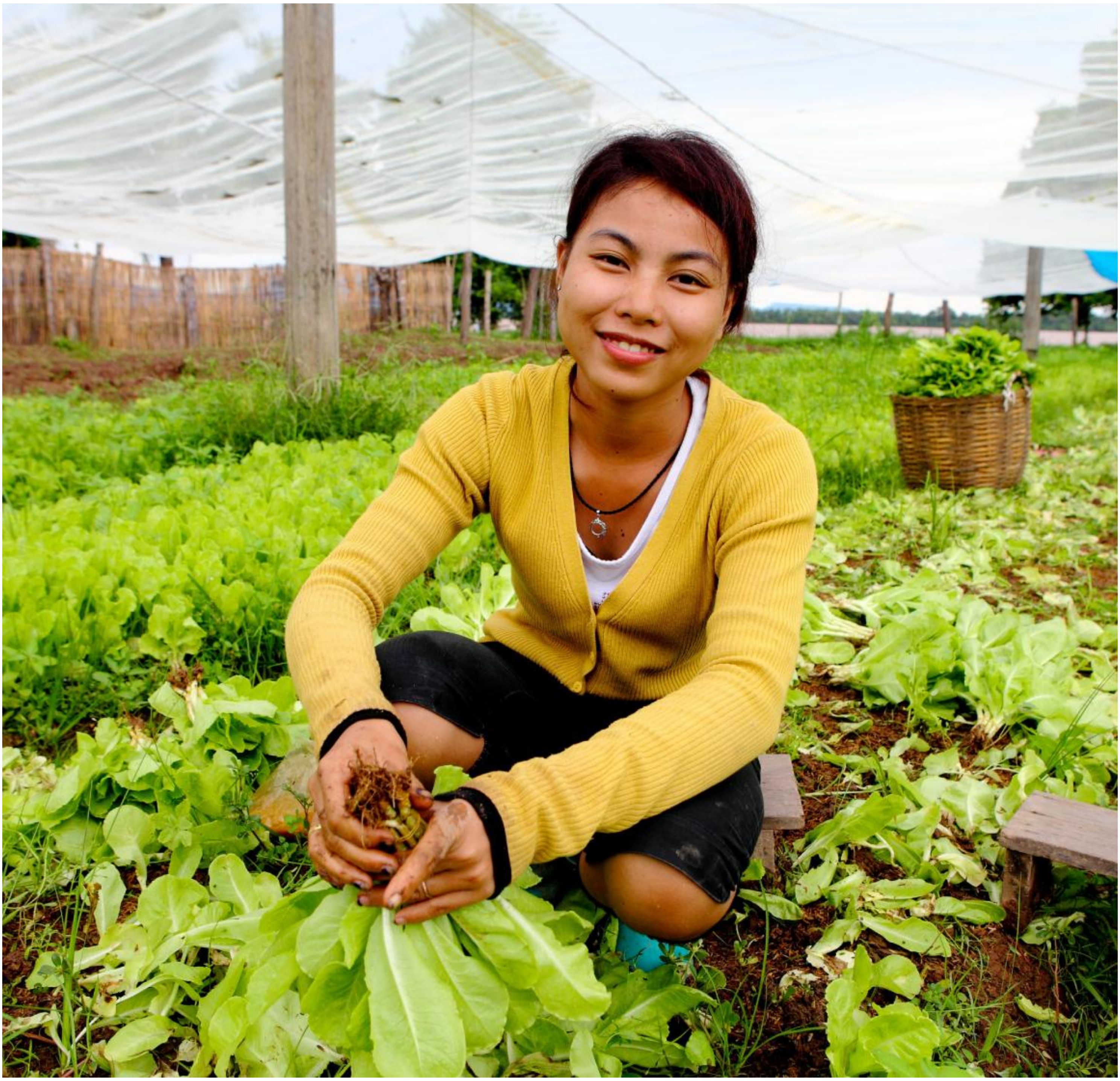
How to do

Climate change risk assessments in value chain projects

IFAD
Investing in rural people

Environment and climate change



How To Do Notes are prepared by the IFAD **Policy and Technical Advisory Division** and provide practical suggestions and guidelines for country programme managers, project design teams and implementing partners to help them design and implement programmes and projects.

They present technical and practical aspects of specific approaches, methodologies, models and project components that have been tested and can be recommended for implementation and scaling up. The notes include best practices and case studies that can be used as models in their particular thematic areas.

How To Do Notes provide tools for project design and implementation based on best practices collected at the field level. They guide teams on how to implement specific recommendations of IFAD's operational policies, standard project requirements and financing tools.

The **How To Do Notes** are "living" documents and will be updated periodically based on new experiences and your feedback.

Originator

Sonja Vermeulen
University of Copenhagen/CGIAR
E-mail: s.vermeulen@cgiar.org

Acknowledgements

The author acknowledges the technical support and contributions, particularly the case studies, received from members of the Environment and Climate Division (ECD) and wishes to thank the peer reviewers Karan Sehgal and Stephen Twomlow from ECD, Mylene Kherallah and Philipp Baumgartner from the Policy and Technical Advisory Division and Myriam Fernando and Doogie Black from GIZ. Paxina Chileshe (ECD) coordinated the internal processing and finalization of this note.

This publication was funded by IFAD's Adaptation for Smallholder Agriculture Programme (ASAP), the single largest climate change initiative for smallholder farmers worldwide.

Contact

Maria-Elena Mangiafico
Knowledge Management and Grants Officer
Policy and Technical Advisory Division
E-mail: ptakmmailbox@ifad.org

September 2015

Table of contents

List of acronyms ii

Introduction 1

Building climate risk analysis into the value chain project cycle 1

Guidance for project design 2

1. Selection of the value chain 2
2. Identification of key climate risks in the value chain 3
3. Choice of the most effective climate interventions 4
4. Targeting those most vulnerable to climate risk 8
5. Reaching scale with climate interventions 9

Case studies of recent IFAD project designs that include a climate change component 12

Djibouti: Facilitating the development of a more climate-resilient fisheries value chain and mitigating its climate risks 12
Lesotho: Managing climate risks at multiple stages of the value chain and across the landscape 12
Morocco: Improving value chain efficiency, sustainability and diversity as a multi-pronged adaptation strategy 13
Nicaragua: Transitioning to a new value chain in the face of climate change 14
Nigeria: Using land and infrastructure management to reduce climate risks across the value chain 15
Rwanda: Addressing critical climate risks in one part of the value chain (post-harvest) 16

References 18

List of acronyms

ASAP	Adaptation for Smallholder Agriculture Programme
CCAFS	Climate Change, Agriculture and Food Security (CGIAR research programme)
COSOP	country strategic opportunities programme
FAO	Food and Agriculture Organization
HTDN	How To Do Note
IIED	International Institute for Environment and Development
SECAP	Social, Environmental and Climate Assessment Procedures
WFP	World Food Programme

Introduction

Successful value chain interventions that achieve poverty reduction goals can in themselves be beneficial to climate change adaption, as they build farmers' assets and institutional linkages. But climate change can have major effects on the outcomes of IFAD-supported value chain interventions for smallholder beneficiaries; these outcomes may be negative or positive, and in many cases are uncertain. Therefore, it pays to do a simple upfront risk assessment to identify and manage risks and opportunities. The purpose of this How To Do Note (HTDN) is to provide guidance on the basics of climate risk analysis for value chain interventions.

