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Costing Adaptation through Local Institutions

Synthesis Report

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SOCIAL DEVELOPMENT DEPARTMENT | SOCIAL DIMENSIONS OF CLIMATE CHANGE

Costing Adaptation through Local Institutions: Synthesis Report

1818 H St., NW
Washington, DC 20433 U.S.A.
Telephone: 202-473-1000
Internet: www.worldbank.org/sdcc
E-mail: feedback@worldbank.org

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ACRONYMS AND ABBREVIATIONS

ABDCC	Area-based Development and Climate Change Adaptation project
CALI	Costing Adaptation through Local Institutions
CMDT	Compagnie Malienne du Développement des Textiles
DPPC	Disaster Prevention & Preparedness Centre
EACC	Economics of Adaptation to Climate Change project.
IDP	Irrigation & drainage project
IFPRI	International Food Policy Research Institute
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
PCDP	Pastoral Community Development Program
PPCR	Pilot Program for Climate Resilience: Yemen
PSNP	Productive Safety Net Program
RALP	Rainfed Agriculture and Livestock project
SLM	Sustainable Land Management Program
WFP	World Food Program

Note: Unless otherwise noted, all dollars are U.S. dollars, all tons are metric tons.

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EXECUTIVE SUMMARY

The Costing Adaptation through Local Institutions (CALI) study aims to highlight how adaptation by households to climate change and climate variability is shaped by institutions,[1] and how governments, through local institutions, can support adaptation that addresses the needs of the poorest and most vulnerable households. The main objective of the study is to provide recommendations regarding adaptation options for households in rural regions and facilitate the necessary institutional support. The approach rests on three critical premises:

- Adaptation to climate change is unavoidable for rural areas in developing countries. However, mitigation policies can alter some of the effects from changes in climate variability that are already taking place.
- Development of future adaptation interventions and plans must take into account past experience and the costs of adaptation to climate variability and change.
- Participatory approaches are necessary to identify adaptation costs and planning options at the local level that are relevant to the lives and livelihoods of vulnerable and marginalized social groups.

1 For the purposes of this study, institutions are defined as structured, formal (or informal) organizations that are the means through which central governments and donors channel resources for local development (Agrawal and Perrin 2009).

The methodology of the study draws on past adaptation experiences, particularly for vulnerable groups in different fragile ecological contexts. It uses participatory approaches to assess the costs of different adaptation strategies used by such groups. In this synthesis report, the analytical results from the three country case studies are presented and compared. Among the adopted strategies in the three cases, some were similar, while others were country-specific. The report describes some of the institutional, socioeconomic, and political differences that contributed to the individual or communal adaptation strategies among the countries. These country comparisons make it possible to present a number of policy recommendations that provide a better insight on how future interventions might be more effectively targeted.

VULNERABILITY

The three countries in the CALI study – Ethiopia, Mali, and Yemen – are semi-arid countries that are regularly threatened by drought. High exposure, however, does not necessarily cause high levels of vulnerability. Low sensitivity to climate variability and high coping capacity can alter the threats from high exposure. On the other hand, households in areas with low exposure can still be in a vulnerable situation if their coping capacity is low. These villages often have limited fallback options during periods of adverse climate conditions. Households receiving remittances from migrating household members, owning more assets, or having more diverse income sources often have better options to respond to income shocks. Furthermore, inter-household differences between the Ethiopian and Yemeni villages are much larger than between the Malian

BOX 1. DEFINITIONS APPLIED IN THE REPORT

Climate-related hazards are hazards related to changes in climate variability. These refer to (a) drought risk, such as changes in the pattern and timing of rainfall; (b) flood risk, such as changes in the intensity of rainfall; (c) average temperature changes; and (d) heat waves, including extreme temperature peaks.

In addition to climate-related hazards associated with variability, this study also considered other hazards such as soil erosion, agricultural or livestock pests or diseases, human diseases, increasing population pressure, credit or market problems, rising food prices, and hazards related to access to land or other resources.

Strategies include the strategies households currently adopt. They can be classified as follows:

- **Agricultural techniques** to adapt to changes in rainfall regime, including changing seed selection, adapting planting dates, adapting fertilizer application, adapting feed techniques, improving food storage facilities, or changing pastoral systems.
- **Water management techniques** to adapt to changes in rainfall regime, including use of water harvesting techniques, rehabilitation of terraces, improved irrigation techniques, or improved watering sites in pastoral areas.
- **Diversification techniques** in order to diversify income sources, including temporary or permanent migration, using alternative sources for fuel wood, practicing home-garden agriculture, changing the consumption pattern, or drawing down livestock.
- **Communal pooling techniques,** including reforestation, rangeland preservation, communal food storage facilities, or local water management rules.

Costing of adaptation strategies refers to (a) the monetary costs households have to make to purchase required inputs, next to the usual expenses they make for their daily practices; (b) the time and effort households invest in implementing a strategy and the time and effort households have to invest in training in order to obtain the necessary skills for implementing and managing the investment; and (c) the effort to create commitment among community members to jointly initiate and sustain communal investments.

Vulnerability refers to the susceptibility to external stresses. It is composed of exposure to risk, sensitivity to that risk, and adaptive capacity (IPCC 2007).

- **Exposure** refers to the external stress to people or communities, which is caused by factors such as changes in rainfall and temperature patterns due to climate change.
- **Sensitivity** refers to the extent to which people or communities are susceptible to exposure to the stress. For example, farmers using irrigation are less susceptible to variations in rainfall than farmers applying rainfed farming.
- **Adaptive or coping capacity** refers to the ability to cope with the external stress. Factors affecting coping capacity include level of education and access to resources.

In general, high levels of exposure, high levels of sensitivity, and low levels of coping capacity result in high levels of vulnerability. High exposure, however, does not necessarily result in high vulnerability if, for example, coping capacity is high.

Vulnerability profiles refer to the profile of characteristics of households showing their vulnerability. Household characteristics include the level of exposure, sensitivity, and adaptive capacity, providing a measure of household vulnerability. Describing the multiple facets of vulnerability shows the extent to which households are capable of successfully dealing with external stresses. The more characteristics are positive, the lower the level of vulnerability. If only a few characteristics are positive, or if only one characteristic is positive—for example, coping capacity is good, but sensitivity and exposure scores are bad—households will still be vulnerable.

(*continued next page*)

BOX 1. (*Continued*)

Institutions are defined as structured, formal, or informal organizations that are the means through which central governments and donors channel resources for local development (Agrawal and Perrin 2009). The focus is on groups of people, organized either formally or informally, who can be approached as a group. Occasionally, the study uses a broader definition of institutions (North 1990; Williamson 2000) that include the norms and rules that govern the behavior of households and organizations. In particular, it is important to include the role of kinship (clan, ethnical group), factors affecting commitment among community members, and factors affecting market functionality.

villages. As a result, for Ethiopia and Yemen aid programs should be tailor-made, focusing on particular groups, whereas in Mali interventions can be more general.

ADAPTATION STRATEGIES

The number of strategies adopted by Ethiopian, Malian, and Yemeni households differs considerably. In Ethiopia, on average 8.5 strategies are adopted per household, compared to 3.5 in Mali and 1.7 in Yemen. In Yemen 40 percent of the households do not adopt any strategy at all. In all three countries, female-dominated households adopt fewer strategies and receive less assistance from institutions. In Figure 1, the selection of strategies used by the households is presented by categorizing these by individual vs. communal strategies and sensitivity reducing vs. coping capacity increasing strategies. The chart only lists strategies that are adopted by at least 10 percent of the respondents.

There are some country-specific patterns. In Mali, the strategies are mostly individual strategies. In Ethiopia and Yemen, there is a mix between individual and communal strategies, even though in Yemen very few innovations are used in the effort to reduce vulnerability. Moreover, the strategies used to reduce sensitivity are quite similar between the three countries, even though there are differences in the percentage of households adopting the strategies.

INSTITUTIONAL SUPPORT

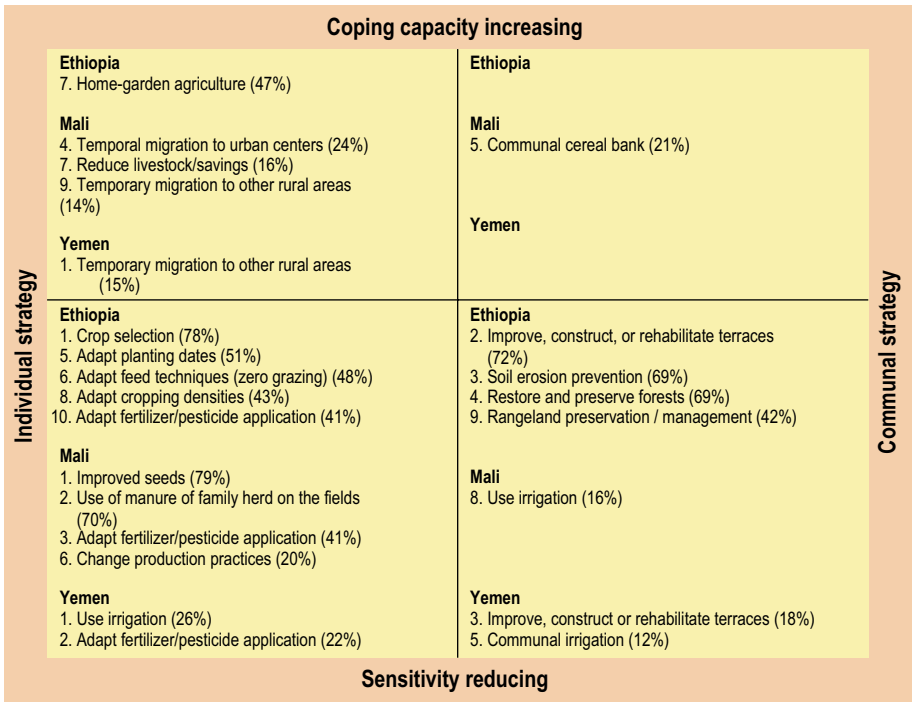
Figure 2 illustrates the percentage of households that actually received support from different institutions in the implementation of adaptation strategies. The darker the color, the more households received assistance. As was already observed, the level of assistance differs greatly between the countries. Figure 2 clearly shows that in Ethiopia almost all households receive some sort of institutional support, while in Yemen this is almost negligible.

The type of institutions most prevalent in each of the countries is partly explained by government policy. Extension services in Ethiopia have a strong and extensive network of agencies covering a large part of the country. In Mali, extension services have a much weaker network. They cover fewer regions, seem to have fewer resources, and reach fewer farmers. In Yemen, households in the study villages hardly have contacts with institutions. Households in Yemen seem to be much more on their own, supported by informal community institutions such as clans and neighbors, but without much help from any formal institution.

For many strategies, cooperation between households and institutions is essential for the successful implementation of the strategy. Even for low-cost and individual strategies like seed selection or the adaptation of planting dates, implementation is expected to be more successful if back-up is provided by institutions in terms of training and knowledge transfer. Furthermore, for the communal strategies that require a sense of ownership on the part of all stakeholders, training and knowledge transfer from institutions helps meet these requirements and thus improves the likelihood of success in implementing these strategies.

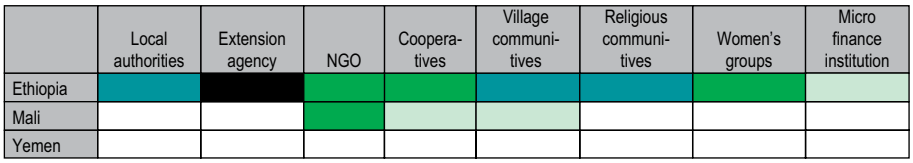
Different institutions play different roles that depend on the level at which they aim their intervention.

FIGURE 1. PERCENTAGE OF HOUSEHOLDS IN THE COUNTRY SAMPLE ADOPTING CERTAIN ADAPTATION STRATEGIES



Notes: categorized by individual vs. communal strategies and sensitivity reducing vs. coping capacity increasing strategies. Only strategies adopted by at least 10 percent of the households are shown.

FIGURE 2. PERCENTAGE OF HOUSEHOLDS IN THE SAMPLE RECEIVING ASSISTANCE FROM DIFFERENT INSTITUTIONS



Legend						
	0%–10%	10%–30%	30%–50%	50%–70%	70%–90%	90%–100%

Institutions should not operate independently, but function as part of a mutually supportive network. Where the central government has a role in realizing a better functioning social and market environment in order to provide the enabling environment required for a well-functioning society, other institutions aim their interventions at the household level. Households need support in terms of training, financial support, techniques, and inputs that give them the skills and means to improve their situation themselves in a sustainable way.

COSTING OF STRATEGIES

Based on the surveys and interviews, the different categories of cost incurred by the stakeholders for implementing adaptation strategies were assessed.[2] Costs for implementation of strategies are more than just monetary expenses. When choosing a strategy, households may lack the knowledge, the skills, the labor, or the money to implement a strategy. This report presents an overview of the different "costs" that are needed to select, and successfully implement, the identified strategies. As it was sometimes very difficult to determine the exact costs in terms of money, skills, or time required to implement a specific strategy, we indicated whether low, medium, or high requirements were needed for monetary inputs, labor inputs, training time, and commitment . This last factor is a measure of the willingness of households to implement a communal strategy; that is, to bear the transaction costs of collective action.

In general, many households choose low-cost strategies for which they can expect immediate gains. The more expensive individual adaptation strategies, such as the use of water harvesting techniques, which are constrained by knowledge and credit constraints, are less often selected. Many of these strategies have positive expected net benefits, but face financing constraints and require higher skills. Furthermore, some strategies are constrained by imperfect market conditions, lack of infrastructure, or they may coincide with periods of peak labor demand. Assistance from formal and informal institutions may lessen some of these constraints. These projects often have high costs that cannot be raised by the participating households themselves and can only be recovered in the longer run. Next to that, these more demanding strategies require higher levels of commitment among households and institutions in order to reach sustainable program results. Reaching commitment, however, is not an easy task and requires a different approach than simply lessening the monetary, training, or technical constraints households often face.

2 It turned out to be difficult to obtain reliable monetary information on the costs incurred for adopting the adaptation strategies. For that reason, the adaptation costs have been assessed qualitatively.

KEY FINDINGS AND RECOMMENDATIOINS

Based on the above, the study makes the following key findings and recommendations:

Household Characteristics Often are More Important Determinants of Vulnerability than Exposure

In the three study countries, drought is the major climate-related hazard faced by the households. The majority of the households see droughts to be a larger threat than flood hazards or extreme rainfall and extreme temperatures. However, households that are less exposed to hazards can still be in a vulnerable situation if they are sensitive to climate variability or have a low coping capacity. The study recommends focusing development programs both on measures to reduce sensitivity and enhance coping capacity. In particular, investments in education should remain an important priority in all three countries, as education levels are very important in the determination of vulnerability. Interventions to decrease household vulnerability should carefully consider household differences and the major constraints these households face.

Target Interventions to Particular Groups and to their Characteristics

- When designing interventions, even within villages, promote a diverse set of strategies that considers the differences in characteristics among households.
- Involving women in decisions—especially regarding home-garden agriculture, petty trade, charcoal sales, and handicrafts—improves adoption levels of these strategies.
- More marginalized groups need special attention, as they are more difficult to reach and have lower adoption levels of the prevailing, low-cost adaptation strategies—such as changes in seed selection, planting dates, and the use of fertilizers and pesticides.
- Wealthier households can invest in more expensive strategies. As they are generally more capable of obtaining assistance, development programs should

particularly focus on the less well-off groups, especially those with low education levels, few income diversification opportunities, and living in remote areas.

Strong Institutions are Necessary for Successful Implementation of New Strategies

To an important degree, the successful implementation of different adaptation strategies depends on the institutional assistance provided during the adaptation process.

- In the three study countries, similar low-cost, sensitivity reducing agricultural strategies are adopted, like seed/crop selection, changes in the cropping calendar, and changed application of farming inputs. As these strategies have proven their value in all three countries, those households that have not yet adopted these practices should be urged to do so.
- Low-cost strategies focusing on improving coping capacities—like home-garden agriculture, charcoal sales, and handicrafts meant for diversifying income—are selected by many fewer households, especially in Ethiopia and Yemen. The adoption of strategies to improve coping capacity is often constrained by malfunctioning input and output markets, financing problems, overlapping labor calendars, and lack of knowledge. Some of these constraints can be overcome with adequate institutional assistance. These constraints furthermore require national actions on improving market situations.
- Due to low education levels and a poorly functioning market environment, only a few households are capable of developing innovative strategies that are suitable for adaptation to more severe climate variability without institutional assistance.
- All three countries lack an enabling environment for effective institutions and markets, which is an essential requirement for the success of new initiatives. Initiating new income generating options or developing more innovative adaptation strategies may be hampered by poorly functioning markets (including credit markets), the low quality of infrastructure (road, electricity, and telecommunications), and low purchasing power. Some of the basic preconditions needed for a well-functioning market environment are currently missing, which can only be realized through public investments. Aside from monetary investments, these public investments should include investments in training and commitment to give households the skills to take their lives into their own hands.

From this, it follows that the objectives of sustainable development will not be reached if interventions focus only on one constraint. Integrated development programs, like those currently executed in Ethiopia and initiated in Yemen, seem to be promising ways of giving households the opportunity to improve their livelihoods.

Better Institutional Coverage Leads to More and More Diverse Strategies

The number of households adopting strategies and the number of strategies adopted per household varies significantly among the countries, with 8.5 strategies adopted per household for Ethiopia compared to 3.5 for Mali and only 1.7 for Yemen. There are several country-specific differences that may explain this. Ethiopia, which benefits more from institutional support than Mali or Yemen, has opted more for community-based strategies, whereas in Mali and Yemen the role of formal institutions is much smaller and households rely more on autonomous and "proven" strategies that can be implemented with the resources that are readily available from the household itself. Moreover, strategies in Ethiopia are more innovative than those adopted in Mali and Yemen. Investments in coordinated networks of extension agencies and NGOs pay off in the adoption of more strategies and more encompassing adaptation strategies, leading to lower levels of vulnerability.

Long-term Presence of Institutions Facilitates the Implementation of Communal Strategies

The household surveys show that a more diverse set of strategies can be adopted if institutions can assist with overcoming some of the managerial, knowledge, and technical requirements the households face when adopting more demanding communal strategies, such as communal irrigation schemes and larger scale reforestation, soil erosion prevention, and terrace rehabilitation

programs. From this, it follows that the adoption of communal strategies requires the long-term presence of institutions to help facilitate the inter-household cooperation and level of commitment required for employing communal strategies. The role of institutions goes beyond the tasks to alleviate technical and monetary constraints. Such constraints can be overcome through short-term interventions. Realizing commitment and sustainable, long-term management of project outcomes, however, requires different types of interventions. These include strengthening (informal) institutional structures and revitalizing norms and rules that strengthen social capital, create commitment, and provide the households and the community the skills to jointly take their development into their own hands. Such interventions, however, are more difficult to monitor and plan.

