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Lecture Notes of the Massive Open Online Course

National Adaptation Plans Climate Resilience in Agriculture Building Climate Resilience in Agriculture

Module 4: Identifying and prioritizing climate adaptation options

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Preface

This document presents a lecture note prepared for the National Adaptation Plans: Building Climate Resilience into Agriculture Massive Open Online Course (MOOC) which is one of the deliverables of the National Adaptation Plans (NAP-Ag) Programme.

The NAP-Ag Programme is a joint effort led by the United Nations Development Programme (UNDP) and the Food and Agriculture Organization of the United Nations (FAO) to support a set of developing countries to identify and integrate climate change adaptation measures in the agricultural sectors into relevant national planning and budgeting processes. Under this programme, UNITAR supported UNDP and FAO in developing a MOOC to raise awareness and increase the capacities of a wide range of interested stakeholders in climate change adaptation planning, specifically for the agriculture sectors.

This MOOC is structured around 6 thematic modules:

1. Introduction to climate change adaptation, agriculture and food security
2. International Frameworks and National Adaptation Planning
3. Identifying and assessing climate change impacts and risks
4. Identifying and prioritizing climate adaptation options
5. Governance, coordination and finance
6. Communications, monitoring and evaluation

The lecture notes include links to complementary lecture videos and additional resources.

The Module 4 presents different types of adaptation actions in the agriculture sector, including specific case-studies from the livestock, croplands as well as aquaculture and fisheries sub-sectors. This module offers practical exercises for learners to get acquainted with the tools and methods at their disposal for prioritizing and appraising different actions. Finally, the module provides insights into the mechanics of designing a climate change adaptation project.

Learning Objectives

(1) Discuss examples of different adaptation actions in agriculture;
(2) Recall approaches and methods for the appraisal and prioritization of adaptation actions.

Acknowledgements

This course and the programme were made possible by the generous funding of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) through its International Climate Initiative (IKI).

WEEK 4

Contents

Part I

4.1.1 Climate adaptation actions in the agriculture sector

Expert: Armine Avagyan, Julia Wolf

Contributions from: Jeongha Kim, Benjamin Laroquette

Key Messages

1) Benefits of adaptation outweigh the costs of inaction by very wide margins.
2) Adaptation actions should begin by addressing present risks and vulnerabilities and restoring the natural resource base and ecosystem services, on which the agriculture and other sectors depend.
3) Adaptation in agriculture should consider commitment across sectors, investment at different levels (field, farm, land-scape, national) and should vary from practices, institutional strengthening, provision of needs based climate information services, early warning systems, agricultural support services, mainstreaming and policy support.
4) Not all proven solutions of climate change adaptation in agriculture are directly transferable as agricultural production tends to be context-specific and site-specific.
5) Adaptation options must consider the co-benefits for greater gender equality and reducing greenhouse gas emissions.
6) The adoption of improved practices by smallholder farmers is still limited as they face barriers such as limited access to markets and credits.

Climate change brings a cascade of risks from physical impacts on (agro-)ecosystem, agricultural production, and food chains to economic and social impacts on livelihoods, income and trade, food security and nutrition.[1] It is estimated that benefits of adaptation outweigh the costs of inaction by very wide margins.[2] Without concerted global action to make agriculture more sustainable, productive and resilient, climate change impacts will continue to seriously compromise food production, particularly in the most fragile countries.[3]

Quick recap: What is climate change adaptation?

Expert: Benjamin Laroquette

Climate change adaptation includes a range of actions and activities that help people adapt to the changing climate conditions. With the emerging necessity to adapt to climate change, countries and communities are starting to design and implement adaptation initiatives of various types, scales, and coverage. These initiatives seek to manage anticipated climate change risks at the national, sub-national, local levels. Some of these focus on developing system-wide local capacities aimed at analyzing, planning, and implementing a range of priority actions that

[1] FAO, 2016b
[2] FAO, 2016c
[3] Ibid.

strengthen the resilience of key stakeholders and institutions against anticipated climate change risks.

Considerations for adaptation options

The identification of appropriate adaptation actions requires:

1. Better understanding of the direct and indirect influences on agricultural and rural systems in a given place;
2. Integration of social, economic and biophysical data;
3. Commitment across sectors, such as agriculture, transportation and water;
4. Investments at different levels, such as farm level, local cooperatives and national institutions;
5. Consideration of different approaches including changes in agricultural practices, institutional strengthening, provision of needs based climate information services, early warning systems, agricultural support services, mainstreaming and policy support. [4]

There are many proven solutions for climate change adaptation in agriculture. However not all of them are directly transferable as agricultural production and the solutions to climate change adaptation in agriculture tend to be very context-specific. The choice of adaptation options depends on the conditions under which they will be applied. Therefore, large-scale approaches which do not consider local environmental, social and economic contexts may lead to maladaptation or have other negative trade-offs.[5]

Key areas of adaptation measures

The publication on "Climate Change and Food Security: Risks and Responses" of the Food and Agriculture Organization of the United Nations (FAO) identifies six key areas of adaptation actions in agriculture and food security[6]:

1. Increasing resilience of livelihoods

Resilient livelihoods are livelihoods that have the capacity to prevent or absorb the impact of and adapt to changing climate conditions and respond to disasters if they cannot be avoided. Social protection programmes, disaster risk reduction and addressing gender-differentiated vulnerabilities are ways of increasing the resilience of rural livelihoods and ensuring a longer-term positive impact on food access. They help improve capacity for coping with risk, lead to positive spill-over effects in local economies by generating additional income, and impact agricultural investment decisions of rural households.

2. Building resilience of agricultural systems

Agricultural systems include crop systems, livestock and pastoral systems, forests, fisheries and aquaculture systems. They can be made more resilient at the farm, throughout the supply chain or other levels. A primary means of increasing the resilience of agriculture-based livelihoods is through increasing and stabilizing the benefits producers obtain from their production systems.

[4] FAO,2016b
[5] FAO, 2016c
[6] FAO, 2016a, b

The role of decent rural employment in increasing climate resilience and reducing climate-induced migration

Expert: Jeongha Kim

Providing Decent Rural Employment (DRE) opportunities in rural areas prone to the negative effects of climate change can increase resilience of the rural community, thereby reducing unwanted migration. The FAO applies an Integrated Country Approach to decent rural employment in multiple countries.

Negative effects of climate change can be both slow onset, and sudden onset. Slow onset events include rise in sea levels, increasing temperature, ocean acidification and salinization, land and forest degradation, loss of biodiversity, and desertification. These slow onset events adversely affect agriculture by overall decrease in productivity, and loss of space (land, water, forest, etc.) for agricultural activities, which can drive out people who rely on it. Most notable sudden events include extreme weather events, such as heat waves, tropical cyclones, droughts and floods. These sudden onset events contribute to physical damage (although often more temporarily than slow onsets) driving out people from their homes and/or lands, water, and forests.

DRE is part of Agriculture and Rural Development (ARD), an umbrella concept that includes investment, policy prioritization, resource allocation, which create enabling environment for DRE to take place, which calls for comprehensive, sustainable investment in rural areas and agriculture. Often, policy intervention for addressing climate change, addressing migration, and addressing ARD take separate and unrelated routes. However, by mainstreaming the nexus among climate change, migration, and agriculture, policy makers and stakeholders can address not only the respective issues of each themes (such as climate-induced migration, maladaptation to climate change, and food insecurity) but also be more efficient and effective with limited resources.

Table 1 gives examples of adaptation measures for the livestock and pastoral systems.

ANIMALS	FORAGE AND FEED CROPS	LABOUR FORCE AND CAPITAL
• Water management (e.g. boreholes) • Breeds resistant to drought, heat and harsh environments • Shifts in species, breeds and/or production systems (e.g. small ruminants, poultry) • Disease control and animal health • Cooling for indoor systems or shading (e.g. trees)	• Irrigation • Purchase feed supplementation • Breed feed crops and forages for water use efficiency and resistance to drought, salinity and waterlogging • Improve grazing management • Change the cropping calendar • Practice agroforestry • Increase mobility for resources	• On- and off-farm diversification • Insurance schemes • Reconversion in the context of national and regional production zoning • Institutional changes (e.g. trade, conflict resolution, income stabilization programmes)

Table 1. Climate change adaptation options for livestock. Adapted from FAO, 2016a.

For further examples covering crop, forest, and fisheries systems, see Tables 2, 3, and 4 in the Annex.

3. Managing genetic resources

Owing to the high uncertainty related to climate change, it is especially important to maintain a high diversity of genetic resources for having options to cope with climate change. There is a need to

conserve genetic resources and identify genetic traits which are key for adaptation, such as resistance to droughts, salinity, floods, pests and diseases as well as for gaining other information such as nutritional content and suitability in different farming systems and ecosystems. Go back to week 2 for a refresher on genetic resources for food and agriculture.