Farmers have dealt with climate risks throughout the entire history of agriculture. Climate change is now increasing the intensity, frequency and variety of those risks – and posing urgent new questions for IFAD's strategy and programming. Well over 50 per cent of IFAD-supported projects have a value chain development component (see *How To Do Note: Designing commodity value chain development projects*, IFAD, 2014).

Climate-related risks can cause major losses of revenue for the sector (Box 1). The livelihoods of smallholders tend to be most at risk. However, climate change also has the potential to offer new opportunities for some agricultural value chains – for example by opening up higher altitude areas for farming. In general, these gains need to be balanced against concerns regarding biodiversity conservation and soil erosion on steep slopes, and may be offset by increasing extreme weather events.

Particular topics mentioned in this HTDN are covered in more depth in other IFAD toolkits, most importantly:

- *Designing commodity value chain development projects* (PTA, 2014) http://www.ifad.org/knotes/valuechain/index.htm
- *Climate-smart smallholder agriculture: What's different?* IFAD Occasional Paper 3 (ECD, 2012) http://www.ifad.org/pub/op/3.pdf
- *Impact of climate change on fisheries and aquaculture in the developing world and opportunities for adaptation* (IFAD) http://www.ifad.org/lrkm/pub/fisheries.pdf

Box 1: Economic impacts of past climate events and future climate change

Droughts: The Horn of Africa drought in 2011 cost the economy of Kenya up to 1 per cent of GDP through direct and indirect impacts. Maize prices for consumers were decoupled from global prices; local prices were 55 per cent higher than world market prices, but smallholders – as net food purchasers – were unable to capitalize on the higher sale prices (Demombynes and Kiringai, 2011).

Floods: In 2012, Pakistan's National Disaster Management Authority reported that flooding had destroyed nearly half a million hectares of cropland, and estimated damage to crops at PKR 250 billion (US$2.64 billion). The main value chains affected were for rice, sugar cane and cotton (Gishkori, 2012; IRIN, 2013).

Tropical storms: Typhoon Bopha caused economic losses of about PHP 32 billion (US$780 million), predominantly to agriculture, infrastructure and private property. The cost to agriculture in the Compostela Valley, home to many poor farmers, was estimated at US$98 million. (Matus, 2012; Lamere, 2013).

Long-term climate trends: By 2050, the areas suitable for high acidity coffee – high acidity being one of the most important attributes that distinguishes Veracruz coffee in Mexico – are expected to decrease by 32 per cent (Läderach et al., 2011).

Building climate risk analysis into the value chain project cycle

This HTDN is directed primarily at the design phase of IFAD value chain projects, though it does have some relevance for both pre-design and implementation phases. It does not lay down mandatory procedures, but rather aims to provide general guidance on the types of issues that project design teams might consider in order to manage climate risks in value chain projects. Specifically, this HTDN can inform the following procedures and protocols:

1. Social, Environmental, and Climate Assessment Procedures (SECAP): The SECAP process to identify, assess and address key risks and safeguards is fully incorporated into the quality enhancement process for IFAD-financed programmes/projects. This HTDN can inform the process of climate risk assessment in SECAP preparatory studies and SECAP project assessments, particularly climate risk analysis for value chain projects for which climate sensitivity is designated “moderate” or “high”.

2. Country strategic opportunities programmes (COSOPs) and project concept notes: This HTDN has more general relevance to COSOPs, particularly the issues to be considered in the strategic orientation of IFAD investments. It is more relevant to the conceptual stages of value chain projects that have a specific climate change component – for example with envisaged/identified climate financing such as a grant from the Adaptation for Smallholder Agriculture Programme (ASAP) modality. This HDTN can inform the project concept notes for any value chain projects included in the COSOPs.

Guidance for project design

Climate change risks and interventions in value chains can be complex and involve considerable uncertainties, whereby actions in one part of the chain may affect other parts for better or worse, and demand trade-offs between different stakeholders or different desired outcomes. In the face of complexity, simplicity is generally a sensible approach. This short HTDN cannot include detailed methodologies and tools, but instead provides a concise set of issues and solution areas to consider.

This HTDN suggests five stages in the design process at which key questions can be asked and key decisions taken:

- 1. Selection of the value chain
- 2. Identification of key climate risks in the value chain
- 3. Choice of the most effective climate interventions
- 4. Targeting those most vulnerable to climate risk
- 5. Reaching scale with climate interventions

The five stages may be sequential or undertaken in parallel, depending on the approach taken in any specific country context. The subsections below provide further detail on issues to consider at each of the five stages. These subsections refer to the six country examples (Djibouti, Lesotho, Morocco, Nicaragua, Nigeria and Rwanda) summarized at the end of this HTDN.

1. Selection of the value chain

Depending on whether the value chain is pre-agreed, there are greater or lesser options for building the climate analysis into the fundamentals of project design:

- **Demand-driven** – whereby a value chain approach is agreed and, perhaps, a project area is identified, but not the specific value chain products, providing an opportunity to select value chains on the basis of: (a) their viability under climate change (e.g. as in the Nicaragua case study); (b) their contribution to drivers of climate-related impacts, such as erosion that might cause problems for the value chain or for wider livelihoods (e.g. as in the Lesotho case study); and (c) their ability to increase the resilience of the poorest and most vulnerable populations associated with the target value chain (e.g. as in the Nigeria and Djibouti case studies).

- **Pre-selected** – whereby value chain products and areas are pre-agreed, providing no opportunity to include climate analysis in the selection of the project approach or the products. Hence, the focus should be on building resilience in the value chain and targeting poorer and more vulnerable people (e.g. as in the Rwanda case study), and on monitoring the performance of the value chain during the implementation and supervision stages of the project.

Some agricultural value chains may no longer be economically viable over timespans of as little as 20 years, as climate change pushes beyond the thresholds of crop, pasture or fisheries suitability in the areas of production. For example, central Chihuahua in Mexico is expected to see a 50 per cent decline in suitability for bean production by the 2020s (Beebe et al., 2011), while by 2050, 80 per cent of Nicaragua's coffee growing areas will no longer be able to support the crop (Läderach et al., 2011). Breeding – for example in beans – is likely to encounter a high proportion of negative climate trends. However, for coffee, the long lag times to get new varieties established, coupled with the rapid rate of emergence of new fungal and other diseases, means that shifting growing areas to cooler altitudes and latitudes is probably the only viable option. It may not make sense to make long-term investments that lead smallholder farmers down "mal-adaptive" pathways – i.e. producing crop, livestock or fisheries products that may not be economically viable in the future and may generate higher opportunity costs with each passing year. On the other hand, some production areas may pass climatic thresholds that allow smallholders to enter into new markets, and engage with new profitable and sustainable value chains. This is particularly true for locations that are currently temperature-limited; for instance, suitability for beanproduction is expected to increase in Uttar Pradesh, India. Tropical high altitude zones may also increase in suitability for agricultural production, perhaps for perennials such as tree fruits or coffee, but there may be trade-offs, with soil erosion on steep slopes and reduced biodiversity conservation.

Apart from the product focus of the value chain, the other major decision is the type of value chain intervention that the project should invest in – for example market access, value chain governance, technology transfer, capacity-building or service provision. Some of these elements have progressively been included in IFAD-supported projects, in addition to post-production processing and related services. Some IFAD-supported projects are also incorporating improvements in governance and inclusiveness along the entire value chain, as well as focusing on closer collaboration with various value chain actors. One of the most effective types of interventions in IFAD-supported value chain projects is institution-building at the level of production and market access, which focuses on helping smallholders to organize themselves and overcome the barriers of entry to higher-earning markets (see *Lessons learned: Commodity value chain development projects* [PTA, 2014]). These types of projects focus more on local institution-building than on technical development of specific stages of the value chain. Thus, even though they are called value chain projects, they may not offer many opportunities for increasing resilience to climate change along the various value chain segments (i.e. pre-production, production, processing, storage, transport, retail and consumption).