Coordination and Cooperation between Institutions Makes it Easier to Reach More Households

Promoting adaptation strategies requires institutional cooperation on three levels. First, formal, governmental, or nongovernmental institutions need to have sufficient coverage to include most villages and set the policy and regulatory framework. Second, (informal) community institutions play an important role in reaching households by facilitating training in good practices, maintaining social networks of norms and rules of behavior, and creating commitment among households. Third, national coordination of interventions can avoid duplication of work, as well as make it possible to learn from each other and raise the more macro-level constraints to the relevant authorities. It depends on the country context whether it is best to realize this through formal, government-related extension agencies (as in Ethiopia) or through nongovernmental channels (as in Mali).

Strengthening Institutions and Assisting Households Requires More than Monetary Costs

The study revealed that monetary constraints are only one of the reasons why promising strategies are not adopted. Often monetary constraints are not the major constraint. Stakeholders may lack the technical or managerial skills, market environments may be counterproductive (due, for example, to the absence of credit markets or malfunctioning transport sectors), laws and rules (such as land ownership laws) may curb communal initiatives, and weak social structures may prevent implementation of community strategies (due, for example, to free-rider behavior). Initiating single-issue interventions that focus on one constraint only—for example, financing the construction of irrigation schemes—may lessen short-term needs. To initiate projects that are sustainable over a longer term, however, more is needed.

Despite its Importance, Many Institutions do Not Provide Training

Training and awareness raising are important ways to provide households with the skills to make their own choices and to create a sense of ownership of the adopted strategies. Without a sense of ownership, households will remain dependent on institutional assistance, and realizing investments that remain productive in the long run will be more difficult. In Ethiopia, institutional assistance includes training, and some institutions—such as cooperatives—also provide inputs, or cash in the case of micro-credit institutions. In Mali, assistance is predominantly in the form of inputs. Both in Yemen and in Mali, institutions provide hardly any training. This difference between Ethiopia on the one hand, and Mali and Yemen on the other, is explained by the Ethiopian network of extension agencies, which also invests in communal strategies—such as irrigation schemes or community reforestation—and public infrastructure such as roads and electricity.

The results of this study confirm the view that it is important to place greater emphasis on integrated approaches to development. A focus on only a single issue will most likely not have the envisaged results and will in the end lead to higher costs. Several constraints—ranging from constraints on a household, village, regional, or national level—prevent households from successfully improving their livelihoods and preparing adequately for changing climate variability. Moreover, due to differences among households, there is no one overall strategy for solving the different problems. The study showed that in order to develop, jointly with households, appropriate and cost-effective strategies, it is important to maintain an institutional presence and institutional coordination and cooperation.

1. INTRODUCTION

GENERAL CONTEXT

CALI: Costing Adaptation through Local Institutions

Climate change is a global phenomenon. Even though local projections of climate change are uncertain, the envisaged increase in climate variability especially affects the world's most vulnerable populations (Adger and Vincent 2005; IPCC 2007). These are also the people who in their daily lives have been struggling for decades with variability in rainfall patterns. To what extent does increasing climate variability affect households in different regions of the world and regions with similar climatic conditions?

The Social Development Department of the World Bank commissioned this study on the costing of climate change adaptation in Yemen, Mali, and Ethiopia. All three countries have a semi-arid climate, face drought risks, and have experienced several periods of extreme drought over the last decades. Due to cultural, historical, political, institutional, and geographical differences, however, agricultural systems and development paths differ among the three countries. As a result, strategies to deal with climate variability vary as well. By comparing lessons learned from each of the three countries, more insight can be obtained into the process of adapting to climate variability. The aim of this study is thus to provide recommendations to decision makers in development projects and government agencies regarding the options available to rural households to adapt to increasing climate variability and the institutional support necessary to facilitate this adaptation process. This study is a reflection of a few fundamental insights, namely that (a) poor, rural households face most of the hazards associated with climate variability; (b) adaptation is more than techniques, but also involves socio-economic factors; (c) understanding local adaptation processes is important for informing macroeconomic policies; and (d) in prioritizing future adaptation, it is crucial to analyze past adaptation strategies.

The objectives of the CALI study are threefold:

1. To identify the main adaptation strategies currently adopted by households;
2. To investigate which institutions support households in adapting to climate variability, and how these institutions facilitate adaptation to climate variability; and
3. To identify important adaptation cost elements (labor, material, and cash) borne by households and institutions.

The CALI Study Assesses Adaptation Options Adopted in the Past...

The study involves an assessment of the adaptation options rural households pursue. It investigates the differential access/adoption rates of various vulnerability groups, as well as the drivers for adopting particular

strategies or constraints or considerations for not adopting others. Households and institutional stakeholders were interviewed in six villages in each of the study countries, focus group discussions were organized, and experts were consulted. The study focused on the manner in which rural households have dealt with hazards related to climate variability in the past, irrespective of whether these hazards might change in the future. For decades, farmers have been facing severe climate-related hazards like extreme droughts, rainfall fluctuations, and temperature fluctuations. The focus of the project is not on how households will respond to an intensification of these climate hazards, but on how they have responded in the past. As a result, the list of strategies presented in this report should not be interpreted as being the best or most wanted strategies to cope with climate variability. It reflects current practice in Yemen, Mali, and Ethiopia and shows what households currently do themselves or with institutional assistance and how it affects their vulnerability. It also considers what households do not do, which factors constrain their set of feasible adaptation strategies, and what is needed to relieve these constraints. Moreover, information is collected about the types of costs the different stakeholders have to make for implementing the strategies. A costing framework was developed to define the costs of adaptation strategies. The costing of interventions goes beyond the monetary costs, but also captures the labor requirements, skill requirements, and need for commitment among stakeholders to jointly initiate and maintain initiatives. Because of the multitude of costing items, we made a qualitative assessment of the types of costs households and institutions have to make to implement adaptation strategies and the constraints that may prevent them from bearing those costs.

...and Investigates Country Differences

This synthesis report compares the results from the analysis in each of the three countries. The main strategies adopted differ among the three countries. Institutional, socioeconomic, cultural, and political differences explain the focus on individual or communal strategies or the way in which vulnerability is reduced. Policy recommendations are intended to relieve some of the constraints that prevent households, communities, or institutions from adequately dealing with hazards related to climate variability. This report focuses on a synthesis of the main results of the three country studies and only briefly discusses the results and peculiarities of the individual countries. Assessments of the results for Ethiopia, Mali, and Yemen are contained in the country reports, which contain a detailed description of the methodology, relevant literature, villages selected, and data.

BACKGROUND

The CALI study is one of a number of initiatives from the World Bank Social Development Department on global climate change adaptation and the role of institutions (Agrawal, Kononen, and Perrin 2009). Two other cross-country studies that are related to the CALI study are the Economics of Adaptation to Climate Change (EACC) project and the Area-Based Development and Climate Change (ABDCC) project. The EACC project, which covered six countries including Ethiopia, combines top-down estimates of the economic effects of climate change with bottom-up insights on the effects of climate change on livelihoods (World Bank 2010a). The ABDCC study took place in a number of West African and Latin American countries and also analyzes institutional investments necessary to facilitate cost-effective adaptation (World Bank 2010b). The approach of the ABDCC study is similar to the CALI methodology, but with a greater focus on institutions and a reduced focus on factors explaining adoption of particular adaptation strategies, which is an important focus of the CALI study.

The CALI study is related to studies and projects in each of the three study countries. In Yemen, the Rainfed Agriculture and Livestock Project (RALP), which uses studies conducted by the Social Fund for Development, invests resources in terrace rehabilitation and development of the livestock sector. Two of the villages in which the CALI study was executed also participate in the RALP project. Recently, the Pilot Program for Climate Resilience (PPCR) was initiated with the objective to prepare a strategic program for climate resilience and identify and prepare potential interventions for making the Yemeni population less vulnerable to climate change. In Ethiopia, the CALI study is closely related to the multidonor Productive Safety Net Program (PSNP), Pastoral Community Development Program (PCDP), and the Irrigation & Drainage project. The villages selected for the CALI study are

situated in the regions where the PSNP and PCDP programs are operating. Next to that, there are a number of initiatives from the International Food Policy Research Institute (IFPRI), the World Food Program (WFP), and the Disaster Prevention and Preparedness Centre (DPPC) focusing on vulnerability and climate change adaptation in rural Ethiopia. Finally, in Mali, the CALI study is related to the Sustainable Land Management program (SLM), a multidonor initiative to support the government of Mali in adopting a programmatic approach to sustainable land management and to develop a strategic investment structure. Under the umbrella of this program, several studies are being implemented by ICRISAT and IFPRI.

THE STRUCTURE OF THE REPORT

This report compares the results from the different country surveys. Chapter 2 briefly summarizes the methodology and the type of data collected for the CALI study. Moreover, it briefly describes the study countries and villages selected. The core of this report is Chapter 3, which first explains differences in vulnerability characteristics and then assesses the elements that explain vulnerability. Second, this chapter discusses the adaptation strategies, showing the differences between countries and examining the characteristics that may explain disparities in strategies adopted. Third, it examines the types of assistance institutions provide to households to assist them in reducing climate-related hazards. Fourth, it evaluates the costing elements involved in adopting the adaptation strategies for all stakeholders. Finally, Chapter 4 presents conclusions and recommendations.

This study covers observations from six villages in each country. The villages are selected in such a way that they cover a diverse set of climatological, agroecological, and socioeconomic characteristics and cover the main agricultural systems present in the country. The differences within each country, however, are so large that the results cannot be extrapolated to the national level to represent the entire country. This should be taken into consideration when interpreting the results. Many of the observations and recommendations made throughout this report, however, do apply to other regions as well and therefore cover not just the study villages.

2. METHODOLOGY AND DATA COLLECTION

METHODOLOGY

As discussed above, the CALI study aims to answer the following research questions:

- Which adaptation strategies are used by people facing hazards of climate variability in the selected locations?
- What motivates the selection of adaptation options, which constraints prevent households from adopting other options, and which factors explain differences between groups of households?
- In what ways do institutions assist households in adopting appropriate adaptation strategies with the objective to reduce their vulnerability to climate variability, and which constraints hinder their actions?
- What types of costs do households and institutions have to make to successfully implement adaptation strategies?

The section below explains which elements are covered by these research questions, how these elements are defined, and what type of information is needed to answer them. The methodology adopted in the study is based on Agrawal and Perrin (2008). The focus of this study is on the local-level actions that can be taken by households themselves, sometimes with help from external institutions or community members. We do not consider the more macro-level strategies described in the National Adaptation Programs of Action (NAPA) for the three countries. These macro-level initiatives, especially early warning systems and improved weather prediction systems, may improve the efficiency with which some of the local-level adaptation options can be implemented.

Focus on Climate-related Hazards without Neglecting Other Hazards

The focus of the study is on hazards related to changes in climate variability. These refer to

- Drought risk: changes in the pattern and timing of rainfall
- Flood risk: changes in the intensity of rainfall resulting in floods
- Average temperature changes
- Heat waves: extreme temperature peaks leading to heat waves.

Next to these climate-related hazards, rural households also face numerous other hazards that may cause livelihood strategies to change. These hazards include soil erosion, agricultural or livestock pests or diseases, human diseases, increasing population pressure, credit or market problems, rising food prices, and hazards related to access to land or other resources (FAO 2006; Thomas et al. 2007). Some of these hazards may indirectly result from climate-related impacts (for example, food price increases due to bad harvests), but it is difficult to identify whether they originate from environmental, climatological, or economic drivers (Adger and Vincent 2005).

Adaptation Strategies can be Categorized into Four Major Categories

The focus of the analysis is on the strategies households currently choose in anticipation or in reaction to external

stresses, phenomena, or events that lead to changing agro-ecological and livelihood characteristics and therefore require behavioral changes (Nelson et al. 2007; Stringer et al. 2009). Most of these strategies have been introduced or promoted since the droughts in the 1970s. These droughts partly destroyed traditional farming systems, which were in some cases more diversified than current systems. Combined with other reasons—such as increasing population pressures, civil unrest, and changing social and political structures—farming systems have changed substantially since the 1970s, which in some cases made them more vulnerable. The strategies households currently practice to adapt to changing levels of climate variability can be classified as follows (Agrawal and Perrin 2008):

- *Agricultural techniques* to adapt to changes in rainfall regime, which include adjusting seed selection, adapting planting dates, adapting fertilizer application, adapting feed techniques, improving food storage facilities, or changing the pastoral system.
- *Water management techniques* to adapt to changes in rainfall regime, which include the use of water harvesting techniques, rehabilitating terraces, improving irrigation techniques, or improve watering sites in pastoral areas.
- *Diversification techniques* to diversify income sources, which include temporary or permanent migration, using alternative sources for fuelwood, practicing home-garden agriculture, changing the consumption pattern, or drawing down livestock.
- *Communal pooling techniques*, which include reforestation, rangeland preservation, communal food storage facilities, or local water management rules.

This analysis particularly focused on the question of whether adaptation is policy- or community-driven and initiated with institutional assistance, or whether it is an autonomous choice made by the households themselves (Stringer et al. 2009).

Vulnerability Depends on Exposure, Sensitivity and Coping Capacity

In order to explain differences in the adoption of strategies, we compared households with each other on the basis of their vulnerability profiles, and then assessed whether the adaption strategies and the institutional assistance differ between the different vulnerability classes. In the literature several definitions of vulnerability exist. Here we refer to a widely adopted definition by IPCC according to which vulnerability is composed of exposure to risk, sensitivity to that risk, and adaptive capacity (IPCC 2007; see also Kok and Jäger 2009 and UNEP 2002).

- Exposure refers to the external stress to people or communities, which is caused by factors such as changes in rainfall and temperature patterns due to climate change.
- Sensitivity refers to the extent to which people or communities are susceptible to exposure to the stress. For example, farmers using irrigation are less susceptible to variations in rainfall than farmers applying rainfed farming.
- Adaptive or coping capacity refers to the ability to cope with the external stress. Factors affecting coping capacity include level of education and access to other resources.

This definition supports the notion that vulnerability is a socially constructed phenomenon shaped by a set of institutional and economic dynamics (Adger 2003). In general, high levels of exposure, high levels of sensitivity, and low levels of coping capacity result in high levels of vulnerability. High exposure, however, does not necessarily result in high vulnerability if, for example, coping capacity is high.

In this report, households are classified according to their vulnerability profile. This refers to the profile of household characteristics that show their level and type of vulnerability. Household characteristics are identified in terms that describe their level of exposure, sensitivity, and adaptive capacity, showing the extent to which households are vulnerable. Describing the multiple facets of vulnerability shows the extent to which households are capable of successfully dealing with external stresses. The more characteristics are positive, the lower the level of vulnerability. If only a few characteristics are positive, or if especially one type of characteristic is positive—for example, coping capacity is good, but sensitivity and exposure are poor—households will still be vulnerable.

Individual households are not able to affect exposure to climate variability. Sensitivity and coping capacity can be affected. Table 1 gives examples of strategies to reduce sensitivity or increase coping capacity. The capability of households to change their level of sensitivity

TABLE 1. STRATEGIES TO REDUCE SENSITIVITY OR INCREASE COPING CAPACITY

Sensitivity reducing strategies	*Coping capacity increasing strategies*
Crop selection (e.g. switch to more drought resistant crops)	Temporary or permanent migration to urban centers
Adapt planting dates	Migration to other rural areas
Adapt feed techniques (zero grazing)	Home-garden agriculture
Adapt cropping densities	Reduce livestock/savings
Adapt fertilizer/pesticide application	Improved food storage facilities
Improved seeds (use seeds that have been improved to be e.g. more drought resistant)	Handicrafts
	Increase market sales
Use of manure of family herd on the fields	Communal cereal bank
Use water harvesting techniques	
Use irrigation	
Improve, construct, or rehabilitate terraces	
Soil erosion prevention	
Restore and preserve forests	
Rangeland preservation / management	
Communal water harvesting	

or their coping capacity depends on many different factors. Examples are financial status, gender, level of education, employment, and group affiliation. Financial status is an important factor as it affects the financial capacity to make investments. It depends, for example, on the amount of land cultivated, agroecological and soil quality conditions, types of crops grown and marketed (food vs. cash crops), amount of livestock owned, amount of assets owned, income earned from other activities, and remittances received from migrated household members.

In Chapter 3, the study assesses whether households especially adopt measures to reduce sensitivity or increase coping capacity. Moreover, we assessed which characteristics explain the adoption (or nonadoption) of particular strategies.

Institutions

For the purposes of this study, institutions are defined as structured, formal, or informal organizations that are the means through which central governments and donors channels resources for local development (Agrawal and Perrin 2009). The focus is on groups of people, who are organized formally or informally and can be approached as a group. For understanding why particular strategies are not adopted or why assistance structures may differ per country, we made use of a broader definition of institutions (North 1990; Williamson 2000) in which institutions also cover norms and rules that govern the behavior of households and organizations. In particular the role of kinship (clan, ethnic group), factors affecting commitment among community members, and factors affecting market functioning are important in this respect.

Disentangle the Different Costing Elements

We developed a costing framework in order to obtain more insight into the types of costs households, communities, and institutions have to incur in implementing the coping strategies. Costing of adaptation strategies refers to several costing aspects:

- The monetary costs households and institutions have to make to purchase additional inputs, next to the usual expenses they make for their daily practices.
- The time investments households and institutions make for implementing the strategy.
- The training needed to obtain the necessary skills to implement and manage the investment by the households and institutions.
- The investments in commitment among community members and institutions at several levels to jointly initiate and sustain investments.

The costing framework is shown in Appendix 1. The design of the survey is based on this framework. The focus is on a qualitative assessment of the costs of adaptation

and that these costs are more than just monetary costs. To elicit reliable quantitative information on the monetary requirements, a different methodology should be adopted.

DATA COLLECTION

The methodological underpinning of the CALI study is based on data collection and statistical analysis of field survey results from the participating countries. There is sufficient flexibility, however, to take into consideration environmental, socioeconomic, and political differences between these countries. The questionnaires used are similar for all three countries, but contain country-specific categories and subquestions. As a result, common analytical methods were applied across all three countries.

In each country, six villages were selected in consultation with ongoing development programs and national and local authorities. They were selected on the basis of the following criteria:

- Cover the main hazards related to climate variability and choose villages with different levels of exposure (for example, low drought risk vs. high drought risk).
- Cover the main agricultural systems in the country.
- Choose some villages that are participating in ongoing development programs (like the PSNP or PCDP in Ethiopia, RALP in Yemen, or the SLM program in Mali).[3]
- Choose villages situated a reasonable distance from the capital for reasons of efficiency.