4. Investing in resilient agricultural development

Adaptation options in this area focus on promoting agricultural development for economic growth, alleviation of poverty and reduction of vulnerabilities in rural areas, focusing on smallholder agriculture. According to the FAO High Level Panel of Experts,[7] a food security oriented agricultural development strategy should make smallholder farming the focus of its attention. Such a strategy should formulate context-dependent channels for a productivity revolution, by shifting to higher-value agriculture, diversifying rural-based non-farm economic activity, connecting better to markets, and establishing an active rural economy.[8]

Targeted investments are needed to increase the resilience of agro-ecosystems through sustainable land management approaches, together with programmes to enhance socio-economic resilience such as social protection, improved agricultural market governance and value chain development, as well as insurance programmes and effective early warning systems.[9]

Enabling **diversification** is an important strategy for increasing resilience among agricultural, fisheries and forestry-based populations. This can be in-farm diversification by shifting to different farming practices or increasing the number of crop and species varieties, or off-farm diversification by shifting to non-agricultural sources of income. The next section provides more information about diversification as an adaptation option and its benefits.

5. Investing in systems to assess risks, vulnerabilities and adaptation options

Developing climate risk and impact assessment tools is the first step to climate change adaptation. Global climate models can provide future climate projections, based on socio-economic and emission scenarios. Then more specific planning support tools can be run based on these scenarios. Aquacrop, for example, is a FAO crop model that reproduces the yield response to water of major crops. The Modelling System for Agricultural Impacts of Climate Change (MOSAICC), that was discussed last week, is another example of a package of tools which enables an interdisciplinary assessment of climate change impacts on agriculture.

6. Enabling adaptation through policies and institutions

Policies and institutional changes are also adaptation options. For example, adaptation policies can support food producers by reducing financial risks, allowing access to financial services and enabling long-term investments. The financial needs of smallholders and family farmers, ranging from working capital expenditures for fertilizers and seeds, to medium- and long-term investments, can best be addressed through decisions made at the policy and institutional level. For example, policies to weather-based index insurance schemes more readily available to smallholder farmers.

[7] HLPE, 2013
[8] FAO, 2016a
[9] FAO, 2016b.

Remote-sensing index for crop Insurance
Expert: Dr. Oscar Rojas

A weather-based index can be used for providing drought insurance to particularly vulnerable smallholder farmers.

In recent years, weather index insurance has gained significant international attention. Multilateral agencies and donors are supporting the development of index insurance products. Weather index-based insurance can help secure the income of smallholders who are particularly vulnerable to climate variability. It can improve rural livelihoods and reduce food insecurity. One of the aims is also to improve access to credit by lowering the risk of default for financial institutions. The weather-based index insurance can be likened to contingency insurance in that a specific event can trigger an insurance payment. A commonly used weather-based index is rainfall data from local weather stations; however, other measures can also serve as weather-based indexes. For example, the Normalized Difference Vegetation Index (NDVI), which is derived from data collected by satellites, gives an indication of vegetation health and thus potential crop yields, and has been used to provide index-based drought insurance. Weather stations have traditionally been the primary data source for weather index insurance programs.

However, in many developing countries the number of weather stations is often very limited and their distribution in relation to the agricultural areas poor. Furthermore, spatial interpolation techniques that can be used in some situations to solve the problem of low density of stations prove to systematically underestimate the extreme values; precisely those extreme events that the insurance programme intends to cover. A potential alternative could be the use of rainfall estimates from satellite data or climate simulation models. However, rainfall estimates when compared with ground measurements (rain gauges) generally over or under estimate rainfall amounts quite significantly depending of the geographical position and topography of the area under analysis. Up to the present, these difficulties in estimating rainfall have prevented the development of weather index based insurance.

One feasible alternative for developing countries could be the use of vegetation indices even if those indices still have some technical limitations that can affect the accuracy of the data captured by satellite (amount of humidity in atmosphere/soil, position of satellite relative to earth surface and the time series is composed of data from several different sensors). The use of NDVI has so far been applied mainly in pastoralist areas, nevertheless, it offers a high potential for use also in cropping areas if analysis is restricted to the growing period and the areas where crops are believed to be grown. Improvement of land use maps to better define agricultural cropping areas could contribute to produce much better results with this technique.

The Global Information and Early Warning System (GIEWS) and FAO developed an "Agricultural Stress Index System" (ASIS) for detecting agricultural areas with a high likelihood of water stress (drought) on a global scale (http://www.fao.org/climatechange/asis/en/).

Weather index insurance – A class of insurance products that can allow weather-related risks to be insured in developing countries where traditional agricultural insurance may not always be feasible, thereby helping to increase farmers' ability (and willingness) to invest in measures that might increase their productivity.

Practical Considerations

Adaptation actions should begin by addressing present risks and vulnerabilities and restoring the natural resource base and ecosystem services, on which agriculture depends. The lack of data, knowledge and accuracy of climate change models make it difficult to know where specific changes in climate will occur and thereby determine appropriate adaptation actions.[10] And yet, although there may be uncertainty, in most cases action still needs to be initiated today.

It is also important to consider the co-benefits of an adaptation action in terms of emissions reductions, and this is why it is so important that Nationally Determined Contributions (NDCs) cover both mitigation and adaptation. Some adaptation actions might also lead to more efficient use of resources (which will most likely lead to emissions reductions). But this is not always going to be the case. Sometimes there may be trade-offs to consider between increased efficiency in the use of resources on the one hand, and resilience to climate change risks on the other. This is why it is important to carefully assess proposed adaptation actions.[11]

It is important to note that the agriculture, forestry and other land use sector (AFOLU) is the largest emitting sector after the energy sector.[12] Thus, agriculture and the food sector at large have an important responsibility in climate change mitigation. Well-designed interventions in the agricultural sector cut across the usual distinction between climate change adaptation and mitigation. They show that climate action can be a driver for sustainable social and economic development.For more cross–cutting issues and approaches to consider in adaptation in the agriculture sector, see 4.1.1 and Table 5 in Annex.

The report on "The State of Food and Agriculture 2016" underlines that to maximize the co-benefits of climate change adaptation and mitigation, deep transformations in agriculture and food systems are needed.[13] Reducing food losses and waste would not only improve the efficiency of the food system, but would also reduce both pressure on natural resources and emissions of greenhouse gases.

And yet, despite agriculture's potential to support adaptation to climate change and mitigate emissions, the adoption of improved practices by farmers is still limited. Adoption is hampered by policies, such as input subsidies, that perpetuate unsustainable production practices. A shift is needed towards policies that promote resource-use efficiency, soil conservation and reduction in greenhouse gas emissions.[14]

Smallholders face a broad range of barriers when adopting improved practices on the path to sustainable agriculture, such as limited access to markets, credit, extension advice, weather information, risk management tools and social protection.[15]

In parallel with policy changes, support from investment finance mechanisms and institutional frameworks is essential. Investments in productive, sustainable and resilient agricultural development can enhance agricultural productivity, output and income; build resilience; contribute to sustainably managing natural resources such as water; while at the same time delivering

[10] FAO, 2016c
[11] FAO, 2016b
[12] IPCC, 2014
[13] FAO, 2016c
[14] FAO, 2016c
[15] Ibid

mitigation benefits by easing the pressures that drive for example deforestation and enhancing soil organic carbon. Week 5 will focus on national and international climate finance arrangements.

Key Definitions

Trade-offs - The concept of trade-offs arises from the idea that resources are scarce. For a given set of resources and technology, to obtain more of a desirable outcome for any given system, less of another desirable outcome is obtained. In adaptation trade-offs, may arise, for example between adaptation and mitigation goals, between adaptation and other policy goals or between different adaptation options or measures.

Abbreviations

GIS – Geographic Information System
CSA – Climate-Smart Agriculture
AFOLU - Agriculture, Forestry and Other Land Use
GHG – Greenhouse Gas

Resources for further learning

FAO, 2016. Climate Change and Food Security: Risks and Responses. Available here: http://www.fao.org/3/a-i5188e.pdf

FAO, 2016. The State of Agriculture and food security: Climate change, agriculture and food security. Executive summary. Available here: http://www.fao.org/3/a-i6132e.pdf

FAO. 2017. Livestock solutions for climate change. https://www.uncclearn.org/sites/default/files/inventory/a-i8098e.pdf

Submission by the Food and Agriculture Organization of the United Nations (FAO) to the United Nations Framework Convention on Climate Change (UNFCCC) on Issues relating to agriculture: adaptation measures. Available at http://unfccc.int/files/documentation/submissions_from_non-party_stakeholders/application/pdf/595.2.pdf

Climate-Smart Agriculture Sourcebook. Available here: www.fao.org/docrep/018/i3325e/i3325e00.htm

4.1.2 Examples of adaptation actions and cross-cutting issues

The following tables provide examples of adaptation actions for croplands, forestry and fisheries (Tables 1 to 3), as well as an overview of cross-cutting issues such as gender, nutrition and tenure rights (Table 5).

