systems', in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, USA, pp. 485-533.

irrigated.[6] The remaining farmland is rain-fed and thus highly exposed to the effects of changing rainfall patterns.

- **Effects of increased CO_2:** Increased CO_2 concentration in the atmosphere – the 'greenhouse effect' – can be beneficial for plant production to a certain extent, due to the CO_2-fertilisation effect. This promoting effect is stronger in some types of crop (e.g. wheat, rice, cotton, soybean, sugar beet and potato) than in others (e.g. maize, sorghum or sugarcane) because of differences in how they absorb CO_2. However, this effect is also dependent of the availability of water and nutrients.



- **Extreme climate events:** Longer-term climate change is also associated with changes in the frequency and severity of extreme weather events, such as floods, droughts, heat waves or storms, which directly affect crops, livestock and fisheries.[7]

The effects of climate change on food production are already evident in several regions of the world. Overall, adverse effects have been more common than positive effects in recent decades.[8] The projected impacts of climate change vary depending on the methods and models used and the scenarios applied to project future greenhouse gas (GHG) emissions. In general, as temperatures rise, total rainfall will increase, but the differences between dry and wet regions will also grow. Moreover, increasing shifts are expected in the timing and length of seasons.[9] Agricultural production will benefit in some regions but face increasing challenges in others.[10]

At a global level, projections of the future direct impacts of climate change on crop production suggest not only that yields may decline, but also that they could become less stable, indicating increasing risks for farmers.[11]

In sub-Saharan Africa and South Asia – where currently 22 % and 15 % of people are undernourished[12] – it is expected that by 2050 yields of the main crops will have fallen by 8 %, due to a decrease in wheat (-12 %), maize (-7 %) and millet (-9 %), while yields of rice and cassava may not be affected.[13] These effects are expected to become increasingly apparent after the next two decades, as global temperatures rise (Figure 1).

In Latin America, maize and beans account for about two thirds of the food crops that are grown and consumed in the region.[14] Climate change impacts will vary across the continent (Figure 2).[15] For example, in Uruguay, Argentina and the far south of the continent, warmer and wetter conditions may promote faster growth and higher yields in the coming decades. In the Andes, north-eastern Brazil and Central America, extreme high temperatures are expected to reduce crop yields. Some areas where coffee and other perennial crops are currently grown may become unsuitable in the future if, for example, these crops are exposed to continuously high temperatures.

6 J.M. Salmon, M. A. Friedl, S. Frolking, D. Wisser and E.M. Douglas (2015), 'Global rain-fed, irrigated, and paddy croplands: A new high-resolution map derived from remote sensing, crop inventories and climate data', *International Journal of Applied Earth Observation and Geoinformation*, 38, pp. 321–334.

7 IPCC (2012), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, USA.

8 IPCC (2013), *ibid.*

9 IPCC (2014 a), *ibid.*

10 IPCC (2013), *ibid.*

11 IPCC (2013), *ibid.*

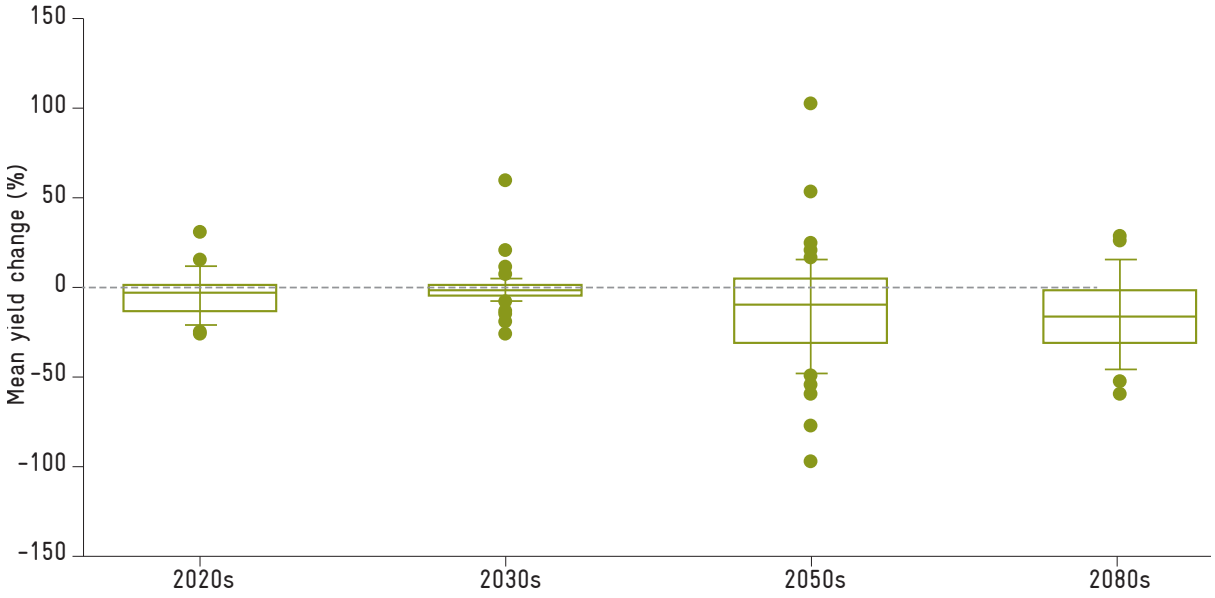
12 FAO (2017), *State of Food Security and Nutrition in the World, ibid.*

13 J. Knox, T. Hess, A. Daccache and T. Wheeler (2012), 'Climate change impacts on crop productivity in Africa and South Asia', *Environmental Research Letters*, 7(3), 034032.

14 FAOSTAT data: http://www.fao.org/faostat/en/#home.

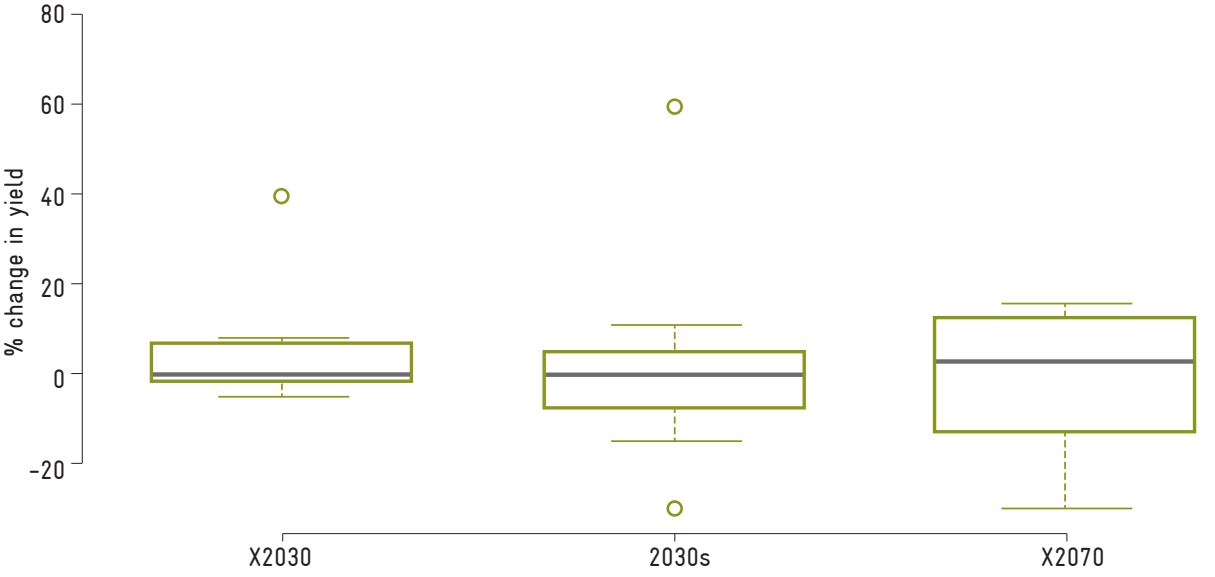
15 IPCC (2014 b), 'Central and South America', in *Climate Change 2014: Impacts, Adaptation, and Vulnerability, Part B: Regional Aspects*, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1,499–1,566.

Figure 1: Projected direct impacts of climate change on crop yields in Africa and South Asia by decade, combining results from 257 studies



Source: J. Knox, T. Hess, A. Daccache and T. Wheeler (2012), 'Climate change impacts on crop productivity in Africa and South Asia', Environmental Research Letters, 7(3), 034032.

Figure 2: Projected direct impacts of climate change on maize and bean yields in Latin America by decade, combining results from 17 studies



Source: This study, based on data in G. Magrin et al. (2015), 'Central and South America', in IPCC Climate Change 2014: Impacts, Adaptation and Vulnerability, Cambridge University Press.

About 70 % of the world's one billion rural poor people depend at least in part on livestock for their livelihoods.[16] Climate change also affects livestock production.[17] Northern and southern Africa are projected to become drier with climate change. Providing water for livestock may become challenging, and prolonged droughts may increase loss of livestock. In East Africa, where many dairy cows and goats are fed on crop stalks, impacts on maize growth would also reduce available feed. Across the world's rangelands – which cover more than a quarter of the world's land surface[18] – plant growth is sensitive to rainfall, and poor vegetation growth increases the risk of land degradation.

Gender and climate change

Women in developing countries are particularly vulnerable to climate change. They are highly dependent on local natural resources for their livelihood. Women responsible for the tasks of securing water, food and fuel for cooking and heating face the greatest challenges. Women experience unequal access to resources and decision-making processes, with limited mobility in rural areas. All of these reasons make it essential to analyse project impacts on gender equality and to identify gender-sensitive strategies that respond to these crises taking into account women's needs.[19]

In addition to direct effects, climate change can also have indirect effects on agriculture,[20] including the following.

Pests: Changes in temperature can result in changes in the distribution of pests and diseases. Some pest species have increased winter survival, and with warmer conditions some pests can reproduce more times in a year than previously.

Water supply: About a sixth of the world's population live in river basins fed by glaciers.[21] Melting glaciers may increase the water available for irrigation in the short term, but water scarcity will follow when meltwater declines.

Sea level rise: Climate change leads to rising sea levels as the polar ice caps melt and oceans get warmer, causing seawater to expand. Fields in low-lying coastal areas, such as river deltas, are vulnerable to intrusion by seawater, which causes soil salinisation.

Because of their complexity, these indirect effects are more difficult to predict. One can be confident, however, that climate change will bring more uncertainty and new challenges to farming in the future.

With a growing world population, there will be a need to increase food production by more than 13 % per decade to 2050.[22] Figures for the major crops show that only maize yields have grown at a faster rate (16 %) in the last 50 years.[23] Yields of rice, wheat and soybean (which together provide about 40 % of global food calories)[24] have been growing at 10 %, 9 %, and

[16] FAO (2009), *State of the World's Agriculture 2009. Livestock in the balance*, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

[17] IPCC (2014 a), *ibid.*

[18] C. Neely, S. Bunning and A. Wilkes (2009), *Review of evidence on drylands pastoral systems and climate change*, Land and Water Discussion Paper 8, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

[19] UNDP (2013), *Gender and Climate Change – Asia and the Pacific*, Policy Brief 1, Global Gender and Climate Alliance (GGCA). United Nations Development Programme (UNDP), New York, USA.

[20] IPCC (2014 a), *ibid.*

[21] IPCC (2007), *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

[22] Estimate based on projections in FAO (2017), *The Future of Food and Agriculture: Trends and Challenges*, op. cit.

[23] D.K. Ray, N.D. Mueller, P.C. West and J.A. Foley (2013), 'Yield trends are insufficient to double global crop production by 2050', *PloS one*, 8(6), e66428.

[24] D. Tilman, C. Balzer, J. Hill and B.L. Befort (2011), 'Global food demand and the sustainable intensification of agriculture', *Proceedings of the National Academy of Sciences*, 108(50), 20260–20264.

