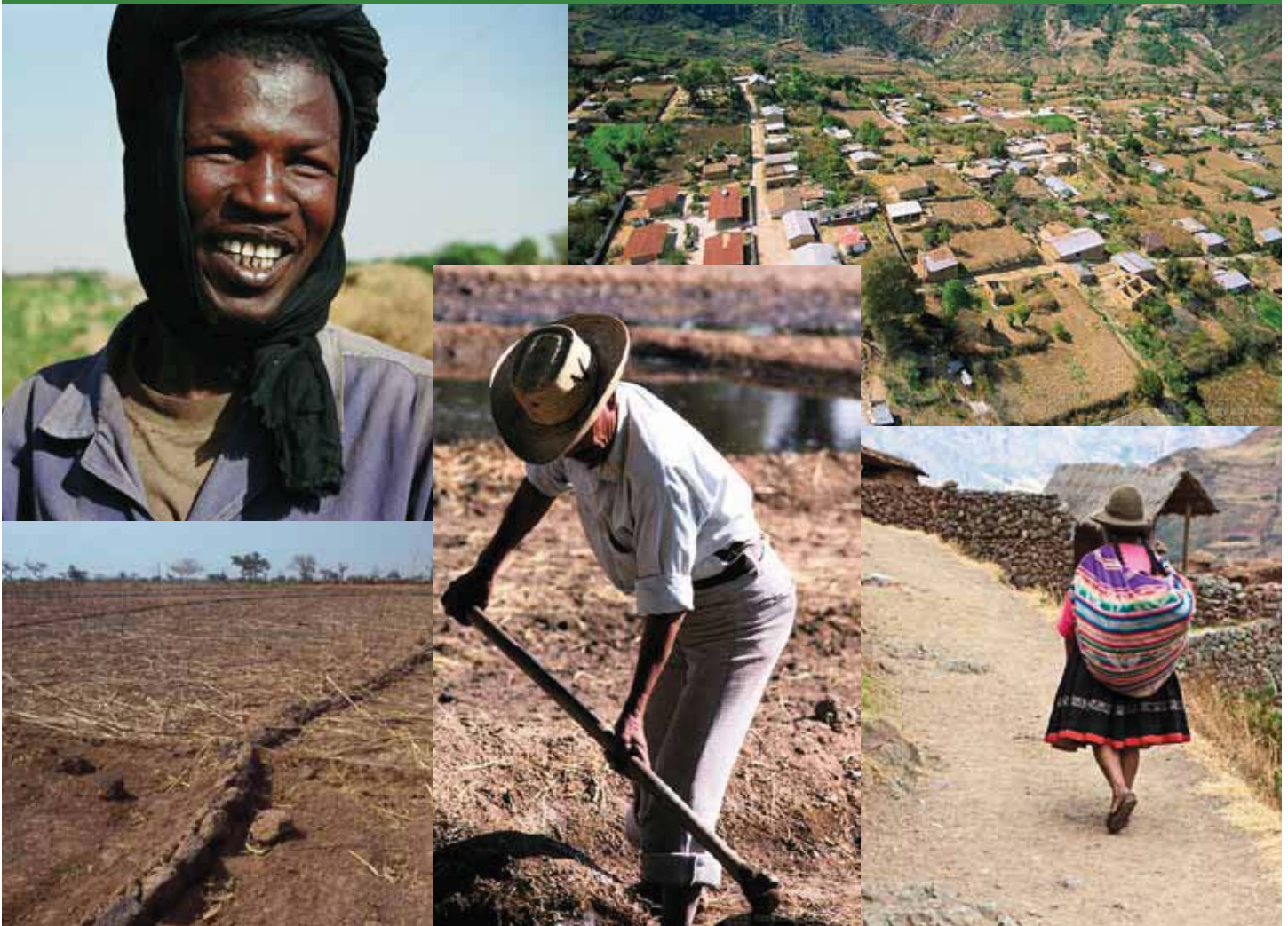




THE WORLD BANK

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Area-Based Development, Local Institutions & Climate Adaptation: A Comparative Analysis from West Africa and Latin America





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A Comparative Analysis from West Africa and Latin America

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EXECUTIVE SUMMARY

Hopes for rapid progress on a global agreement to reduce emissions have slowly receded. It is increasingly important to learn how to limit damages of climate impacts and enable progress towards development goals in the face of adverse climate change. **The need for improved knowledge to inform decisions and policies is nowhere greater than for more vulnerable social groups.** Despite not contributing to the problem of worsening climate, many poor, resource-dependent populations are already coping with substantial climate variability, particularly in low income countries.