Table 1. Climate change adaptation options for croplands (Source: FAO 2016a; 2016b)

RISKS	RESPONSES
Changing climate conditions and climate variability and seasonality	• Participate in monitoring schemes when available. • Optimize planting schedules (e.g. sowing data), including for feedstock and forage. • Plant different varieties, species and cultivars. • Use short–duration cultivars. • Use varieties of breeds capable of producing under different environmental extremes or those with broader environmental tolerances. The use of currently neglected or rare crops and breeds should be considered. • Practice early sowing, which can be made possible by improvements in sowing machinery or the adoption of dry sowing techniques. • Increase the diversity of varieties or crops to hedge against risk of individual crop failure. • Practice intercropping. • Use integrated systems involving livestock and/or aquaculture to improve resilience. • Change post–harvest practices (e.g. the time required for drying grain and post–harvest storage procedures). • Consider the effect of new weather patterns on the health and well–being of agricultural workers.
Change in rainfall and water availability	• Participate in monitoring schemes when available. • Change irrigation practices. • Adopt enhanced water conservation measures. • Use marginal water resources and wastewater. • Make more use of rainwater harvesting and capture. • In some areas, increased precipitation may allow irrigated or rain–fed agriculture in places where previously it was not possible. • Alter agronomic practices. • Reduce tillage to lessen water loss and incorporate manures and compost, and plant cover crops to increase soil organic matter to improve water retention.
Increased frequencies of drought, storms, floods, wildfire events, sea level rise	• Participate in monitoring schemes where available. • Adopt general water conservation measures, particularly during drought. • Use flood–, drought– and/or saline–resilient varieties. • Improve drainage, increase the amount of organic matter in the soil and strengthen farm design to avoid soil loss and gullying. • Consider, where possible, increasing insurance coverage against extreme events.
Pest, weed and diseases, disruption of pollinator ecosystem services	• Participate in risk–monitoring and risk–prevention schemes where available. • Use expertise in coping with existing pests and diseases. • Build on natural regulation and strengthen ecosystem services.

Table 2. Climate change adaptation options for increasing forest resilience (Source: FAO 2016a; 2016b)

RISKS/IMPACTS	SOCIAL, ECONOMIC AND ENVIRONMENTAL IMPLICATIONS	RESPONSE MEASURES FOR RISK REDUCTION AND INCREASED RESILIENCE
Decreased forest vitality and productivity	Reduced revenue from wood and non–wood forest products; reduced forest ecosystem services	Adjust silvicultural practices, change composition of species and varieties; increase forest biodiversity; implement forest restoration measures

Increased forest pests and diseases	Reduced forest revenue; reduced forest ecosystem services	Implement and intensify pest and disease management measures; adjust silvicultural practices.
Increased wildfires	Loss of life; damage to infrastructure; reduced forest revenue and ecosystem services; wildlife losses	Implement and intensify wildfire management; adjust silvicultural practices.
Increased water erosion and landslides	Damage to forest and infrastructure (towns, roads, dams); reduced water quality	Undertake watershed management measures, including protecting and increasing vegetation cover; reduce intensities of harvesting and other uses
Drought–induced forest and tree dieback and land degradation	Reduced availability of forest products; increased wind damage; reduced grazing values	Plant windbreaks; maintain tree cover; change composition of species and varieties
Increased storm damage	Reduced forest revenue and ecosystem services; increased risk of pests and disease	Change species to adjust tree spacing to reduce risk; salvage harvesting; pest and disease control
Reduced extent and vitality of mangroves and coastal forests	Increased exposure of land to storm damage; reduced productivity of coastal fisheries	Increase protection, restoration and enhancement of mangroves and other coastal forests
Changes in species ranges and species extinctions	Reduced forest ecosystem functions; loss of forest biodiversity	Restore or increase forest connectivity and wildlife corridors; assist migration; take ex– situ conservation measures

Table 3. Climate change adaptation options for fisheries and aquaculture (Source: FAO 2016a; 2016b)

IMPACT AREA	POTENTIAL RESPONSES
Capture fisheries	
Reduced yield	Access higher–value markets; shift and widen targeted species; increase fishing capacity and efforts;**21** reduce costs, increase efficiency, diversify livelihoods; abandon capture fisheries
Increased yield variability	Diversify livelihoods; implement insurance schemes; promote adaptive management frameworks
Change in distribution	Migrate fishing efforts and strategies and processing and distribution facilities; implement flexible allocation and access schemes
Sea level rise; flooding and surges	New and improved physical defences; managed retreat and accommodation; rehabilitation and disaster response; integrated coastal management; early warning systems and education
Increased dangers of fishing	Weather warning systems; improved vessel stability, safety and communications
Social disruption/new fisher influx	Support existing local management institutions and develop new ones; diversify livelihoods
Aquaculture	
Extreme weather events	Improve farm siting and design; individual and cluster insurance; use indigenous or non– reproducing stocks to minimize biodiversity impacts
Temperature rise	Better water management; feeds; handling; selective breeding and genetic improvements; adjust harvest and market schedules
Water stress and drought conditions	Improve efficiency of water usage; shift to coastal aquaculture; culture–based fisheries; select for short–cycle production; improve water sharing; improve seed quality; efficiency

Sea–level rise and other circulation changes	Shift sensitive species upstream; introduce marine or euryhaline species (wide saline tolerance); use hatchery seed; protect broodstock and nursery habitats
Eutrophication, upwelling, and harmful algal blooms	Better planning; farm siting; regular monitoring; emergency procedures
Increased virulence of pathogens, new diseases	Better management to reduce stress; biosecurity measures; monitoring; appropriate farm siting; improved treatments and management strategies; genetic improvement for higher resistance
Acidification impact on shell formation	Adapt production and handling techniques; move production zones; species selection
Limits on fish and other meal and oil supplies and price	Fish meal and fish oil replacement; better feed management; genetic improvement for alternative feeds; shift away from carnivorous species; culture of bivalves and seaweed
Post–harvest, value addition	
Extreme event effects on infrastructure and communities	Early warning systems and education; new or improved physical defences; accommodation to change; rehabilitation and disaster response
Reduced and more variable yields; supply timing	Wider sourcing of products; change species; add value; reduce losses and costs; more flexible location strategies to access materials; improve communication and distribution systems; diversify livelihoods
Temperature, precipitation and other impacts on processing	Better forecasting, information; change or improve processes and technologies
Trade and market shocks	Better information services; diversify markets and products

Source: Adapted from FAO, 2016, Daw et al., 2009, De Silva and Soto, 2009

Table 4: Cross–cutting issues and approaches to consider in adaptation in the agriculture sectors (Adapted from FAO, 2017)

ISSUE	CONSIDERATIONS
Co–benefits and externalities	It is important not to propose adaptation actions in isolation from existing and new climate change, environment and development goals. One prioritization criteria for adaptation actions is whether in addition to increasing resilience, they will have positive or negative impacts on other aspects of agricultural development (e.g. productivity or GHG reductions) or on vulnerable populations or women. It is also important to identify and weigh possible synergies and trade–offs between the objectives and where possible, compensate for the trade–offs. It is also crucial to ensure that actions aimed at increasing productivity or reducing GHG emissions will not lead to maladaptation in the agriculture sectors.
Gender–responsive adaptation	Women farmers are more exposed to climate risks compared to men because women usually have fewer endowments and entitlements, have limited resources to invest in required inputs, have less access to information and services, and are less mobile. The same inequalities also often affect female fishers, fish–farmers and forest–dwellers. Women are often excluded from decision–making and may not benefit from technologies and practices that help farmers adapt to new climatic conditions. Gender inequality not only has negative impacts on women, but also on their households, communities, and on the society as a whole, and hinders agricultural production and sustainable development. A gender–responsive approach to adaptation identifies and addresses the different constraints faced by men, women, youth and the elderly and recognizes their specific capabilities. It reduces gender inequalities and ensures that men, women, boys and girls can equally benefit from adaptation interventions and practices, and helps to bring about more sustainable and equitable results (World Bank, FAO and IFAD, 2015). Integrating a gender perspective into the NAP can help to ensure that there is equal participation of men and women in the decision–making and in the implementation of adaptation activities. It can also help to ensure that the NAP and the activities it entails will not exacerbate gender inequalities. It can lead to better adaptation, and more resilient communities.