13 % respectively per decade.[25] In the future, the negative impacts of climate change on agricultural production will increase over time, threatening global food security unless effective adaptation measures are taken.

Maintaining agricultural growth in the face of a changing climate is essential for rural livelihoods. An estimated 380 million households worldwide depend on farming for part of their living.[26] It is also critical for poverty alleviation: more than 80 % of the reduction in poverty worldwide has been due to development in rural areas rather than migration to cities.[27] For every 10 % increase in farm yields, there has been a 7 % reduction in poverty, and agricultural growth is at least twice as effective in reducing poverty as economic growth originating outside the agriculture sector.[28] In this context, it is also critical to consider gender needs.[29] Beyond the farm gate, food processing, transport, retail, restaurants and other services also provide jobs for millions.[30]

Developing countries have indicated the importance of adaptation in the agriculture sector in their climate change policies. The Paris Agreement of 2015 requires countries to submit their nationally determined contributions (NDCs) to achieving the objectives it sets of 'holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels'. When submitting their NDCs, many countries also took the opportunity to state their adaptation priorities, targets and plans.

Of 132 developing countries that submitted an NDC, 126 included adaptation, and all but six of these listed adaptation in agriculture as a priority.[31] The Agreement provides for a mechanism for the continuous monitoring of NDCs. A global stocktaking will take place every 5 years. All countries have to report on current progress of their NDCs and enhance ambition targets. A first review of the efforts is planned for COP24 in 2018[32].

Many countries have prepared national adaptation plans (NAPs), and agriculture is widely listed as a priority sector. The 50 least developed countries have also received support to identify their priority and urgent needs, which are set out in national adaptation programmes of action (NAPAs).[33] Among the specific projects listed in NAPAs, the largest share (20 %) is related to food security. Adding projects that consider areas related to land, coastal resources and the water and infrastructure sectors, the majority of priority projects are directly or closely related to agriculture.

Many countries are developing national policies and plans to promote 'climate-smart agriculture' (CSA) – agriculture that supports food security, adaptation to climate change and mitigation of greenhouse gas emissions.[34] While mitigation of greenhouse gas emissions in agriculture in developing countries can have important synergies with productivity and resource use efficiency, resilience to climate change and food security are often the priorities pursued in CSA.

[25] Ray et al., *ibid.*

[26] L.H. Samberg, J.S. Gerber, N. Ramankutty, M. Herrero and P.C. West (2016), 'Subnational distribution of average farm size and smallholder contributions to global food production', *Environmental Research Letters*, 11(12), 124010.

[27] World Bank (2007), *World Development Report 2008: Agriculture for Development*, World Bank, Washington D.C., USA.

[28] World Bank (2007), *ibid.*

[29] UNDP (2013), *ibid.*

[30] World Bank (2017), *Future of Food: shaping the food system to deliver jobs*, World Bank, Washington D.C., USA.

[31] CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) (2016), 'Agriculture's prominence in the INDCs', Data and maps, https://ccafs.cgiar.org/agricultures-prominence-indcs-data-and-maps#.Wh2Qw9Jl_IU.

[32] World Resources Institute (2017): Designing the Global Stocktake under the Paris Agreement: The Catalyst for Climate Action. www.wri.org/blog/2017/05/insider-designing-global-stocktake-under-paris-agreement-catalyst-climate-action

[33] A. Maybeck, N. Azzu, M. Doyle and V. Gitz (2012), 'Agriculture in National Adaptation Programmes of Action', in *Building Resilience for Adaptation to Climate Change in the Agriculture Sector*, Food and Agriculture Organization of the United Nations (FAO) and Organisation for Economic Co-operation and Development (OECD) , Rome, Italy.

[34] FAO (2013), *Climate-Smart Agriculture Sourcebook*, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

2 Potentials and challenges of adaptation in agriculture

The precise trend in future climate change is uncertain, and information for particular farming areas is often lacking. In development planning processes, climate change is only one important factor to be considered among others; markets, environmental trends, socio-economic conditions and other factors are also relevant. Practical tools are needed to support decision-making at all levels, from farm to national level, considering climate change along with other factors.

Many farming practices can increase or improve the stability of yields under different climate conditions, but making information available is insufficient to reduce farmers' vulnerability. Many farmers in developing countries need better access to finance and farming inputs to make adoption of adaptive practices possible. Farming practices often need to be coordinated with other efforts, such as risk management or biodiversity conservation. Comprehensive strategies and integrated measures are needed to support farmers in coping with a variety of risks, including those beyond the agriculture sector. Adaptation in the agriculture sector therefore requires a holistic, integrated approach.

Strengthening institutions at all levels is necessary to provide an enabling environment for adaptation measures. At local level, planning and implementation of adaptation requires collective action for managing communal resources and for coordinated action among farmers to reduce risks. Multi-stakeholder dialogues are required to ensure that plans are coordinated within regions and across sectors and to ensure that women, the poor and other vulnerable groups have a voice in planning processes.

Coordination across sectors is essential to integrate climate, agriculture and other sectors, such as water management, social welfare and the finance sector. National agricultural policies and strategies provide a key entry point for integrating climate concerns, because they provide the framework for both domestic and international investment and support. National strategies for the agriculture sector need to be aligned with national climate change strategies and plans in other sectors in order to ensure coherent action across government.

Because of the complexity of climate-resilient development processes in the agriculture sector, adaptation options and strategies should be based on vulnerability or climate risk assessment to identify hot spots and adaptation measures and evaluate their effectiveness.

3 GIZ's approach to adaptation in agriculture

Sustainable development is GIZ's guiding principle. In order to ensure that this principle and the GIZ sustainability directive and gender strategy are applied in all its contracts, GIZ has established a **Safeguards + Gender Management System**. The system consists of a set of management processes and procedures that allow GIZ to identify, analyse, avoid, minimise and mitigate any potential adverse environmental and social impacts of its activities. Through a systematic assessment process, GIZ is able to identify external risks and unintended negative effects – as well as potentials for promoting gender equality – at an early stage and plan projects accordingly so as to better ensure the protection of people and resources. The safeguards cover the following areas:

- environment,
- climate,
- conflicts and context,
- human rights,
- gender.

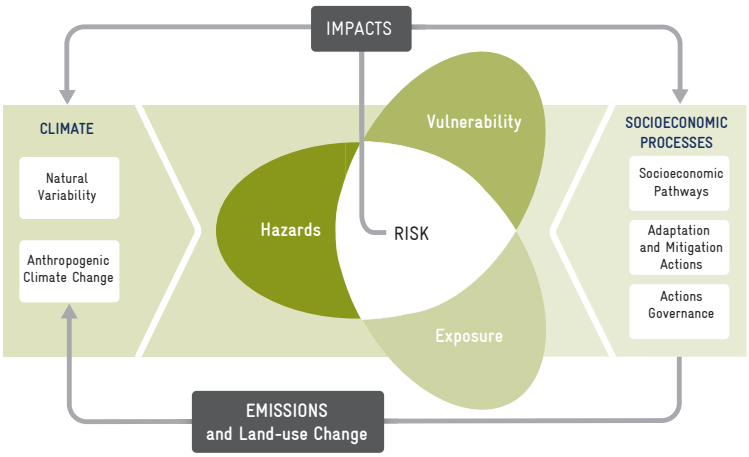
The **'Climate Safeguard'** looks at the impact of the project on climate change (greenhouse gas emissions) and the need to adapt to the effects of climate change.

GIZ has its own **position paper on adaptation to climate change**, detailing the corporate position and recommendations on the issue. The paper states that every adaptation measure proposed should be based on an explicit 'adaptation hypothesis'. The adaptation hypothesis is the plausible assumption of how a project activity contributes to adapting to climate change impacts or harnessing associated potentials and is based on a sound appraisal of context-specific climate impacts. Thus, the identification and selection of adaptation options and strategies must be preceded by a vulnerability or climate risk assessment.

The GIZ understanding of climate risks is based on the core concepts and definitions of the IPCC from the 5th Assessment Report (see figure 3) [35]. Risk of climate-related impacts results from the interaction of climate-related hazards (including hazardous events and trends) with the vulnerability and exposure of human and natural systems. Changes in both the climate system and socioeconomic processes including adaptation and mitigation are drivers of hazards, exposure, and vulnerability.

[35] IPCC (2014 c), *Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).* Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32..

Figure 3: Illustration of the core concepts of the IPCC Working Group II.



Source: Climate Change 2014: Impacts, Adaptation and Vulnerability, Summary for policymakers (IPCC, 2014)

GIZ's approach to adaptation in agriculture uses multi-level and holistic interventions to reduce the risk of climate-related impacts to smallholder farmers.

A multi-level approach: Sustained adaptation to climate change by farmers requires an enabling environment to be in place to support adoption and continued adaptation of climate-resilient practices. For support to farmers to be sustained, it is not enough to focus on the capacities of smallholder farming households. Building the capacities of many other actors whose decisions impact on farmers is essential. Therefore, GIZ adopts a multi-level approach, providing targeted support to influential actors at different levels: individuals, organisations, networks of organisations and policy frameworks.

For example, in the small island state of Grenada, the National Climate Change Committee identified the agriculture sector as a priority in its NAP. GIZ's CSA pilot project supported the Ministry of Agriculture in integrating climate change into its sectoral plans and annual organisational work plans. To support delivery of these plans, GIZ collaborated with other institutions to provide training for the Ministry's technical officers, who would then provide training and advice to farmers on climate-smart agricultural practices. By revising monitoring methods used by technical officers to include CSA practices, the project has further strengthened the mainstreaming of CSA in the day-to-day operations of the Ministry.

By coordinating interventions at multiple levels, GIZ also supports the development of capacities for learning and innovation within organisations and networks of organisations. For example, GIZ supports the Secretariat of the Association of Southeast Asian Nations (ASEAN) to generate and share knowledge about climate-resilient agricultural practices. The ASEAN Climate Resilience Network plays a key role in this, facilitating national consultations and bringing together policy-makers, researchers and other stakeholders to share their knowledge and to collaborate in developing common strategies for regional cooperation.

A holistic approach: Capacity is multi-dimensional: social, ecological, economic, physical and institutional. Often, it is necessary to develop capacities in more than one dimension in order to achieve effective and sustainable outcomes. For example, in Ethiopia, constructing weirs (physical capacity) improves the ecological functioning of river valleys to prevent flooding, while increasing soil moisture and ground water recharge (ecological capacity). GIZ also works with vocational colleges to increase construction skills and to create employment opportunities (social and economic capacities), while agronomic interventions to increase crop yields enhance the economic capacity of farmers.

In delivering support to multi-level, holistic interventions, GIZ uses a range of development cooperation mechanisms, including:

- **Policy advice:** GIZ advises policy-makers on formulating and implementing national adaptation strategies for the agriculture sector. This also includes integrating climate change adaptation considerations into existing agricultural strategies and programmes. Where new strategies are designed, GIZ supports the piloting of practical options to support decision-making processes.

  For example, in Namibia, policy-makers perceived a lack of concrete evidence on the effects of different tillage methods as a barrier to promoting conservation tillage. GIZ's field trials on both experimental stations and farms will provide the evidence needed to effectively implement the country's Conservation Agriculture Strategy.

- **Capacity development:** GIZ builds the capacity of partners from the local to the national level to analyse adaptation needs, select adaptation options and plan and implement adaptation measures.

  For example, in Benin, local authorities prepared development plans without any consideration for climate change. GIZ developed standardised methods and procedures for stakeholders at the commune level to analyse climate change and to plan and implement adaptation measures. Climate-sensitive planning has been upscaled from three to ten municipalities, by building their capacities to incorporate these methods into the planning process.

  Many of GIZ's agricultural adaptation projects also provide extension workers and farmers with tech-

nical training in good practices that are water efficient, prevent erosion and provide reliable harvests in the face of a variable climate.