In some cases, a particular value chain approach or set of value chain interventions may escalate the underlying drivers of climate risk – for example by including processes that increase greenhouse gas emissions and contribute in the longer term to high-carbon development pathways. One example is cassava value chains. On the one hand, cassava is expected to be far more resilient in the face of climate change than other staple crops. On the other hand, preferred processing technologies for local-level value addition are associated with unsustainable fuel use (including of fuelwood, leading to forest degradation) and both water and air pollution (FAO and IFAD, 2001). Project design should identify and mitigate such risks, as well as promote "greener" processing technologies.

2. Identification of key climate risks in the value chain

All stages of the value chain have associated climate risks. The likelihood and potential impact of most of these risks is difficult to quantify in advance. At the local level, climate change futures are relatively uncertain. For example, there may be insufficient information to analyse the exact risks of flooding at proposed sites for processing hubs. In general, much less research has been done on climate risks in the non-production stages of value chains than on risks to agriculture; as yet, there is little guidance to share with project design teams on appraisal or management of climate risks in transport (apart from aspects dealing with the physical infrastructure) and storage of agricultural produce, or on how to deal with the impacts of climate variability on consumer demand or producer prices.

Given that it is not possible to include all interventions in a single project, prioritization of a top set of climate risks is critical. In many project designs, the identification and prioritization of climate risks to tackle will be a matter of educated expert judgements rather than formal quantitative analyses. For instance, even though climate risks occur throughout the value chain, for most agricultural value chains the highest risks facing small-scale producers are likely to be concentrated in the production stage of the chain. Use of formal scientific climate risk analyses, like those already commissioned in current IFAD project designs that include a specific climate component, can be supplemented by stakeholder perspectives and priorities. The Lesotho project design, for example, elicited herders' views on changing climatic and environmental risks to inform priorities and entry points for action.

3. Choice of the most effective climate interventions

Every project needs a strong, evidence-based climate narrative that justifies the final selection of interventions in terms of the major climate risks facing vulnerable households associated with the value chain. For example, the Rwanda project identified increases in (already high) post-harvest losses as the key climate problem, and established a set of interventions that will increase farmers' resilience and adaptive capacity, while also increasing near-term food security and – hopefully – mitigation of greenhouse gas emissions.

As mentioned above, climate risks that affect small producers are likely to be focused in agricultural production, but some basic analysis of climate risks in the pre-production and post-production phases of the chain can improve the quality of interventions. For example, the Djibouti project addresses input supplies (i.e. freshwater) and the post-harvest stages of the value chain (i.e. cooling and storage), but puts the most emphasis on fisheries production (i.e. participatory management of mangroves and adapted fishing practices). In some cases, it is possible to combine risk reduction with seizing of new opportunities. For example, in Nigeria, where "rainfall aggressiveness" is identified as a key climate risk for land degradation and infrastructure, the project will improve climate resilience (i.e. better design of bunds, roads, etc.) and also take advantage of water harvesting via these improvements.

In general, effective climate interventions in value chain projects will include the following three elements:

1. **Diversification**: Inclusion of a wider set of options to increase farmers' livelihood, farming and environmental management portfolios as a risk management strategy.
2. **Climate-proofing**: Specific interventions to make key stages of the value chain more climate-resilient in ways that bring livelihood and resilience benefits to farmers.
3. **Supply chain efficiencies**: Measures such as waste reduction or inventory management that increase efficiency, deliver higher profitability (and hence higher adaptive capacity in a general sense) to farmers and small businesses in the value chain, and generate mitigation co-benefits.

A checklist of how value chain interventions might produce climate-resilient outcomes at the pre-production (input supplies), production and post-production stages of the value chain is provided in the table below.

Checklist of how value chain interventions might produce climate-resilient outcomes

Value chain interventions/ outcomes	Climate risk issues	Climate risk management opportunities
Input supplies		
Seeds	High-yield varieties may perform poorly under higher temperatures, humidity, salinity; certain hybrid seed varieties degrade soils over the long term	Provide access to specific climate-adapted varieties where available (e.g. heat-tolerant, submergence-tolerant); maintain diversity through seed banks, including wild relatives (CGIAR, 2013); test different seeds under different conditions
Fertilizers	Generally positive in low-input systems, but may increase inter-annual variability in yields; trade-offs with emissions	Integrate fertilizer advice and supply with wider soil management (FAO, 2013, Module 4); precision farming
Animal feed and breeds	Feed quality helps emissions reductions, but larger better-fed animals may be more exposed to climate-related water stress	Evaluate heat tolerance, housing and feed requirements of proposed livestock (FAO, 2013, Module 8)
Pest management	Possible increases in pests and diseases for crops (e.g. maize stem borer, tomato flies, cassava mealy bug) and livestock (e.g. cattle ticks)	Promote integrated pest management (e.g. push-pull methods [Minja 2006]); develop monitoring, knowledge and applied research systems for pests and diseases of crops, livestock and fisheries
Information services	Advance climate information enables better decisions about the timing of planting, input application and harvesting, and the choice of varieties, labour inputs and planting or grazing locations	Enable provision of seasonal and near-term forecasts in formats usable and accessible by farmers (Tall, 2013); strengthen early warning systems; invest in country-level capacity in scaled down climate impact modelling (WCRP, 2013; CCAFS, 2013) and scenario planning
Financial services	Lack of upfront capital may be a major drawback for farmers to adopt climate-resilient practices	Investigate financial channels to reduce risks associated with innovation (e.g. microfinance, small grants programmes, index-based weather insurance (WFP and IFAD, 2011)
Tools and equipment	Possible damage of tools and equipment (e.g. water tanks, irrigation canals, pumps, generators, vehicles, seed storage) from extreme weather events	Substitute low-cost high-efficiency systems wherever possible (e.g. rainwater harvesting plus surface water irrigation); provide access to early warning systems; introduce protective features to the siting and storage of seeds, tools, vehicles, fuels and energy infrastructure
Agricultural production		
Soil management	Rising temperatures, greater soil moisture evaporation and more destructive interplay between dry spells and intensive rainfall events increase soil erosion and reduce soil organic content	Introduce measures to counter soil erosion (e.g. terracing, contour bunds, drainage, agroforestry, perennial crops); increase soil carbon and improve the management of soil organic matter; rehabilitate degraded lands (FAO, 2013, Module 4)
Water management	Greater crop evapotranspiration; loss of soil water; changes in amount and timing of rainfall; more variable river run-off; reduced groundwater recharge; changes in sea level; salinity intrusions into soil and groundwater	Adopt water conservation and efficiency measures such as water harvesting, efficient irrigation infrastructure, check dams, flood management and drainage; support riparian habitat restoration; undertake hydrological and salinity monitoring; introduce water allocation systems (FAO, 2013, Module 3)