In consultation with local authorities, within each village, 50 households were randomly selected and about 10 institutional stakeholders were identified. Moreover, people were selected for the focus group discussion in such a way that different sexes, age classes, and wealth classes were present. In total, 901 households were interviewed, about 150 institutional stakeholders were consulted, and 18 focus group discussions were organized. National and international experts were consulted to discuss the set-up and results of the study. The data were analyzed using statistical methods (descriptive analysis, cluster analysis, and factor analysis).

The household questionnaire contained three categories of questions. First, for creating a household profile, questions were raised on household composition (gender, age), education, occupation, migratory behavior, crops cultivated, livestock owned, and assets owned. We also collected information about the types of hazards the household was facing in order to find out whether climate variability-related hazards were perceived as important problems and whether these hazards had affected household behavior. Second, the questionnaire elicited information about the choice of adaptation strategies. Which strategies had been adopted in the past, for reducing which hazard? What were the necessary investments (monetary, labor, time) for this and were the tasks gender-specific? For this a participatory appraisal method was adopted. Finally, questions were raised about the assistance institutions provide when adopting adaptation strategies. Which institutions did assist, what type of assistance did they provide, and was this assistance helpful?

The focus of the institutional stakeholder interviews was especially on the types of services they provided, their role in assisting households with adaptation, their linkages with authorities, and the cost of performing their tasks. In addition, the study discussed the main constraints limiting their activities and the effects of extreme climate events on their activities.

In each village, a focus group discussion was organized with a group of 15 to 20 people from the village. The objective was to obtain hands-on and detailed information on concepts, perceptions, and ideas of a group. The results from the discussion complement the results and insights from the household questionnaires, institutional stakeholder interviews, and expert interviews. The group discussions gave additional information about the perceptions of the main (climate) hazards and their changes; about the reasons for adoption or nonadoption of an adaptation option; about the advantages, disadvantages, bottlenecks, strong points, or weak points of the different adaptation options; about the institutions facilitating the

3 In Ethiopia, the PSNP (Productive Safety Net Program) and PCDP (Pastoral Community Development Project) are two of the large, multi-donor, integrated development projects. A third project, executed in the north of the country, is the Irrigation and Drainage Project (IDP). The distance to the IDP area was too far to be covered in the CALI study as well. The RALP project (Rainfed Agriculture and Livelihood Project) is one of the large rural development projects in Yemen, which is executed jointly with the Social Fund for Development. The SLM project (Sustainable Land Management) in Mali is a multi-donor initiative with the aim to promote sustainable land management.

adoption of certain adaptation options; and about differences in strategy adoption between socioeconomic groups.

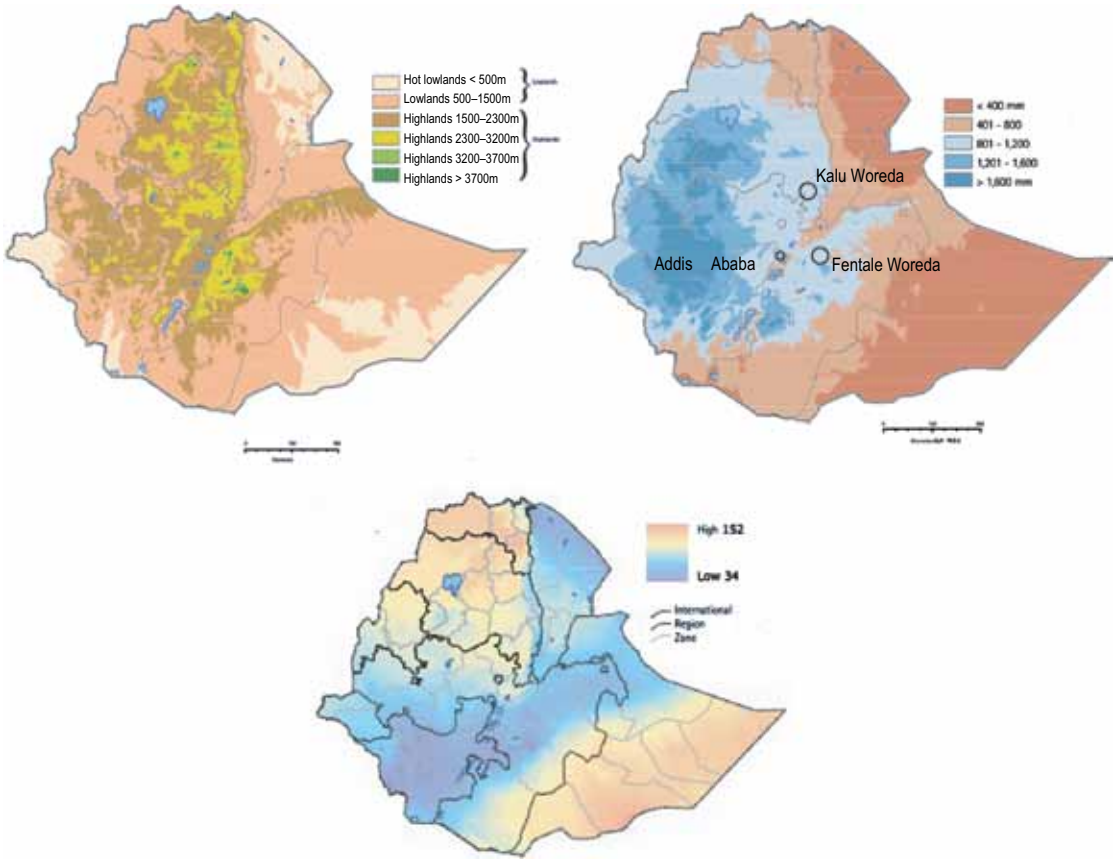
COUNTRY PROFILES

The section below discusses the main characteristics of the study countries and the regions in which the field surveys took place. The country reports provide a more in-depth discussion of the study area and study villages.

In Ethiopia Climate Differs between Low-, Mid- and Highlands

Ethiopia is vulnerable to climate variability due to its low adaptive capacity (that is, low level of socioeconomic development, high population growth, inadequate infrastructure, and lack of institutional capacity) and heavy reliance on natural-resource-based activities. The north and southeastern parts of the country experience lower rainfall and higher temperature levels than the rest of the country (see Figure 3). Climate variability is mainly manifested through the variability and decreasing trend in rainfall and increasing trend in temperature observed in the last decades. The major climate hazards observed in Ethiopia include drought, flood, and livestock and human diseases (LIU/DMFSS 2009). Although floods are more of a lowland phenomenon, floods in the lowlands are partly attributable to activities in the highlands. Generally, due to the varying rainfall and temperature patterns, the arid, semi-arid, and subhumid lowlands are more vulnerable than the highland areas (Admassie

FIGURE 3. AGROECOLOGICAL ZONES (LEFT), MEAN ANNUAL RAINFALL (RIGHT) AND RAINFALL VARIABILITY (BOTTOM LEFT) IN ETHIOPIA



Source: Atlas of the Ethiopian Rural Economy, 2006.

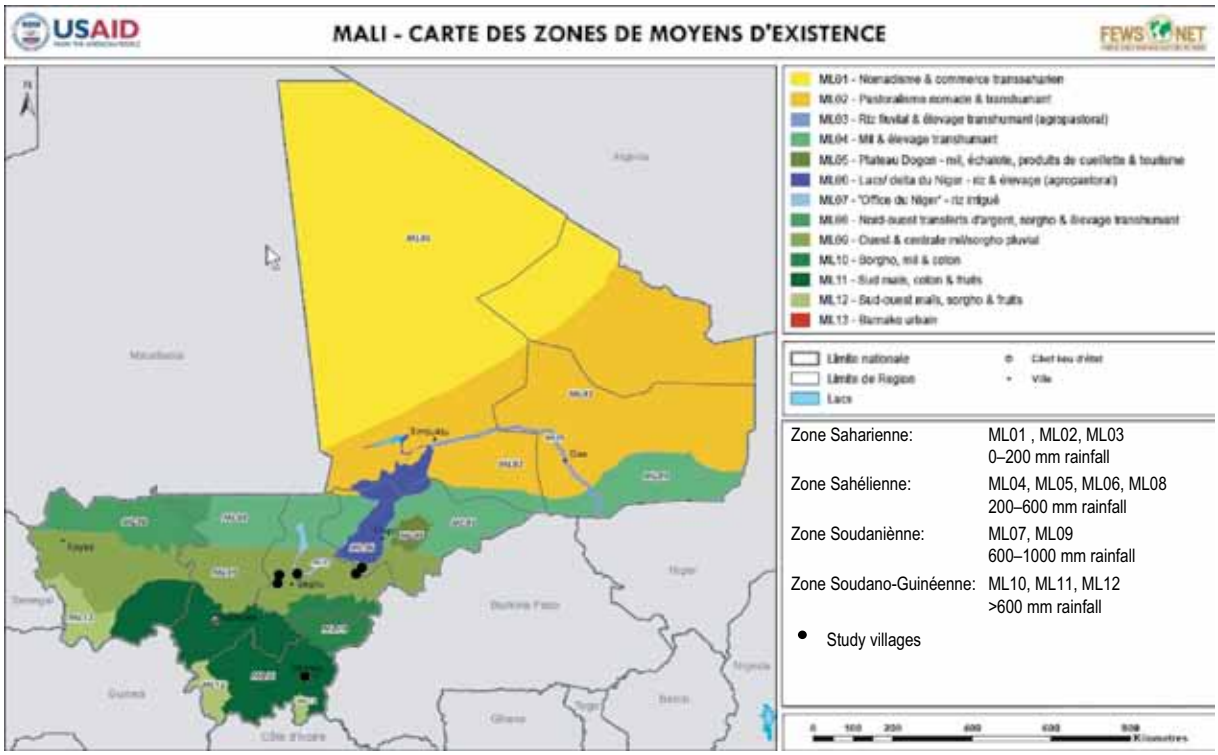
et al. 2008; Deressa et al. 2008). If the trend of warming and drying continues, vulnerability among the agricultural farming and pastoral livelihoods is expected to increase.

The field surveys were executed in four villages (*kebelle*) in Kalu woreda and two villages in Fentale woreda (see the upper right map in Figure 3). Kalu consists of highland, midland, and lowland agroecological zones. In the lowland area, rainfed crop production in the main rainy season of *kremt* (July–September) is the main economic activity with some livestock rearing. The area receives the lowest average annual rainfall in the Amhara region. The mountainous area is highly degraded and has a bimodal but erratic rainfall pattern. The midland areas have a relatively reliable rainfall pattern, which feeds several major rivers. Rainfed crop production mainly during the *kremt* season (June to mid-September) and livestock are the main economic activities. In Kalu, two villages were selected from the midland areas (Choresa and Birko Debele) and two from the highland areas (Keteteya and Hardibo). They differ especially in the hazards faced and in accessibility. Fentale is predominantly a lowland area. Crop production is only a recent phenomenon in this predominantly pastoralist region. The main hazards in the zone include drought due to erratic and delayed rainfall, crop pests, and floods. In Fentale, two villages were selected. Haro Kersa is a remotely located, predominantly pastoralist village, whereas Gola is easier to reach and currently in a transformation process from pastoralism to sedentary farming.

In Mali Drought Risks are High but the Presence of Rivers Enables Irrigation

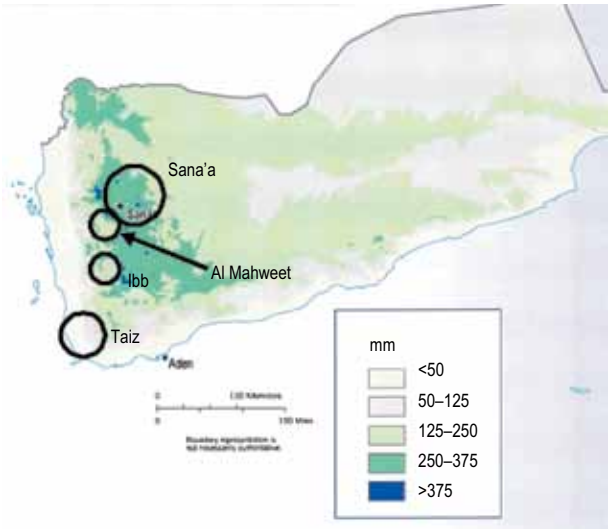
In Mali, climate variability is very high with extreme periods of drought in the 1970s and 1980s. The climate zones more or less prescribe the agricultural potential (Figure 4). An exception is the Inner Niger

FIGURE 4. AGROECOLOGICAL AND RAINFALL ZONES IN MALI



Source: FEWSnet livelihood zones Mali.

FIGURE 5. ANNUAL RAINFALL (MM) IN YEMEN



Delta wetland located in the Sahel and Sudan climate zones, which stretches along the Niger River and its tributary the Bani. In Mali, the average maximum temperature in the shade is between 34° and 37°C. The country has one rainy season, which lasts six months in the south to three months in the northern regions. The country has become hotter and drier over the last decades. Projections show that rainfall levels continue to decline and become more variable and that temperature will increase. As a result, both drought and flooding probabilities increase. Even though climate variability affects the rural environment, other factors also have a significant impact. Examples are increasing population pressure leading to intensified agriculture and cultivation of marginal lands, and changes in social structures, which have reduced mitigation of vulnerability through trusted kinship networks.

The field surveys took place in three regions, covering about four farming systems. In the region of Ségou, three villages were selected. Fambougou and Kondogola are in the southern Sahel millet-based cropping system. Households practice rainfed cereal-based farming most often in the Sahel region. The area is threatened by desertification. In the village of Togou, households apply irrigation by controlled flooding (submersion controlée). The irrigation schemes are managed by the Office du Riz Ségou. From the region of Sikasso, in the northern Guinean agroecological zone, the village of N'Tjilla was selected. This village is in a more favorable rainfall zone and faces lower drought risks than the other villages. N'Tjilla is in the area where the cotton cooperative CMDT is operating. In the region of Mopti, Kandara and Touara were selected; they represent the receding flood farming system (agriculture de décrue). They are situated in the Inner Niger Delta and benefit from the Bani and Niger rivers, from which they can also fish. The areas face a higher flood risk but also benefit from the water resources for rice cultivation and fisheries. They also face drought risks, especially in case of late arrival of the floods.

Climate Patterns and Agricultural Opportunities in Yemen Show Large Differences

In Yemen rainfall varies widely across the country. Precipitation occurs primarily in spring and summer. Temperature depends on the elevation of the locations. In the highlands, the average annual temperature is 12°C, while in the coastal areas, close to the sea, the average annual temperature is 30°C. Not only has rainfall decreased over a large part of Yemen, the timing of rainfall, the intensity of individual storms, the delay between falls, and the frequency of interannual variability have changed as well in the last decades. When projected annual changes in rainfall are combined with changes in potential evaporation, a new climate regime for Yemen is likely to exist by 2050.

Yemen can be divided into five regions: mountain massif, eastern plateau, desert regions, coastal plains, and Yemen islands. The villages selected are in four governorates: Sana'a and Al-Mahweet governorates in the central mountain massif and Ibb and Taiz governates in the southern mountain massif. The southern and western coastal plains and lower mountain slopes have an arid tropical climate, which is characterized by high temperatures and low precipitation (0 to 400 mm). The lower and upper mountain slopes areas and the eastern plateau region (Taiz, Ibb, and Al-Mahweet governorates) have an arid subtropical climate with temperatures between 16 to 28°C and precipitation ranging from less than 100 mm to 800 mm. Finally, the high mountains ranging from 1,800 to 3,700m above sea level (Sana'a) have a temperate climate with

relatively low temperatures (10–18°C) and precipitation varying from 200 to 1,200 mm. In most areas, the reliability of rainfall is of critical concern, reflected by the fact that little or no truly rainfed agriculture is practiced. In virtually all cases, there is some form of rainfall supplementation, whether tubewells, hand-dug wells, or flood-water harvesting.

The field survey was conducted in three villages with rainfed agriculture (Al Wathan in Sana'a, Magahem Asha'abi Dhi Shraq in Ibb, and Mu'aneet in Al Mahweet), two villages in the highlands with rainfed agriculture supplemented by spring irrigation (Al Masajed in Sana'a and Al Mehraq in Taiz) and one village with mixed agriculture in the dryland area (Arraheeba in Taiz). Mu'aneet and Al Masajed are located in the area where the RALP project is working. The village of Al Wathan is relatively close to Sana'a. Both highland villages and Mu'aneet are rather difficult to reach. Even though all villages face a drought risk, this risk is highest for the dryland village of Arraheeba.

3. COMPARING ADAPTATION IN ETHIOPIA, MALI, AND YEMEN

This section presents the results of the field studies. It indicates the extent to which differences within and between the countries explain how climate hazards are perceived and what actions are taken. First, the chapter explains differences in vulnerability. Second, it shows the differences in strategies adopted, and discusses why different categories of strategies were adopted. Third, it discusses differences in the roles of the institutions. Finally, the costing of adaptation strategies is worked out in more detail.

VULNERABILITY PROFILES

This section explains the differences in vulnerability within and between the three countries. First, it compares the villages. Differences in village vulnerability are explained by differences in exposure, sensitivity, and coping capacity. Second, as exposure and the options to reduce sensitivity are location-specific, clusters of households are distinguished based only on coping capacity characteristics. This shows why some households are better equipped to deal with hazards. It then considers the question: Can we identify universal characteristics that explain vulnerability?

Ethiopia

Vulnerability Depends on Altitude

The study villages show clear differences in the level of vulnerability. Households in the lowland, pastoralist village own many cattle, but are still vulnerable to climate shocks. Their coping capacity is limited due to their large household size and low levels of education and landholdings. The second lowland village is in a transformation process from pastoralism to a mixed farming-livestock system. Due to a high dependency ratio and low income, they currently are vulnerable. This is expected to change if future income is more diversified and if their new farming systems are more climate-proof. The midland and highland villages generally are less vulnerable, in part due to their lower exposure to drought risks. The midland villages are least vulnerable. Compared to the highlands, their coping capacity is higher (higher landholdings, education levels, and migration rates), but due to more irregular rainfall patterns, they are more exposed to climate hazards. High erosion in the highlands makes these regions sensitive to climate variability. For all villages, drought is the main climate hazard. Also in the highlands, prolonged periods of drought and reduced rainfall levels have appeared more often in the last decade. Not all hazards, however, are directly related to climate. Hazards with an indirect link to climate variability include high food prices, soil erosion, and animal diseases.