- **Knowledge and experience exchange:** Efficient and effective knowledge management is an essential support to learning and innovation. Adaptation of agriculture to climate change is a new topic in many countries. Farmers, technicians, scientists and policy-makers are all learning how to address the challenges and grasp the opportunities presented. Capitalising on its practical experience, GIZ promotes learning and experience exchange.

  For example, to promote climate mainstreaming in African agricultural policies, GIZ has promoted regional exchanges of experience among African Union member states and supported the establishment of the Africa Climate-Smart Agriculture Alliance and Platform. These activities have helped focus attention on agriculture and climate change at pan-African meetings and supported African countries as they participate in the UN climate change negotiations.

  GIZ's reports, guidance and training materials, based on its practical experience, are well known in the development community.

- **Access to finance:** Project funds from commissioning parties, such as the German Federal Ministry for Economic Cooperation and Development (BMZ) are one source of finance for agricultural adaptation. Through project investments, expert advice is provided and pilot activities are financed to enable farmers and other stakeholders to learn from practice. Mainstreaming climate change adaptation in the agriculture sector can help align government investments with the adaptation needs of farmers. GIZ cooperates with a wide range of organisations – including donors, banks and the private sector – to enable farmers to access co-financing from other sources for adaptation activities.

  GIZ also advises clients on how they can make use of national and international financing opportunities for climate change adaptation in the agriculture sector. In Africa, GIZ has supported the establishment of the NEPAD [36] Climate Change Fund, which has supported 18 projects to implement adaptation measures and revise agriculture-related policies.

- **Monitoring and measuring adaptation:** GIZ has pioneered the development of methods to monitor and evaluate the effects of adaptation interventions at different levels. As more and more countries elaborate national adaptation plans, monitoring and evaluating adaptation at national level has gained in importance. For example, GIZ has assisted the Government of Morocco in developing an adaptation monitoring system that tracks changes in vulnerability, monitors adaptation interventions and supports the formulation of regional climate change strategies within the framework of the national strategy.

- **Reducing vulnerability:** The vulnerability of agriculture and farmers in a particular location depends on their sensitivity or susceptibility to harm and their capacity to cope and adapt. In addition to this, the risk of the agriculture sector being negatively affected by hazardous climate events is also influenced by the exposure of its elements. Figure 4 gives a schematic overview of the factors that determine vulnerability and the level at which adaptation measures address climate change.

GIZ's support for adaptation is therefore implemented through three pathways:

- **Reducing the sensitivity of farming systems to climate change:** For example, rice varieties that are tolerant to both drought and flooding make rice cultivation less sensitive to variations in rainfall. In the ASEAN region, GIZ supported multi-country studies on climate-resilient practices in the rice sector. These studies identified adoption of new stress-tolerant rice varieties as an important and broadly relevant option. After documenting the results of field-testing, GIZ supported ASEAN working groups in developing technical guidelines for the promotion of stress-tolerant varieties in the region.

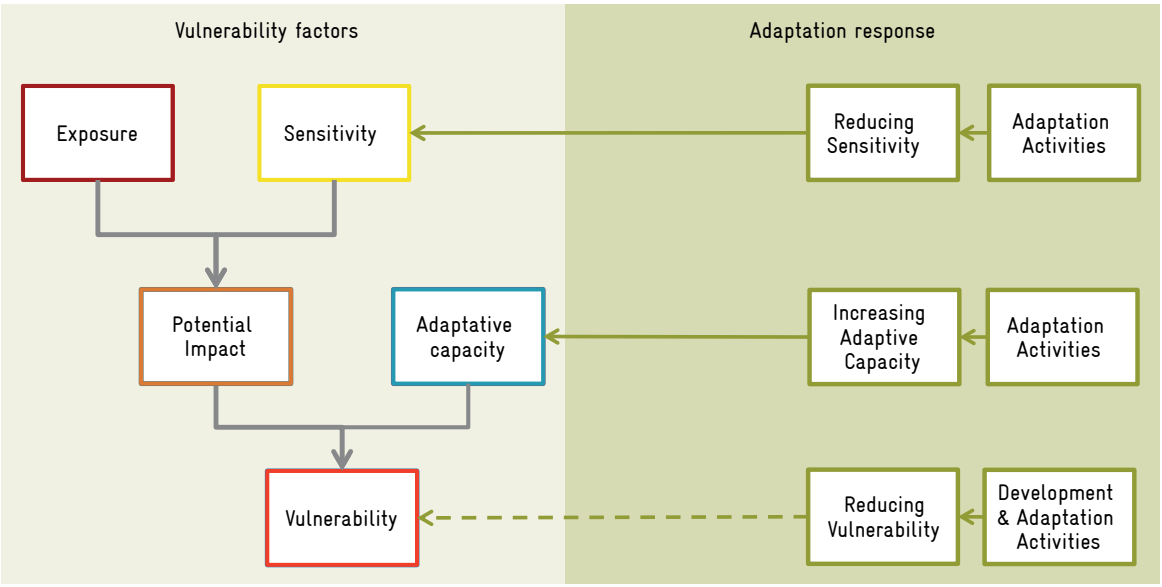
[36] New Partnership for Africa's Development: www.nepad.org.

- **Reducing the vulnerability of farmers to climate impacts when they happen:** For example, traditional diets in some Pacific islands are based on a limited number of foods, so dietary intake is often severely affected when cyclones occur. By increasing the variety of vegetables and poultry products that farmers produce – including crops that are tolerant of salt water – GIZ's interventions have made women and children less vulnerable to the effects of cyclones.

  In addressing adaptation to climate change, GIZ promotes inclusive approaches within its partner countries, paying special attention to vulnerable groups, such as women. Women across the world are actively involved in agricultural activities but often do not have land rights and have less access to information and services than men. This increases households' vulnerability to climate change. Because of these gender inequalities, women face unique challenges in adapting to climate change. Some of GIZ's projects are building women's adaptive capacity by supporting women's groups, while others ensure that planning processes and technical service delivery are gender-inclusive.

- **Increasing farmers' adaptive capacity:** Many of GIZ's agricultural adaptation projects increase the ability of farmers to access extension advice and other support for adopting climate-resilient practices. Training extension staff and improving the delivery of extension services enables farmers to access advice on climate-resilient practices. Many projects disseminate information on climate-smart practices and strengthen farmers' participation in farmer organisations and local planning processes, all of which increase the access of farmers and the people they work with to the support needed to continue adapting to the climate risks they face.

Figure 4: Effects of adaptation activities on reducing vulnerability to climate change



Source: Julia Olivier (2015), presentation to the workshop 'Indicators for climate-resilient development', Brussels, 25 March 2015.

4 Case studies of GIZ's support for adaptation in agriculture

Integrated climate change adaptation strategies (ICCAS) in Grenada

Country of implementation	Grenada
Implementation period	November 2012 to January 2019
Funding sources	German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU) under its International Climate Initiative (IKI)
Implementation partners	Environment Division of the Ministry of Agriculture, Lands, Forestry, Fisheries and the Environment (MALFFE), GIZ and UNDP

Country context: Grenada is a developing small island state in the Eastern Caribbean. It is made up of three islands – Grenada, Carriacou and Petite Martinique – and has a population of 110,000. Until the 1990s, Grenada's economy was heavily reliant on agriculture. Since then, the economy has diversified towards services, such as tourism. However, nutmeg, mace, cocoa, bananas, vegetables and fish are still important export crops. Cinnamon, ginger and cloves are also produced. While about 8 % of Grenadians work in agriculture and fishing, subsistence farming is a very common practice in Grenadian households.

Grenada lies in the path of the North Eastern Trade Winds and is vulnerable to tropical storms, storm surges and hurricanes, particularly during the hurricane season from June to November.[37] The majority of the Grenadian population lives in low-lying coastal areas, where there are fishing villages. Another lesser challenge is saltwater intrusion on agricultural lands located in the coastal zone.

Grenada's three islands are highly dependent on sufficient and timely rainfall for the water supply for both domestic use and agriculture. Rainfall patterns have become more unpredictable, with an increase in heavy, unseasonal rain events. The islands are mountainous with steep slopes, and inadequate land use practices increase the risks of soil erosion. This affects the capacity of watersheds to ensure a sufficient supply of water. In recent years, the Caribbean has been experiencing a significant increase in the number of consecutive dry days. A drought in 2009/2010 reduced water availability by up to 65 %. The islands of Carriacou and Petite Martinique have few surface water resources, which makes them severely vulnerable to changing rainfall patterns. Farmers have also experienced an increased occurrence of pests and diseases, heat stress on livestock and decreased yields.

The project: The ICCAS pilot programme has an integrated, multi-sectoral approach, with the objective of increasing resilience to climate change risks through integrated adaptation strategies. The programme has four components:

- strengthening the capacity of the government to mainstream adaptation considerations;
- improving the planning, management and efficient use of water and coastal zone resources;
- increasing the adaptive capacity of communities through a community fund;[38]
- facilitating access to funding for climate change measures;

[37] Government of Grenada (2000), Grenada's Initial Communication to the UNFCCC, St. George's.

[38] This component is implemented by UNDP.

- strengthening understanding and awareness.[39]

The project works at multiple levels, supporting policies, plans and capacities at the national level, mainstreaming climate change adaptation in the work of line ministries and supporting adaptation actions at the community level.

How the project supports adaptation: The National Climate Change Committee – which was inactive in the three years prior to the project – has been given a renewed mandate, and representatives from the Ministry of Agriculture have been actively involved in national planning processes. Climate change adaptation has been integrated into national development plans, and in 2017, a five-year national adaptation plan (NAP) was approved to ensure that priority adaptation actions are supported and that adaptation is further mainstreamed in national and sectoral plans and actions.

Based on the two types of plans, a systematic analysis of climate risks and a consultation and prioritisation process involving more than 160 stakeholders, Grenada's NAP sets out 12 programmes of action. Recognising the vulnerability of the agriculture sector, the NAP included a Food Security Programme of Action. Agriculture is also relevant to programmes for sustainable land management, coastal zone management and water management.

Under the ICCAS programme, a CSA pilot project is being implemented which takes a comprehensive approach, involving four main types of intervention:

- **Integrating adaptation into agriculture sector planning:** The project has supported the Ministry of Agriculture in integrating climate change considerations into the Ministry's Corporate Plan for 2016 as well as into the work plans of individual divisions within the Ministry, such as Extension, Livestock, Agronomy, Pest Management, Land-Use and, to a lesser extent, Forestry. A Climate Change Adaptation Action Plan for the Agriculture Sector has also been developed. Therefore, climate change has now been integrated into both national strategies and sectoral plans.

- **Capacity building:** Capacity building is achieved through the Climate-Smart Agriculture Capacity Building and Dissemination Programme (CSA-CapDiP). The CSA-CapDiP provides training in sustainable agriculture and other topics to technical agricultural and extension officers. The programme works through a Training of Trainers approach. The first round of training for technical officers was implemented in partnership with the Inter-American Institute for Cooperation on Agriculture (IICA). The trained technical officers have gone on to train additional technical officers, who then provide ongoing training and advice to farmers on CSA practices.

  The training of trainers approach is already beginning to show fruit. Some of the technical officers have provided training to farmers in Carriacou on water and soil conservation. This has led to farmer-to-farmer exchange on practices such as mulching, composting and contour drainage – practices that improve soil quality and prevent soil erosion. Farmers noticed that improved soils retain water, so less irrigation would be needed and plants would be less affected in the dry season. A technical resource manual is being developed, as requested by

[39] This component is implemented by UNDP.

Demonstration on how to mulch correctly at training for Ministry of Agriculture extension officers.

the technical officers, on water and soil conservation, using examples from the training and farmers' experiences.