	Gender integration requires conducting a gender analysis to identify gender–based differences. Gender analysis can be expanded into a wider social analysis to ensure that marginalized and disadvantaged groups, who often depend on smallholder agriculture, forestry and fisheries, will be included in formulating and implementing adaptation actions. A gender and social analysis can reveal the barriers to adaptation faced by different groups and suggest ways of overcoming them. In this context, youth often require special attention.
Indigenous peoples	Indigenous peoples are among the first populations to face the direct consequences of climate change because of their dependence upon, and close relationship with the environment and its resources. Climate change exacerbates the difficulties indigenous communities already face: marginalization, loss of land and resources, human rights violations and discrimination. However, by drawing on ancestral knowledge, indigenous peoples can also provide solutions to the problems created by climate change and contribute to building the resilience of the ecosystems they live in. Indigenous women often suffer a triple discrimination due to gender inequality, racial bigotry and poverty. This discrimination affects all spheres of their lives and exacerbates inequalities. Despite their key role as custodians of seeds, traditional knowledge, and ecosystem management, indigenous women suffer from a wide range of rights violations both inside and outside their communities. It is paramount to empower indigenous women to achieve gender equality and to work in partnership with them in adaptation initiatives.
Nutrition	Climate change affects nutrition status and dietary choices because of its impacts on food security, diseases, water safety, sanitation, livelihoods and caregiving. In turn, these impacts limit people's capacity to adapt to, or mitigate, climate change (IFPRI, 2015). Climate change amplifies the impact of droughts, floods and storms and exposes large numbers of people to the risk of undernutrition following extreme climate events (Confalonieri *et al.*, 2007). Seasonal patterns of inadequate food availability and access, a major cause of undernutrition among poor rural communities, are accentuated by climate change, which also has impacts on livelihood security and on intrafamily food distribution, which particularly affects the nutritional status of children and women (Wijesinha–Bettoni *et al.*, 2013). Some studies indicate that in some climate change scenarios the nutritional quality and safety of key food crops could be diminished due to lower mineral and protein content and increases in food–borne pathogens and toxic compounds. When assessing climate change impacts and vulnerabilities, using nutritional aspects as one of the criteria can result in a deeper analysis and reveal specific challenges of the most vulnerable groups. Using nutritional impacts as criteria in the prioritization of adaptation actions can help to target the most affected populations.
Social protection	Social protection can contribute to household adaptive capacity. It includes three broad components: social assistance, social insurance and labour market protection (FAO 2015d). Of these three, social assistance programmes are the most relevant to climate change adaptation. They include publicly provided conditional or unconditional cash or in–kind transfers or public work programmes. Other types of interventions have also an explicit social protection function as they are aimed at reducing risks (e.g. crop insurance). The increased climate–induced agricultural production variability in some regions is likely to increase the importance and need for safety nets in reducing hunger (FAO, 2015a). Social assistance programmes play an important role in risk management and building the overall resilience of households and individuals. The risk management function is a prime area of focus in the context of the increasing exposure to risk from climate change (HLPE, 2012). This is why social protection has a potentially key role to play in adaptation strategies. In addition to reducing vulnerability to climate change related hazards, social protection programmes can enhance the households' ability to invest time and money in adaptation and more effective natural resource management (HLPE, 2012; Béné, Devereux and Roelen, 2015).
Disaster risk management and reduction	Increasing frequency and intensity of extreme weather events calls for strengthened DRM, improved local practices for risk reduction and enhanced emergency response and rehabilitation. Measures for DRR may include risk assessment, early warning systems and preparedness for climate–related hazards in crop and livestock production, forestry, and fisheries and aquaculture. It is also important to expand and improve the transition and linkages between emergency prevention and response, rehabilitation, climate change adaptation and development (FAO, 2011; Cattermoul *et al.*, 2014; LEGS, 2014).

	Integrating DRR and climate change adaptation allows for a more effective use of resources, knowledge, capacities, technologies, and innovations that can address both the short– to medium–term challenges of coping with shocks and the long–term challenges of slow onset impacts of climate change. DRR and climate change adaptation are seen more and more as complementary and inseparable elements to be merged under national comprehensive policy frameworks. A global framework that guides countries DRR work is the Sendai Framework for Disaster Risk Reduction 2015–2030.
Migration	Climate change can be a root cause of rural migration and is exacerbating other socio–economic drivers of migration, such as rural poverty and food insecurity. Observations and scenarios suggest that the increasing frequency and intensity of climate extremes is likely to lead to increased migration. The vulnerability of agricultural communities to climate change is one of the drivers of distress migration, i.e. the movement of people for whom migrating is perceived as the only viable option out of poverty. Climate change has considerable impacts on rural areas, which can be both the places of origin for migrants and their destination. The consequences of these impacts in urban areas further amplify the challenges facing migrant populations. Migration is a coping strategy and can be an opportunity for reducing rural poverty. Disruptive climate–related events can be conflict stressors. They have the potential to make existing conflicts worse, or to increase the likelihood of conflicts where there are pre–existing tensions. This can in turn lead to greater migration. Improving food security in climate sensitive and vulnerable areas is central to the global response to the migration crisis. Sustainable agricultural development is essential to enhance resilience against climate risks, increase livelihood opportunities and reduce distress migration from rural areas. Investing in resilient rural livelihoods, providing rural communities in developing countries with access to social protection and decent jobs, especially for young men and women, creates a more stable living environment in areas prone to climate risks. These investments can limit the damage and losses caused by hazards and address some of the root causes of distress migration.
Tenure rights	Insecure land tenure has proved to be a major barrier to the adoption of practices and technologies (e.g. agroforestry, irrigation infrastructure and soil conservation) that can reduce vulnerability to climate change. It also discourages long–term planning in favour of maximizing short–term profits and complicates the implementation of effective climate change adaptation and mitigation plans. Tenure is a decisive factor in the identification of stakeholders whose food security and livelihoods are affected by the impacts of climate change. People with insecure tenure face the risk that their rights to resources will be threatened by competing claims, or may even lose their rights through evictions. Climate change is likely to increase competition for land, especially when linked to water. Strengthening smallholder farmers' tenure rights can contribute to empowering them to become drivers for climate change adaptation and custodians of natural resources. Bolstering tenure institutions can enhance systems for disaster risk preparedness and management, for the reallocation and redistribution of land as well as for redefining use and property rights both in rural and urban settings. Tenure security is seen as critical to allow individuals and communities to take into account the future value of current decision– making and decide how climate change action affects their food security and livelihoods. *The Voluntary Guidelines on Responsible Governance of Tenure of Land, Fisheries, and Forests in the Context of National Food Security* (FAO, 2012) can be used as a tool to improve tenure governance and can contribute to improving the capacity to develop policy, legal and organization frameworks regulating tenure rights over land, fisheries and forests. They can inform countries on tenure policy and legal frameworks as they develop their climate change strategies.
Food–energy nexus	The agriculture sectors and energy are closely intertwined. Consequently, the impacts of climate change on agriculture may also have implications on energy use. For example, reduction in rainfall may result in increasing groundwater pumping for irrigation and greater energy consumption. When analysing adaptation options for the agriculture sectors, it is also valuable to consider energy–related issues. It is necessary to ensure adequate access to energy services at all stages in agricultural value chains. This supports adaptation in two