Household Characteristics Explain Vulnerability

If clusters of households are classified based on coping capacity characteristics only, it becomes clearer which households are better capable of dealing with the hazards. By using cluster analysis techniques, for each country six clusters of households are distinguished, based on household characteristics (for example, household size and average age, education, income, activities,

and asset ownership).[4] The vulnerability profiles of these clusters are shown in spider diagrams. Spider diagrams are a graphical method to display multiple quantitative variables in one chart by distinguishing several axes starting from the same point. The spider diagrams show how households score on sensitivity and coping capacity characteristics. These diagrams show the multifaceted character of vulnerability. They are set up in such a way that for each variable, the value is normalized between 0 and 1. A higher value implies that the household is less sensitive or has a higher coping capacity for that variable. The larger the scores (so the larger the spider web), the less vulnerable households are. Spider webs do not give absolute values of vulnerability, but clearly show the relative differences between the household types. Six clusters are distinguished, described as follows:

1. **Low-educated pastoralists**: lowland pastoralist households, having a large household size and low migration rates, education levels and asset ownership and cultivating only a few small plots.
2. **Young agropastoralists**: agropastoralists, having a high dependency ratio, little temporary migration, low education levels, and cultivating average amounts of land.
3. **Large, landowning households**: farmers cultivating a relatively large acreage, having only few children, relatively high education levels, and high migration rates.
4. **Asset-rich households**: farmers with average household characteristics, but a relatively high education level and ownership of assets and owning many fruit trees.
5. **Small, poor households**: farmers with a high percentage of female-headed households, low education levels and low asset, land, and livestock ownership.
6. **Average household**: average farm household having an above average migration rate, cultivating especially cereals, and some qat as a cash crop.

Figure 6 shows that all household types are at least to some extent vulnerable. They show the multifaceted character of vulnerability. The diagrams are set up in such a way that the larger the spider web, the less vulnerable households are. They don't give absolute values of vulnerability, but clearly show the relative differences between the household types. The main conclusions are the following:

- Most household types are dependent on only one source of income and only have limited fallback options.
- The low-educated pastoralists still are in a relatively wealthy situation due to their herds; climate change may deteriorate their situation, however, which is difficult to alter due to their dependence on livestock and low education levels.
- The small, poor farmers are in the most difficult position, with limited income earning possibilities, few fallback options, and a larger percentage of female-headed households.
- The young agropastoralists currently are in a vulnerable situation. Once their children grow older, their scope for exploiting more income diversification activities improves.
- The asset-rich farmers can fall back on their assets in difficult years; their scope for future improvement is positive due to their above-average education levels.
- The large, landowning farmers have the highest coping capacity; however, they only cover 2 percent of the sample.
- Differences between households are large on all characteristics, so it is not possible to identify which characteristics affect vulnerability the most. Interventions by institutions are expected to be most effective if they are tailor-made and properly consider the characteristics causing the most vulnerability.

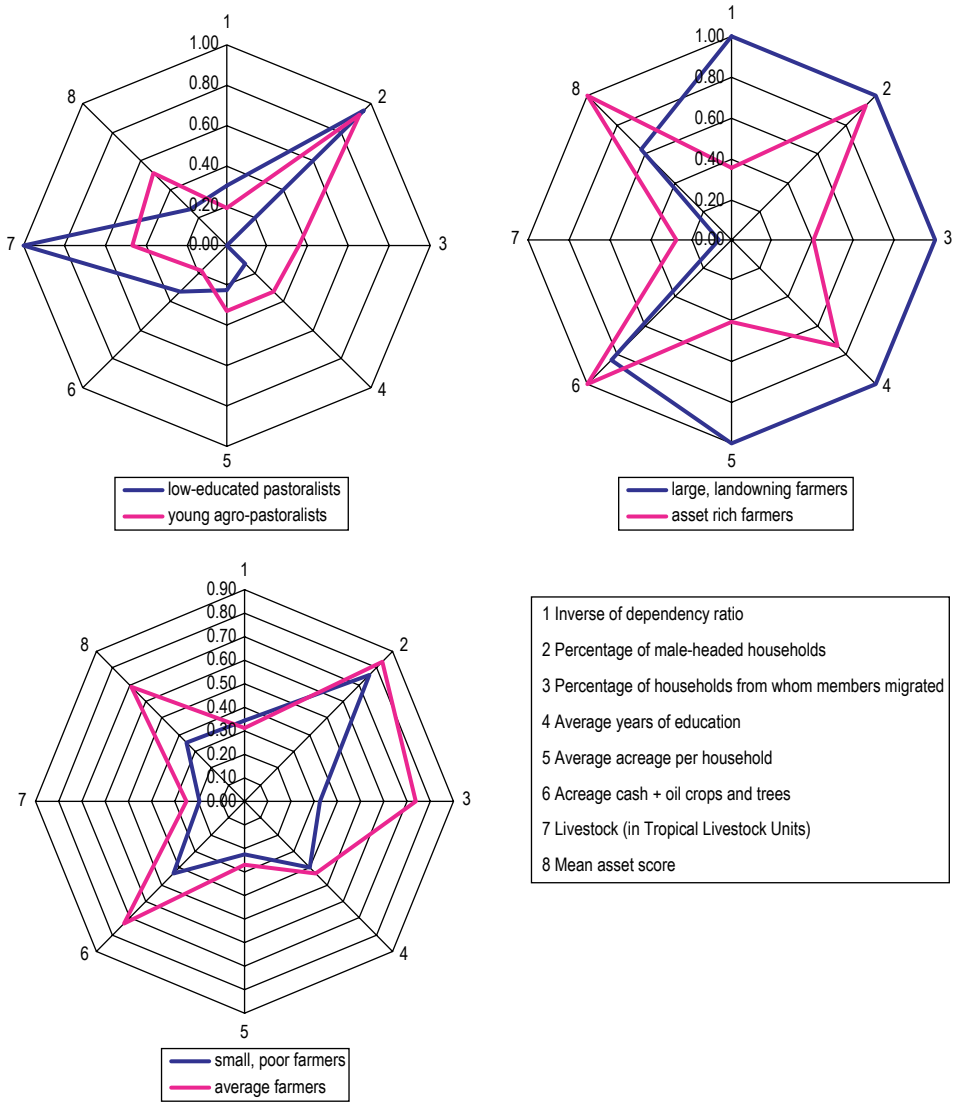
Mali

Annual Rainfall and Presence of Water Resources Explains Vulnerability

Vulnerability in Mali depends to a large extent on the exposure to climate variability. The study villages in the Ségou area, practicing rainfed agriculture, are the most exposed. They score low on agroecological capacity and climatological suitability. They are highly dependent on agriculture and livestock, so they are also very sensitive to climate variability. The study village in the climatologically more favourable Sikasso area, although not

4 Six clusters of households were distinguished. Throughout the analysis, it was concluded that distinguishing more clusters would make the differences between them too small to be interpretable. Distinguishing less would not show the differences between the households adequately.

FIGURE 6. THE MAIN VULNERABILITY CHARACTERISTICS FOR ETHIOPIA



very exposed, has a limited coping capacity through a strong focus on agriculture. The other three villages in the Mopti and Ségou area, practicing receding flood farming or controlled flooding systems, currently have a medium exposure to climate variability. Due to their higher rates of migration, cash crop earnings, and income diversification (for example, from fisheries), they have better coping capacities than the other villages.

Different Types of Households are Present within Each Village

If geographical location is set aside, but only coping capacity characteristics are considered, six clusters of household types can be distinguished:

1. **Educated, wealthy livestock farmers:** better educated livestock farmers, owning large herds of small

and large cattle, and producing cereals and cash crops.
2. **Diversified, rich farmers:** households with a diversified income that are rich in assets, landholdings, and livestock.
3. **Large fisheries households:** households producing cereals and few cash crops, involved in fisheries, and having a high percentage of permanent migration.
4. **Larger cash-crop growing households:** better educated cash-crop producers with low migration.
5. **Poor households:** households having especially small ruminants, producing cereals and some cash crops, having low levels of education, a relatively high dependency ratio, and low migration.
6. **Smallholder cash-crop growers:** smallholder cash-crop growers, cultivating especially cereals and cash crops and owning only a few animals.

Figure 7 shows that the poor households and the small cash-crop producers are most vulnerable to climate change. Their spider webs are smallest. The diversified rich farmers and the large fisheries households are the least vulnerable. Their income is more diversified, they have higher cash crop earnings, and they own more land and livestock.

Education and Income Diversification are Important for Defining Vulnerability

For Mali, the dependency ratio and rate of migration are not determining factors of household vulnerability. All households score more or less the same. Education, cash-crop earnings, and livestock are important characteristics explaining the differences among the clusters. Involvement in fisheries is important for increasing income diversification and thus increasing coping capacity.

Villages Exhibit Signs of a Social Divide

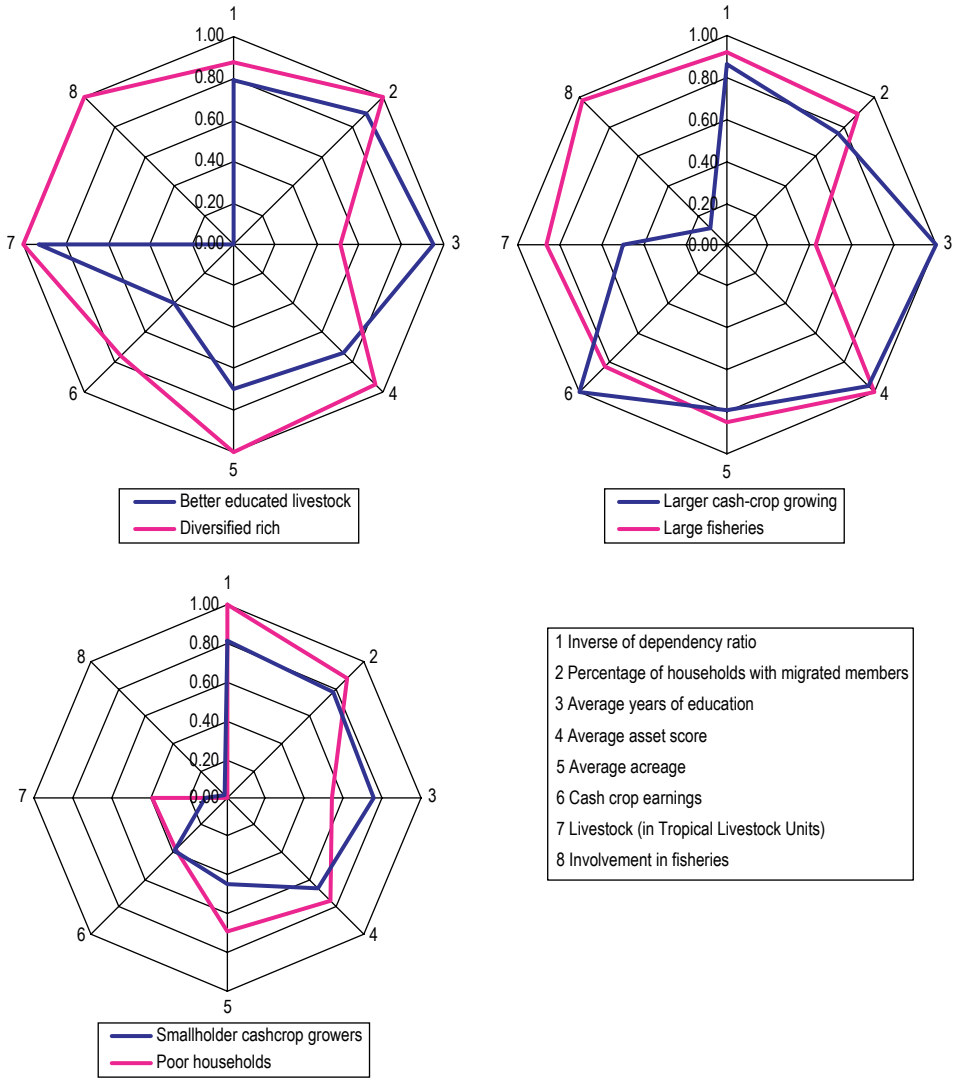
The cluster analysis shows that the "better educated, wealthy livestock farmers" and the "poor households" are living in three study villages in the Ségou area. In these villages, there seems to be a social divide between the better-off and worse-off households. In addition, the fisheries community in the Mopti area is divided into two groups (cluster 2 and 3), of which the more diversified households from cluster 2 seem to be somewhat better off than those of the "large fisheries households." The "large, cash-crop growing households" are a relatively small group. They have a less diversified income, but their higher education levels and higher cash earnings put them in a less vulnerable situation.

Yemen

High Exposed Villages are Not Necessarily Vulnerable

Vulnerability and agroecological potential in Yemen are related to altitude, which is related to rainfall. The study village in the coastal plains (Arraheeba in Taiz) is the most exposed. This village scores low on agroecological capacity, yet the households are highly dependent on agriculture. The three study villages with an arid subtropical climate are somewhat less exposed. The two villages in the highlands with a relatively high precipitation are the least exposed to climate variability. The highly exposed villages, however, are not necessarily the most vulnerable. The most exposed village in the coastal plains is vulnerable. They have low cash-crop earnings, low income diversification, and relatively low educational levels. Due to low soil fertility, their higher landholdings do not result in high yields. The least vulnerable village seems to be the rainfed agriculture village Al Wathan in Sana'a governorate. They are highly exposed but compared to most other villages, they also have higher cash-crop earnings (both from qat and fruits and vegetables), higher landholdings, more livestock, more assets, and higher education levels. Their sensitivity to climate variability seems to be relatively low and their coping capacity good. Both highland villages score very differently. Al Masajed in Sana'a governorate has relatively good landholdings, income from livestock and migration, and relatively good levels of education. The highland village of Arraheeba in Taiz governorate has lower landholdings and also a low income level, which makes them more vulnerable. Vulnerability in the Yemeni study villages seems to be less dependent on climate exposure but more on other factors. For example, proximity to the capital Sana'a most likely makes the villages in the Sana'a governorate less vulnerable.

FIGURE 7. THE MAIN VULNERABILITY CHARACTERISTICS FOR MALI



Differences between Household Types are Large

If geographical location is set aside, but only coping capacity characteristics are considered, six clusters of household types can be distinguished:

1. **Diversified, wealthy farmers with livestock** who are better educated, own large herds of cattle, and produce cereals and cash crops (qat).
2. **Highland smallholders** in the southern highlands with relatively low landholdings, moderate asset ownership, and that mainly produce grains.
3. **Diversified households** with a high share of females and low dependency ratio, rich in landholdings, producing herbs and legumes, and a high share of migration.
4. **Highly educated cash-crop growing farmers** with a high dependency ratio, small landholdings, relatively

many assets, and producing cereals and cash crops (qat).
5. **Fruit and vegetable farmers** producing cereals, vegetables, and fruits, with some livestock, a relatively high dependency ratio, and relatively low levels of education.
6. **Dryland farmers** with large landholdings, producing cereals but no cash crops, low in education, owning only a few animals and having a high dependency ratio.

Villages Exhibit Signs of a Social Divide

Figure 8 shows that the clusters vary across the villages.

- The "diversified, wealthy livestock farmers" (cluster 1) and the "highland smallholders" (cluster 2) account for two-thirds of the respondents in the survey.
- The "diversified, wealthy livestock farmers" (cluster 1) are the least vulnerable. They are present in all six villages, although villagers of Al Wathan (Sana'a) are most frequently present. Note that Al Wathan was also the least vulnerable village.
- The "highland smallholders" are most vulnerable. About half of them live in Thi-Yashreq (Ibb) and Al Mehraq (Taiz). They score much lower on all characteristics, which is a sign that villages are divided into better-off and worse-off households.
- Most households in the dryland village of Arraheeba in Taiz are "fruit and vegetable farmers" or "dryland farmers" (cluster 5 and 6). They are in a vulnerable situation. The fruit and vegetable farmers are somewhat better off as they have a higher and more diversified income. Both household types, however, have low education levels, which gives them a low capability of improving their livelihoods themselves.
- The situation of the "highly educated cash-crop growing farmers" (cluster 4) is difficult to assess. Their low dependency ratio and high levels of education and assets indicate they are more capable of deciding about adaptation themselves. Low landholdings and income earning capacities, however, put them in a vulnerable situation.

Synthesis

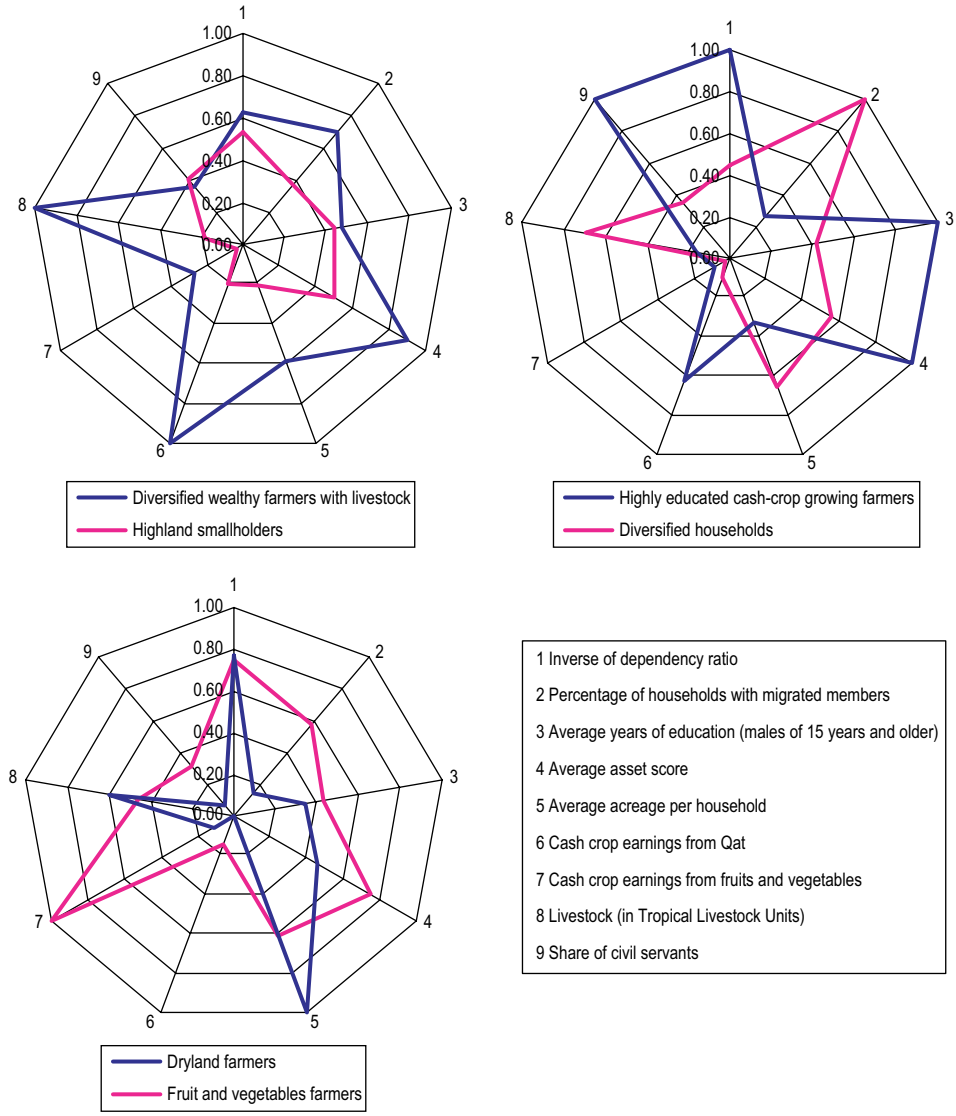
Exposure Affects Vulnerability but cannot be Reduced by Adaptation Policies

An important factor causing vulnerability among farm households is exposure to climate variability. The three countries in the CALI study are located in semi-arid regions and are regularly threatened by prolonged periods of drought and experience years with low levels of rainfall. Despite the different characteristics of the regions in which the study villages are located, it is clear that rainfall variability and rainfall levels are important determinants of vulnerability. The more erratic the rainfall and the lower rainfall levels, the higher the vulnerability. Therefore, the lowlands in Ethiopia, the Sahelian villages in Mali, and the coastal plains and low mountain areas in Yemen have a more disadvantaged starting position compared to the other villages. Climate adaptation policies cannot change this disadvantage. Only climate mitigation policies on a global level may affect exposure on a local level, even though the pace of this effect will be slow.