Value chain interventions/ outcomes	Climate risk issues	Climate risk management opportunities
On-farm energy	Mechanization using fossil fuels causes emissions increases; use of fuelwood can cause deforestation and erosion	Undertake trade-offs analysis (FAO, 2011; FAO, 2013, Module 5); introduce renewable energy sources (e.g. solar energy for heating, cooling, drying and pumping, small wind turbines, biogas digesters)
Diversification	Monoculture crops are more prone to catastrophic losses from climate extremes than diversified systems	Investigate potential for sustainable intensification and diversified cropping systems through crop rotations (e.g. staple/horticulture), intercropping, agroforestry, mixed crop/livestock systems (FAO, 2013, Module 6)
Livestock	Declining pasture productivity; increasing livestock mortality from heat stress; loss of productive pasture from erosion; damage to livestock infrastructure; declining fodder quality	Introduce mixed crop/livestock farming systems; support pasture restoration; diversify livestock breeds; improve rangeland management; make livestock infrastructure more climate resilient; increase production efficiency (FAO, 2013, Module 8)
Fisheries and aquaculture	Changing salinity conditions in natural reservoirs; shifting fish stocks due to higher water temperatures; migratory shifts of biodiversity	Improve production efficiency and feed management (FAO, 2013, Module 10); diversify aquaculture; introduce mixed crop/aquaculture or aquaculture/livestock systems; introduce mixed fish/crop/forest systems
Production infrastructure	Value chain-related production facilities in certain locations (including fields, greenhouses, livestock facilities) face greater exposure to floods, wildfires, high wind speeds	Include physical risk management structures at farm-level (e.g. windbreaks, flood control dykes, firebreaks); retrofit or relocate sensitive infrastructure; create buffer zones (e.g. wetlands, greenbelts, flood recession schemes)
Landscape-level management	Positive value chain outcomes (e.g. higher incomes) may incentivize greater land clearance and unsustainable water use, affecting local microclimate and hydrology and compounding climate hazards	Undertake participatory mapping and land-use planning; remote sensing-based landscape monitoring; exploit all available incentives (financial, regulatory, etc.) for sustainable environmental management in the project area (FAO, 2013, Module 9)
Skills base of farmers and local institutions	Local knowledge and capacity is central to managing production under conditions of rapid change	Invest in local capacity for planning, monitoring, decision-making and financial management; transfer control to local institutions; provide training on climate issues and support to farmer-based research and knowledge systems; include smallholders in policy dialogue and scenario-building exercises
Post-production: storage, processing, transport and retail		
Post-harvest management	Rising losses in harvest volume; declining safety, market quality and nutritional value due to increasing temperatures, humidity, pests and diseases	Incentivize waste reduction measures and value addition for by-products (FAO, 2013, Module 11); provide renewable energy sources to cover changing requirements for cooling, drying, milling and threshing
Siting of processing facilities	Extreme climate events (such as floods, heatwaves, storms) may damage processing facilities; shifting climatic conditions may render some sites redundant or increase transport costs	Use hazard exposure and crop suitability maps to inform siting of processing facilities; retrofit processing facilities with protective features; insure processing facilities against extreme climate events

Value chain interventions/ outcomes	Climate risk issues	Climate risk management opportunities
Energy in processing	High dependence on local bioenergy (wood, charcoal, dung, crop residues) has trade-offs with better soil management; rising temperatures require more energy for cooling	Provide renewable energy sources (such as solar photovoltaic panels for cooling/drying/milling/heating, wind, biogas); equip processing facilities with energy-saving appliances (e.g. solar lighting, solar charging, efficient cook stoves); adopt pollution control measures
Water in processing	Declining and more irregular water supplies; growing competition with other domestic or industrial users	Re-site facilities; increase water storage and distribution capacity (water harvesting, communal ponds, groundwater recharge); introduce demand-side water efficiency measures;support conflict resolution for different water users (e.g. water user groups)
Packaging materials andmethods	Rising temperatures and humidity may increase or decrease post-harvest losses and waste, as well as impact food safety	Design suitable packaging materials in parallel with waste and storage management strategies
Processing infrastructure	Buildings and roads exposed to higher peak rainfall, winds and heat stress	Introduce protective features and reinforcements into the design of critical infrastructure to handle higher maximum water run-off and higher temperatures; improve ventilation in buildings; harvest surplus water and energy from rooftops and appliances; use early warning systems
Transport hubs and routes	Routes may become seasonally or permanently impassable (or open up); extreme events will disrupt logistics	Re-site hubs; develop contingency plans for road, rail, water and air transport; co-design value addition, storage and transport components to avoid high-risk transport routes and seasons; upgrade docks, jetties, roads, railways
Refrigeration and cold chains	Temperature rises increase requirements for and costs of refrigeration; rising energy requirements increase greenhouse gas emissions	Conduct cost-benefit analyses of dependency on refrigerated cold chains; introduce renewable energy sources for cooling and ventilation; optimize storage and transport management
“Just-in-time” logistics	Extreme climate events (floods, storms, heatwaves) can make it impossible to comply with “just-in-time” requirements	Develop contingency plans for climate shocks and extreme events; create contingency storage opportunities; link into regional markets to avoid over-dependence on high-value export markets
Demand from retail and consumers	Shifts in quantity requirements and seasonality with climatic trends; disruptions in demand with climate variability; hence higher price fluctuations	Assess market risks and opportunities before value chain implementation, including likely climatic impacts on high-value markets; strengthen and diversify storage to buffer price fluctuations; diversify into “off-season” crops
Commodity labelling and certification	Higher awareness of consumers about climate change creates new markets for sustainably produced and processed commodities with a low carbon footprint	Explore opportunities of sustainable procurement, green labelling and certification (IIED, 2013)

4. Targeting those most vulnerable to climate risk

For various reasons it may be difficult for the project design to target climate interventions to the people most in need. Beneficiaries targeted for the value chain project may not be the population groups most vulnerable to climate change; value chain projects often involve a trade-off between establishing an economically sustainable value chain and reaching people who are either very poor or particularly susceptible to climate change. Sometimes the value chain is specified purely in terms of the commodity and general production area, while the farmers who will be targeted for inclusion in the value chain will be identified only later at the implementation phase. Those farmers may be highly dispersed and their localities may not match the localities where the climate risks are the biggest problem.

©IFAD/Pablo Corral Vega
Peru - Management of Natural Resources in the Southern Highlands Project (MARENASS)

Also, climate change has the potential to accentuate existing gender norms and inequalities. For example, decreasing access to water may put a particular burden on women, or decreasing agricultural potential may increase male labour migration, thereby changing roles in the household. Women farmers have less access to the technologies that modern value chain and climate interventions commonly rely on, such as mobile phones for agro-climatic and market advisory services (Chaudhury et al., 2012). Ensuring gender equality in projects – by designing interventions that reach and benefit both genders – means greater resilience for communities as a whole (*The Gender Advantage: Women on the front line of climate change* [IFAD, 2014]). The importance of gender-sensitive value chain designs is thoroughly articulated in the *How To Do Note: Designing commodity value chain development projects* (PTA, 2014).

There is no simple blueprint for incorporating a component of climate-based targeting in the project design. Possible approaches include:

1. **Use climate vulnerability analysis to drive targeting of the value chain project interventions:** Undertake a climate vulnerability analysis that can prioritize areas or groups of beneficiaries in terms o*f their climate risk profile – for example the "Hazards Wheel" for coastal areas (Appelquist, 2013) – and then target both value chain and climate interventions to these places or groups (e.g. as in the Djibouti case study).

2. **Make provisions for more detailed targeting at the implementation phase:** During the implementation phase, select a subset of the value chain target area (or beneficiaries) for the climate investment to focus on, based on climate risk and preferably using a participatory method (e.g. as in the Nigeria case study); this approach may be especially useful where value chain beneficiaries are not known at the design phase.