	ways: it builds resilience by fostering self–sufficiency in energy; and diversifies incomes when it is possible to sell extra energy generated on farms. It is also advisable to promote adaptation options that decouple the development of agriculture systems from dependence on fossil fuels. Bioenergy is part of a mix of options for addressing energy concerns in the agriculture sectors and addressing climate change. Other options include increasing energy efficiency, using more renewable energy, shifting to local energy sources and adopting new patterns of energy production and consumption. For example, solar–powered irrigation systems have already been tested.
Water	In many regions of the world, increased water scarcity under climate change will present a major challenge for climate adaptation. Competition for water and the growing water scarcity are constraining both current availability of water for irrigation and further expansion of the irrigated area. In some cases relying on extraction from non–renewable aquifers, withdrawals can exceed 100 percent of total renewable resources. Certain regions already experience very severe water scarcity, with withdrawals that can exceed renewable resources as a result of groundwater use and recycling. Furthermore, in many parts of the world water tables are declining significantly. Water scarcity aggravates land scarcity. Climate change is adding significant uncertainty to the availability of water in many regions in the future. It will affect precipitation, runoff and snow/ice melt, with effects on hydrological systems as well as on water quality, water temperature and groundwater recharge. Climate change will also significantly impact sea level with potential impacts on the salinity of surface and groundwater in coastal areas. This will intensify competition for water use. The increase in temperature will trigger increased demand for water for evapotranspiration by crops and natural vegetation and will lead to more rapid depletion of soil moisture. Constraints on freshwater availability in heavily irrigated areas, may lead to reductions in the irrigated share of overall agricultural production, amplifying direct climate change impacts and increasing weather–induced variability in these regions. Adaptation to climate change needs to carefully consider competing water uses and their various implications for food security and nutrition (HLPE, 2015). Measures that can mitigate one type of adverse impact could also exacerbate another. For example, increased storage infrastructure to meet the water needs of irrigated agriculture arising from increased crop water demands, higher evapotranspiration and longer or more intense dry spells might exacerbate conflicts in river basins and negatively impact downstream fisheries.
Biodiversity and genetic resources	Biological diversity is important for building resilience and reducing vulnerability. Biodiversity and ecosystem functioning will be affected by climate change and will continue to be shaped by other factors (e.g. land–use change and the introduction of invasive species). Phenological cycles and food webs will be disrupted and modifications in the migratory ability of organisms may change the ecological community. With for instances be changes in pests and diseases. Diversity of genetic resources for food and agriculture allows for greater options when selecting plant and animal species and breeds that can adapt to drought, salinity or diseases. The narrow genetic base of improved varieties or breeds is one of the causes for genetic vulnerability (Khoury *et al.*, 2014). When considering adaptation options, it is important to characterize and prioritize species, varieties, breeds and populations, including wild relatives, for selection and conservation. This should be done based on climate change projections and include species that have direct socio–economic importance and associated species that provide ecosystem services (FAO, 2015a).
Landscape approach	A landscape approach expands the focus of sustainable development initiatives from a farming location or specific sector to the broader landscape. It deals with large–scale processes in an integrated and multidisciplinary manner, combining natural resource management with environmental and livelihood considerations. It differs from the ecosystem approaches (see below) in that it may include multiple ecosystems. The landscape approach also factors in human activities and their institutions, viewing them as an integral part of the system rather than as external agents. This approach recognizes that the root causes of problems may not be site specific and that a development agenda requires multi-stakeholder- interventions to negotiate and implement actions. The landscape approach

	helps to identify and develop positive externalities (e.g. ecosystem services) and reduce negative impacts, especially from individual land users. Placing human well–being at the center of the land–use decision–making ensures that the rights and cultural values of communities and minority groups are respected, along with their goals regarding land use. Crops, livestock, forestry, fisheries and aquaculture are often managed in isolation, which can be counterproductive. Coordination among the agriculture sectors at a larger scale facilitates the integrated management of production systems and natural resources and is important for climate change adaptation.
Ecosystem approach	To achieve food security, ecosystems need to remain healthy, functional and productive. They need to continue to provide, regulate and support the ecosystem services that are crucial for crop, livestock, forest and aquatic production systems and rural livelihoods. Productivity depends on ecosystem functioning, and the health and resilience of ecosystems depend to a great extent on biological and genetic diversity. Climate impact and vulnerability assessment and identification of adaptation options may call for widening the scope from the scale of a farm to a system–wide approach. Ecosystem–based adaptation uses biodiversity and ecosystem services in an overall adaptation strategy. It includes the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to both current climate variability and climate change (Colls, Ash, and Ikkala, 2009; Lo, 2016).
Value chain approach	Some stages of the agriculture value chain are more vulnerable to climate change than others. However, some adaptation actions may be applicable to every step in the value chain and make the entire chain more sustainable. It is often useful for climate impact assessments to examine the whole value chain. This was done, for example in Viet Nam where FAO supported the tea and coffee value chain analysis under climate change (see FAO, 2015b). Failure at the production stage will lead to disruptions in aggregation, processing and distribution. In wine production, for example, warmer nights lead to chemical changes in the grapes, which requires changes in processing to maintain quality (MGAP–FAO, 2013). Dysfunctional value chains may lead to excessive food losses and waste. In developing countries, food losses and waste often occur at the farm level owing to inappropriate production methods and post–harvest practices. Reducing food losses and waste at all stages of the value chain supports sustainable development and builds resilience to the impacts of climate change (FAO, 2014). Adding gender and nutrition perspectives to the value chain analysis delivers more sustainable results.

4.1.3 Diversification as an option to adapt

Expert: Solomon Asfaw

Contribution from: Daniela Coswig Kalikoski

Key Messages

1) Diversification is an important strategy for increasing resilience in rural areas.
2) Decision-makers should be aware that diversification needs to be carefully assessed to be compatible with the needs of the different segments of rural population, rather than applied "across the board".
3) Although external trends and shocks play an important role in pushing rural people towards a diversified livelihood strategy, diversification choices are also firmly rooted in the micro-economic logic of farming households.
4) Building resilience in rural livelihoods should be addressed as a complex adaptive process aimed at ensuring an optimal trade-off between satisfying immediate consumption needs and ensuring resilience against shocks.

Changes in farming practices and choices can be considered in-farm diversification. Farmers may diversify their crops by choosing a combination of crops, based on the amount and type of land that they cultivate. Shifts of time and resources to non-agricultural activities can be considered off-farm diversification. For example, farmers can allocate some of their time to non-farm activities, including wage labor and self-employment in household enterprises.

In both cases, diversification strategies range from a temporary change of the household livelihood portfolio to a more deliberate attempt to optimize livelihoods in the long-term. In other words, agricultural households may adopt a strategy to achieve smoother income streams through better risk management and smoother income streams, or a strategy of short-term adjustment in the wake of shocks or crises.

In the last three decades, diversification has been a policy objective for most developing countries to transform their agriculture from traditional grain-dominated production towards more market responsive approaches, largely in order to meet the increasing demand for food variety and quantity. However, diversification has also been pursued by many countries as an adaptation strategy to the changes in climatic patterns, with the primary objective of building resilience to climate change.

In the past five years, FAO's Economic and Policy Innovation for Climate-Smart Agriculture team has conducted studies using nationally representative farm household surveys linked with climate data in four sub-Saharan African countries: Burkina Faso, Malawi, Niger and Zambia. The studies assessed the drivers and impacts of diversification on farm household welfare, giving attention to the impact of climate risk as well as how different policy factors can affect diversification choices and ultimately welfare patterns.

The studies find that the levels and types of diversification that farm households adopt is highly dependent on the nature of exposure to climate variability. For instance, crop, labor and income diversification tends to be higher where climate variability is greater. The basic logic at work here is

that previous experience of weather shocks can provoke diversification as a means of spreading out perceived risk and reducing the impact on household consumption.

It is critical for policymakers and development practitioners to recognize the potential trade-offs when farm households pursue diversification as an adaptation strategy. For instance, working off the farm could potentially reduce household food availability due to the competition for family labor between farm and off the farm work. Yet, when combined with risk-mitigating measures, such as crop insurance or social protection, taking risks (high-productivity activities) could lead to higher incomes overall and help accelerate poverty reduction. By contrast, if farmers diversify to other low-productivity activities, it may reduce average income, force households to sell off assets in the event of shocks, and trigger a vicious cycle of greater vulnerability and exposure to risk.

Addressing these trade-offs requires a proper assessment of the barriers that poor smallholders face in diversifying their livelihood. Identifying which factors are the main drivers of diversification will provide insight into the role of diversification, either as a matter of necessity and survival to manage risk on the one hand, or as a choice and opportunity for improving standards of living on the other. Identifying desirable diversification strategies and the factors that enable households to undertake them is necessary to design policies that explicitly account for household diversification behaviors as possible determinants of their future level of welfare. The assessment should be the subject of dialogue among all stakeholders to decide what changes in policies and incentive structures are needed to create the enabling conditions for the transition.

'Leaving no one behind' in agriculture adaptation

Expert: Daniela Coswig Kalikoski

Poverty is one of the biggest obstacles to human development and economic growth. About 2.1 billion people still live in poverty and 767 million are extreme poor. Most of them live in rural areas and depend on agriculture and rural livelihoods for their income and food security. Evidence shows that climate change is already hurting the rural poor, damaging infrastructure, depressing crop yields, jeopardizing fish stocks, eroding natural resources and endangering species, causing significant damage to agriculture, water resources, ecosystems, and human health.

This poses an additional challenge to the pledge to 'leave no one behind', enshrined in the new 2030 Agenda for Sustainable Development. In fact, it is precisely in situation of crises that we face the largest risk of leaving the poor and marginalized behind. Those without substantial or diversified resources are likely to be hit the hardest: climate change can exacerbate their pre-existing economic and social vulnerabilities, forcing them to resort to negative coping mechanisms such as selling off productive assets, over-exploitation of resources, dropping children out of school, and/or fleeing their country as an attempt to meet immediate needs.

With the adoption of the 2030 Agenda on Sustainable Development, countries have renewed their commitment to fight against poverty, hunger and malnutrition, acknowledging that tackling climate change is key for moving people out of poverty. Target 1.5 of SDG 1 (No poverty) pays special attention to building resilient livelihoods and helping the rural poor reduce their exposure and vulnerability to climate change and natural disasters.