Training alone is often not enough to bring about long-term change in practices. The Extension Division's monitoring sheet (Farmers' Register) has been revised to include the monitoring of CSA practices implemented on farms. The new monitoring sheets are being piloted, and preliminary results show that some of the officers are actively advising farmers to use CSA techniques, such as mulching and contour drainage. Including CSA practices in monitoring sheets is a key tool for mainstreaming CSA in the daily activities of extension officers.

The project has also included a farm sustainability assessment tool, known as RISE (response-inducing sustainability evaluation tool).[40] Extension officers have been trained to apply the tool. It helps them and farmers to identify aspects of the farm, such as water or soil management, that need to be improved. This enables extension officers to provide targeted advice. The Ministry is now considering whether to integrate the tool into its standard advisory services package.

- **Pilot projects:** The CSA pilot project has supported the establishment of the Grenada Ecological Resilience Research Institute (GERRI). GERRI is a collaborative effort between the non-governmental organisation People in Action (PIA), the Environment Division (Government of Grenada), GIZ and the wider community to create an experiential learning and research institute that demonstrates CSA practices. For example, the GERRI farm has been used to demonstrate and train farmers in the re-use of pig manure in biogas digesters. The digesters produce energy for cooking as well as slurry that is used as a bio-fertiliser. This helps farmers to reduce energy and fertiliser costs and prevents pig waste from getting into waterways. GERRI not only demonstrates CSA practices to community members, but also works with them on developing a number of tools to support agro-processing and community-based businesses, through the activities of PIA, e.g. community asset mapping.

The use of compost and container beds turned a previously unproductive plot into one with successful yields.

Demonstrations supported by the project have led to replication of CSA practices on private sector sites, school gardens and individual farms. For example, after receiving advice from GERRI, the Grenada Marine has begun to apply composting and container and companion planting.

- **Awareness:** The project undertakes activities to sensitise a broader audience about the impacts of climate change on the agriculture sector and CSA through presentations, radio shows, newspaper articles and other written publications. The programme collaborated with IICA in its regional competition 'CSA: Stories from farmers in the Eastern Caribbean States'. This provided a medium through which farmers shared their practical experiences in the use of CSA practices on their respective farms with the entire Caribbean region.

[40] The response-inducing sustainability evaluation tool (RISE) was developed by the University of Bern.

Feature Box

Mr Winston Ottley is a Grenadian farmer who has changed his agricultural practices to become more sustainable. Specifically, he wanted to improve soil fertility. He therefore approached the Ministry of Agriculture to seek advice on how to produce organic fertilisers so as to substitute some of the conventional fertilisers that he had previously been using. Mr Ottley explained that his inner motivation was to leave the soil better than he found it.

This request by Mr Ottley was used as an opportunity to train agricultural officers on how to do composting on his farm. As a result of the composting, Mr Ottley reported a decrease in his use of inorganic fertilisers, improved soil conditions, an increase in soil organisms and improved soil productivity. Mr Ottley continues to receive advice from the Ministry of Agriculture on the production and use of alternative organic fertilisers, such as seaweed.

Mr George Phillip, who is a senior agricultural officer, remarked that the project had increased awareness about CSA as an approach to address climate impacts on the agriculture sector among both agricultural officers and farmers.

Christabelle sits with farmer Joseph Braveboy in his field of peppers. He is one of 35 members (owning a total of 22 farms) in the North East Farmers Organization. Christabelle visits the farmers regularly to discuss ways to practice sustainable farming. Photo: Flickr, creative commons, © Terrence Franklyn, Sarah Boyd, www.flickr.com/photos/sarah-boyd/15630735529, is licensed under CC BY 2.0

Strengthening drought resilience in the arid and semi-arid lowlands of Ethiopia

Country of implementation	Ethiopia
Implementation period	2013 to 2018
Funding sources	German Federal Ministry for Economic Cooperation and Development (BMZ)
Implementation partners	Ministry of Agriculture

Context: Ethiopia is among the countries most vulnerable to climate risks in Africa. Its arid and semi-arid areas are prone to erratic rainfall and often suffer from both extreme drought and flash floods. More than half of the 6.7 million inhabitants in the Afar and Somali regions live below the poverty line. In these regions, most people are pastoralists, herding camels, sheep, goats and cattle. Agro-pastoralism – livestock keeping with some arable farming – is also emerging along some permanent and temporary rivers in locations where small-scale irrigation is being developed. Here, the traditional diet of dairy products is supplemented with some cereals and pulses when there is sufficient rainfall. Climate change and extreme weather events add new and uncertain dimensions to the development challenges that these vulnerable communities are facing. Acute malnutrition is widespread in both regions, especially affecting women, infants and young children. Opportunities to work off-farm are often taken by better skilled people from other areas. With limited access to natural resources and few other employment opportunities, thousands of young people have left for Europe via Libya.

Ongoing degradation of natural resources increases the vulnerability of pastoralists and farmers to climate risks in the Afar and Somali regions. Degradation of land and vegetation is due to population growth and high livestock density. The recurring droughts mean that large areas of pasture are no longer productive for livestock grazing. The area of usable pasture for livestock is shrinking, and the quality and quantity of fodder plants is decreasing. This restricts people's access to natural resources and exacerbates the degradation process. Droughts and floods lead to crop failure and the loss of animals.

Decades of emergency assistance have not been able to mitigate the causes of pastoral vulnerability, such as degraded ecosystems, lack of infrastructure and facilities, low investment, absence of economic opportunities and conflict. With these interlocking factors, a mild stress event, such as inadequate or untimely rainfall, can result in a major shock because communities are highly vulnerability and lack the means to cope with the effects of the disaster.

The project: On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), the project is working in five districts of the western Afar region whose combined population is approximately 300,000. Around 265,000 of these people, including 120,000 women, live in rural areas. The project aims to enable pastoralists and agro-pastoralists to have more reliable access to natural resources, including water, land and pastures, and to make more intensive use of them. Because the drivers of vulnerability are multidimensional, the project takes a holistic approach.

How the project supports adaptation: The project implements a series of interrelated measures, as described below.

- GIZ has introduced new methods of soil and water harvesting, based on methods successfully tested in the Sahel. In the fertile but degraded dry river valley areas, the effects of strong rainwater runoff and sporadic flash floods are reversed by constructing water-spreading weirs. These weirs prevent flooding by spreading water across a larger area. This also increases soil moisture and recharges ground water. The rehabilitated valleys are then used for the cul-

tivation of animal feed and diverse food crops and provide access to water for people and animals. So far, 1,500 hectares have been rehabilitated, benefiting about 65,000 people and 100,000 head of livestock.

- Skills are needed to construct the weirs and other infrastructure. GIZ cooperates with vocational colleges to offer certified mason courses and ensure that the Afar and Somali population has the necessary masonry skills. As at May 2017, about 200 graduates have received their official certificate of competence. These graduates are not only able to work on the rehabilitation sites supported by GIZ, other implementing agencies and governmental projects, but can also open their own small businesses in the construction sector.

- To make more intensive use of the rehabilitated riverbeds, GIZ is working with an international research institute to pilot the production of a mix of multi-purpose crops – including cereals, pulses and fodder – with higher yields than under rain fed production. Working with the traditional clan-based sharing systems in the area, the introduction of small-scale mechanisation has been easy and also provides job opportunities for young entrepreneurs.

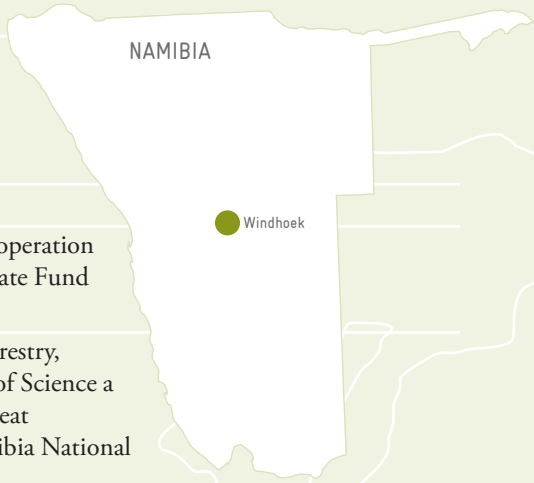
- These technical measures have been combined with participatory land use planning in which men and women pastoralists work with local authorities to develop a concrete vision of how to manage land and ensure access to natural resources.

Overall, the holistic approach aims to improve livelihoods for the people most severely affected by climate change and food insecurity. The project's impacts can be seen in several dimensions:

- productivity has increased on participating farms, where yields are now comparable to those in the country's more productive highlands;
- newly built elements in the productive landscape are a very visible outcome of the project and are regarded as a success by participants, who see 'fodder and food where before there were floods';
- household incomes have increased, which reduces households' vulnerability to extreme weather events.

Zehara Arba, aged 40, is married with ten children. She is an agro-pastoralist in Teaboy Kebele in the Sheqayibiru village of Chifra. Prior to the construction of water-spreading weirs by GIZ's Strengthening Drought Resilience/Afar Soil Rehabilitation Project (SDR/ASRP) in her village, Zehara's livestock suffered shortages of pasture and fodder. At that time, she had little knowledge of crop and fodder cultivation, which was difficult due to the scarcity of water. The family was food insecure and was supported by relatives who donated livestock fodder from their irrigated plot near the Mille River. *'Since the water-spreading weirs were built,'* she explains, *'rainwater spreads onto the plain, allowing us to grow crops and fodder for the first time on this land. Last season I grew maize, sorghum and mung beans on 1.5 hectares, which we eat at home. The straw from this also provided enough fodder for the livestock for three months.'*

Adaptation of agriculture to climate change in northern Namibia



Country of implementation	Namibia
Implementation period	February 2015 to September 2019
Funding sources	German Federal Ministry for Economic Cooperation and Development (BMZ), Energy and Climate Fund (EKF)
Implementation partners	GIZ, Ministry of Agriculture, Water and Forestry, University of Namibia, Namibia University of Science a nd Technology, International Maize and Wheat Improvement Center (CIMMYT) and Namibia National Farmers' Union (NNFU)

Country context: More than half of Namibia's 2.3 million inhabitants live in the country's seven northern regions, where over two thirds of households are engaged in agriculture. Most carry out small-scale mixed farming. Pearl millet, sorghum, maize and cowpeas are common crops grown under rain-fed conditions.

Due to limited and erratic rainfall and poor soils, crop yields and farmer incomes are low and unstable. Organic and mineral fertiliser use is limited, and declining soil fertility as well as soil erosion are common in northern Namibia. Rainfall is highly variable, and in recent years high temperatures with below-normal rainfall have caused successive droughts.[41] At the same time, high intensity rainfall events and floods have been occurring. With increasing temperatures and declining rainfall over time, soil moisture will be reduced and crop yields will fall and become more variable from year to year. By 2050, some regions may become unsuitable for rain-fed crop production.

In northern Namibia, the most common method of land preparation is ploughing by disking, which pulverises and degrades the soil, leading to compaction. Rainwater does not penetrate as well into compacted soils, and as more water runs off the surface of the soils and evaporates, less moisture is available for plant growth.

Conservation agriculture (CA) is a promising alternative to conventional practices. CA can reduce soil erosion and improve the use of scarce water resources in arid environments. It is therefore a key approach for adapting to changing rainfall patterns in the arid areas of northern Namibia.

Key principles of conservation agriculture

Minimum mechanical soil disturbance: Tillage can increase soil fertility in the short-term, but eventually causes loss of soil nutrients and physical erosion.

- **Permanent soil cover:** Crop residues should be left on the soil surface. This protects the soil from the physical impacts of rain (e.g. erosion), retains soil moisture and improves the soil's physical structure and fertility.
- **Crop rotation:** Since crop residues are not removed, methods for pest and disease management are needed. Mixing crop types (intercropping) and changing crops grown at different times (crop rotation) are basic methods to manage pests and diseases and if legumes are grown, this can also increase soil fertility.

[41] Republic of Namibia (2015), Third National Communication to the UNFCCC, Windhoek.