3. **Assume a good match between value chain targeting and climate targeting:** Integrate climate interventions into the value chain in general, rather than target them towards specific beneficiary groups within the value chain who are defined in terms of their climate risk profile (e.g. as in the Rwanda and Lesotho case studies); this approach has most applicability for value chain projects that are mostly targeted to the poorest social groups or to those with the most climate-sensitive livelihoods.

5. Reaching scale with climate interventions

Institutions are arguably a greater priority for climate change adaptation than new practices or technologies employed in the value chain. Projects concerned with institutional strengthening provide some lessons to orient value chain approaches in IFAD, whereas the lessons learned from the implementation of various IFAD-supported value chain projects provide some strategic recommendations that enable future interventions to build on evident opportunities (see *Lessons learned: Commodity value chain development projects* [PTA, 2014]). These lessons also reveal opportunities for climate risk management based on the typology of value chain projects, as summarized in table 1. The table gives examples of opportunities to scale up climate risk management through innovative IFAD value chain project designs. Major opportunities include: (a) maximizing the use of existing value chain links for information flow, especially climate information; and (b) diversifying value chains, so that they are not just about output markets for farmers, but also include markets for inputs that promote climate resilience, such as drip-feed irrigation or drought-tolerant seeds. FAO (2013) provides guidance on strengthening institutional support for climate resilience among smallholders, including at the local level (FAO, 2013, Module 12) and the national level (FAO, 2013, Module 13), as well as in terms of capacity-building at all levels (FAO, 2013, Module 17).

With thoughtful design, it is possible to ensure that value chain interventions help to enhance and sustain a healthy natural resource base over the long term and scale up climate change resilience benefits for the most vulnerable participants. The case studies in this HTDN show a range of approaches. The Djibouti and Morocco projects put particular emphasis on information flows and technology transfer. The Nicaragua project is designed to scale up by strengthening farmers' cooperatives across the country, while the project in Nigeria uses a capacity-building approach based on demonstration plots to reach scale. Lastly, the Rwanda project engages with policy – specifically, the national building codes.

The final – and perhaps most important – message of this HTDN is that resilience to climate change is an outcome of adaptive capacity. Climate change is often seen as a biophysical issue that can be solved by technical interventions. Thus, initiatives to address climate risks can encourage investment in technologies and infrastructure at the expense of institution-building and capacity enhancement. However, it is intelligent investment in local capacity that will generate widespread and lasting benefits from climate risk management. Hence, the emphasis on local institutions in IFAD value chain projects is appropriate, as it provides a strong foundation for building the institutional components of adaptive capacity.

Table 1. Opportunities for reaching scale with climate risk management in value chain project designs

Intervention within a value chain initiative	Lessons learned	Climate risk management opportunities that can be coupled with this intervention
Inclusion of smallholders	Regular monitoring is essential for detecting structural shifts in the power structure of the chain at an early stage to ensure sustainable income benefits	Build links among key agencies responsible for delivery of climate information and technology transfer; include farmers in decision mechanisms
Capacity-building	Investing in and supporting small-scale producers and small-scale processors, who have the potential to become competitive, ensures they remain engaged in the chain	Facilitate farmer-led research on climate adaptation options; build low-cost knowledge networks to accelerate learning as climates shift
Promoting on- and off-farm micro- entrepreneurial development	Support to micro-entrepreneurial development has often proved to be a key part of effective value chain development	Promote efficiencies, such as reductions in post-harvest losses, that benefit climate adaptation and mitigation as well as incomes
Coordinated delivery of services, including by the private sector	Market goods and services in ways that truly add value for farmers	Include climate-relevant services, such as climate information services, “climate-smart” extension and weather insurance in the package
Integration	A value chain approach should help to identify strategies and mechanisms for sharing risks and costs more equitably throughout the chain (i.e. equitable risk management business models) and to seek innovative risk management instruments	Encourage on- and off-farm value addition as an adaptation option (e.g. livelihood diversification, access to by-products for animal feed or soil improvement)
Strengthening sector and producers’ associations	Associations can be well placed to provide information of great use to their members and can have the necessary influence to organize attractive contracts	Facilitate collective purchase agreements, as well as collective marketing, e.g. for drip-feed irrigation, new livestock varieties or biogas digesters
Addressing the possible trade-offs between product specialization and diversification	Find an appropriate balance between food and cash crop production; take a market-oriented approach, identify the right partners and develop solutions that provide real financial benefits	Promote diversified farming systems, land use and livelihoods; appraise likely performance of crops in future climate scenarios before selecting new species and varieties to promote
Inputs supply	Services and inputs are a critical part of the value chain upgrading strategy and overcome challenges of lack of assets and skills	Use value chain channels to increase access to climate-robust technologies (e.g. breeds and seeds, water conservation and energy saving appliances), coupled with extension information
Adapting a value chain approach in constrained circumstances	Investments that enhance social, physical or natural resource assets may have food security and risk reduction benefits	Include climate-relevant information and technologies in extension packages
Market linkages	The market is the basic driver of all value chains. Production decisions must be based on an analysis of market realities	Exploit options for using value chain relationships to share climate and early warning information

Intervention within a value chain initiative	Lessons learned	Climate risk management opportunities that can be coupled with this intervention
Trust-building	Building trust and commitment to engaging in long-term relationships, rather than seeking opportunistic, short-term, price-related gains, ensures the sustainability of a value chain	Maximize access to good climate information and climate-savvy extension services; enable South-South knowledge transfer (e.g. study visits to/from other farmers' groups)
Information flows	Promoting a transparent and symmetric flow of information, and facilitating and brokering co-beneficial contractual arrangements is key for ensuring the sustainability of a value chain	Develop public-private models for delivery of climate information, e.g. voice-message agro-advisory services at low cost to farmers
Multiple intervention points	Projects can have multiple points of entry to improve efficiency and capacity at different nodes. Taking a "win-win" perspective on the distribution of financial benefits along the value chain can often be a cost-effective way of increasing farmers' incomes	Enable climate finance to be delivered as microfinance; couple subsidies/matching grants with conditionalities for environmental sustainability Invest in value chains to promote and deliver environmentally-sound technologies (not just product sales chains)
Public-private partnerships	Creating incentives for the private sector to provide the necessary goods and services enables small-scale producers to expand their participation in the value chain	Explore the scope for partnerships addressing technology transfer for adaptation, information services, financial services
Infrastructure development	Basic infrastructure (feeder roads, electricity, large irrigation systems, etc.) is a typical public good that is critical for the viability of the whole value chain	Increase resilience of any major infrastructure investment (e.g. run-off harvesting from roads, elevated storage structures, reinforced buildings)
Policy/enabling measures	Policy engagement – in collaboration with other development partners and country stakeholders – may help establish a more favourable environment for sustainable value chain growth	Engage with cross-cutting national policy vehicles, such as National Adaptation Plans (NAPs), but also work with sector-specific procedures and regulation, such as building codes and land-use planning procedures

Legend

Present in the design of >90 per cent of IFAD value chain projects (Raswant et al., 2011).

50-90 per cent of IFAD projects

<50 per cent of IFAD projects

Case studies of recent IFAD project designs that include a climate change component

The following examples illustrate some of the approaches that have been taken in recently designed projects to ensure the integration of climate risk analysis in agricultural value chains and their anticipated results. Each approach included the following activities: selection of a viable value chain, sometimes informed by climate risk analysis; identification of climate risks affecting the value chain; selection of appropriate adaptation measures; targeting to the most vulnerable; and identification of pathways to reach scale beyond the immediate project investment. The examples given here are recent, but build on the cumulative experience that IFAD has gained in project design for environmental risk management over many years.