As part of its mandate to eradicate hunger, poverty and foster sustainable agriculture, FAO is supporting countries to achieve effective pro-poor development in the face of climate change, by promoting multi-sectoral, pro-poor and climate-informed development policies, sustainable and inclusive production, diversification and decent rural employment, as well as risk informed and shock responsive social protection systems, with a view to leaving no one behind.

Resources for further learning

FAO, 2016. Diversification strategies and adaptation deficit: Evidence from rural communities in Niger, by Solomon Asfaw, Alessandro Palma and Leslie Lipper. ESA Working Paper No. 16-02. Rome, FAO.

FAO, 2016. Diversification under climate variability as part of a CSA strategy in rural Zambia, by Aslihan Arslan, Romina Cavatassi, Nancy McCarthy, Leslie Lipper, Federica Alfani and Misael, Kokwe. ESA Working Paper No. 16-07. Rome, FAO.

FAO, 2015. Livelihood diversification and vulnerability to poverty in rural Malawi, by Solomon Asfaw, Nancy McCarthy, Adriana Paolantonio, Romina Cavatassi, Mulubrhan Amare and Leslie Lipper. ESA Working Paper No. 15-02. Rome.

Part II

4.2.1 Appraisal of adaptation actions: Using Cost Benefit Analysis

Expert: Babatunde Abidoye

Key Messages

1) There is a need to rank and prioritize adaptation options that emerge as equally plausible from the NAP process.
2) Cost Benefit Analysis provides a framework to identify, quantify, and if possible, monetize all impacts of an adaptation project or policy option.
3) It is important to understand the opportunities, limitations and process involved in carrying out a Cost Benefit Analysis.

Different options exist for governments, private sector and individuals to adapt to climate change. Given the costs of these options, decision makers are left with the difficult problem of appraising and deciding which investment project and policy to adopt, especially in the context of the uncertainty and complexity that climate change brings. This requires an objective, transparent and scientific framework to help decision makers decide on the optimal adaptation option.

For adaptation options that have implications on entire sectors, a market analysis is required to illustrate how an entire economic system is affected. This can be done at two levels – a sector by sector approach or an inter-sectoral approach. At the project or policy level, Cost Benefit Analysis (CBA) provides a means of assessing and comparing the impacts of projects and policies, even when benefits and costs occur over long time horizons.

CBA provides a framework to identify, quantify, and if possible, monetize all impacts of a project or policy (including their environmental impacts). CBA is a project evaluation framework where all **direct and indirect benefits and costs** of a project are identified, quantified in biophysical terms, valued in monetary terms, and compared against a range of optimality criteria on an **ex-ante basis**, and across all stakeholders. It provides a process of comparing the losses and gains of a project or a policy using a measurement that all stakeholders can relate to – generally monetary terms. Losses and gains also need to be expressed in a unit that informs the economic efficiency of a project or policy. The ex-ante basis part of the definition is important given that the appraisal is most useful when used early in the project cycle, to catch bad projects and bad project components. End of project appraisals are only useful to help in the decision of whether to scale up a project.

The **principle of "with or without"** is essential for appraising adaptation options. Examining the difference between the availability of inputs and outputs with and without the project is the basic method of identifying project costs and benefits; which is different from the **before and after comparison**. The "with" and "without" comparison enables analysts to assess incremental vs. absolute net benefits of the investment project. "Before and after", by contrast, fails to account for changes that would occur without the investment project. This would lead to erroneous attribution of changes in net benefits to the project investment.

Policy makers need to be introduced to the CBA, its potential as well as limitations with respect to the appraisal of adaptation options; specifically, the mechanics of conducting a technically rigorous CBA in the context of distinct projects.

4.2.2 Introducing climate variability into Cost Benefit Analysis

Experts: Giacomo Branca, Enrico Mazzoli

Key Messages

1) CBA is an ex-ante methodology to identify efficient solutions (either policy options or investment projects) in allocating society's scarce resources. It plays an important role in the decision-making process estimating the costs and benefits of climate change adaptation options.
2) CBA consists of a series of analytical steps. It also relies on a set of assumptions which project the expected outcomes of climate change adaptation options of projects and policies.
3) The application of standard CBA should be complemented by specific analytical elements: impacts of climatic changes on agriculture sector and related risk; uncertainty of climate scenarios; climate change adaptation policies; and long-term interventions and investments.

Cost Benefit analysis (CBA) is an invaluable tool for assessing the financial, social and economic impact of large-scale development projects. The CBA technique is extensively applied by official government and international development agencies to better inform the decision-making process and to make optimal decisions concerning public investment and rank investment options according to their economic efficiency and social desirability.

The methodology requires comparing project benefits and costs and evaluating whether the project can be initiated. CBA entails measuring project effects (benefits and costs) for all parties involved in the project (stakeholders) and to simultaneously consider external effects – both positive and negative - that the project might trigger. Therefore, this assessment rests on the assumption that costs and benefits can be measured in monetary terms and calculated at a given point in time. Yet, when it comes to evaluating environmental projects, the lack of formal market regulating environmental goods and services is a major limitation for a proper and rigorous evaluation. At the same time, growing global concerns about climate change and collective actions towards promotion of NAPs require that stronger evidence-based decision processes and rigorous evaluations are put in place.

Studying the theory and practice of CBA in the context of climate change adaptation implies explicitly introducing the climate variability associated with 'alternative climates' in the analytical scenarios. It also implies considering the wide range of adaptation measures that can be implemented in response to observed or anticipated climate variability and change. Climate modelling is used to define climate scenarios.

The evaluation of climate change adaptation options and strategies requires an estimation of the related benefits and costs. Cost options are generally known as they depend on the adaptation options selected, and can be easily estimated. Benefits should be carefully estimated using available direct and indirect methods for the evaluation of the environmental goods.

A fundamental issue in conducting CBA of adaptation options is the treatment of uncertainty

pertaining to climate change and the handling of multiple climate projections. As future projections of climate change effects are uncertain, this requires decision-makers to make decisions about adaptation to climate change under uncertainty. This is strictly linked to climate risk (e.g. hazards and extreme events). Analyzing the distribution of climate-related risk and opportunities is a determinant of the sensitivity analysis which is part of the CBA methodology.

Key Definitions

CBA is an ex-ante methodology to identify efficient solutions (either policy options or investment projects) in allocating society's scarce resources.

Resources for further learning (4.2.1a)

The Asian Development Bank (ADB), 2013. Cost-Benefit Analysis for Development: A Practical Guide. Available here: https://www.adb.org/documents/cost-benefit-analysis-development-practical-guide

Examples of Cost- Benefit Analysis Reports. Available here: http://adaptation-undp.org/resources/examples-cost-benefit-analysis-reports

World Bank. 2010. Cost-Benefit Analysis in World Bank Projects. IEG Fast Track Brief. Washington, DC. Available here: https://openknowledge.worldbank.org/handle/10986/10481

Resources for further learning (4.2.1b)

Hallegatte, S., 2009. Strategies to adapt to an uncertain climate change, Global Environmental Change 19 (2), 240-247

Hanley N., Barbier E.B., 2009. Pricing Nature: Cost-Benefit Analysis and Environmental Policy. Edward Elgar, Cheltenham, UK

UNFCCC, 2011. Assessing the costs and benefits of adaptation options: an overview of approaches. The Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change.

Part III

4.3.1 Designing a climate change adaptation project

Expert: Reis Lopez Rello

Key Messages

1) Consultation with key stakeholders, and receiving feedback from them on climate change impacts and possible actions to reduce vulnerability is essential.
2) Climate change adaptation and agriculture projects need to align with and respond to national adaptation and agriculture priorities, as identified in various plans and policies, including NAPs.
3) Flexible monitoring mechanisms should be integrated into climate change adaptation projects from the outset, as to measure the contribution of a given intervention in achieving adaptation goals and to help measure the effectiveness of adaptation finance.

Climate change adaptation (CCA) projects should respond to adaptations needs based on the identification and appraisal of adaptation interventions and on the target areas/sectors. Adaptation priorities should be identified as part of national development and adaptation planning processes, including NAPs. Many of the steps recommended in the NAP Technical Guidelines can also feed valuable information to the steps needed in designing climate change adaptation projects.

1. **Assess climate change impacts, barriers and gaps**

CCA projects should respond to climate impacts and socio-economic vulnerabilities identified through e.g. vulnerability and impact assessments and other approaches. They should respond to identified barriers (that are rooted and/or magnified by climate change impacts) and help to overcome these. Any gaps in climate information, capacities (human, technical, financial) and relevant public policy framework should be identified and mapped out.

2. **Active participation by stakeholders, align intervention with national and local priorities, build on lessons learned**

Key stakeholders, especially targeted communities, need to be engaged from the outset of CCA project design. In the case of agriculture, this might include for example: Ministries of Agriculture, Planning, Environment, Finance; local level beneficiaries such as farmers, extensions officers and resource user groups; civil society organizations; agriculture research institutes etc. (see also next section).