Hazards are Not Only Caused by Changing Climate Variability

Many of the other hazards faced by households are indirectly related to high rainfall variability and low rainfall levels. Increased levels of soil erosion, high food prices, and increased incidence of human, animal, or crop diseases are related to rainfall variability. Other hazards, which are seemingly climate related, may be caused by human-induced factors. Among villages near the Malian rivers, flood hazards are partly caused by construction activities in low-lying, flood-prone areas. In one of the villages in the Ethiopian lowlands, flood hazards are caused by dikes built to protect neighboring estates, which prevents water from freely flowing toward lower areas. Flood hazards in Ethiopia's highlands and in Yemen are partly caused by decreasing water infiltration due to deforestation and soil erosion. One has to be careful blaming all hardship on climate change. Instead of focusing too much on adaptation only, an integrated development approach is recommended. This means that one has to be careful initiating projects focusing on a single theme, such as soil erosion prevention, without emphasizing the importance of communal, sustainable

FIGURE 8. THE MAIN VULNERABILITY CHARACTERISTICS FOR YEMEN



soil management. This requires more than just the technical soil erosion prevention works, but should also address costs for cooperation and management skills and systems.

Low Sensitivity and High Coping Capacity can Alter the Threats from High Exposure

High exposure does not necessarily cause high levels of vulnerability. Low sensitivity to climate variability and high coping capacity can alter the threats from high exposure. For Mali, the villages near water resources have the opportunity to apply irrigation and are thus less sensitive to rainfall variability. Their dependence on flood irrigation, however, still makes them more sensitive than households that are part of (multi)village irrigation schemes or use independent on-farm irrigation systems. Note, however, that communal schemes require good institutional backing to assure sustained operation of the schemes. As will be discussed in the next section, in Ethiopia many households adopt

sensitivity reducing measures in order to become less dependent on rainfall variability. In Yemen, many farmers install groundwater pumps to reduce their sensitivity to rainfall variability.

The Variety in Household Types Signals the Need for Tailor-made Interventions

Even households in areas with low exposure can still be vulnerable if their coping capacity is low. Many of the households in the Sikasso area in Mali are still vulnerable because of their dependence on income from agriculture. If harvests fail, they only have limited fall-back options and limited capacities to repay debts from their cotton input purchases. Households receiving remittances from migrating household members, owning more assets, and having more diverse income sources—for example, from fisheries, livestock, or trade—have better options to respond to income shocks. In addition, households with better education levels have greater capacity to find alternative ways of living. The spider web diagrams give evidence that interhousehold differences between the Ethiopian and Yemeni villages are larger than between the Malian villages. As a result, for Ethiopia and Yemen aid programs should be tailor-made, focusing on particular groups, whereas in Mali interventions seemingly can be more general. Note that the ABDCC study also concludes that vulnerability and therefore also interventions are locally specific (World Bank 2010b). On the other hand, generally speaking, the coping capacities of Malian households seem to be better than in most of the Ethiopian households. Households are larger, migration is a more common practice, more households own some cattle, and (in the study villages) almost all households cultivate some cash crops. In Ethiopia, the lowland households transforming from pastoralism to a sedentary mixed farming-livestock system acknowledge the importance of income diversification. In many of the other villages, households still focus on livestock or agriculture instead of broadening their income sources. In Yemen, differences between households are also large. Proximity to Sana'a seems to be beneficial for households, and many households benefit from cash incomes from qat sales and migration. Within villages, differences may be large. For designing appropriate, tailor-made aid programs, attention should be given to the particular constraints households face. As the data show that better educated households are in a better position, improving school enrollment remains an important development priority.

Women's Roles and Positions Differ between the Three Countries

From the survey findings, it is difficult to give conclusive judgements about the position of women in the different household types in the sample villages. Several observations, however, can be made. A disadvantage of the small household sizes in Ethiopia is that women have few fall back options if they become single. On the other hand, the results indicate that Ethiopian women have a larger say in household decision making than in the other two countries. In Mali, the larger household sizes may serve as some sort of insurance as women can support each other in difficult times. There is, however, also evidence of hidden poverty in extended households because of hierarchical differences. In Yemen, due to cultural reasons, women only have a marginal say in household decisions even though their role is important in nearly all household tasks. When designing gender-specific development programs, account should be given on how to reach the most destitute groups. This deserves special attention, especially for Yemen. The choice of adaptation strategies is also gendered, as described in the following section.

ADAPTATION STRATEGIES

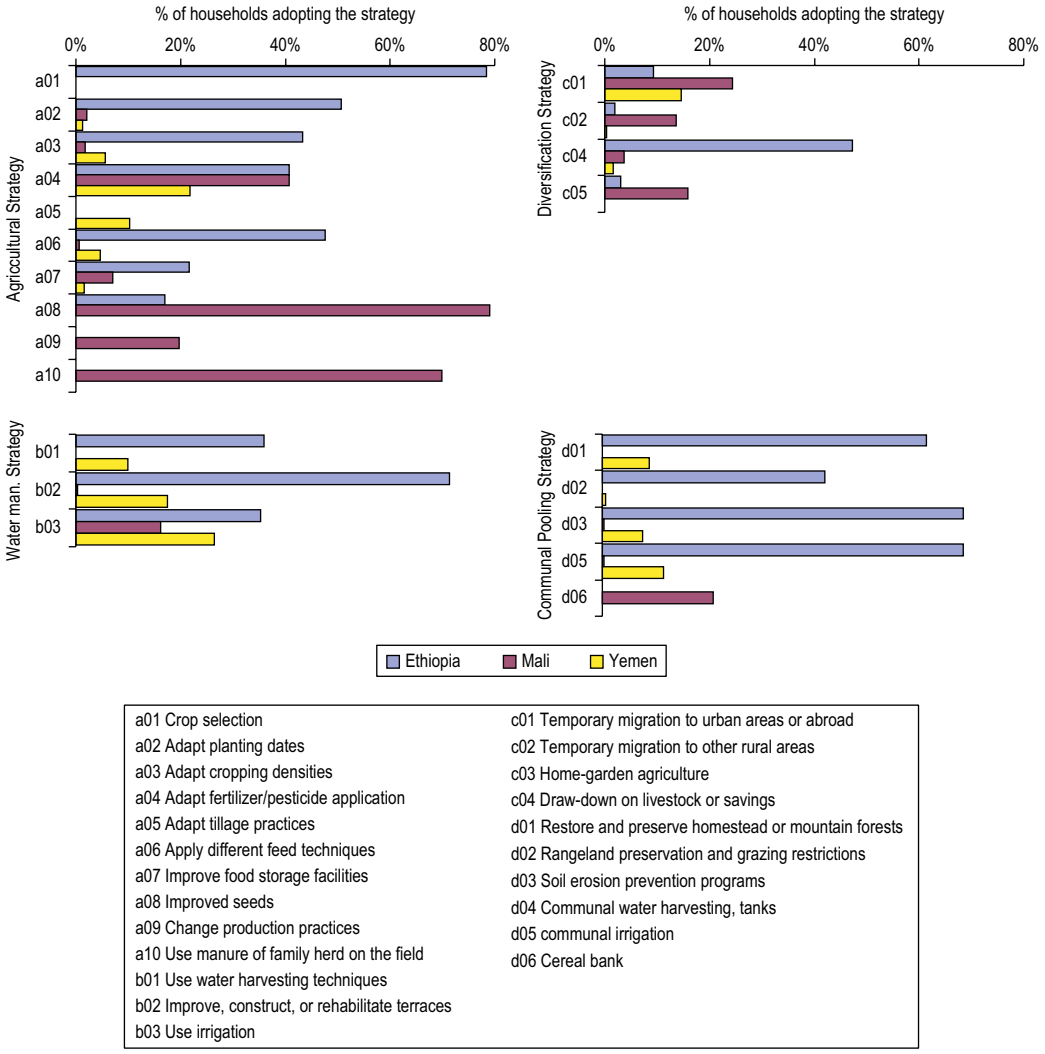
This section discusses which adaptation strategies are adopted by the different types of households. It explains differences observed within and between countries and whether universal strategies can be identified. The number and type of strategies adopted by households differ substantially between the countries. Moreover, this section assesses the causes of differences in adoption of individual or communal strategies, or of strategies focusing on reducing sensitivity or improving coping capacity.

Ethiopia

Households Adopt a Mix of Individual and Communal Strategies

For Ethiopia, each household in the sample adopts on average 8.5 strategies. Figures 9 and 10 show the distribution of the strategies. The top five most important strategies are (1) crop selection (adopting

FIGURE 9. PERCENTAGE OF HOUSEHOLDS ADOPTING A PARTICULAR STRATEGY FOR ETHIOPIA, MALI, AND YEMEN



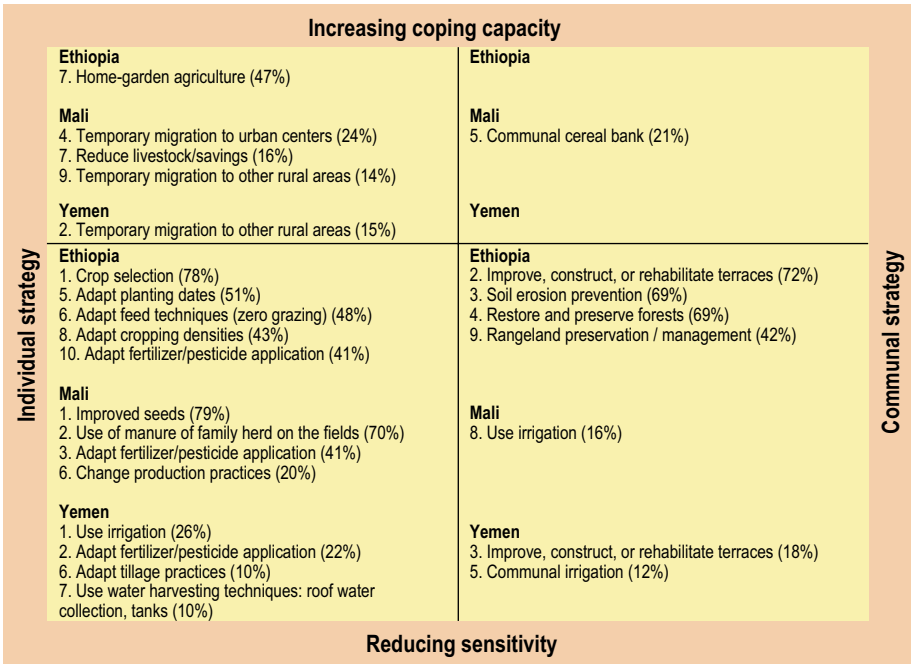
drought-tolerant crops; chosen by 78 percent of the households); (2) improve or rehabilitate terraces (adopted by 72 percent); (3) soil erosion prevention programs (chosen by 69 percent); (4) restore or preserve homestead or mountain forests (adopted by 62 percent); and (5) adapt planting dates (adopted by 51 percent).

Three of these strategies are communal strategies that have to be implemented jointly with other households and often with the help of institutions. This shows that institutions play an important role in improving livelihoods in the villages. Similar conclusions are drawn from the IFPRI study (Deressa et al. 2008; Bryan et al. 2009).

Sensitivity Reducing Measures are Favored

Strategy choice differs between the clusters. For the young agropastoralist households, the top five strategies

FIGURE 10. PERCENTAGE OF HOUSEHOLDS IN THE SAMPLE ADOPTING ADAPTATION STRATEGIES



Note: Categorized by individual vs. communal strategies and sensitivity reducing vs. coping capacity increasing strategies. Only strategies adopted by at least 10 percent of the households are shown.

are individual strategies focusing on improved agricultural practices (crop selection, planting dates, cropping densities, fertilizer application, and feed techniques). The low-educated pastoralist households choose communal strategies focusing on improved water management and water storage to reduce their sensitivity to climate variability. They are dependent on communal grazing lands and watering points and only have limited individual strategies at their disposal. The midland and highland households have a more mixed strategy of crop selection combined with soil erosion prevention and home-garden agriculture designed to reduce sensitivity to climate variability. In Ethiopia, communal strategies implemented with assistance from extension agencies are relatively important. These are promoted by, among others, World Bank-supported development programs like the Productive Safety Net Program (PSNP), the Pastoral Community Development Project (PCDP), and the Irrigation and Drainage Project. Income diversification strategies to improve coping capacity are not regularly chosen. Home-garden agriculture is the main income diversification strategy adopted. Furthermore, it is observed that only a few households see migration as a suitable strategy to reduce hazards (Box 2).

Strategy Choice is Gendered

Decisions on strategies related to market sales, livestock, savings, or pastoral areas are mainly made by the men. For most agricultural decisions, men also make the decisions more often than women. Women generally decide about home-garden agriculture, handicrafts, consumption decisions, and charcoal and timber sales. Financial decisions also are gendered; especially among the "low-educated pastoralist" cluster, financial decisions are made exclusively by men. In the other clusters, women are involved more in financial decision making.

BOX 2. TEMPORARY MIGRATION

Many of the participants in the focus group discussions indicated that at least one of the household members had migrated to other towns during the last year. Many youngsters traveled ong distances for salt mining work to the nearby towns or to Addis. Some women travel to countries like Dubai and Saudi Arabia. Many migrants send remittances back home. In a focus group discussion in Keteteya, the downside of the situation is expressed as follows:

''due to food shortages, some girls are forced to drop out of school and travel to the nearby towns to look for work; some of the girls ended up in prostitution and came back home with HIV/AIDS."

Better-off Households Invest More and Adopt More Communal Strategies

The costing data provides evidence that the better-off groups invest more money and time in their adaptation strategies than the more vulnerable groups. This is spent on communal soil erosion prevention and water management strategies. This indicates that access to institutional support is easier for the better off households. Costing of adaptation strategies is discussed in more detail later in this chapter.

Mali

Most Households Make Use of Similar Strategies

In Mali, most households make use of a limited number of coping strategies; see Figures 9 and 10. The top five most important adaptation strategies include (1) using improved seeds (adopted by 79 percent of the households); (2) using manure from the family herd on the farm (adopted by 70 percent); (3) adapting fertilizer/ pesticide applications (adopted by 41 percent); (4) temporary migration to urban areas or abroad (adopted by 24 percent); and (5) using the cereal bank (adopted by 21 percent).

Strategies Aim both at Sensitivity Reduction and Coping ...

The adopted strategies aim at reducing sensitivity to climate variability through selection of drought-resistant seeds and increased use of soil improvements, as well as improving coping capacity through migration and improved food storage. Strategies should focus on both of these elements of vulnerability.

... But have a Limited Variety

The variety of strategies that are adopted in Mali is rather limited. As explained below, strategies requiring community action were not observed. The regions in which the study villages are located only allow for a limited number of strategies to diversify income. Due to low income levels, the consequential low levels of household demand and malfunctioning market institutions like credit markets, there is only limited scope for broadening the strategies households can choose to diversify their income. This is an important reason why migration is such a commonly used coping strategy. The range of strategies adopted, however, is rather limited, which carries the danger of a certain "saturation" of the effectiveness of a strategy if climate variability increases.

Communal Strategies are Difficult to Implement

One of the most popular strategies is a communal strategy (cereal bank). Water management strategies, which usually are communal strategies, are seldom used, even though they are expected to have positive benefits in climate zones where drought is one of the major threats to livelihoods. Communal actions seem to be difficult to set up in the study villages. Communal actions need both investments and training from external institutions, but also a sense of urgency and a feeling of ownership on the part of the households. Community actions require a very active approach from institutions in creating adequate commitment by households. In many

villages, several institutions actively attempt to implement community development plans. Training and awareness creation are particularly underdeveloped.

Yemen

Only a Few Strategies are Used

In Yemen only a few strategies are used. On a country level, the top six most important strategies to adapt to climate change were identified as (1) using irrigation (26 percent); (2) adapting fertilizer/pesticide applications (22 percent); (3) improving, constructing, or rehabilitating terraces (18 percent); (4) temporary migration to urban areas or abroad (15 percent); (5) adjusting crop selection (14 percent); and (6) developing communal irrigation (12 percent).

Other strategies were adopted by less than 10 percent of the households. About 40 percent of the households in the survey did not adopt any of the strategies listed in the questionnaire. Three of the top six strategies are communal strategies, for which cooperation with neighbors or other households is necessary. The number of strategies adopted is rather limited; some of the strategies are adopted in only one or two villages. Furthermore, the number of strategies that are adopted between the villages is very different. The village of Al Wathan has adopted 3.5 strategies on average, whereas the village of Al Merhaq only adopted less than one (0.7) strategy on average per household. Among the villages, the percentage of responding households that did not adopt any strategy also varied significantly.

Strategies Mostly Aim at Reducing Sensitivity

Most strategies aim at reducing sensitivity to climate variability through irrigation, fertilizer/pesticide applications, or the improvement, construction, or rehabilitation of terraces. The only strategy focusing on coping capacity is through temporary or permanent migration. Differences between villages and clusters are notable. In the vulnerable villages of Al Mehraq and Arraheeba in Taiz governorate and in the most vulnerable clusters, only a few households adopt some strategies. The highland village especially focuses on migration and prevention of soil erosion (terracing and reforestation), whereas the dryland village of Arraheeba focuses on irrigation and adapting farming practices. The better-off households seem to adopt more strategies than the worse-off, even though differences are not large. For the villages participating in the World Bank-supported Rainfed Agriculture and Livestock Project (RALP), there were no significant differences in strategy adoption. Terrace rehabilitation and reforestation are important for them as well as the use of water harvesting measures, but not much higher than in the other villages.