This report presents the results of field-based research and original data analysis for six countries in West Africa and Latin America (Burkina Faso, Niger, Senegal, and Mexico, Peru, and the Dominican Republic). The studies were carried out over a period of two years during 2009–10, and involved in-country research partners as well as extensive consultations with decision makers at different levels and in different sectors. The study's **basic findings and recommendations in three key domains are based on data from surveys of more than 1,000 households and interviews with nearly 100 decision makers** in the six countries.

The research starts from and builds upon the following three key assumptions:

- **Supporting adaptation strategies requires an understanding of the nature of the vulnerability, livelihood strategies, and the needs of poorer and more marginal social groups.**

- **Poorer, more marginal groups have developed their existing adaptation practices over centuries of experience with climate variability** and these practices form an important basis for supporting future adaptation to climate change.
- **Effective policy interventions to support adaptation must incorporate diversity in their design:** diversity of socio-economic and climatic contexts, variations in institutional arrangements, and differences in the locally available resources that structure current adaptation practices.

These three key assumptions of the study are encapsulated in its cornerstone – the area-based development approach. **The area-based approach highlights institutional linkages and integration across sectors for a given territory, and emphasizes the need to improve connections among households and institutions in a given area as well as linkages across areas to promote cohesive development processes.** It suggests that effective pursuit of development at all levels requires better knowledge and analysis of available endowments and assets, capacity building to address weaknesses of agents and territories, and effective partnerships among households, organizations, and development agencies.

To understand the vulnerability of rural households and communities, the study operationalizes the area-based development approach by building upon existing work on vulnerability indices. Because most households and communities in the areas covered by the study are highly vulnerable, differences in their levels of vulnerability are insufficient to inform policies, address key sources of vulnerability, or redress the factors that make households and communities vulnerable. Therefore,

instead of developing composite measures of vulnerability, the study focused on vulnerability profiles to generate clear information about how and why different clusters of households are vulnerable. In

constructing vulnerability profiles, the research relied on measures of exposure, sensitivity, and adaptive capacity – the three commonly used components of vulnerability.

Vulnerability profiles can be based on qualitative as well as quantitative data. Both these approaches were used in the study for communities and households. They show that even groups at the same level of vulnerability require very different forms of support for adaptation depending on the nature of their exposure to climate hazards, their forms of livelihoods and resource dependence, the kinds of adaptations they rely upon, and the institutions to which they have access.

Households in the studied villages and countries practice a vast array of adaptation strategies to address the climate risks they face – their choice of adaptation strategies is inevitably influenced by the forms of livelihoods they practice. The study developed a succinct set of **five categories of household level adaptations: mobility, storage, diversification, communal pooling, and market exchange.** The remarkable array of adaptations used in the studied communities can be classified using the above five categories. These categories of adaptation practices are closely linked to the distribution of risks that households confront and the adaptations are a response to these different forms of risks.

- **Mobility** helps households adapt to risks distributed across space;
- **Storage** is useful to deal with risks and hazards experienced over time.
- **Diversification** helps address risks that affect different asset classes owned by households, or different goods they consume or sell.
- Different households as units of social organization are often subject to different risks. **Communal pooling** helps address risks distributed across households. And, finally,
- **Market exchange** is a highly versatile mechanism to address many different types of risks for those households that have the wherewithal to participate in markets, although it can also reduce the ability of

households to deal with risks in cases of over-specialization.

The above approach to examining adaptation and to assessing how adaptation strategies help reduce risks associated with climate variability and change also helps make a conceptual distinction between development (improvements in human welfare in multiple dimensions) and adaptation (enhanced ability to manage risks of different types).