CCA projects should be aligned with national priorities, for example in terms of prioritized vulnerable areas, vulnerable sectors and vulnerable groups (often identified during a vulnerability and impact assessment). These might be put forward aligned to plans and policies, such as National Development Plans/Poverty Strategies, Climate Change Strategies, NAPs, sectoral plans such as Climate Smart Agriculture Strategies and NDCs.

Lessons learned from prior projects in adaptation and agriculture should be used to inform the design of interventions and overall approach of implementation.

3. Design the intervention

Design of a CCA project should be based on a theory of change or other approach that defines how the project interventions are expected to address prioritized adaptation goals while overcoming climate change-related barriers, for example to reduce vulnerability to climate impacts that affect the agriculture sector specifically such as drought and flooding, or to increase the adaptive capacity of vulnerable groups such as farmers or fishermen. In addition, CCA interventions should respond to impacts and barriers put forward in the assessment stage.

The project design stage includes consultations with key stakeholders and beneficiaries; identification of activities; identification of entry points in national/sectoral/local planning processes; budget design, etc.

Certain donors require specific background studies to be carried out, which can inform the CCA project design, such as: feasibility studies of the proposed interventions, a gender appraisal; assessment of social and environmental safeguards; and cost-benefit analysis, among others.

4. Fulfil proposal development and submission requirements

The CCA project needs to be designed in line with the proposal requirements put forward by given donors, such as bilateral funds from governments, multilateral development banks or climate funds (e.g. Adaptation Fund, Least Developed Countries Fund and Special Climate Change Fund).

For example, the Green Climate Fund (GCF) provides Project Preparation Funds (PPF) that countries can apply for and use for the following type of activities as part of the project design process: feasibility studies; environmental and social safeguards, and gender assessment, etc. The full project proposal should be submitted by an Accredited Entity[16]. The project should meet the Environmental and Social Safeguards[17] of the GCF, including on gender, and be based on extensive consultations with those who would be impacted by the project. A no objection letter signed by the Nationally Designated Authority (NDA) needs to be submitted as part of the proposal.

In Samoa, the United Nations Development Programme (UNDP) supported the development and approval of a Green Climate Fund proposal focused on addressing flooding by increasing resilience of infrastructure and the built environment to climate change.[18] UNDP worked together with the National Designated Authority, Ministry of Finance (MoF) and with other ministries, to have internal meetings to discuss the adaptation needs in Samoa, frame the main issues, barriers and possible interventions. Government of Samoa was interested in climate-proofing infrastructure along the Vaisigano River that runs through the heart of Apia, the capital city, and that overflows with cyclones and heavy rains every year. Cyclone Evan[19] had devastating impacts on livelihoods and

[16] http://www.greenclimate.fund/how-we-work/tools/entity-directory

[18] Green Climate Fund, 2016

[19] Samoa's livelihood and economic assets were devastated by Cyclone Evan (Category Three) in late 2012. The impact of Cyclone Evan saw the undoing of years of economic gain in infrastructure development and hard earned livelihood sources, loss of human lives and degradation of native habitats and species populations. According to the Post Disaster Needs Assessment (PDNA) undertaken by the GoS with the assistance of the World Bank, the total damages were estimated to be approximately US$200 million with a further US$70 million required for rebuilding human capital. By comparison, in 2012, Gross Domestic Product (GDP) was estimated to be US$683.7 million2. The total impact of Cyclone Evan was therefore 40% of Samoa's GDP at the time.

economic assets in the country and the government wanted to use GCF resources to reduce the likelihood of future impacts of cyclones in Apia. After meetings with NDA, UNDP developed a theory of change around the main climate change issues (floods) and developed interventions aiming to increase resilience of the communities living along the Vaisigano River.

UNDP led extensive consultations with stakeholders (local governments, communities, NGOs,) to explain the proposed interventions to integrate feedback and to foresee any possible risks that may occur during implementation. UNDP, NDA and Ministry of New and Renewable Energy (MNRE) worked together in filling out all sections of the GCF funding proposal template. In parallel, all required reports were being developed (feasibility studies of the proposed interventions, a Gender Assessment and Action Plan, Environmental and Social Management Plan, Economic Analysis, among others). Once the proposal and supporting documents were finalized, these were submitted to the GCF for review and for consideration of the GCF Board members for approval.

Abbreviations

Green Climate Fund (GCF)
Ministry of Finance (MoF)
Ministry of New and Renewable Energy (MNRE)
Nationally Designated Authority (NDA)
Project Preparation Funds (PPF)
Vulnerability and Impact Assessments (VIAs)

Resources for further learning

GCF – 101
Adaptation Fund – how to apply for funding
Accessing Resources under the SCCF
Accessing resources under the LDCF

4.3.2 Consultations with stakeholders

Expert: Srilata Kammila

Key Messages

1) Engaging key stakeholders from the concept stage of project development enables identification of project activities that respond to local needs and priorities and create ownership of the project.
2) It is important to return for feedback and vetting of proposed project approaches, as project development evolves.
3) Consultation processes themselves should be designed in accordance to local socio-economic realities and decision-making processes, particularly with regards to marginalized groups.
4) Comprehensive stakeholder engagement plans enable the identification of who are the stakeholders to engage, their roles and responsibilities, in eventual project implementation.

Stakeholder engagement is required under international declarations such as the Universal Declaration on Human Rights, the International Convention on Civil and Political Rights and the United Nations Declaration on the Rights of Indigenous peoples (UNDRIP). UNDP defines stakeholder analysis and stakeholder engagement as follows:

Stakeholder analysis is the process of identifying a project's key stakeholders and assessing their interests in the project and the ways in which these stakeholders may influence the project's outcomes. Stakeholder analysis provides the foundation for planning stakeholder engagement throughout the project cycle.

Stakeholder engagement is an overarching term that encompasses a range of activities and interactions with stakeholders throughout the project cycle. The intensity and scale of stakeholder engagement will vary with the type of project, its complexity, and its potential risks and impacts. It starts early in project planning and spans the entire life of the project.

In identifying the key steps towards any successful climate change adaptation initiative and paving the way for an effective implementation, engaging relevant stakeholders from an early stage is essential. Throughout the design of climate change adaptation projects, it is essential to ensure commitment and ownership by engaging relevant stakeholders, especially at the community level, from the initial project idea. Key stakeholders are initially mapped out and later consulted on an inter-sectoral level using a bottom-up approach, including local communities, focal points from key line Ministries (Ministry of Environment, National Planning, Finance and other relevant Ministries), other government parties, the private sector, civil society, non-governmental organization (NGO), academia and international development organizations.

Methods for engaging

Methods for engaging various stakeholders include focus group discussions, followed by discussions with gender-specific groups, youth groups, private sector groups, NGOs and civil society groups. The level of engagement depends on the project scale and outcome. Projects involving hard measures and

construction, land use changes, marginalized and indigenous peoples' groups or potential economic/physical displacement require a more detailed stakeholder engagement plan.

Consultation processes themselves should be designed in a way that is responsive to cultural, social and economic realities and decision-making patterns. Free, prior and informed consent (FPIC) of Indigenous Peoples, through consultation and cooperation through their own representative institutions, is required where project activities may affect the rights, lands, territories or natural resources of indigenous communities. Stakeholder engagement should include gender targeting and identify gender responsive project solutions.

In Zambia, UNDP has been supporting the development of a Green Climate Fund (GCF) proposal focused on climate-smart agriculture. The process has included socio-economic mapping and comprehensive consultations with farmers on issues ranging from seed varieties to value chains and market development. The process has enabled increased understanding not only of farmer practices and needs, but also of the needs of stakeholders involved across the value chain, from storage to processing and marketing. Project opportunities and risks are duly mapped, enabling the design of gender-responsive, farmer-centric climate-smart agriculture practices which are likely to be adopted by farmers, sustained in the long run and have more potential to be upscaled across value chains.

Key Definitions

Stakeholder analysis – the process of identifying a project's key stakeholders and assessing their interests in the project and the ways in which these stakeholders may influence the project's outcomes. Stakeholder analysis provides the foundation for planning stakeholder engagement throughout the project cycle.

Stakeholder engagement – an overarching term that encompasses a range of activities and interactions with stakeholders throughout the project cycle. The intensity and scale of stakeholder engagement will vary with the type of project, its complexity, and its potential risks and impacts. It starts early in project planning and spans the entire life of the project.