Coping Capacity Improvement Strategies are Hardly Applied

For all villages, coping capacity strategies are restricted to migration to urban areas or abroad. Other possible strategies—like migration to other rural areas, home-garden agriculture, or increased market sales or handicraft—are hardly used. As the cultivation of fruits and vegetables is already applied by many, home-garden agriculture as it is promoted in Mali and Ethiopia may be a less relevant strategy. Moreover, one reason for increased sales of animals or for savings is the need for cash for medicines or water. In such cases, these strategies should be categorized as distress strategies instead of strategies to improve coping capacity. The lack of coping capacity strategies may be caused by market problems, political problems, or financial constraints. Moreover, political instability generally does not create receptive conditions for initiating new activities.

Communal Strategies are Adopted Especially by the Better-off Households

Even though communal strategies like terrace rehabilitation and communal irrigation are chosen regularly, differences in the choice of communal strategies differ a lot among the villages. In the more vulnerable villages in Taiz and in the more vulnerable clusters, many fewer households adopt communal strategies than in the better-off villages and clusters.

Synthesis

Households in the Study Countries have Different Perceptions About Strategies to Cope with Climate Variability

The number of different strategies in Mali is much smaller than in Ethiopia (3.5 versus 8.5), while in

Yemen households hardly use any strategies (on average 1.7 strategies per household, with 40 percent of the households adopting no adaptation strategy at all). Figure 9 shows the differences among the three countries and shows what category of strategy is adopted the most (agricultural, water management, diversification, or communal pooling). There are some country-specific patterns. Water harvesting techniques are adopted in Yemen more than in the other countries. In Ethiopia, water harvesting techniques currently are promoted by the extension programs, but they still are not adopted by many households. Improved seeds are adopted especially in Mali, whereas in Ethiopia and Yemen households switch to more drought-resistant crops if necessary.

Malian households, especially those in the Sahelian regions, have for the most part already made the switch from sorghum to more drought-resistant millet. The other countries are still in this process. In Ethiopia, more effort is expended on solving the problem of deforestation. This is a typical example of an institution-based strategy that individual households will not easily adopt and that requires the presence of strong institutions. Furthermore, in Mali the selected strategies are mostly individual strategies, while in Ethiopia and Yemen there is a mix between individual and communal strategies. Figure 10 shows the top 10 strategies adopted in the study villages according to the characteristics of communal versus individual, and enhancing coping capacity versus reducing sensitivity. Although for Yemen there also is a mix between individual and communal strategies, in general very few strategies are adopted and differences between households are large, which makes it difficult to assess. Impressions from the field are that in Yemen few innovations are used by households to reduce vulnerability. In particular, a considerable percentage of households do not make use of adaptation strategies. There still seems to be much less attention to climate adaptation in Yemen than in the other two countries. Recently, a number of World Bank and multidonor programs have started focusing on this issue. Due to a lack of institutional backup, Yemeni households do whatever they can, even though this is limited, especially for the worse-off groups. In Ethiopia, the focus on adaptation is stronger, resulting in more and more diverse strategies. Awareness of the issues at stake and the options available seem to differ among the countries, showing the importance of awareness creation.

Individual Strategies Reducing Sensitivity are Already Applied by Most Households

Figures 9 and 10 show that the strategies used to reduce sensitivity are quite similar among the three countries, even though the percentage of households adopting the strategies differ substantially. These are predominantly individual strategies and are aimed at introducing improved agricultural techniques on the farm level. Although the individual strategies are similar—for example, for the strategy "crop selection" or "improved seeds"—there can still be considerable differences among countries in the actual crops that are selected or the type of seed improvement that best fits the characteristics of the region and preferences of the population. In addition, optimal cropping strategies, planting dates, cropping densities, and fertilizer/pesticide applications are dependent on regional characteristics. As a result, these strategies should be promoted in all three countries, even though their exact interpretation is region-specific.

Despite their Importance, Communal Strategies are Hardly Adopted in Mali

A further distinction can be made between the different strategies according to the level of outside assistance needed; that is, strategies for which households are solely responsible versus strategies in which the government or other institutions have a clear input. These strategies are adopted more regularly, especially by the Ethiopian households. Although they are also part of the top 10 strategies for Yemen, adoption levels in Yemen are very low. In Mali, hardly any communal strategies are adopted. Households seem to be much more on their own. Well-functioning individual strategies may spread throughout the community, but jointly implementing strategies that require cooperation between neighbors and community members hardly occurs. Communal strategies, however, are important, as they may create conditions under which individual strategies become more efficient. Soil erosion prevention, reforestation, communal irrigation, and terrace rehabilitation have public good characteristics. All community members benefit from better agroecological

conditions, whereas nobody can be excluded from them. When initiating such activities, strong institutions are necessary to create commitment among community members and account for factors such as free-rider behavior. Moreover, attention should be given to the worse-off households who seem to have less access to communal strategies.

Strategy Choice is Gendered

The results show that strategy choice is affected by gender. In Yemen, men make most decisions and the role of women is marginal. Water fetching is a task that costs women more and more time. In Mali, men make most decisions, but women have a role, particularly in some activities like handicrafts and petty trade. In Ethiopia, women play a larger role. They especially decide about trade, handicrafts, and home-garden agriculture, but they are also involved in decisions about agriculture. To ensure that interventions reach the target groups, it is important that institutions target their activities to those groups making the decisions and implementing the strategies. This means that those strategies in which women have an important role, like home-garden activities and handicrafts, have to be carefully targeted in order to get an adequate active participation. In general, women are more difficult to reach, yet in general they are more vulnerable than men because of their lower education levels, lower income diversity, and lower asset ownership.

INSTITUTIONAL ASSISTANCE

This section explains the differences between institutional assistance received by the households in the different countries. The strength of the institutional networks in the three countries show remarkable differences. This partly explains the difference in the number and type of strategies adopted.

Ethiopia

The Majority of the Households Receive Assistance from Extension Agencies

In Ethiopia, some institutions reach a large part of the villages and households. In the study villages, almost all households are in touch with local authorities, extension agencies, village communities, and religious communities (Figure 11). In the sample, NGOs especially act in the lowland villages, whereas the lowland households have less contact with the local authorities. This is related to the pastoral nature of these villages and the focus of the extension agencies. The extension agencies focus especially on agricultural and communal development. It seems they put less emphasis on promoting other strategies, or that households do not view them as helpful with these issues. Informal village community institutions are important for mobilizing households for the implementation of communal strategies and for spreading good practices among the households. The somewhat better off, "large, land-owning farmers" and "asset-rich farmers" (clusters 3 and 4) have more contacts with the village community. This indicates that the better-off farm types, who also adopt communal strategies more often, have the strongest position in the informal community institutions and are more effective in advancing their requirements. Accessibility to community institutions is more difficult for the marginalized groups, especially for female-headed households, or these groups lack information on the assistance the village community can offer.

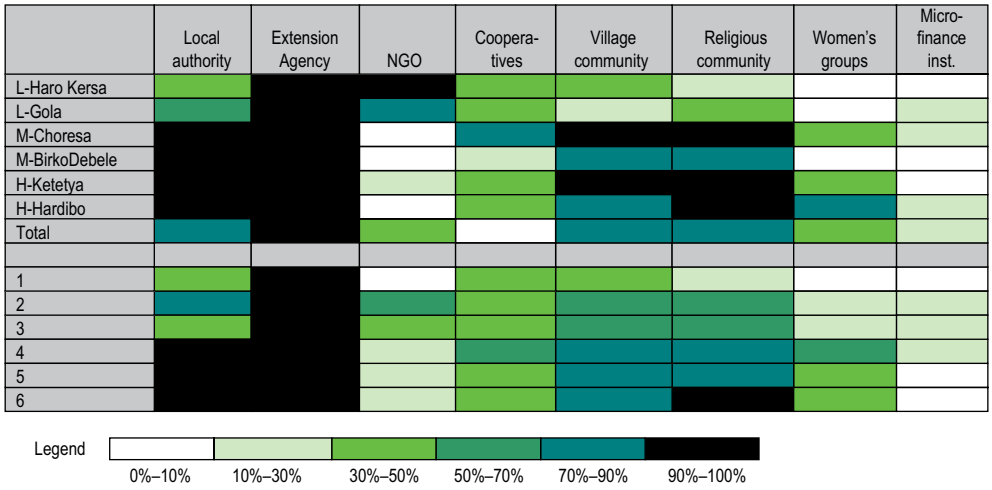
Extension Agencies Especially Provide Training

Extension agencies provide assistance, especially in terms of training, which improves the skills of households to improve their own situation. Other tasks, like input provision, is mainly carried out by cooperatives, while cash provision is carried out by NGOs and formal microfinance institutions. It seems that the informal micro-credit, community institutions are less important for obtaining cash; the cash requirements may outweigh their capacity, so formal institutions have to be approached.

Many Households can be Reached by the Network of Extension Agencies

Extension agencies, which cover almost all of the households in the villages where they are working and are supported by the PSNP and PCDP programs, are an important asset in Ethiopia. They give the authorities the means to reach the households in a relatively easy

FIGURE 11. PERCENTAGE OF HOUSEHOLDS HAVING CONTACTS WITH INSTITUTIONS IN ETHIOPIA



Note: L - Lowland villages are Haro Kersa and Gola, M - Midland villages are Choresa and Birko Debele, H - Highland villages are Keteteya and Hardibo. 1) low-educated pastoralist households, 2) young agro-pastoralists, 3) large, landowning farm households, 4) Asset-rich farm households, 5) small, poor farm households, 6) average farm households.

manner. Moreover, the broad focus of the safety net programs, which make investments both in the public (roads, irrigation canals) and in the private domain (assisting households with their individual household strategies), is a promising strategy. It strengthens the enabling environment and the capacity of households to improve their own situation.

Institutional Assistance is Constrained

The institutional stakeholders point to a number of constraints. They face managerial and financial constraints, lack adequate infrastructure in terms of road networks and information dissemination networks, and sometimes face government policies and laws that restrict or discourage their activities. The long-term presence of the institutions in the regions—so they can build trust in their relationships with households and have the opportunity for follow-up activities—is relatively well-organized in Ethiopia. Realizing trustworthy relationships with farmers and raising awareness among the stakeholders, however, requires continuous effort.

Mali

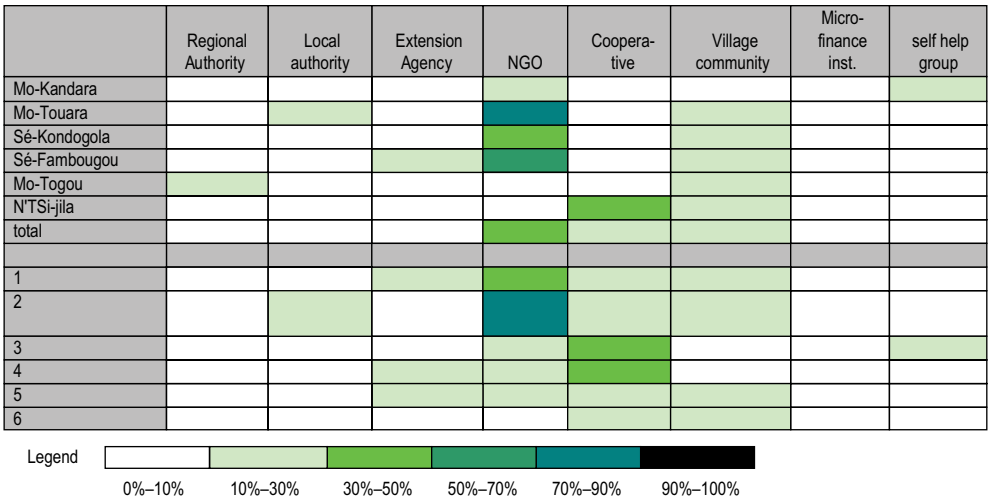
Assistance to Villages is Divided Among Institutions

In Mali, although each of the study villages receives support from more than one institution, certain institutions focus on certain villages (Figure 12). There has seemingly been a division among the institutions in order to cover as many villages as possible and try not to duplicate efforts. This is illustrated by the figure below, showing the percentage of households in contact with the various institutions.

Poor Clusters are Difficult to Reach

Poor households seem to be more difficult to reach. NGOs and village communities provide assistance to the cluster of poor households in terms of assistance to adopt adaptation strategies. International donors, national authorities, banks, schools, and religious communities are not mentioned as institutions that are in contact with the households. However, from the interviews with the

FIGURE 12. PERCENTAGE OF HOUSEHOLDS HAVING CONTACTS WITH INSTITUTIONS IN MALI



Note: Mo - Kandara, Touara, and Togou are in the region Mopti area, Sé - Kondogola and Fambougou are from the Ségou area, and Si - N'tjilla is in the Sikasso area. In Togou area, rice is cultivated.

institutional stakeholders, it follows that many of the institutions that are in contact with the households receive financial and sometimes technical support from the national authorities and international donors.

Assistance Given is Mainly Inputs

The assistance institutions provide to households is predominantly given in the form of inputs like seeds, fertilizers, and pesticides. Training is virtually absent in the listing of assistance received by the households. In the institutional stakeholder interviews, however, training was mentioned as an activity that was provided to the households. Apparently, the households do not envisage this as training.

More Educated Households Benefit More from Assistance

It is an important observation that training and capacity building apparently receive so little attention in the institutions' activities. Training is one of the major ways to give people the capacity to take responsibility and initiate activities to improve their livelihoods. It seems that development assistance in the study villages is focusing more on setting up top-down initiatives, in maintaining traditional cooperative institutions, and providing inputs. In addition, trade organizations such as the Compagnie Malienne pour le Développement des Textiles (CMDT) focus more on input provisioning than on training to improve capacity. This approach gives an advantage to the people that already have an above-average education. They are better equipped to identify the opportunities to improve their livelihoods.

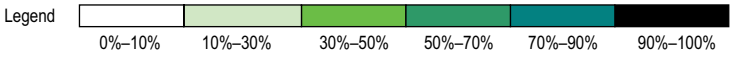
Yemen

Institutions Play a Minor Role in Preparing for Climate Change

In the study villages, institutions play a minor role in the livelihoods of the Yemeni farmers. Figure 13 shows that compared to the other two countries, hardly any of the villages or clusters receive any assistance. According to the findings from the Yemeni village studies, there was almost no contact between households and institutions. Only 7 percent of the households have had contacts with institutions. About half of these households judge these contacts as being useful in the adoption

FIGURE 13. PERCENTAGE OF HOUSEHOLDS HAVING CONTACTS WITH INSTITUTIONS IN YEMEN

Villages	Regional Authority	Local Authority	Extension Agency	NGO	Cooperatives	Village community	Micro-finance institution	Self-help group
R - Al Wathan								
D - Arraheebah								
R - Dhi Shraq								
R - Mu'aneet								
H - Al Mehraq								
H - Al Masajed								
Total								
Clusters								
Diversified, wealthy hh								
Highland smallholder								
Diversified household								
Educated cash crop hh								
Fruit/vegetable hh								
Dryland farmer								



Note: R = villages characterized by rainfed agriculture, D = village with dryland agriculture, H = highland villages with rainfed agriculture and supplementary irrigation. Villages participating in the RALP program are Mu'aneet and Al Masajed.

of adaptation strategies. Extension agencies are the institution mentioned most frequently. Furthermore, national authorities, regional authorities, local authorities, and seed production authorities are contacted for assistance, but only by a few households. Due to the low level of institutional contacts, it is difficult to judge whether particular villages or clusters have more contacts than others. It seems as if the better-off clusters (1 and 5) have somewhat more contact with institutions than the worse-off households; these results, however, are not significant. Moreover, surprisingly, for the villages included in the RALP project, institutional assistance is not higher than in the other villages. This may be due to the fact that the RALP project is a rather new initiative or the fact that households included in the village survey were not familiar with it. As will be discussed later, for setting up networks of extension agencies, as done in the RALP project, gaining trustworthy relationships with the village households takes time. Next to the few "outsiders" who provide help to the households, the respondents indicate that they receive some help or cooperation from neighbors or people from the clan group. Even though these are community institutions, the respondents apparently don't judge them to be an institution. The low institutional coverage and dependence on kinship is well-known in Yemen. In rural Yemen, the role of the national government is often contested and officials are viewed with suspicion, which makes setting up national extension services difficult.

Institutions Hardly Provide Any Assistance

Most of the adaptation strategies adopted by the households were financed and realized by the households themselves using their own resources. Formal institutions hardly provided any assistance in terms of training, inputs, or cash. Only people from the community helped each other through the provision of labor for rehabilitating terraces and setting up irrigation or water management measures. The low number of strategies adopted may partly be explained by this low institutional coverage. Households adopt the strategies they know. The majority have already been applied for centuries; only a few modern strategies are adopted. Households often lack the knowledge, awareness, and financial means to adopt such strategies. Moreover, it often is difficult to adopt them due to malfunctioning markets. Because of the virtual absence of formal institutions, reducing market problems is difficult.