Djibouti: Facilitating the development of a more climate-resilient fisheries value chain and mitigating its climate risks

1. **Selection of the value chain:** Given the decreasing sustainability of land-based (i.e. crop and livestock) livelihoods in Djibouti, this value chain project seeks to develop fisheries-based livelihoods. Relative vulnerability to climate change was a strong driver in the selection of the marine-based value chain as opposed to land-based ones. The "demand-driven" value chain approach involved the selection of commodities partially as a response to climate change (among other linked stress factors).

2. **Identification of key climate risks in the value chain:** In the fisheries value chain, major climate risks are: increasing severity of coastal storms and flash floods; infiltration of saltwater, which affects infrastructure, settlements and health; coastal erosion; and ocean acidification, which degrades fish stocks and corals.

3. **Choice of the most effective climate interventions:** Climate finance will be allocated to all value chain interventions in order to mainstream climate change adaptation, given the broad-based nature of the identified climate risks. The project will rehabilitate coastal mangroves and coral reefs, and implement a long-term adaptive monitoring system, coupled with participatory management of coastal resources. Further investment will go towards protection of coastal infrastructure, improvement of post-harvest cooling and storage facilities, and improvement of access to freshwater for fisheries value chains.

4. **Targeting those most vulnerable to climate risk:** Interventions are being targeted directly to the communities most vulnerable to climate impacts, using a "Hazards Wheel" – a methodology for multi-hazard assessment and management – for coastal zones. Women constitute an important target group as they do 80 per cent of fish marketing. Since Djibouti is a small country, the project aims to reach 30 per cent of the total population.

5. **Reaching scale with climate interventions**: In addition to the project's broad reach relative to Djibouti's population, it will scale up via a strong focus on knowledge management. The project will draw on regional lessons generated within the UN system (e.g. by UNEP, UNDP, WFP and FAO) on key climate change innovations – such as the Banc d'Arguin co-management system in Mauritania and the small pelagic fishing system in Yemen – and transmit this knowledge to its beneficiaries through community-based communications. The project will be implemented over six years, commencing in 2014.

Lesotho: Managing climate risks at multiple stages of the value chain and across the landscape

1. Selection of the value chain: The selected value chains are wool and mohair produced in the mountain and foothill regions of Lesotho. The goal is to boost producers' resilience to the adverse effects of climate change, while enabling them to generate higher incomes and improve sustainability of their livelihoods.

Vulnerabillity of wool and mohair value chains to climate change was a not a driver in the selection of value chains, which were pre-selected by the government on the basis of current economic potential.

2. Identification of key climate risks in the value chain: Rangelands have become degraded for climatic and other reasons. The project design took into account herders' views, as well as scientific analysis. Herders noted multiple problems, including: less predictable seasons, less snow in winter and hence less melt water for pasture and crops; late frosts that affect crops and fruit trees; prolonged drought periods followed by heavy rains, which kill livestock and erode soil. These climatic problems are compounded by socio-political trends, such as increasing conflicts over resource access and management roles. At later stages in the value chains, the main constraints are predicted to be the lack of roads and electricity (e.g. for shearing) rather than climate risks.

3. Choice of the most effective climate interventions: The project has three components that address the interrelated constraints across the landscape and the value chains. The intention is for herders to have a smaller number of animals that produce a much higher proportion of top grade wool. The measures include delivery of: participatory range management, backed by information systems; improved animal nutrition, health and breeding to counter climate-based mortality and quality risks; improved capacity to manage herds and post-production processes in order to deliver higher quality wool and mohair to national and international markets.

4. Targeting those most vulnerable to climate risk: The value chain approach of this project makes provisions to improve inclusion and reduce risks for people involved at multiple stages of the value chain – for example women and youth who work in the shearing sheds, as well as their representative organizations. The project also addresses the interdependence of cropping and herding – for example with regard to the competing use of crop residue as compost versus as winter feed for livestock.

5. Reaching scale with climate interventions: As Lesotho is a small country, the challenges of reaching scale are smaller than elsewhere. The project gives substantial attention to engagement with all relevant government departments, private-sector bodies and civil society organizations (e.g. Mohair Trust, Womens' Association) to secure buy-in and long-term sustainability. Each organization has specific responsibilities in relation to the delivery of project outcomes. Project implementation is expected to last seven years, commencing in 2015.

Morocco: Improving value chain efficiency, sustainability and diversity as a multi-pronged adaptation strategy

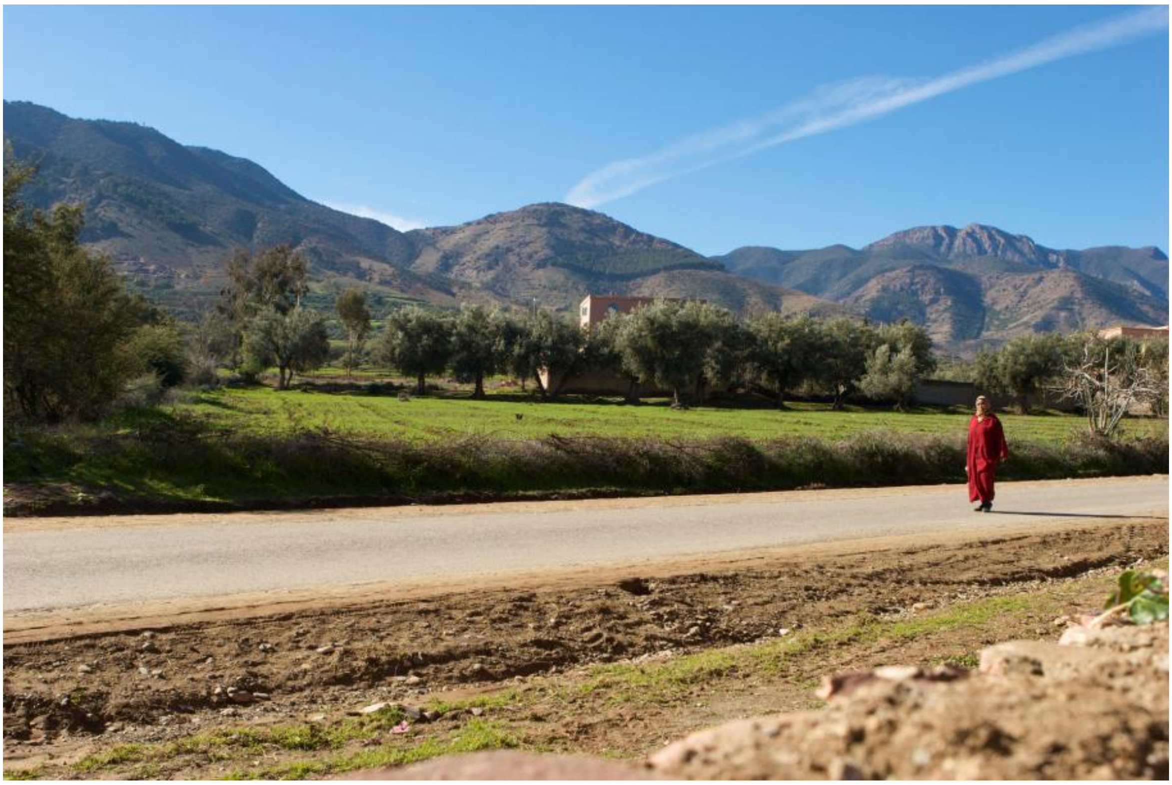
1. Selection of the value chain: The selected value chains are for honey, walnut, almond, carob, apple, plum and cherry. Relative vulnerabillity to climate change was not a driver in the selection of these value chains, which were pre-selected on the basis of current farmer preferences and economic potential.