The main land preparation method used in CA in Namibia is ripper furrowing, where furrows are made through compacted soils to a depth of 30 cm. This can be done using either animal- or tractor-drawn machinery. This method reduces soil disturbance and contributes to rainwater harvesting. There are some challenges that still need to be overcome. For example, since fields are no longer ploughed, weeds may increase initially. In addition, free-ranging animals may prevent vegetation cover from being established.

Recognising the potential of CA, the Government of Namibia has included measures to promote it in its NDC and developed a Comprehensive Conservation Agriculture Programme 2015-2019. As the policy paper notes, however, the variable results of previous pilot projects show a need to further adapt the CA approach to the country's different agro-ecological zones.

The project: The project aims to support small-scale farmers in northern Namibia to successfully use climate-adapted farming methods, focusing efforts on CA. GIZ is working with the Ministry of Agriculture, Water and Forestry and research institutes to link research and development and thus ensure that proven CA approaches are disseminated to farmers. The project builds on the experience of other national and international organisations and is being implemented in one of Namibia's three poorest regions.

How the project supports adaptation: The project adopts a multi-level approach, testing, introducing and promoting climate-adapted measures through advisory services to small-scale farms, mainstreaming proven approaches in advisory services' plans and activities and incorporating the lessons learned into policy dialogue.

The project's main fields of activity are: (1) training measures for farmers, (2) agricultural service provision, (3) research and knowledge management and (4) policy advice.

- **Training for farmers:** Conservation agriculture is knowledge-intensive, and farmers are trained in the practical application of CA. The 'lead farmer' approach is used, whereby each person trained as a lead farmer trains other farmers in his or her community. Each lead farmer establishes a 0.5 to 1 hectare demonstration plot that is used to train other farmers.

  The project conducts training events and supports field days in villages as well as exchange visits. The training content covers agricultural cultivation methods as well as nutritional advice in order to address both the question of food availability and access and dietary issues.

  Because HIV prevalence is particularly high in the north-eastern communal areas, HIV/AIDS mainstreaming is included in these training measures. Since women head 44 % of farming households, emphasis is placed on ensuring that men and women are equally represented in group training and that gender issues are addressed for both female- and male-headed small-scale farms.

'Conservation agriculture is not easy to implement, but I keep going,' says Lucia Kandambo. Like most farmers in Namibia, her farm suffers the effects of declining and irregular rainfall. That's why Lucia is looking for new methods to ensure sufficient harvests. *'I have the impression that conservation agriculture is the right way. The yields are already significantly higher in the first year than in conventional agriculture'.* Lucia is one of the lead farmers in her village. She tests the methods on her fields and conveys the results to other farmers. *'CA is new, and there is much to learn, but we already have many more interested parties in our village.'*

- **Agricultural service provision:** The project is working to strengthen public and private providers of agricultural services. CA trainers and extension workers receive further training to upgrade their knowledge and skills and are supported in their day-to-day work. For example, farm advisors are made aware of the specific needs of women and how to address them in the services that they provide.

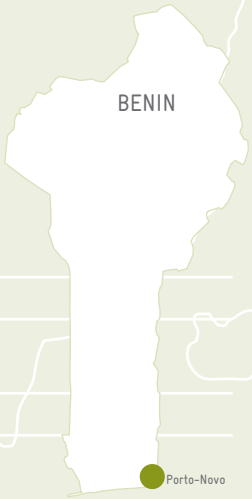
  The project also promotes services related to CA, such as soil analysis and seed multiplication. Private providers of CA soil cultivation services (whether using tractors or draught animals) receive advice on organisational and business matters. In addition, the project offers the Namibian Government logistical advice on the provision of subsidies for agricultural inputs. One significant innovation is the use of a mobile soil-testing laboratory, mounted on a 4X4 vehicle so that it can reach remote locations. This lab can quickly determine fertiliser needs and will serve farmers across the northern regions in the future.

- **Research and knowledge management:** The project activities serve to ensure that knowledge and lessons learned in the area of conservation agriculture are evaluated and documented. Despite the basis laid by previous projects, there is still a lack of sound evidence of the impact of conservation agriculture in Namibia. In cooperation with national and international research institutes, the project implements scientific trials on different CA methods. The project supports on-station research to identify practices for recommendation to farmers, undertakes on-farm research to test the acceptability of practices to farmers and demonstrates CA methods at the national extension service's agricultural development centres and on farms.

- **Policy advice:** The project provides specific further training and advice on climate change issues for Ministry of Agriculture, Water and Forestry staff. The project also organises workshops to support the development of strategies for the adaptation of agriculture to climate change. As results from trials and demonstrations become clear, the project will be well placed to feed the lessons learned into national policy dialogues.

Conservation agriculture methods, combined with other good agricultural practices, should have a key role to play in the adaptation of agriculture in arid regions. Building the evidence base is critical to identify viable adaptation options and the necessary enabling activities. The project Adaptation of agriculture to climate change in northern Namibia is contributing evidence on proven CA practices as well as demonstrating effective approaches for upscaling adoption. Working with researchers, extension officers, farmers, the private sector and ministry officials, the project supports an integrated approach to the promotion of conservation agriculture that harmonises the activities of stakeholders across the sector.

Adapting agriculture to climate change in northern Benin (PACC)



Country of implementation	Benin
Implementation period	2014 to 2019
Funding sources	German Federal Ministry for Economic Cooperation and Development (BMZ), Energy and Climate Fund (EKF)
Implementation partners	GIZ and Ministry of Agriculture, Livestock and Fisheries (MAEP)

Country context: Benin is one of the world's least developed countries, with about half of the population living on less than US$1.90 a day.[42] Agriculture is central to the economy of Benin, providing about 25 % of GDP and employing around 45 % of the workforce. Most agriculture in the country is subsistence farming. Some 0.8 million people, or 7.5 % of the population, are undernourished, and rates of food insecurity are much higher. Atacora and Donga departments in the north and west of the country are among the most food insecure, with 35 % to 40 % of households experiencing some food insecurity during the year. About a quarter of children are malnourished at different times of the year, and the proportion of women who are malnourished increases significantly in the post-harvest and lean periods.

Farmers in northern Benin grow crops such as maize, yam and beans and raise small livestock for subsistence, while cotton is a common cash crop. Almost all farming is rain-fed and thus strongly dependent on precipitation. Historically, rainfall has been highly variable in Benin, with short periods of deficit alternating with years of surplus. In recent years, the start of the rainy season has often been delayed or rains have stopped suddenly. The spatial distribution has also been uneven, with pockets of high intensity rainfall and drought. Projections suggest that changes in rainfall patterns will require shifts in farming practices.

The adverse effects of climate change in northern Benin are aggravated by poor management of natural resources, which results in low and unstable agricultural yields and soil erosion. Benin's agricultural development strategy aims to strengthen the performance of agriculture while taking into account environmental and climatic aspects, notably through improved water and soil management.

Women are rarely visible in local political decision-making, and in the traditional inheritance system, women have no land rights. They are sometimes able to access poor quality land to till from their husbands or farm home gardens. In some areas, women's associations have formed to support women's participation in local development. Activities such as market gardening, processing of agricultural products and small businesses are popular.

The project: The PACC project aims to promote measures for sustainable natural resources management so that vulnerable agricultural areas of northern Benin can adapt to climate change. The project focuses on three municipalities – Matéri, Kérou and Tanguiéta – with a total population of about 350,000 people. The municipalities border on the Pendjari and W National Parks, which are UNESCO biosphere reserves and home to the last remaining specimens of some wild mammal species in West Africa. The project supports the planning and implementation of soil and water management activities in water catchments – a level at which local communities can be effectively engaged – and actively supports women's organisations to develop agricultural activities.

[42] http://povertydata.worldbank.org/poverty/country/BEN

How the project supports adaptation: Prior to the project, municipalities had development plans, but they did not explicitly consider climate risks and how to address them. The project focuses on the three areas of intervention described below.

1. **Planning climate change adaptation measures at the municipal level:** In Benin, water and agricultural infrastructure are owned by the municipality. Therefore, the PACC provides advisory services to municipalities for investment planning and engages in advocacy for the mobilisation of adaptation funding.

   In the three targeted municipalities, the project has focused on nine water catchments. In each catchment, men and women farmers and other stakeholders took part in participatory diagnosis to identify communities with natural resources, the potentials and constraints faced, climate hazards and opportunities for better adapting agriculture to climate change.

Women are very attentive during training sessions and ready to ask questions about their traditional practices . Photo: Flickr, creative commons, © Rémi Kahane, GlobalHort. Benin, July 2011, www.flickr.com/photos/globalhort/6836233694/in/album-72157629585045489, is licensed under CC BY 2.0

   On this basis, the three project municipalities updated their municipal development plans and investment plans, which also included capacity building actions to strengthen the ability of municipalities to address adaptation and gender in their planning and implementation processes.

   With the intention of replicating the watershed approach, the municipality of Matéri has conducted water catchment planning using the standardised processes developed by the PACC. Subsequently, the Association of Communes of Atacora and Donga (ACAD) has been supported to facilitate the municipal planning process in the other ten municipalities in the region.

   By strengthening the capacities of the government and farmers' organisations at the municipal level, the PACC puts in place the conditions necessary for the development, management and sustainability of adaptation measures.

2. **Investments in adaptation measures at the watershed level:** The PACC supports pilot initiatives through two types of interventions: local grants and a capacity building fund. The local grants fund is used to support implementation of pilot initiatives, while the capacity building fund is used to establish and strengthen local committees of users and other types of community organisation to ensure that the infrastructure put in place is sustainably managed.

The specific measures implemented include the following:

- Two soil and water conservation initiatives have been implemented, involving the planting of approximately 18,500 plants for multiple purposes in two water catchments. The trees, shrubs and grasses planted improve vegetation cover, thereby reducing the risks of drought and flooding while meeting the livelihood needs of farmers.

Benin. Photo: Flickr, creative commons, © jbdodane, www.flickr.com/photos/jbdodane/10628839534, is licensed under CC BY 2.0

- Women's groups have been supported to develop off-season market garden production. The project assisted in constructing four irrigation channels around a total of 8 hectares of land. Water is pumped using solar pumps. About 180 women have benefitted from this investment. Off-season production increases the availability of nutritional foods and enables women to achieve higher prices for their produce.

- The project has introduced a new low-cost approach to rice cultivation, known as the 'Smart Valley' approach. This involves farmers and village chiefs working with technicians to identify valley sites where irrigated rice can be cultivated. Together, the team assesses the suitability of soil and water resources, land tenure and the potential for the consumption and marketing of rice in the area. Designs are then drawn up, defining water sources and drains and bunds that enable water to be retained in the fields and excess water to be drained. With this low-cost approach, farmers are able to increase water retention in their fields, reduce the risk of fertiliser losses due to flooding and increase rice yields. Support was provided for a pilot initiative on 2 hectares of land involving 23 women.

The project also supports the municipalities in developing project proposals to mobilise funding from other donors present in the project area, which also helps to ensure synergies with other ongoing initiatives.

Benin. Photo: Flickr, creative commons, © Rikolto (Vredeseilanden), www.flickr.com/photos/vredeseilanden/2247595211, is licensed under CC BY 2.0

3. **Knowledge management:** Through an inventory of best practices and the organisation of demonstration sessions and other activities, the PACC promotes documentation and sharing of knowledge on three levels: at the local or municipal level; at the regional level in two departments (Atacora and Donga); and at the national level, where the project works with ministries of agriculture, environment, water and decentralisation. The PACC develops standardised methods and procedures for stakeholders to analyse climate change and to plan and implement adaptation measures. These methods have been collated in a toolbox that is to be widely disseminated through the press, radio, documentaries and local government agencies.