Synthesis

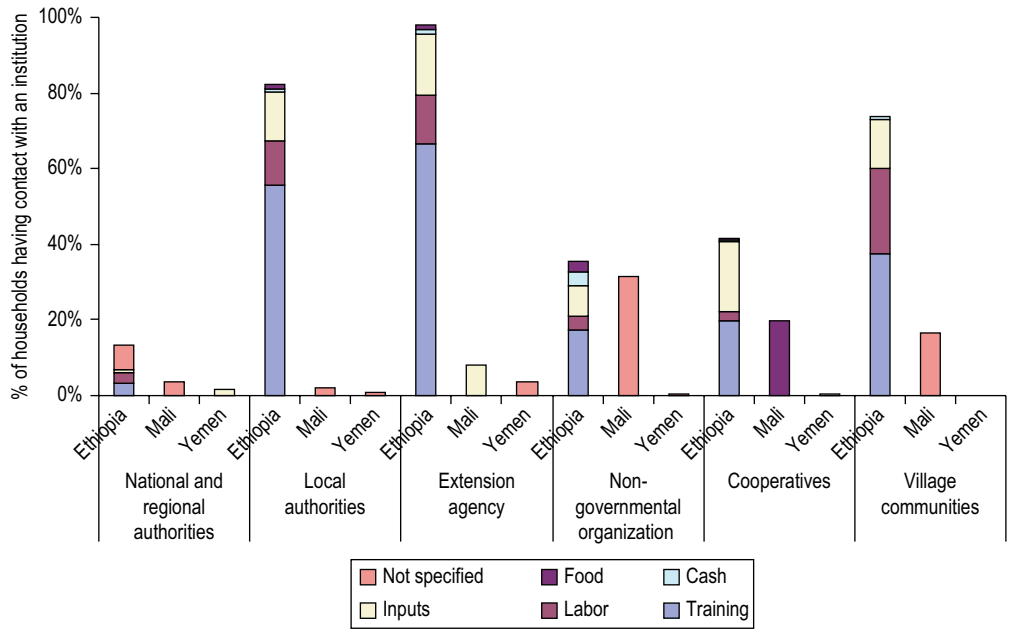
Institutional Coverage is Low in Yemen and High in Ethiopia

The type of institutions most prevalent in each of the countries is partly explained by government policy. The extension services in Ethiopia, supported by efforts such as the PSNP and PCDP programs, have a strong and extensive network of agencies covering a large part of the country (Figure 14). Those regions not covered, or marginally covered, by the extension services host a higher number of NGOs. In Mali, the extension services have a much weaker network. They cover fewer regions, seem to have fewer resources, and reach fewer farmers. They also seem to have less well-coordinated development programs. In Yemen, households in the study villages hardly have any contacts with government institutions, and NGOs are not consulted regularly. Households seem to be much more on their own without much help from any institution, except for the informal community institutions (clans and neighbors). Community institutions in Ethiopia also play an important role. In Mali, communities seem to be much more loosely organized. Due to the large household sizes and high rates of migration, strong community links seem to have become less important. Micro-finance institutions, through formal institutions or as part of community institutions, are important in Mali and Ethiopia. In Yemen, financial capacities of households seem to be larger, among other things due to the cultivation of qat and other cash crops. The growing role of formal micro-finance institutions may be a sign that the financial requirements of modern adaptation strategies outweigh the capacity of informal institutions. As these more innovative strategies require more financial means, the role of micro (or meso) finance institutions may become more important in the future.

Differences in Institutional Coverage have Historical and Political Reasons

Differences in the role of institutions in the three countries are partly explained by historical and political factors. The presence of authorities in rural areas has always been much more prevalent in Ethiopia than in Mali, so spreading knowledge and planning development assistance can

FIGURE 14. PERCENTAGE OF HOUSEHOLDS HAVING CONTACT WITH AN INSTITUTION



Note: The subdivision of the bars shows the allocation of the types of assistance households receive.

be done in a much more coordinated way. In Mali, development assistance is scattered over a large number of organizations and funded by a large number of donors. It lacks the integrated, multi-donor, government-coordinated development programs such as in Ethiopia. For Yemen, the clan culture explains why authorities only play a small role in some parts of the countries. As a result, the recent initiatives to set up integrated, nationwide development programs will be a challenging job and should include at least the set-up of a network of trustworthy extension agencies with minimum political interference and an assurance of long-term financing and planning.

Except for Yemen, Female-dominated Households Adopt Fewer Strategies and Have Less Access to Institutions

Female-headed households often are in a more vulnerable situation than most of the male-headed households. The results show that for Ethiopia and Mali, female-headed households and households with a larger share of adult women adopt fewer strategies than male-headed households. These lower adoption rates are valid for all strategies but especially so for the more demanding strategies like irrigation. Female-dominated households more often adopt strategies like handicrafts and charcoal sales. Sadly, they also receive less assistance from institutions. In Ethiopia, this is especially so from authorities and extension agencies, but also from the community institutions and women's groups. This is partly compensated by extra attention received from religious institutions and micro-finance institutions. In Mali, extension agencies provide less assistance to female-dominated households. When targeting assistance, donors have to pay special attention to the question of how to reach female-dominated households. In Yemen, the reverse is true. Female-dominated households adopt more strategies, even though the types of strategies adopted are not different. One explanation for this is that in Yemen, the richer men have the capacity to marry more women and also the capacity to adopt more strategies. In Mali, polygamy seems to be less related to wealth.

Institutional Assistance Increases Efficiency of Adaptation Strategies

The analysis shows that for many strategies cooperation is needed between the households and institutions. Even for cheap and individual strategies like seed selection or the adaptation of planting dates, implementation is expected to be more successful if back-up is provided by institutions in terms of training and knowledge transfer. In Ethiopia extension agencies play such a role (Figure 14). In Mali, training is almost absent, but institutions fulfil other tasks. In Yemen, the institutions are almost absent and households are more or less on their own. For communal strategies, commitment is very important. It requires a sense of ownership on the part of all stakeholders and the will to cooperate. More training and knowledge transfer about the pros and cons of the different strategies helps improve this sense of ownership and stimulates households to make their own choices. Moreover, some communal strategies require substantial investments in terms of money or labor input. It depends on the strategy whether institutions provide these investments or whether they are (partly) financed by households. Most commonly observed constraints for all strategies are the financial constraints and the difficulty in obtaining affordable loans by households and managerial and budgetary constraints by institutions. Solving these constraints requires intervention from higher level institutions. When properly targeting interventions, account should be given to these constraints. Adaptation strategies will not be successful if these constraints are not resolved.

Each Institution has Its Particular Role

The different institutions play different roles that depend on the level at which they aim their intervention. Institutions do not operate individually but are part of a network of institutions that support and depend on each other. The central government has a role in realizing a better functioning social and market environment, such as improved roads, telecommunications, input and output markets, credit facilities, veterinary facilities, and meteorological information dissemination. These options provide the enabling environment needed for a well-functioning society. Other institutions aim their interventions at the household level. Households need support in terms of training, financial support, techniques, and inputs, which give them the skills and means to improve their situation themselves in a sustainable way. This level of intervention is mostly carried out by NGOs, extension agencies, and community organizations. Institutions have to be aware of their role and their position and responsibilities in the network of nationally operating institutions. If these roles and responsibilities are formulated clearly, institutions can

be held accountable for their activities and it can be checked whether all the tasks necessary for a successful development strategy are covered.

COSTING ADAPTATION

Implementing Strategies Requires Cooperation

The surveys provide evidence of the types of investments stakeholders have to make for implementing adaptation strategies. It is important to realize that investments not only include monetary investments, but also investments in terms of time, skills and social relations (social capital). For many strategies, households are not, or only to a limited extent, capable of choosing and implementing these themselves. Households may lack the knowledge, the skills, the labor, and the money or the help from formal or informal institutions. Further, institutions may lack these resources and skills, which may constrain their activities. Table 2 presents an overview of the investments needed to choose, and successfully implement, a strategy. The figure is based on the costing framework presented in Chapter 2 and Appendix 1. The figure shows the type of resources needed by households, community institutions, and governmental and nongovernmental institutions to implement a strategy.

A distinction is made between the following resources;

- *M* = monetary needs,
- *L* = labor inputs required to actually carry out the tasks,
- *T* = time needed for training, negotiations, and social contacts and
- *C* = commitment needed, which refers to the willingness to furnish the effort to successfully and, in case of communal action, jointly implement the strategies.

For each of the resources, based on the costing information from the households, the institutional and the stakeholder interviews, it is indicated whether low, medium, or high investments are expected and what currently constrains the successful implementation of the strategy. As discussed in the introduction, given the general lack of information about the costs of implementing adaptation strategies, the sensitivity to ask such information from households and the low response rate on these questions, it has been difficult to elicit reliable quantitative information about the monetary costs of adaptation strategies. Reliable costing information from other sources is also almost nonexistent. For that reason, a qualitative assessment is provided here of the different costing elements involved in adopting adaptation strategies. Moreover, no distinction is made between assistance to be provided by governmental or by nongovernmental institutions. In principle, the same type of assistance can be provided by governmental or nongovernmental institutions. It depends on the local context and the organizational and financial capacity of the institutions present whether governmental or nongovernmental institutional back-up is preferable.

Household Investment Capacities are Low

In order to properly interpret the qualitative costing assessment, one has to be aware of the limited investment capacity of most of the households in all three countries. Average cost observations for Mali are on the order of magnitude of XOF 110,000 ($200), which is mainly caused by the high investment costs of cereal banks; without cereal banks average costs are XOF 63,000 ($120). For Ethiopia, average cost observations are on the order of magnitude of Birr 780 per household ($57). Without the communal strategies, this amounts to Birr 575 ($43). For Yemen, the irrigation schemes are costly (YER 680,000 = $3,000). The other strategies are much cheaper and in the range of YER 40,000 per household ($182). As already discussed above, these numbers should not be interpreted as the investment costs for the adaptation strategies, as these should also include the regular costs made for items such as seed, fertilizer, and labor. Moreover, especially for Mali and Ethiopia, the costs provided by the households seem to be rather large, as their earning capacities are generally rather low. Moreover, in all three countries, rural households spend 50 percent to 80 percent of their income on food, so only a limited amount of money remains for making productive investments.[5]

5 For Yemen, expenditures on food are estimated to be on average 45 percent of household income, rising to 60 percent for the poorest quintile (WFP 2010). For Mali and Ethiopia, average food expenditures reach 75 percent of household income, rising to 82 percent for the poorest quintile (Kpodar 2006; World Bank 1998). With average income levels for Ethiopia and Mali ranging between $150 and $250, households only have a limited investment capacity. In Yemen, with an average income of around $1,000, investment capacities are somewhat larger.

Adoption of Low-cost Strategies Depends on their Expected Benefits

Table 2 and the above discussion on adaptation strategies show that low-cost strategies for which households expect immediate gains are already chosen by many households.[6] This is especially true for sensitivity reducing agricultural strategies such as seed selection, changing planting dates, or changing cropping densities. The color coding in Table 2 shows that for these strategies, little institutional assistance is required and that monetary, labor, and training requirements in most cases are relatively low. For well irrigation, monetary investments may be constraining; for manure application, labor requirements may be constraining. As most of these strategies can be adopted without help from the community or institutions, required levels of commitment among the community is limited. Training needs are low for these strategies. Training, however, may improve efficiency. Institutions can play a role in mitigating some of the constraints; for example, malfunctioning markets constrain the purchase of inputs (see below). Without assistance, adoption of strategies may reach a saturation level and new innovative strategies, for more severe climatic variability, may not be developed. The results for Mali and Yemen provide some evidence for this. The most common individual strategies are mostly adopted, but the essential back-up is lacking to initiate the more demanding communal strategies. In order to prepare households in Mali and Yemen for future adverse climatic variability, cooperation between households and institutions is necessary in order to develop new innovative strategies that meet the new challenges.

There are several other promising low-cost strategies—like handicrafts, charcoal sales, or non-timber forest product commercialization—that are selected by only a few households. In addition, home-garden agriculture is a technique that could be selected by many more households and is expected to have high benefits, both in nutritive value and as cash earnings. There may be several reasons why expected benefits turn out to be negative: (a) markets for these goods may be too thin or malfunctioning; (b) inputs may be difficult to acquire if markets are missing; (c) households may lack the knowledge to implement the strategies; (d) for home-garden agriculture, households may lack seeds, irrigation/watering equipment, or storage techniques to make it a successful strategy; and (e) home-garden agriculture may not be adopted because of coinciding peak labor demands with other farm activities.

Alternatively, households may not perceive the focus on coping capacities as being useful in reducing their vulnerability even if net benefits are positive. For most people, agriculture has been the main income source for decades, without any major new income source (except perhaps for migration). It is not evident that people easily initiate new income earning activities, especially if there is not an enabling environment for this activity and if education levels are low. As previously noted, in all three countries only a few strategies to improve coping capacity are adopted. Both formal and informal institutions have an important role in the adoption of these strategies since they can provide training, raise awareness, and promote good examples.

Adoption of High-cost Strategies Requires Cash Income or Institutional Assistance

As indicated above, the more expensive individual adaptation strategies—like the use of water harvesting techniques, improved food storage facilities, and the use of individual irrigation (e.g. pumps)—are also affected by knowledge and credit constraints. Many of these strategies have positive expected net benefits, but face financing constraints and require higher skills. They also require higher levels of social capital (commitment), as households have to invest time and acquire skills to learn how to manage and maintain the new equipment. For Yemen, the use of pumps for irrigation is in many regions a necessity to cultivate crops. Households do not receive institutional assistance but use income from cash-crop sales. So, on the one hand cultivating cash crops provides them with the cash income to improve their coping capacities. On the other hand, cash-crop sales are a necessity for earning sufficient cash in order to operate and maintain the pumps. This necessity also creates a new vulnerability as the risk of bad harvests may cause financial problems. In Ethiopia, several of these more expensive strategies are adopted in consultation with the governmental or

6 In the questionnaire, we asked for the type of benefits households expect from the adaptation strategy. Most households answered that the strategies would reduce their hazards. Most of the strategies were not adopted in the expectation of higher monetary benefits.

nongovernmental institutions present in the area. In Mali, the more expensive individual strategies are hardly used.

More Expensive Communal Strategies Face Financial and Managerial Constraints

Implementation of communal strategies requires coordination among the different households in order to avoid free-rider behavior and share the costs and benefits in an equitable way—as is shown by the red and orange colors in the column showing required commitment levels. Expected net benefits of these strategies are in many cases positive, but they are constrained by financing and managerial skills. Such projects often have high costs, which cannot be met by the participating households themselves, and which can only be recovered in the longer run. For that reason, the involvement of governmental or nongovernmental institutions is often necessary. In the three study countries, only in Yemen such higher cost strategies are adopted without much interference from formal institutions. Additionally, this type of project often requires technical expertise, which most households do not possess. Moreover, informal community institutions play an important role in guaranteeing sufficient commitment among the participating households (Table 2). The longer run investments (in terms of money and labor) to operate and maintain initiatives such as communal irrigation schemes require commitment among all participants. This also implies creating a sense of ownership among the participants to ensure that the strategies can also be applied in the longer run. With changing economic circumstances in each of the three study countries, social networks also have changed. This has had effects on social capital, social cohesion, and therefore commitment to jointly initiate investments. More training and knowledge transfer about the requirements and pros and cons of the different strategies would help improve this sense of ownership and stimulate households to make their own choices. Processes to create such awareness are often difficult and time consuming. Compared to construction or training activities, they are difficult to plan and success is difficult to measure. The governmental or nongovernmental institutions implementing these communal strategies must therefore show that their presence and involvement is assured over a longer period as well. For this, it is important to have coordinated, longer term, and integral commitment from donors.

Assistance from Formal and Informal Institutions May Relieve Adoption Constraints

From the above, three conclusions can be drawn. First, low-cost individual strategies, with low requirements for labor and skills, are already adopted by almost all household types. Monetary benefits will be limited, but the strategies can reduce climate-related hazards.

Second, adoption of some promising strategies, even though their expected net benefits are in many cases positive, may be affected by financial constraints, labor constraints, or knowledge constraints. As discussed above, these strategies have several types of cost elements, each of which may constrain adoption. More wealthy household types—usually having more cash income, more assets, more cash crop cultivation, and more diversified income sources, can adopt the more expensive strategies that reduce their sensitivity or increase their coping capacity. Larger households, with more productive household members—can adopt strategies that are more labor demanding. Higher educated households, having a larger share of household members who attended at least primary education, are better capable of choosing the strategies that best fit their livelihoods. Assistance from formal and informal institutions may lessen some of these constraints. It requires, however, tailor-made strategies by the institutions, carefully targeting the different constraints to strategy adoption.

Third, implementation of communal strategies requires back-up by formal and informal institutions. These strategies require awareness raising, creation of commitment, technical expertise, financial support and managerial back-up. Each of these cost elements may constrain the successful implementation of communal adaptation strategies. Long-term commitment and integrated coordination by the international donor community may lessen some of these constraints. Some of the actions are specific for particular strategies; others are more general investments in public goods necessary to create an environment that is suitable for sustaining adaptation strategies.

TABLE 2. OVERVIEW OF COSTS AND INVESTMENTS NEEDED TO IMPLEMENT ADAPTATION STRATEGIES

Strategy	*Household*				*Community institutions*				*Governmental or non-governmental institutions*				*Constrained by*
Costing elements	M	L	T	C	M	L	T	C	M	L	T	C	
Individual strategies													
Crop Selection and selection of improved seeds													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial
Purchase and application													constraints for extension agencies credit constraints for farmers,
Adapt planting dates: adapt planting dates according to the most up-to-date meteorological information													
Awareness about improved croping calender													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Application of improved croping calender													for extension agencies availability of appropriate meteorological information; need for a well functioning meteorological institute
Use manure of family herd on the field													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Collection and application	?												for extension agencies Adequate supply of manure from own animals, otherwise funds will be needed for purchase of manure
Adapt fertilizer/pesticide application													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial
Implementation													constraints for extension agencies credit constraints for farmers,
Irrigation (wells or pumps)													
Awareness creation													ability to set up training activities to learn how to proplery construct, operate and maintain individual wells or pumps constraint for
Construction and implementation													credit, materials and knowledge on how to dig, operate and maintain wells; constraint for community members providing
Operation and maintenance													assistance constraint for credit, materials and knowledge on how to maintain and repair wells; commitment to maintain wells
Use water harvesting techniques: roof water collection, tanks													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Installation of water harvesting equipment													for extension agencies credit or financial constraints, depending on who finances equipment; labour contstraints for farmers;
Operation and maintenance of equipment													managerial constraints for (N)GO's labour and knowledge constraints for farmers; commitment needed to sustain operation
Temporal migration													
Implementation													Adequate labour availability within the household that can be spared for migration and off-farm labour
Home garden agriculture: promote vegetable and fruit cultivation on home gardens													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Apply home garden agriculture													for extension agencies credit and labour constraints during some months for the farmers
Communal strategies													
Improve or rehabilitate terraces: rehabilitate existing or create new terraces along slopes of hills													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Implementation	?				?				?				for extension agencies constraint for materials (and maybe labour) for party financing construction
Maintenance													constraint for materials and credit for party financing maintenance
Soil erosion prevention: programmes focussing on improved tillage techniques (e.g. improved ploughing and installation of eroson prevention materials (e.g. rock bunds)													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Implementation													for extension agencies necessary to create commitment and sense of ownership among participants
Maintenance													necessary to create commitment and sense of ownership among participants
Restore or preserve forests: prevent deforestation and (re)plant homestead or mountaines forests to prevent soil erosion and improve water infiltration													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Implementation									?				for extension agencies constraint for materials for party financing; constraint on alternative fuel sources
Maintenance													
Cereal bank													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Install infrastructure					?								for extension agencies credit or financial constraints, depending on who finances infrastructure
Create management organisation													managerial constraints for households and/or (N)GO's; high commitment needed to sustain operation
Maintain infrastructure and management system													managerial constraints for households and/or (N)GO's; danger of "free-rider" behavior; commitment needed to sustain operation
Use irrigation: installation and management of communal irrigation systems													
Awareness creation													willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints
Install irrigation systems	?				?								for extension agencies constraint for high labour input by households and high financial needs by extension agencies of NGO's
Operate irrigation systems													constraint for financial needs (e.g. for pumps) and managerial skills; high commitment needed to sustain operation
Maintain irrigation systems													constraint for financial needs (e.g. for pumps) and managerial skills; high commitment needed to sustain operation

= low = medium = high

M = monetary investments, L = labour needed, T = time required, C = commitment

4. CONCLUSIONS AND RECOMMENDATIONS

The field studies in Ethiopia, Mali, and Yemen generated a number of observations on differences in household vulnerability, adaptation strategies adopted, reasons why promising strategies may not be adopted, and the type of assistance institutions provide. These observations make it possible to draw conclusions about why particular patterns are observed and make recommendations on future interventions.