2. Identification of key climate risks in the value chain: Across Morocco as a whole, average temperatures are projected to rise between 2 and 5 degrees Celsius by the end of the century, while rainfall is projected to drop by 30 per cent, with severe impacts on both agriculture and industry. Climate risks relevant to farmers in the project areas are land degradation and desertification, meteorological adversities (hail, frost, drought) and associated decline in agricultural productivity.

3. Choice of the most effective climate interventions: The interventions in Morocco focus on building overall resilience to climate risks, rather than countering specific risks with specific responses. Common strategies for all seven value chains include agricultural components (e.g. new cultivars, grafting, irrigation, erosion management) and post-production components (e.g. processing technologies, tailored information services, marketing, certification). The project also involves innovative information management: it uses mapping tools to identify vulnerabilities across the landscape and then tracks these over time, enabling project participants to learn iteratively about what works in terms of vulnerability reduction and resilience-building from the environmental perspective.

4. Targeting those most vulnerable to climate risk: Direct project beneficiaries are 144,000 farmers living in the central uplands of Morocco, where climate change impacts are expected to be among the most severe. Farmers in this area are considered to have low adaptive capacity due to lack of access to markets, transport and processing technologies; their post-harvest losses currently amount to 40-45 per cent of production.

5. Reaching scale with climate interventions: The project's scaling up strategy involves sharing of learning among cooperatives, farmers' unions and government stakeholders from multiple project zones. The use of simple cost-effective user-friendly tools, such as a mapping tool that has Google Maps as its platform, is a deliberate strategy to enable local project participants to monitor their own progress and to learn more easily from each other's experiences. Project implementation is expected to last six years.



©IFAD/Susan Beccio
Morocco - Rural Development Project in the Mountain Zones of Al Haouz Province

Nicaragua: Transitioning to a new value chain in the face of climate change

1. Selection of the value chain: The project aims to facilitate productive investments and provide technical assistance to improve productivity and increase adaptation capacities of poor smallholder producers of cocoa and coffee. Relevant public institutions and policies oriented at providing improved climate-sensitive inputs for production and weather information systems will also be strengthened. Vulnerabillity to climate change was a strong driver in the selection of these particular value chains. Due to the growing climate-related risk of coffee rust, the intervention is supporting both management of the disease and transition to cocoa production in lower altitude growing areas.

2. Identification of key climate risks in the value chain: Past extreme events, such as hurricanes, have disproportionately affected Nicaragua's agricultural sector. Cocoa and coffee are complementary crops, with the former providing natural shade for the latter. Climatic effects are expected to result in an increasing overlap of the cocoa and coffee production areas. The expected increase in temperature could reduce the current area of coffee production and, along with humidity, increase the outbreaks of coffee rust (*roya*). Evaluations indicate that infestation and incidence of coffee rust on coffee plantations resulted in production losses of more than 40 per cent since 2012, due to high temperatures associated with a concentrated rain season in 2011.

3. Choice of the most effective climate interventions: Climate finance will fund investment plans designed and managed by producers' organizations with demonstrated capacity and ability to link with markets. Private goods for collective use, such as collection and storage facilities, will be partly financed through matching grants. At the farm level, varieties adapted to higher temperatures and altitude, as well as pests and decreased rainfall, will be financed in addition to water storage infrastructure, reforestation, etc. A well-articulated production chain will facilitate the transmission of market signals and generate the necessary trust environment for investment and innovation.

4. Targeting those most vulnerable to the climate risk: The target population is 40,000 families, including smallholder farmers with less than 20 *manzanas* (approximately 14 hectares) who produce coffee or cocoa, and families belonging to indigenous and Afro-descendant communities that have the potential to participate in the selected productive chains.Geographic location and vulnerability to climate change, poverty, gender and belonging to vulnerable and indigenous populations were among the criteria applied by the targeting strategy.

5. Reaching scale with climate interventions: Investment in public goods and strenthening of public institutions and policies are the main scaling-up strategies. Investments in roads, storage facilities, etc., will facilitate market access for small-scale producers through the existing capacity of consolidated producers' cooperatives (in management, marketing, infrastructures, etc.). The project will be implemented over a six-year period, starting from 2014.

Nigeria: Using land and infrastructure management to reduce climate risks across the value chain

1. Selection of the value chain: The value chain project – a scaling-out of a successful phase 1 – will establish "market ready" community development associations to enhance market access. Farmer and market priorities will determine the choice of products that the value chain project will include (i.e. demand-driven). To increase productivity and generate surplus for sale to markets, the project will make investments in extension services, farmer seed systems and environmental management. Vulnerability to climate change was not a specified factor in value chain selection, but emerging climatic vulnerabilities may be a determinant of local choices.

2. Identification of key climate risks in the value chain: Climate projections for Nigeria anticipate an increase in heavy rainfall events and flooding, including in more arid areas. Uncertain rainfall will continue to be a major (and likely growing) risk factor for rainfed agriculture. Increasing temperatures and "rainfall aggressiveness" will exacerbate current problems with soil degradation.

3. Choice of the most effective climate interventions: Climate finance will be used to integrate climate risk management into value chains, with a particular emphasis on management of soil, land and infrastructure. Actual interventions will be subject to local planning exercises, but are likely to include measures to limit soil erosion (bunds, hedges, stone works, etc.), improving roads to harvest excess run-off and prevent flood-damage, water harvesting and conservation, and rangeland restoration. There will also be investments in improving access to diversified, renewable energy sources. These interventions address both production and post-production segments of the value chain (i.e. transport, processing, etc.).

4. Targeting those most vulnerable to climate risk: The value chain project targets 350,000 of the "moderately poor" and "productive core poor" people, who make up 90 per cent of households in the programme areas, covering seven northern states of Nigeria. The project includes a series of community-based planning exercises in order to ensure that beneficiaries of climate finance (i.e. people and locations) are indeed those most vulnerable to climate risks affecting the chosen value chain.

5. Reaching scale with climate interventions: Soil and water conservation packages will be demonstrated on seven sites linked to over 10,000 hectares, and coupled with enhanced communications and capacity-building, will provide the mechanism for the climate intervention to achieve scale. The project will be implemented over seven years.

Rwanda - Post-Harvest and Agribusiness Support Project (PASP) and Kirehe Community-based Watershed Management Project (KWAMP)

Rwanda: Addressing critical climate risks in one part of the value chain (post-harvest)

1. Selection of the value chain: This project seeks to improve returns to smallholder farmers from cassava, Irish potato, beans, maize and dairy produce. Farmers' associations will be the main implementation mechanism, linked to physical hubs that will be centres for processing, marketing and capacity-building. Vulnerabillity of value chains to climate change was not a driver in their selection; the value chains were pre-selected by the government on the basis of current economic potential.

2. Identification of key climate risks in the value chain: Climate extremes, in the form of droughts and extended dry spells, interspersed with heavy rainfall events, impact on agricultural productivity, post-harvest processes and rural infrastructure. Post-harvest losses are singled out as the most critical risk, amounting to as much as 30 per cent of production for all major crops (cassava, Irish potato, beans and maize); these losses are strongly influenced by the extremes of temperature and humidity associated with erratic rainfall. As for most countries in the world, reliable future climate projections are not yet available at the subnational level, but there is anecdotal evidence that the rainy season is becoming more unreliable, suggesting that the current challenges will intensify in the future.