Adaptation to climate change in agricultural development in Africa (CAADP-Climate)

Region of implementation	55 member countries of the African Union
Implementation period	2012 to 2019
Funding sources	German Federal Ministry for Economic Cooperation and Development (BMZ)
Implementation partners	NEPAD Planning and Coordinating Agency (NPCA) and GIZ

Regional context: In 2003, in response to the widely recognised crisis in African agriculture, members of the African Union (AU) signed the Maputo Declaration on Agriculture and Food Security. This Declaration included a commitment to allocate at least 10 % of national budgets to agriculture in order to achieve 6 % growth in the agriculture sector. The NEPAD Planning and Coordinating Agency (NPCA), which is a technical body of the AU, takes the lead in working with member countries to meet these commitments. The NPCA's focus in the agriculture sector is on the Comprehensive Africa Agriculture Development Programme (CAADP). This programme brings key stakeholders together to identify priority areas for investment. These priorities are incorporated into a CAADP Compact agreement, which is signed by all key partners, including national governments, the AU and other regional bodies, and representatives of the private sector and civil society. Countries should then include the priorities in their national agriculture investment plans (NAIPs). Forty countries have signed a CAADP Compact, and two thirds of those have formulated a NAIP.

Since then, the effects of climate change on agriculture have risen on the policy agenda. The adverse effects of climate change have been identified as one of the main challenges to achieving the CAADP goals. Sub-Saharan Africa is strongly dependent on rain-fed agriculture and natural resources. Infrastructure, including irrigation facilities, is lacking, and poverty and food insecurity levels remain high among farming populations. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) suggests a strong likelihood that African agriculture will be impacted by rising temperatures, more frequent droughts and floods, and changes in precipitation patterns. Agricultural yields are likely to fall unless adaptation measures are taken. Climate change may also alter the suitability of many regions for crop production. These threats present new demands for innovation in crop varieties and livestock breeds, changes in agricultural production practices and new investment. It is therefore essential that climate change is placed high on Africa's agricultural development agenda.

In 2014, leaders came together again and subscribed to the Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods. It reaffirms the central commitments of the Maputo Declaration and includes, among other things, a commitment to enhance the resilience of livelihoods and production systems to climate var-

iability and other shocks, setting the target of at least 30 % of farms or pastoral households in Africa being resilient to shocks by 2025.

At the same time, the international community has agreed under the Paris Agreement to take action to limit the increase in the global average temperature to well below 2 °C above pre-industrial levels. By late 2017, 40 African countries had submitted nationally determined contributions (NDCs) towards this goal. Most African NDCs have included adaptation in the agriculture sector among their priorities.

The project: Implementation of the CAADP is coordinated by the NPCA, which supports AU member countries in developing and implementing NAIPs and mobilising resources and partners for their implementation. Anchoring climate change adaptation within NAIPs ensures that climate change adaptation measures are planned and subsequently funded from national budgets.

GIZ has thus collaborated with the NPCA to support countries in mainstreaming climate change adaptation into agricultural development strategies and NAIPs and to identify and implement the agricultural priorities in the countries' NDCs.

How the project supports adaptation: The project assists the AU and the NPCA with technical expertise and advisory services to support AU member states in the development of climate-friendly NAIPs and the implementation of climate-smart agricultural measures. It does this in three ways, as described below.

- **Capacity strengthening for a consistent climate change adaptation strategy:** To ensure their effective implementation, policies and technical measures to adapt agriculture to climate change must be promoted at the national level. CAADP-Climate supports the integration of climate adaptation strategies into NAIPs. Furthermore, the CAADP Unit within the NPCA has been strengthened in terms of CSA expertise, which improves the advisory services available to member states.

  Over 15 African countries have now mainstreamed climate change into their NAIPs and are implementing climate-relevant measures, such as soil and water management, agroforestry and improved grazing management.

How the NEPAD Climate Change Fund supports adaptation

In Ethiopia, more than 1,300 women were trained in entrepreneurship, leadership and environmental protection and management. This was done in collaboration with Ethiopia's Ministry of Women, Children and Youth Affairs. One specific outcome of the training was that the Government of Ethiopia allocated about 60 hectares of land for afforestation and 290,000 seedlings were planted.

In Nigeria, 150 policy-makers and 1,200 women farmers were familiarised with CSA practices and aquaculture. Four hundred applications for aquaculture equipment grants were processed.

Hundreds of extension officers and farmers in South Africa were trained on the use of weather forecasts, climate predictions and science-based knowledge in farm planning and decision-making. In addition, 700 traditional council members in Kwa-Zulu Natal were sensitised on climate change issues and committed to minimising practices that contribute to climate change in their communities.

The project also strengthens country capacities to develop funding proposals for climate-smart agriculture programmes to be submitted to international funds. These measures improve the coherence of agriculture and climate policies, support the implementation of NAIPs in line with the Malabo Declaration and sup-

port countries in implementing their commitments under the United Nations Framework Convention on Climate Change (UNFCCC).

- **Country-specific support for the implementation of adaptation measures:** A NEPAD Climate Change Fund was established with German support. The fund's purpose is to finance measures aimed at adapting agriculture to climate change and biodiversity conservation. The fund offers technical and financial assistance to AU member states, regional economic communities and African civil society institutions. The NEPAD Climate Change Fund has already received almost 500 project proposals. Some 22 projects are benefiting from support for implementation across Africa. These projects focus on two areas: implementation of concrete climate change adaptation measures and revision of agriculture-related policies, and promotion of dialogues in the area of access and benefit sharing.

- **Improved knowledge and experience sharing for CSA:** The project has supported the Economic Community of West African States (ECOWAS) and the Common Market for Eastern and Southern Africa (COMESA) in regional exchanges of experience in the field of climate change adaptation. It has also assisted the NPCA in establishing the Africa Climate-Smart Agriculture Alliance and Platform. This platform brings together 30 countries and facilitates regular exchanges on climate change and agriculture. Dialogue has been supported among government representatives to strengthen essential cooperation between ministries of agriculture and environment. This helps AU member states develop a strong and united African position at international climate negotiations to obtain maximum opportunities and benefits for the continent.

To sustain the momentum of agriculture in international climate negotiations, the project facilitates learning opportunities for representatives of ministries of agriculture and other relevant stakeholders on how to operationalise agriculture sector commitments in NDCs.

As a result of these activities, the topic of climate change is receiving more and more attention at high-level pan-African meetings, such as the AU's 2014 Summit in Malabo, and at the international level in UN climate change negotiations.

CAADP-Climate plays a key role in building national and continent-wide capacities to mainstream climate change adaptation in agriculture and to implement agricultural adaptation measures in this most vulnerable sector.

Photo: UNclimatechange, www.flickr.com/photos/unfccc/26607650464/in/album-72157668246770466

Adaptation to climate change in the West Bank

Country of implementation	Palestine
Implementation period	2014 to 2018
Funding sources	German Federal Ministry for Economic Cooperation and Development (BMZ), Energy and Climate Fund (EKF)
Implementation partners	GIZ and Palestinian Ministry of Agriculture

Country context: Agriculture plays an important role in the State of Palestine's economy. Although agriculture only accounts for a small proportion of GDP, it provides about 78 % of food consumed locally and is vital to the country's food security.[43] The 100,000 hectares of arable land in the West Bank and Gaza Strip are used to produce fruit, olives, vegetables and cereal and fodder crops. Most arable land, especially in the West Bank, is not irrigated. Yields in the West Bank are much lower than in neighbouring countries, such as Israel or Jordan, despite sharing a similar agro-ecological environment.

Agriculture faces multiple threats due to fragile political conditions, high production costs, fragmented land plots and severe marketing difficulties. Even though climate change is not the most pressing issue for the people in the Palestinian Territories, climate risks are significant and will compound current and future vulnerability. Inhabitants of the West Bank and Gaza already face serious challenges in terms of water availability. Recent and projected climate trends indicate that temperatures in the area will rise, precipitation will decrease and high precipitation events will occur. This will result in increased water shortages, flooding and subsequent challenges to food security.

Shrinking water availability and changing rainfall patterns have gradually become apparent. The capacity of the Palestinians to cope with and adapt to these challenges is constrained due to their limited control over and access to land and water. In the 1970s, the Palestinians began to cover part of their rising demand by purchasing water from Israel. However, the 1995 Oslo II Accord limits Palestine to using only water resources within its territory.

Within the current governance framework, the Palestinian Water Authority is therefore unable to implement an integrated water management approach. However, in the agriculture sector, decentralised water management initiatives are feasible. An integrative watershed management approach can address both water and agricultural land management. In the Palestinian context, this requires a focus on improving the management of surface water in the upper reaches of watersheds and enhancing the efficiency of irrigation water use in the lower reaches. The development of non-conventional water resources, such as harvested rainwater and purified wastewater, has also been highlighted as an important priority in Palestine's National Adaptation Plan (NAP).

The project: Funded by the German Federal Ministry for Economic Cooperation and Development (BMZ), the project works with the Ministry of Agriculture and other stakeholders in the West Bank to improve water and land management in the agriculture sector. GIZ's assistance includes technical and financial support. Technical support focuses on the planning and implementation of community-based land, water and crop management initiatives. The project then provides financial support to community or public initiatives to pilot and showcase promising technical and organisational measures.

How the project supports adaptation: The project takes a multi-level approach, working at local, regional and national level. At regional level, the project has pilot intervention areas in three watersheds: one wa-

[43] United Nations Conference on Trade and Development (UNCTAD) (2015), *The Besieged Palestinian Agriculture Sector*, UNCTAD, New York and Geneva.

tershed in the western aquifer, one in the eastern aquifer and another in the southern West Bank. Within each watershed, the project supports community initiatives at local level to improve land, water and crop management practices in order to cope with the impacts of climate change. At national level, the project engages stakeholders in dialogues on creating an enabling policy environment for community investments and integrated land and water resources management.

The project has three main fields of activity, as described below.

- **Farmer organisations:** The project supports the establishment and strengthening of farmer cooperatives, water associations and other local community institutions so that members' interests can be taken into account in local, regional and national decisions affecting water management.

  The project provides training to farmer cooperative members on climate-smart agriculture practices, such as adapted crops and cropping patterns, efficient irrigation, water storage and the use of non-conventional water resources. It also supports the organisational development of farmer cooperatives and water associations.

by the communities themselves. These proposals are assessed by a technical committee consisting of project staff and Ministry of Agriculture officials, based on their replicability, relevance and innovative value. Initiatives supported by the project include construction of water storage tanks, rehabilitation of terraces and development of irrigation systems.

This infrastructure has direct benefits for adaptation. For example, building small-scale rainwater retention structures in low-lying places or hollow depressions not only provides water for agricultural production but also protects microwatersheds from erosion and floods.

- **Enabling environment:** The project supports the development of an enabling policy environment for adaptation initiatives at local level and the translation of national climate change adaptation policies into integrated action planning at regional and watershed level. For example, creating by-laws on water user associations has enabled water users to join

together for collective action on water issues. Information about innovative and effective approaches to land and water management is also fed into policy dialogues at regional and national levels. This helps to build the case for policy support for investments by private and voluntary sector organisations in sustainable agriculture and water resources management.

The combination of support for the organisational capacities of communities, the institutional framework, training on good agricultural practices and tangible infrastructure investments has proven to be a good way to engage local communities in actively adapting to climate change.

Conservation of water resources through the Sustainable Sugarcane Initiative (SSI) method in Kolhapur, Maharashtra, India

Country of implementation	India
Implementation period	2013 to 2016
Funding sources	German Federal Ministry for Economic Cooperation and Development (BMZ)
Implementation partners	GIZ, KfW, National Bank for Agriculture and Rural Development (NABARD) and Shri Datta Shetkari Sahakari Sakhar Karkhana Ltd (SDSSSKL)

Country context: Sugarcane production contributes about 7 % of the total value of India's agricultural output.[44] At just over 5 million hectares, India's total area planted to sugarcane accounts for about 18 % of the world total, and its output of 352 million tonnes ranks it second in the world, after Brazil.