Household Characteristics often are More Important Determinants of Vulnerability than Exposure

In the three study countries, drought is the major climate-related hazard faced by the households. The majority of the households see periods of drought to be a larger threat than flood hazards or extreme rainfall and extreme temperatures. Generally, the regions in the dryer and in lowland areas are more exposed to drought hazards than those in regions receiving more rainfall and those in more mountainous areas. However, households with less exposure to hazards can still be in a vulnerable situation if they are sensitive to climate variability or have a low coping capacity.

Important determinants of vulnerability are low coping capacities—for example, because of low education levels and low income diversity—and high sensitivity, which can be caused by factors such as low landholdings, low cash income, and low adoption levels of water management techniques. Coping capacity can improve when households have more income earning opportunities, less children, and higher education levels. Therefore, in all three countries, investments in education remain an important priority. Better educated people are more capable of making informed decisions on how to improve their livelihoods. Interventions to decrease household vulnerability should carefully consider household differences and the major constraints these households face. Improving income earning opportunities requires improvements in market environments.

Moreover, sensitivity to climate variability can be reduced in the mountainous areas of Ethiopia and Yemen by investments in improving water availability, such as soil erosion prevention or terrace rehabilitation. For all three countries, investments in water management techniques (water storage and irrigation) are important. The dry and low-lying areas in the three countries will benefit from water retention techniques, while those areas closer to streams and rivers will benefit from irrigation schemes. Promoting pump or well irrigation provides short-term benefits, but is unsustainable in many cases because of decreasing groundwater levels.

For all interventions proposed here, not only the physical investments are important. It is probably more important that these investments fit within a broader program of integrated development in which attention is given to the improved social capital needed to sustain the investments in the future.

Target Interventions to Particular Groups and to their Characteristics

Differences in household characteristics within and between villages seem to be larger in Yemen and Ethiopia than in Mali. Furthermore, the roles of men and women differ among the three countries. Where men make almost all decisions in Yemen and Mali, the role of women in Ethiopia seems to be more important. Additionally, in Ethiopia there are more female-headed households, which usually are more vulnerable. Moreover, women generally receive less assistance from institutions than men. For that reason, it is important that interventions are properly targeted, considering especially strategies designed to reach the most vulnerable groups and women. The effectiveness of any strategy—and constraints preventing its adoption—is influenced by household characteristics. Some lessons from this study include the following:

- In Mali, targeting interventions seems to be easier than in Ethiopia and Yemen, as differences between villages and between the household types are smaller. As a result, more generic strategies can be developed that are suitable for particular areas and applicable to all households present. In Yemen and Ethiopia, even within villages a more diverse set of strategies has to be promoted, in which attention is given to the differences in characteristics between households.
- It is advisable to involve women in decisions, especially regarding home-garden agriculture, petty trade, charcoal sales, and handicrafts. Without their involvement, these strategies may not be adopted.
- More marginalized groups need special attention. They are more difficult to reach and have lower adoption levels of the prevailing, low-cost adaptation strategies such as seed selection, changed planting dates, and changed use of fertilizers and pesticides. Furthermore, in Yemen, low institutional outreach makes it even more difficult to reach marginalized groups. In Ethiopia, the situation is better, but still these groups are less involved in communal actions.
- More wealthy households have the opportunity to invest in more expensive strategies. The better-off households in Yemen more often adopt pumped irrigation. In Ethiopia, they more often adopt the more demanding communal soil erosion and water management strategies. As the more wealthy groups are generally more capable of obtaining assistance, development programs should particularly focus on the less-well-off groups. In particulr, lower educated households and households living in remote rural areas are more vulnerable. For Mali and Ethiopia, female-dominated households were identified as especially vulnerable. They usually have lower education levels and low income and assets, and thus have fewer resources to implement adaptation strategies. For all three countries, villages in remote areas with bad infrastructure and far away from urban centers were more vulnerable and adopted fewer strategies to prepare for climate change.

Strong Institutions are Necessary for Successful Implementation of New Strategies

Successful implementation of the different adaptation strategies depends in large part on the institutional assistance that is provided during the adaptation process.

- In the three study countries, similar low-cost, sensitivity reducing agricultural strategies were adopted. These included using more drought-resistant crops and improved seeds, and adapting planting dates and cropping densities. Even though most households can adopt these more traditional strategies themselves, institutional assistance will improve their efficiency. As these strategies have proven their value, institutions such as extension agencies and NGOs should actively support their adoption among households where they are not yet practiced.
- Low-cost strategies focusing on improving coping capacities (like home-garden agriculture, charcoal sales, handicrafts) are selected by fewer households, especially in Ethiopia and Yemen. Migration is one of the few strategies used regularly to diversify income in all three countries. The adoption of strategies to improve coping capacity is often constrained by malfunctioning input and output markets, financing problems, overlapping labor calendars, and lack of knowledge. Some of these constraints can be overcome with institutional assistance. These constraints also require national actions to improve market conditions.

- Due to low education levels and a poorly functioning market environment, few households will be capable of developing innovative strategies that are suitable for adaptation to more severe climate variability. Institutional assistance will be necessary. In all three countries, currently the institutional and market environment does not create an enabling environment in which new initiatives can be easily sustained. Initiating new income generating options or developing more innovative adaptation strategies may be hampered by poorly functioning markets (including credit markets), low quality of infrastructure (roads, electricity, and telecommunications), and low purchasing power. Some of the basic preconditions needed for a well-functioning market environment are currently missing and can only be realized through public investments.

From this, it follows that the objectives of sustainable development will not be reached if interventions focus only on one constraint. Integrated development programs, which are currently executed in Ethiopia and initiated in Yemen, seem to be promising ways of giving households the opportunity to improve their livelihoods.

Better Institutional Coverage Leads to More and More Diverse Strategies

The number of households adopting strategies and the number of strategies adopted per household varies significantly among the countries, with 8.5 strategies adopted per household for Ethiopia compared to 3.5 for Mali and only 1.7 for Yemen. There are a number of country-specific differences. Ethiopia, which benefits more from institutional support than Mali or Yemen, has opted more for community-based strategies. Mali and Yemen, where support through institutions is small (Mali) to negligible (Yemen), households stay with more individual and "proven" strategies that can be implemented with the resources that are readily available from the household itself. Moreover, strategies in Ethiopia are more innovative than those adopted in Mali and Yemen. It appears as if the number and type of strategies adopted depends on institutional coverage, whether through a network of extension agencies (as in Ethiopia) or through a network of nongovernmental institutions. Investments in coordinated networks of extension agencies and NGOs pay off in the adoption of more and more encompassing adaptation strategies, leading to lower levels of vulnerability.

Long-term Presence of Institutions Facilitates the Implementation of Communal Strategies

The preference for individual strategies in Mali seems to be due to the fact that communal action is difficult to organize. This is accentuated by the fact that households are normally large. With these large households, there is sufficient labor to organize strategies that even for Ethiopia would need to be organized on a communal basis because of the lack of labor. Furthermore, the focus on their own household makes it more difficult to cooperate with other households, as these other households are also large and therefore significant additional gains are required in order to justify the involvement of outside assistance. For Yemen, the situation is different. The focus on their own clan and the distrust of authorities makes it difficult to accept assistance from outside the village. Despite the marginal role played by formal institutions, however, households adopt several communal strategies. Due to their relative wealth, they may overcome some of the financial constraints of communal strategies. A more diverse set of strategies can be adopted, however, if institutions can assist with overcoming some of the managerial, knowledge, and technical requirements that households encounter when adopting more demanding communal strategies—for example, communal irrigation schemes, larger scale reforestation, soil erosion prevention, and terrace rehabilitation programs. From this, it follows that the adoption of communal strategies requires the long-term presence of institutions. Institutions can build trustworthy relationships with village households, create commitment among the households to jointly improve livelihoods, and prove the additional gains that can be reached through cooperation.

Coordination and Cooperation Among Institutions Makes it Easier to Reach More Households

Promoting adaptation strategies requires institutional cooperation on three levels.[7] First, formal, governmental,

7 The ABDCC study also concludes that assistance to households has to include cooperation among community-based organizations, local administrative and technical services, traditional rulers, and civil society organizations, as well as NGOs (World Bank 2010b).

or nongovernmental institutions working in the villages have to cover most villages. Ethiopia has a network of extension agencies reaching a large part of all households. In Yemen and Mali, it is more difficult for the formal institutions to fully reach the households. In Mali, institutional assistance is scattered over a number of nongovernmental institutions. Even though most regions are covered by at least one NGO or extension agency, it is difficult to set up well-coordinated nationwide programs because there is little communication between the institutions and limited coordination of interventions.

Second, informal community institutions also play an important role in reaching households. To set up community strategies and spread good practices among the households, commitment among households is essential. This is a task for community institutions. For Mali, these community institutions play a much smaller role than in Ethiopia, so creating commitment among households is more difficult. For Yemen, even though households indicate that community institutions are not important, the strong clan culture explains why communal strategies like terrace rehabilitation and irrigation are applied.

Third, national coordination of interventions can avoid duplication of work, strengthen opportunities to learn from each other, and make it possible to raise the more macro-level constraints to the relevant authorities. Whether it is best to realize this through formal, government-related extension agencies (like in Ethiopia) or through nongovernmental channels (like in Mali) depends on the country context. If setting up a governmental network of extension agencies is not feasible or not possible due to political reasons, it may be useful, for example, to develop a national platform for the exchange of experiences. To realize this, it is important to take further steps to mainstream climate change adaptation across all relevant policy sectors and not make climate change adaptation the responsibility of a single ministry or agency (Kok and Coninck 2007; Stringer et al. 2009).

Despite its Importance, Many Institutions Do Not Provide Training

In Ethiopia, institutional assistance includes an important training component. Some institutions also provide inputs (for example, cooperatives) or cash (for example, micro-credit institutions). Training and awareness raising are important ways to provide households with the skills to make their own choices and to create a sense of ownership of the strategies adopted. Without a sense of ownership, households will remain dependent on institutional assistance and realizing investments that remain productive in the long run will be more difficult. In Mali, assistance is predominantly in the form of inputs. Both in Yemen and in Mali, training by institutions is virtually absent. These differences among the three study countries are explained by the Ethiopian network of extension agencies, which apart from individual assistance also invest in communal strategies (such as irrigation schemes or community reforestation) and public infrastructure (such as roads and electricity). They not only try to improve the skills and opportunities of the households, but also try to relieve some of the constraints limiting the adoption of particularly promising strategies. For Yemen and Mali, such an integrated, coordinated approach is still nonexistent. In Yemen, recent initiatives have a similar focus to the multi-donor, government coordinated, integrated development programs in Ethiopia.

Investments in Adaptation Strategies Require More than Monetary Investments

Investments in adaptation strategies not only include monetary investments. Equally important are investments in terms of time, skills, and social relations. For many strategies, households are not (or only to a limited extent) capable of choosing and implementing these themselves. Households may lack the knowledge, the skills, the labor, the money, or the help from formal or informal institutions. Furthermore, institutions may lack resources and skills, which may constrain their activities, or they may not have the resources, knowledge, or interest to sustain positive changes over time. Especially for the more demanding strategies in terms of money and skills (such as pump irrigation, water storage) and for those for which households have to cooperate to implement and maintain the changes (such as soil erosion prevention programs, irrigation schemes, cereal banks, or input cooperatives), outside assistance is often needed. In particular, the required social capital (commitment and coordination among communities and institutions)

may be constraining. Processes to create such commitment are often difficult and time consuming. Furthermore, compared to construction or training activities, they are difficult to plan and success is difficult to measure.

The results of this study confirm the view that it is important to place greater emphasis on the importance of integrated development. Climate change adaptation strategies have to go hand in hand with sustainable development strategies to be successful (Schipper, 2007). The focus on only a single issue will most likely not result in the envisaged results. Several constraints—on a household, village, regional, or national level—present households with challenges to successfully improve their livelihoods and prepare themselves adequately for changing climate conditions. Moreover, due to differences between households, there is no one overall strategy for solving these different problems. The study shows that in order to develop jointly with households, the appropriate strategies, institutional presence, and institutional coordination and cooperation are important.

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APPENDIX 1. COSTING FRAMEWORK

	Costs						
Costing adaptation methodology	*Individual costs*			*Communal costs*		*External costs*	
Adaptation options	*inputs*	*time*	*training needs*	*inputs*	*time*	*Inputs*	*training needs*
Agricultural techniques							
Seed selection: select drought resistant/tolerant crops like sorghum and heat and salinity resistant crops	costs of improved or different seeds		training on cultivation methods			improved seeds	training on use of improved seeds
Adapt planting dates		changes in labor allocation	training on cultivation methods				training on cultivation methods
Adapt cropping densities / mixed cropping	changing input costs	additional labor time due to intensification	training on cultivation methods				training on cultivation methods
Adapt fertilizer / pesticide application	changing input costs	additional labor due to changed input use	training on cultivation methods			fertilizer and pesticides	training on cultivation methods
Adapt tillage practices (changes in priorities in land use, land area cultivated, labor input)	changing input costs	additional labor time related to new tilling methods	training on cultivation methods			new tillage tools	training on cultivation methods
Apply different zero grazing techniques	costs for feed use; costs for stall construction	additional labor due to changing livestock farming methods	training on livestock management	communal labor provisioning		material for stall construction; feed	training on livestock farming
Change composition of herd (e.g. more goats and less cattle) and livestock products	costs for feed ; opportunity costs for different types of livestock	additional labor related to changing livestock farming methods	training on livestock management				
Improve food storage facilities	costs for food storage construction	labor for storage facility construction	training on food storage facilities	communal labor provisioning			training on food storage
Change the herd composition	costs for livestock purchase/sales	labor time for alternative herd management	training of livestock management				
Change the pastoral system (distance and frequency of mobility)		labor time for alternative herding regimes					
Water management techniques							

Use water harvesting techniques: collect water from roofs, collect water in tanks	materials needed for water harvesting	labor time	training on water harvesting	land for water wells, harvesting systems and ponds	labor time for construction and maintenance of water storage facilities	materials needed for water harvesting	training on water harvesting techniques
Improve, construct or rehabilitate terraces	materials needed for terrace construction and renovation	labor time for construction, maintenance, and rehabilitation	training on farming on terraces	land for terraces	labor time for construction, maintenance, and rehabilitation	materials needed for terrace construction and renovation	training on terrace construction and maintenance and on farming on terraces
Use irrigation	materials for construction and maintenance of irrigation systems; costs for water; costs for pumping	labor for construction of irrigation systems; time for communal water management	training on the use of irrigation facilities and water management	land for irrigation canals and systems	labor for construction of irrigation systems; set up of water user association or a comparable organizaton	materials needed for set up of irrigation systems; legal documents for organizing water user associations	training on setting up and maintaining irrigation; training on communal water management
Re-use treated wastewater	systems to redistribute water from wastewater facility to plots	labor for managing wastewater treatment and for applying treated wastewater		set up of wastewater storage and treatment facility	labor to set up, maintain and manage wastewater treatment facility; training on wastewater treatment and management	materials for wastewater storage and treatment facility	training on wastewater treatment facilities and management
Improve watering sites in pastoral areas		labor for well and pond construction		land for ponds; materials for designing, constructing, and maintaining ponds	labor for pond construction; set up of water user association	materials for designing, constructing, and maintaining ponds	determination of optimal location and design of ponds; assistance with water user association
Diversification							

	Costs						
Costing adaptation methodology	*Individual costs*			*Communal costs*		*External costs*	
Adaptation options	*inputs*	*time*	*training needs*	*inputs*	*time*	*Inputs*	*training needs*
Use alternative sources for fuelwood	costs for new cooking facilities and fuel		training on alternative cooking facilities			new cooking facilities and fuels	capacity building on cooking, fuelwood problems, etc.
Temporary migration to urban areas or abroad	investments in transport costs and living expenditures	reduced on-farm labor availability during off-season		dependence of those staying at home on neighbors			awareness raising on (dis) advantages of migration
Temporary migration to other rural areas (e.g. plantations)	investments in transport costs and living expenditures	reduced on-farm labor availability during off-season		dependence of those staying at home on neighbors			awareness raising on (dis) advantages of migration
Permanent migration (to other rural areas, urban areas or abroad)	investments in transport costs and living expenditures	reduced on-farm labor availability during entire year		dependence of those staying at home on neighbors			awareness raising on (dis) advantages of migration
Non-timber forest product commercialization (e.g. gum production)	investments in tree cultivation	labor time needed for planting and maintaining forests		investments in tree cultivation	labor time needed for planting and maintaining forests	investments in tree cultivation	training on non-timber forest product commercialization
Home-garden agriculture / legume based agroforestry / horticulture	investments in home-gardens; seeds, fertilizers	labor for home-garden cultivation				improve marketing channels; seeds, etc.	training on home-garden cultivation
Increase market sales		labor for marketing		improve local markets		improve marketing channels and road infrastructure	information on price fluctuations and price development
Handicrafts/commerce	inputs for handicrafts	labor for handicrafts		improve local markets		improve marketing channels	information on price development
Reduce expenses by changing consumption patterns (meal composition, frequency of meals)	lower costs but high opportunity costs due to reduced productivity						
Draw-down on livestock, surpluses, or savings	lower reserves						
Communal pooling							

Restore and preserve homestead or mountain forests to reduce erosion and peak flows from intense rainfall	costs of reforestation	labor for replanting	training on reforestation		labor for replanting	trees, seeds, materials, fertilizers,…	training on reforestation
Rangeland preservation and grazing restrictions		labor for implementing management systems	rangeland management training		Set up a rangeland management system	legal embedding of rangeland management systems	assistance with rangeland management system
Set up community seed banks and food storage facilities		labor for facility implementation		storage facilities	labor for storage management	storage facilities	knowledge on optimal storage techniques
Soil erosion prevention programs of farming land	costs for erosion prevention works	labor for erosion measures			labor for erosion measures	inputs needed for erosion measures (e.g. stones, trucks, materials)	training on erosion prevention measures (e.g. rock bunds,…)
Change local water management rules and regulations		labor for alternative water management	water management training		labor for water management association		training on water management