3. Choice of the most effective climate interventions: Climate finance will be used to mitigate increasing climate risks in the post-harvest segment of the value chain – for example to increase the climate resilience of storage infrastructure at the hubs, and introduce solar energy and biogas to dry produce. Funds will also be allocated to facilitate the use of weather and climate information by the hubs and national policymakers in planning post-harvest management. In addition, there will be investment in promotion of fast-maturing crop varieties that are better matched to the shorter rainy season.

4. Targeting those most vulnerable to climate risk: The value chain project is targeted to people classified as very poor (21 per cent of the population, including those who are landless but able to work), poor (51 per cent, including those who have land but no agricultural surplus) or poor with resources (17 per cent, including those who possess land and some agricultural surplus), together comprising 89 per cent of Rwanda's population. It excludes the extreme poor (4 per cent, including those dependent on begging). The project focuses on the major production areas in the country for each of the selected commodities. Around 50 per cent of the beneficiaries will be women. The assumption made here is that targeting the poorest is the same as targeting those most vulnerable to climate risk.

5. Reaching scale with climate interventions: The project includes policy work to improve building codes, so that increasing climate resilience of infrastructure in value chains becomes standard practice at the national level. The national-level climate information work is another mechanism to achieve scale. The project will be implemented over five years, commencing in 2014.

References

Appelquist, 2003. Generic Framework for Meso-scale Assessment of Climate Change Hazards in Coastal Environments. *Journal of Coastal Conservation* 17 (1) : 59-74,

Beebe, S., J. Ramírez, A. Jarvis, I.M. Rao, G. Mosquera, J.M. Bueno, and M.W. Blair. 2011. Genetic improvement of common beans and the challenges of climate change. In *Crop adaptation to climate change*, eds. S.S. Yadav, R. Redden, J.L. Hatfield, H. Lotze-Campen and A. Hall. Oxford: Wiley-Blackwell.

Chaudhury, M., P. Kristjanson, F. Kyagazze, J.B. Naab, and S. Neelormi. 2012. Participatory gender-sensitive approaches for addressing key climate change-related research issues: Evidence from Bangladesh, Ghana and Uganda. Working Paper 19. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark.

Consultative Group for International Agricultural Research (CGIAR) 2013.Crop genebank knowledge base . Available at: http://cropgenebank.sgrp.cgiar.org

2013. Spatial Downscaling Methods: CCAFS-Climate Data Portal. Available at: https://ccafs.cgiar.org/spatial-downscaling-methods#.Um5plBZIp_c

Demombynes, G., and J. Kiringai. 2011. The drought and food crisis in the horn of Africa: Impacts and proposed policy responses for Kenya. World Bank Economic Premise Paper 71. World Bank, Washington, D.C.

Food and Agriculture Organization of the United Nations (FAO). 2013. *Climate-smart agriculture sourcebook.* Rome: FAO. Available at: http://www.fao.org/docrep/018/i3325e/i3325e.pdf

_____. 2011. Energy-smart food for people and climate. Issue paper Rome: FAO. Available at: http://www.fao.org/docrep/014/i2454e/i2454e00.pdf

Food and Agriculture Organization of the United Nations (FAO) and International Fund for Agricultural Development (IFAD). 2001. *Strategic environmental assessment: An assessment of the impact of cassava production and processing on the environment and biodiversity*. Rome: FAO and IFAD.

Gishkori, Z. 2012. Floods have left 369 dead, nearly 3m affected. The Express Tribune, 19 September 2012.

Integrated Regional Information Networks (IRIN). 2013. Slow retreat of monsoon floods in Pakistan hinders recovery. IRIN online, 23 April 2013.

International Fund for Agricultural Development (IFAD). 2014. *How To Do Note: Designing commodity value chain development projects*. Rome: IFAD.

_____._2014 *Impact of climate change on fisheries and aquaculture in the developing world and opportunities for adaptation.* Fisheries Thematic Paper: Tool for project design. Rome: IFAD. Available at: http://www.ifad.org/lrkm/pub/fisheries.pdf

_____. 2014. *Lessons learned: Commodity value chain development projects.* Rome: IFAD.

_____. 2014. *The Gender Advantage: Women on the front line of climate change*. Rome: IFAD.

_____. 2011. Climate-smart smallholder agriculture: What's different? Occasional Paper 3. Rome: IFAD.

International Institute for Environment and Development (IIED). 2013. Certification and private voluntary standards. http://shapingsustainablemarkets.iied.org/category/information/certification-and-private-voluntary-standards

Läderach, P., M. Lundy, A. Jarvis, J. Ramirez, E.P. Portilla, K. Schepp, and A. Eitzinger. 2011. Predicted impact of climate change on coffee supply chains: The economic, social and political elements of climate change. Climate Change Management Series, ed. W. Leal Filho. Berlin, Germany: Springer. pp. 703-723.

Lamere, C. 2013. Super Typhoon Bopha shows why developing countries are most vulnerable to climate change. New Security Beat, 15 January 2013.

Matus, M. 2012. Super Typhoon Bopha rips through the Philippines leaving hundreds dead and thousands displaced. Inhabit, 12 May 2012.

Raswant, V., R. Khanna, and N. Nicodeme. 2011. Pro-poor rural value-chain development: Thematic study. Policy and Technical Advisory Division, International Fund for Agricultural Development (IFAD), Rome.

Tall, A. 2013 What do you mean by climate services. WMO Bulletin. Vol. 62. Geneva

Tirado, M.C., R. Clarke, L.A. Jaykus, A. McQuatters-Gollop, and J.M. Franke. 2010. Climate change and food safety: A review. *Food Research International* 43: 1745-1765.

United Nations Industrial Development Organization (UNIDO). 2011. Pro-poor value chain development: 25 guiding questions for designing and implementing agroindustry projects. Vienna: UNIDO.

United Nations Office for Disaster Risk Reduction (UNISDR). 2013. From shared risk to shared value: The business case for disaster risk reduction. In *2013 Global Assessment Report on Disaster Risk Reduction.* Geneva, Switzerland: UNISDR.

Vermeulen, S.J., B.M. Campbell, and J.S.I. Ingram. 2012. Climate change and food systems. *Annual Review of Environment and Resources* 37: 195-222.

Vermeulen, S.J., J. Woodhill, F.J. Proctor, and R. Delnoye. 2008. Chain-wide learning for inclusive agrifood market development: A guide to multi-stakeholder processes for linking small-scale producers with modern markets. UK: International Institute for Environment and Development (IIED)/Wageningen, The Netherlands: Wageningen University.

World Climate Research Programme (WCRP). 2013. Coordinated Regional Climate Downscaling Experiment (CORDEX). Available at: http://www.cordex.org/

World Food Programme (WFP) and International Fund for Agricultural Development (IFAD). 2011. Weather Index-based Insurance in Agricultural Development A Technical Guide. Rome: WFP & IFAD

IFAD
International Fund for Agricultural Development
Via Paolo di Dono, 44 - 00142 Rome, Italy
Tel: +39 06 54591 - Fax: +39 06 5043463
E-mail: ifad@ifad.org
www.ifad.org
www.ruralpovertyportal.org
ifad-un.blogspot.com
www.facebook.com/ifad
instagram.com/ifadnews
www.twitter.com/ifadnews
www.youtube.com/user/ifadTV