Despite the long tradition and large area of sugarcane cultivation in India, yields and the sugar content of cane are low, the latter typically around 10 %. This means that farmers receive low prices for their cane. The inefficient use of land, water, nutrients and other inputs reduces the profitability of sugarcane production. In particular, water use is very inefficient: in some areas, it takes 2.5 tonnes of water to produce just one kilogramme of sugar.

With the changing climate, water availability is becoming more limited and unpredictable. In Maharashtra, India's second largest sugarcane producing state, water resources have come under increasing pressure in recent years, and almost half of the state's land area is drought-prone. Excessive water use for agriculture is lowering the groundwater table in the state. When the rains fail, dams and local water reservoirs regularly dry up, resulting in massive crop losses and distress among farmers. Sugarcane farmers often use irrigation water from the four major rivers that traverse the state. The common irrigation method is flood irrigation, in which water is spread across a whole field. Much of the water evaporates, so scarce water resources are wasted. After evaporating, salt is left in the fields, which affects soil quality. Due to acute water shortages in recent years, local authorities have been forced to ban the use of water from riverbeds for sugarcane cultivation.

Water is a key issue in sugarcane production in Maharashtra, but improving the efficiency of resource use in sugarcane production requires changing more than just water management practices. Low yields and low prices are a result of many factors – improper cultivation practices, poor plant protection measures, imbalanced nutrient management and monocropping – including unpredictable water availability.

In conventional production practices in Maharashtra, farmers plant stem cuttings (called setts) directly in the field. Mortality rates are high, which increases the number of setts required and raises the cost of production. Setts are not graded and farmers do not plant setts of uniform quality, so only a small proportion of harvested canes can be milled for sugar. In addition, sugarcane is mostly planted as a monocrop, and farmers have to wait until the sugarcane harvest to obtain earnings. This leaves them vulnerable to the effects of water scarcity and other risks during the growing season.

The project: The SDSSSKL project is part of the Umbrella Programme for Natural Resource Management (UPNRM). UPNRM is a joint venture of the National Bank for Agriculture and Rural Development (NABARD), GIZ and KfW Development Bank. KfW pro-

[44] www.fao.org/faostat/en

vides soft loans and grants to NABARD. Shri Datta Shetkari Sahakari Sakhar Karkhana Ltd (SDSSSKL) – a sugar cooperative in Kolhapur, Maharashtra – applied for a loan from NABARD and on-lends this loan to its member farmers to install drip irrigation systems. GIZ implements technical cooperation activities in association with this loan programme, and SDSSSKL repays the loan to NABARD from the cane sold to them by the member farmers.

The project is implemented in a cluster of 20–25 villages in Shirol, Hatkanangle, Kagal and Athani Talukas in the Kolhapur district (Maharastra). Thus far, about 1,000 farmers in the project villages have adopted SSI cultivation.

How the project supports adaptation: The SDSSSKL project promotes an integrated approach to improving sugarcane production, known as the Sustainable Sugarcane Initiative (SSI).

One key component of SSI is drip irrigation. Irrigation water is supplied in controlled volumes close to the plant roots so that most of the water is taken up by the plant instead of evaporating. This greatly increases the efficiency of water use, avoiding the waste of water resources that is common with flood irrigation. Total water use by farmers has decreased by 40 %. The use of drip irrigation also helps limit soil erosion and soil salinity. Because water is targeted to sugarcane plants, weeds have greatly decreased, and farmers' expenditures on herbicides have fallen by 35 % to 40 %.

Alongside investment in drip irrigation, the project provides advisory services to farmers to improve other farming practices. Compost made using worms and other organic inputs is used to replace chemical fertiliser, reducing farmers' fertiliser costs by 30 %. SSI also promotes new cultivation practices. Young setts are first propagated outside the main fields and good quality setts selected for transplanting to the field. Setts are planted with wider spacing than in conventional practices. Together, these measures have increased sugar cane yields by 30 %, and a higher sugar content increases their value.

SSI promotes inter-cropping with other cash crops, such as groundnuts. This diversifies farmers' incomes. With groundnut cultivation, profits per hectare have increased by 72 % compared to conventional sugarcane monoculture.

The resilience of farmers depends not just on water savings but also on the sustainable and profitable use of land and water resources. Farmers with higher, more reliable and more diverse incomes are better able to face other challenges that climate change may bring. A significant proportion of the project's financial benefits for farmers is the result of cost savings from more efficient resource use.

For Dayanand Patil, a progressive farmer and member of SDSSSKL, training in SSI along with the adoption of a drip irrigation system proved to be a game changer: *'I used to reap about 60 metric tonnes per acre of sugarcane using flood irrigation. But with the twin interventions of drip irrigation and SSI cultivation, my yield has increased to 92 tonnes of sugarcane per acre.'*

The success of the project is measured through a combination of socio-economic and environmental indicators.

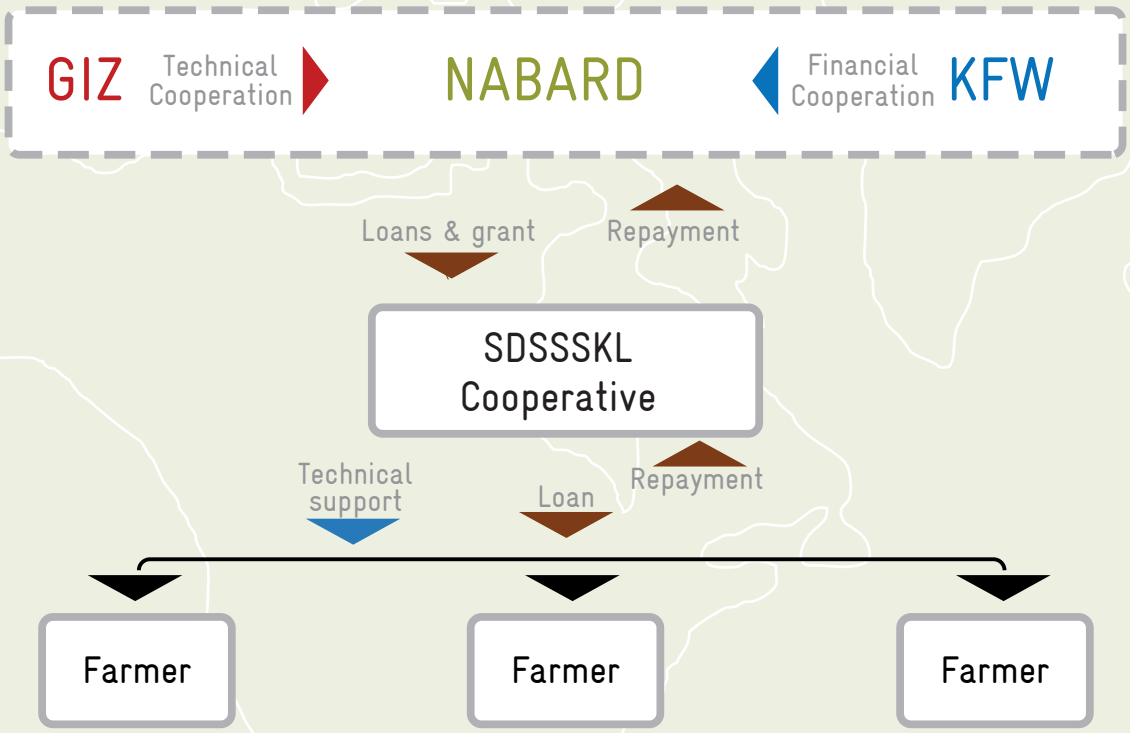
Socio-economic indicators:

- numbers of beneficiaries,
- sugarcane yields,
- production costs,
- profit per hectare.

Environmental indicators:

- volume of water savings,
- soil erosion and soil salinity.

In addition to monitoring these indicators, the cooperative maintains a management information system that tracks farmer information regarding credit, repayments, input needs and marketing support. Field technicians also monitor farmers' practices to ensure that timely technical support is provided.


GIZ
Technical Cooperation
NABARD
Financial Cooperation
KFW
Loans & grant
Repayment
SDSSSKL Cooperative
Technical support
Loan
Repayment
Farmer
Farmer
Farmer

Forestry and climate change (FOR-CC)

Countries of implementation	ASEAN member states
Implementation period	2015 to 2017
Funding sources	German Federal Ministry for Economic Cooperation and Development (BMZ)
Implementation partners	ASEAN Secretariat (ASEC), Thailand Department of Agriculture, ASEAN Climate Resilience Network (ASEAN-CRN), ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD), ASEAN Sectoral Working Group on Crops (ASWGC), ASEAN Working Group on Climate Change (AWGCC) and GIZ

Regional context: Southeast Asia is one of the world's regions most vulnerable to climate change, due to its long coastlines, the high concentration of population and economic activity in coastal areas and heavy reliance on agriculture, fisheries, forestry and other natural resources.[45] While the economy of Southeast Asia has been growing rapidly, the benefits have been unequally distributed. One third of the population are living on less than US$2 a day.[46] The rural poor, especially women, are particularly vulnerable to the effects of climate change. Rice, maize and cassava are the most important crops in the region. Fisheries are also the basis of livelihoods for millions of rural households.

Climate hazards, such as high temperatures, erratic rainfall patterns and the increasing frequency of extreme weather events threaten agricultural production, damage coastal marine resources and exacerbate the degradation of soils and other natural resources that are already being overexploited. While future rainfall trends in Southeast Asia are uncertain, increasing demand and poor management of water resources increase the likelihood that the region will face decreasing water availability. Many communities are dependent on coastal and marine resources for fisheries-dependent livelihoods. The fish catch potential in tropical Southeast Asia is expected to decline as waters warm. Land in most of Asia's large deltas is sinking relative to sea level as a result of excessive groundwater use, floodplain engineering and other human factors. Rising sea levels due to climate change will increase coastal flooding, erosion and saltwater intrusion into surface and groundwater.

The Association of Southeast Asian Nations (ASEAN) – which includes Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam – has recognised the importance of promoting sustainable agriculture and forestry that both reduces GHG emissions and minimises the risks and impacts of climate change. The ASEAN Multi-Sectoral Framework on Climate Change: Agriculture and Forestry towards Food Security (AFCC) was adopted in 2009. The AFCC set

[45] Asian Development Bank (ADB) (2009), *The Economics of Climate Change in Southeast Asia: Regional Review,* ADB, Manila.

[46] ASEAN (2016), *ASEAN Statistical Leaflet: selected key indicators 2016,* ASEAN Secretariat, Jakarta.

out a number of strategic actions to integrate climate change mitigation and adaptation into development policy frameworks and to enhance cooperation among member states on adaptation and mitigation measures. The strategic actions included further assessments of climate change impacts and risks, formulation of response measures and their integration into national development strategies, policies and programmes.

However, ASEAN's institutions and its member states lacked the technical and administrative capacities needed to ensure efficient cooperation among member states and to achieve a common position on this topic. This has impeded joint efforts to develop competitive agriculture and forestry sectors that are resilient to the effects of climate change.

The project: FOR-CC is one of two modules of the ASEAN-German Programme on Response to Climate Change in Agriculture and Forestry (GAP-CC). Commissioned by BMZ, the project is implemented by GIZ in close cooperation with the ASEAN Secretariat (ASEC).

FOR-CC provides capacity building to improve cooperation and the joint positioning of ASEAN member states on key climate change issues in the areas of agriculture and forestry. One project component addresses forestry issues, while another focuses on agriculture. The agriculture component aims to increase the financial and technical capacities of ASEAN member states to disseminate climate-smart agriculture practices.

How the project supports adaptation: The project works at national and regional levels and also supports ASEAN in contributing to international negotiations on agriculture and climate change.