Abbreviations

Free, prior and informed consent (FPIC)
Green Climate Fund (GCF)
United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)
United Nations Development Programme (UNDP)

Resources for further learning

UNDP. Multi-Stakeholder Decision-Making. A Guidebook for Establishing a Multi-Stakeholder

Decision-Making Process to Support Green, Low-Emission and Climate-Resilient Development Strategies. Available at http://www.undp.org/content/dam/undp/library/Environment%20and%20Energy/Climate%20Strategies/Multi-stakeholder%20Decision-Making_Sept%202012.pdf

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4.3.3 Environmental safeguards during climate change adaptation projects

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Key Messages

1) A safeguard is a rule or institution that can be set by an investor, project implementer or country that seeks to avoid, minimize, or mitigate adverse environmental and social impacts.
2) The concept of safeguards emerged in parallel with the concept of sustainable development and the development of national and international frameworks to foster this type of development.
3) Safeguards typically cover many key social and environmental impact categories associated with development projects.
4) While climate change has been incorporated into most safeguards systems, most do not include measures to assess climate change risks and identify appropriate adaptation measures to reduce vulnerability.
5) Safeguards are necessary in the context of adaptation projects to avoid the potential for any associated negative impacts or maladaptation that may result from implementation.

The concept of safeguards emerged in parallel with the concept of sustainable development and the development of national and international frameworks to foster this type of development. Safeguard norms and best practices are often underpinned by international agreements on social and environmental issues.

The concept of safeguards in a development project context was traditionally pioneered by the multi-lateral development banks, particularly the World Bank. As the Banks incorporated environmental oversight mechanisms – starting as early as 1970 with the establishment of the World Bank's Office of the Environment and expanding during the late 80s and 90s – they moved from ex-post monitoring and remedial action to the preventative approach that characterizes safeguards. This process was driven by:

- Responding to and learning from environmental catastrophe – particularly high-profile cases such as the World Bank Polonoreste project in Brazil (which aimed to pave an existing 1,500 kilometer dirt road from the densely populated south central region into the sparsely populated Amazon with unintended effects on deforestation),
- Norm development within and between member countries, paralleled by the development of country-level safeguards systems of laws and enforcement mechanisms to prevent social and environmental harm.
- Evolving consensus over what constitutes sustainable development during the 70s and 80s culminating in the Bruntland Report in 1987 and the Rio Earth Summit in 1992.

The World Bank adopted the first safeguards measures in 1989 and later adopted 10 'do no harm' safeguards in 1997. Other development banks and development institutions have followed suit in adopting safeguards measures to ensure that projects implemented meet a 'do no harm' minimum standard. Empirical evidence suggests that traditional safeguards have been successful in steering

multi-lateral development banks toward investing in projects that involve less social and environmental risks.[20]

Safeguards areas and climate change

Safeguards cover a variety of substantive areas in environmental and social management. While there is no agreement at an international level regarding what should be covered under a safeguards system, most safeguards systems employed by organizations involved in supporting climate change adaptation projects, such as the World Bank or the Green Climate Fund, cover the following areas:

- Environmental and/or social impact assessments
- Biodiversity
- Pollution prevention
- Climate change mitigation
- Rights of indigenous people
- Involuntary resettlement
- Labor, health, safety
- Cultural heritage
- Transparency
- Consultation requirements
- Grievance procedure

More recently climate change vulnerability and adaptation have also been identified in some safeguards systems as an issue. However, in general, the design of specific measures to address climate vulnerability in a project context is not yet a requirement in the application of these systems.

One exception is the African Development Bank (AfDB) and its Climate Safeguards System (CSS). AfDB's CSS is a set of decision-making tools and guides that enable the Bank to screen projects in vulnerable sectors for climate change risks and identify appropriate adaptation measures to reduce vulnerability.

The system comprises four modules including specific modules on Climate Screening and Adaptation Review and Evaluation Procedures (AREP). The Climate Screening Module involves assessing projects and categorizing them according to a climate vulnerability scale. Based on the classification, the AREP module requires that project developers design appropriate adaptation measures to address the climate risks identified.

The CSS is a pilot tool for the AfDB and their investment operations with government borrowers in the agriculture, water, energy and transport sectors. It provides a useful example of how climate vulnerability and adaptation may be more formerly integrated into safeguards systems in the future.

Function & Application of Safeguards

Environmental and social safeguards are applied to perform functions highlighted below:

[20] Faubert et al, 2010; Nielson, D. L., & Tierney, M. J., 2005

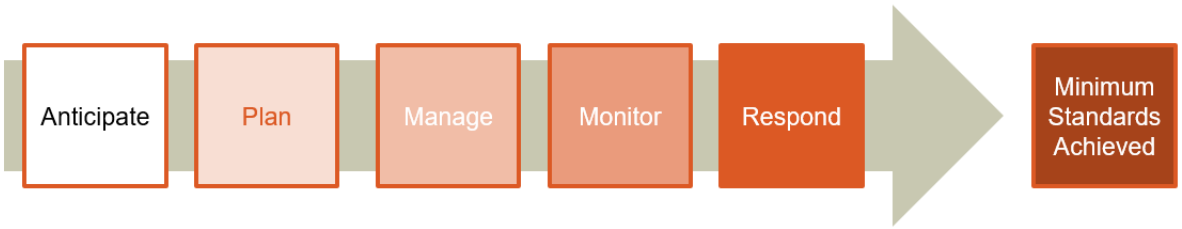

Figure 1 - Functions of a Safeguard System (Larsen & Bellestros, 2014)

- ***Anticipate***: Determining the potential positive and negative effects of the investment on the areas of concern. Most safeguards systems require screening of proposed projects to anticipate risks. Projects are categorized into risk categories depending on the type, location, sensitivity and scale of project and potential impact. The risk category determines safeguards required in project development and implementation.
- ***Plan***: Once the appropriate risk category is determined, environmental and social management plans are developed to avoid, minimize, or mitigate negative impacts. Plans could include changes to a project design or the inclusion of measures to address specific risks.
- ***Manage***: The environmental and social management plans developed are later implemented in parallel with the project.
- ***Monitor***: Implementation of the environmental and social management plans is monitored over the life of the project to assess the effectiveness of these plans in avoiding, minimizing, mitigating environmental and social risks.
- ***Respond***: The final function of safeguards is to respond to problems that may arise during project implementation including the application of grievance mechanisms to respond to complaints from project stakeholders.

Key issues with safeguards and climate change adaptation projects

Maladaptation: While adaptation projects aim to address negative climate change impacts, it does not mean that any potential other negative impacts are avoided. It is possible that adaptation projects could result in negative impacts or maladaptation which need to be addressed both in the design and implementation phases of adaptation projects.

Safeguard system failure: The presence of safeguards systems can fail to fully anticipate and address environmental and social risks associated with adaptation projects. There are an increasing number examples of projects that have resulted in negative impacts that were not adequately addressed by the applicable safeguards systems.[21]

Safeguard System Adequacy: It is reasonable to question whether safeguards systems adequately address the full range of risks associated with project implementation. As noted above, safeguards generally represent a 'do no harm' minimum standard for project implementation. Safeguards systems generally do not require positive action to enhance the sustainability aspects of projects implemented.

Investor/project implementer or country safeguard systems: A country approach to safeguards has the potential to be a single, unified approach through which a country can accommodate the

[21] See Damen, 2017 for some examples.

safeguards obligations of different initiatives, donors and investors. As governance systems improve around the world, a key future challenge associated with safeguards will be to determine under what circumstances and to what extent country safeguards systems can adequately substitute for traditional safeguards systems developed by investors/project implementers. Recently, multi-lateral development banks have incorporated greater flexibility into their operations to allow the application of country safeguards systems during project implementation. Some groups have questioned whether country safeguards adequately address the full range of negative impacts addressed by investor/project implementer safeguard systems and power asymmetries that disadvantage marginal groups in society.

Key definitions

Safeguard - a rule or institution that seeks to avoid, minimize, or mitigate adverse environmental and social impacts. These rules and institutions can be set by the investor/project implementer and/or the recipient country.

Rule - articulated and codified principles that set the substantive and procedural limits of a safeguard system by defining what should or should not occur. Examples of rules include laws, regulations, policies, procedures, and guidelines.

Institution - a governmental or non-governmental body such as a public agency, civil society, organization or private company.

Safeguard systems - the combined set of rules and institutions that ensure adequate social and environmental protection. Safeguard systems can apply at country and institutional levels.

Resources for further learning

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MOOC videos

Week 4 Part 1 - Climate Adaptation Options. Watch here: https://www.youtube.com/watch?v=3zVTYs1qhQ4&list=PLyBRsrYRs7YfwMYIxKbV41CPwMgeC1e-h&index=7

Week 4 Part 2 - Identifying and Prioritizing Adaptation Actions. Watch here: https://www.youtube.com/watch?v=id4B7U8hgTQ&index=8&list=PLyBRsrYRs7YfwMYIxKbV41CPwMgeC1e-h

Climate Action | Adaptation in livestock sector (Anne Mottet). Watch here: https://youtu.be/fbpwE92aWFc