Many climate-smart agriculture (CSA) practices are being used or piloted in ASEAN member states. Some practices are indigenous methods, while others are novel crop management measures or policy measures that still need to be better understood. At national level, FOR-CC has been providing advice to national agencies on the basis of studies and pilot projects.

Five priority climate-smart agriculture practice s identified for scaling up in ASEAN countries

- Adoption of stress-tolerant maize varieties
- Adoption of stress-tolerant rice varieties
- Use of weather-index based agricultural insurance
- Alternate wetting and drying in rice cultivation
- Dissemination of cropping calendars for rice and maize

In collaboration with the ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD) and national agencies, FOR-CC commissioned studies in seven member states to document and analyse good practices for promoting the resilience of rice and maize production. The studies not only documented more than 20 good practices, but also assessed the support needed to promote wider adoption and identified related activities for regional cooperation. Studies have also been conducted on pilot agricultural insurance programmes and inclusive business opportunities that support climate-resilient agricultural value chains.

The studies have been conducted in partnership with ongoing pilot initiatives and document the practical benefits of CSA practices for rural people. For national governments, the results of these studies and pilot projects have provided important insights into good practices and future options to inform national policies and plans.

The studies have also provided a critical basis for regional exchange and cooperation. Although the good practices documented are often context specific, they can also be modified to suit other settings. On the basis of country case studies, FOR-CC has worked with ATWGARD and national partners to produce technical guidelines on five climate-smart practices identified as priorities for scaling up in the region. These technical guidelines and facilitation of related discussions in ASEAN forums help raise awareness of CSA options among policy-makers.

At regional level, the project has facilitated the establishment of the ASEAN Climate Resilience Network (ASEAN-CRN). The network builds capacities

for adaptation through the exchange of CSA information, expertise and experiences among ASEAN member states. By providing a dialogue platform on CSA in the region, the ASEAN-CRN established links between policy-makers and scientific institutions, universities, national agricultural research institutions and international organisations. For example, ASEAN-CRN has co-organised workshops with development partners working on the same topic to promote harmonisation of CSA activities in the region. One recent workshop was on agricultural insurance, co-organised with the Stockholm Environment Institute (SEI). Another was on the use of meteorological information services in the agriculture sector and was co-organised with the Food and Agriculture Organization (FAO) of the United Nations. These workshops enable member states to provide inputs to regional guidance on the effective application of CSA working approaches in national adaptation plans and national agriculture development plans.

ASEAN leaders have recognised that collaboration and coordination are essential to strengthening national capacities to respond to climate risks and address transboundary issues. Common frameworks and strategies to guide close cooperation and collaboration between ASEAN technical bodies and members are essential to addressing climate change in ASEAN.

FOR-CC has developed guidelines for regional cooperation among member states to support efficient South-South knowledge exchange. ASEAN-CRN plays a key role in sharing knowledge, data and information. The project has also supported the formulation of the Strategic Plan and Vision for ASEAN Cooperation on Food, Agriculture and Forestry 2016-2025. This strategic plan will guide ASEAN towards implementation of the Sustainable Development Goals as it pursues economic integration. Resilience to climate change and mitigation of GHG emissions feature prominently in the Strategic Plan.

Testing stress-tolerant rice varieties in Cambodia

Rice is the most important crop for millions of people in Cambodia. Women have the main responsibility for farming and feeding their families. With increasingly unpredictable rainfall, there is a need for rice varieties that are tolerant to both drought and waterlogging. FOR-CC collaborated with the Cambodian Agricultural Research and Development Institute (CARDI) and the Wildlife Conservation Society to test DMSK, a stress tolerant variety. Nineteen families received seeds and training. Socheat Yin, one of the women trained in the pilot project, explained how important the training she received was: 'What I learned from CARDI is how to select the best quality seeds. When I plough, I can clearly tell the difference between the seed types. The DSMK leaf has a different shape.' Knowledge of how to select, prepare and harvest seed is key to incorporating the new variety in farming systems.

Thida Ri, another woman farmer, plants DMSK – a late-maturing variety – alongside two other types of rice. 'I grow three types of sticky rice. The benefits that I get from this crop are that I can cook it for my daily meal and for dessert for my family.' Diverse varieties with different growth patterns make farming systems more resilient to climate risks. As a glutinous rice variety, DMSK has a higher value than other types of rice. Market tests with consumers have shown that the variety has strong potential for marketing. A successful trial in Cambodia could be replicated in neighbouring countries.

In order to secure support from the international community for scaling up CSA practices in the region, FOR-CC collaborated with other regional partners to help ASEAN member states formulate a common position on agriculture in relation to UNFCCC negotiations. Several submissions have been made in the name of ASEAN member states to the UNFCCC. Joining with other developing countries, ASEAN member states were successful in achieving a ground-breaking decision at COP 23 in 2017, whereby agriculture and climate change will be discussed in two key UNFCCC bodies. This process will put more knowledge and methodologies at the disposal of countries to guide them in promoting climate-resilient agriculture.

Coping with climate change in the Pacific island region (CCCPIR)

Countries of implementation	Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Timor-Leste and Vanuatu
Implementation period	Since 2010
Funding sources	German Federal Ministry for Economic Cooperation and Development (BMZ), European Union, United States Agency for International Development (USAID), Swiss Agency for Development and Cooperation (SDC) and the Australian Government through the Department of Foreign Affairs and Trade
Implementation partners	Pacific Community (SPC), Secretariat of the Pacific Regional Environment,Programme (SPREP) and the Pacific Islands Forum Secretariat (PIFS)

Context: Changing rainfall patterns, longer droughts, more intense cyclones and rising sea levels are likely to affect all Pacific communities and key economic sectors, such as agriculture and fisheries. To address these challenges, a Pacific regional framework integrating disaster risk management, climate change adaptation and low-carbon development has been created, known as the Framework for Resilient Development in the Pacific (FRDP). This framework provides high-level strategic guidance to different stakeholder groups on how to enhance resilience to climate change and disasters in ways that contribute to sustainable development.

At the national level, countries are mainstreaming climate change into sector policies, strategies and plans. The implementation of these national plans is an urgent priority that requires financing. While climate finance resources are available, the Pacific island countries face challenges in accessing climate finance because of gaps in national finance systems and current public financial management processes. Addressing these gaps is key to unlocking access to finance for effective adaptation to climate change.

The project: Building on previous initiatives and collaborating with other stakeholders, CCCPIR's overall objective is to enhance climate resilience and climate change mitigation in Pacific island states. CCCPIR supports Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Timor-Leste and Vanuatu in the following areas:

- mainstreaming climate change issues into national and sectoral policies, strategies and plans and supporting policy and decision-making processes;
- piloting and replicating best practices in climate change adaptation, including technologies and associated capacity building, with a focus on food security, water security, sustainable resources management (terrestrial and marine) and land use planning;
- capacity building for national REDD+ (reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests and forest carbon stock enhancement) processes (Fiji only);
- integrating climate change issues and learning tools into national education systems (Fiji, Vanuatu, Kiribati and Samoa);
- strengthening information and knowledge management systems, including the development and dissemination of informational and awareness products;

- accessing climate finance through strengthened institutional capacities (Kiribati, Samoa, Solomon Islands, Tuvalu and Vanuatu).

How the project supports adaptation: The country approach used in Solomon Islands illustrates the multi-level approach to adaptation taken by the project.

A vulnerability and adaptation assessment was undertaken to understand the exposure, sensitivity, adaptive capacity and vulnerabilities of the local population in Choiseul province. The assessment considered historical climate and current vulnerabilities as well as projections of future climate change. It used participatory methods so that the knowledge and views of ordinary people could be heard. Based on the findings of the assessment, stakeholders identified a suite of adaptation options to address the priority vulnerabilities.

In the agriculture sector, the adaptation measures identified included land use planning, contour planting on slopes and improved agricultural practices, such as matching crops with soil types, adjustments in the agricultural calendar to avoid periods of high risk, making home-made pest repellents and fertilisers and planting swamp taro, which grows in slightly salty water and is an important emergency crop when other crops fail.

In Choiseul province, nine demonstration sites were established in different communities. Various demonstration activities were conducted to raise awareness of the adaptation options. Nurseries were established to grow plants and trees for transplanting to the field, contours were constructed along slopes, integrated gardening models were introduced and homemade pest repellents were demonstrated to reduce crop losses to pests. A series of awareness raising and training activities using the demonstration sites are ongoing.

The demonstration and outreach activities are conducted with a broad range of partners, including government, NGOs and community-based organisations. These partnerships enable the project to draw on a range of expertise and help with replication of the technologies and approaches developed.

For example, dozens of farmers have been supported to construct backyard gardens that have raised seed trays and planting beds to protect them from storm waters. With the support of the project, local agricultural extension officers provide training and a package of backyard garden equipment and material, including vegetable seeds. Farmer cooperatives have been established to support backyard farmers with growing, harvesting and marketing their vegetables. These cooperatives will have a key role in continuing support for farmers after the project ends.

Gladys Kaloris is a 55-year-old woman from an isolated village in the Republic of Vanuatu. She and her children grow root crops, including yam and cassava. These, combined with fish, form the family's staple diet which is limited and extremely vulnerable to climate-related disasters like drought. Green vegetables generally include only a local variety of spinach, called nopa, which requires substantial rainfall. Gladys has received support to grow drought-tolerant vegetable varieties, including beans, tomatoes and cabbage. 'With the seeds, tools, and training I have received, my backyard vegetable plot now provides nutrient-rich vegetables throughout the year, supplementing my children's daily school lunches as well as providing sun-dried foods for us when climate disasters strike.'

Many of these innovations have been taken up in national policies and strategies. Since 2012, the project has supported Fiji, Samoa, Tonga, Vanuatu and Kiribati in integrating climate change issues into the national education curriculum, including in technical and vocational education and teacher training. Curricula in schools and technical and vocational training centres now include modules on climate change and disaster risk management, including climate-resilient agricultural production and food security.

CCCPIR has also supported the development of national climate change policies and strategies, national guidelines, joint national plans on climate change and disaster risk management and integration of climate change issues into sector policies in Fiji, the Federated States of Micronesia, Kiribati, Palau, the Republic of the Marshall Islands, Tonga and Vanuatu. For example, with the project's support, the Government of Vanuatu has drafted a policy for the use of vouchers to obtain emergency supplies and the basic equipment (e.g. agricultural hand tools, nets and fishhooks) needed to restore livelihoods following a natural disaster. Support for national policy processes has involved awareness raising and training activities relating to policies and climate change issues and engagement with a broad range of stakeholders.

At the regional level, the project has enhanced and facilitated information exchange on climate change through the development of a regional climate change portal. At the national level, the project supported the development of national climate change portals and websites in Fiji, Tonga and Vanuatu.

In Vanuatu and Solomon Islands alone, more than 20,000 vulnerable farmers have been reached by the programme and received support to build more resilient livelihoods. For example, the project's support for cyclone and drought coping measures has had significant benefits for food security:

- The variety of vegetables being planted has increased, as has the variety of livestock types raised. The project has reduced dependence on imported food bought at stores, by providing more nutritious and affordable local alternatives.
- Vegetables, eggs and chicken meat are now more frequently consumed than before, including by women. This has led to healthier diets and eating habits, and children in particular have responded positively to healthier and more varied school lunches.
- Excess eggs are sold through the farmer cooperatives. Women have found that this extra income helps with other household expenses, such as healthcare and educational expenses for children.

The project has also helped coordinate and harmonise climate change adaptation projects by different agencies. The GIZ-supported Food Security Cluster in Vanuatu is regarded as one of the most responsive clusters in times of climate-related emergencies and disasters.

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

Friedrich-Ebert-Allee 36 + 40
53113 Bonn, Germany
T +49 228 44 60-0
F +49 228 44 60-17 66

Dag-Hammarskjöld-Weg 1 - 5
65760 Eschborn, Germany
T +49 61 96 79-0
F +49 61 96 79-11 15

E info@giz.de
I www.giz.de