External policy support can enable improved adaptation through **three types of intervention mechanisms – information, incentives, and institutions.** These mechanisms play specific roles in structuring household- and community-level adaptation strategies. New information leads households and communities to make decisions that allow the best use of resources already available to them; new incentives can address adaptation deficits or gaps in the abilities of households and communities to cope with climate threats and hazards; and new institutions or organizations (or reconfigurations of existing institutions) help coordinate adaptation practices across sectors and levels of decision making. In practice, policy interventions often combine these three types of mechanisms.

The findings and recommendations of the study fall into three major categories: institutional capacity and cross-scale institutional coordination; the political economy of vulnerability and adaptation; and the role of information, assets, and institutional access in adaptation.

Institutional Capacity and Cross-Scale Institutional Coordination

In nearly all the studied countries some national-level efforts are under way to improve country-wide plans for adaptation to climate change. The study also finds that climate adaptation strategies are ubiquitous in interviewed households and communities. But **organizational mechanisms to build a stronger connection between local-level adaptation actions and national-level planning are missing** in nearly all the cases. Similarly, there is only limited information and resource sharing among different ministries and agencies in relation to climate change impacts and solutions. **Cross-sectoral coordination among institutions and agencies**

is **inadequate** or absent at the local level also. These gaps in coordination and information sharing suggest that resources available to different institutions and agencies are often not put to the best uses to support adaptation. Finally, although local organizations are crucial to households that pursue adaptation strategies, most **existing local organizations have limited capacity** to provide resources and information to their constituents. Higher demands from constituents to cope with impacts of climate change are likely to further fray their weak capacity and the ability to establish links with other organizations.

These patterns of institutional weakness point to obvious areas for external interventions to support adaptation: particularly in enhancing cross-scale coordination and in promoting interactions among organizations at local levels so that they can make better use of available resources. These analytical results also highlight the importance of the area-based approach in pursuing effective adaptation to climate impacts by improving institutional and organizational linkages across sectors and hierarchies.

Overcoming barriers to institutional coordination will require substantial investments – the absence of such coordination at present indicates that under the status quo, coordination is costly. **Investments in boundary organizations, formulation of strategic policy coordination initiatives, improved information provision about climate threats and impacts, and provision of added material resources to offset organizational costs can support greater interaction, coordination, and information sharing.** But success is likely to hinge on clarity regarding commonality of goals, and may be more achievable across scales than across sectors owing to competition over resources among sectoral organizations at the same level. The example of local organizational coordination in the Yacus sub-basin in Peru so as to secure more resources from central agencies also suggests that such coordination may be easier to promote at the local level through centrally disbursed incentives.

Resources that can be used by decentralized organizations to enable more effective adaptations by household and community decision makers are necessary owing to the unpredictability of climate threats and their impacts in specific locations. Such **unpredictability of climate**

threats means that appropriate adaptation responses require both information and resources to be available in a decentralized fashion. The mismatch between the information needed to direct resources socially and spatially to their most valued uses (more available with local organizations and households) and the availability of resources (with central agencies and decision makers) can be addressed. **Two strategies to address resource and information mismatch are to develop, implement, and support institutional mechanisms for more effective information flows and make more resources available to local organizations and institutions that are accountable to their constituents.**

The Political Economy of Vulnerability and Adaptation

The study finds that most interviewed households and communities are highly vulnerable to climate risks – thus, climate hazards translate rapidly into economic hazards. Nonetheless, different groups of households are vulnerable in different ways and for different reasons. At the most basic level, some are vulnerable because of greater exposure to climate hazards and others because of greater sensitivity of their incomes to climate threats, and yet others because they are highly specialized in terms of their assets or occupations. Indeed, the studies also show that **substantial shifts in livelihood strategies and relative dependence of vulnerable social groups on different livelihood resources are already under way.** In Peru's Yanamarca sub-basin, for example, remittances have become a major source of household income and livelihoods, displacing agriculture as the key income source. The same is true of households in Michoacán. External adaptation interventions must take into account the changing structure of livelihoods in the rural areas of the developing world, mainly by recognizing the need for adaptive shifts in policy focus in parallel with changing livelihoods and needs in target regions.

Studies in all six countries indicate that the **adaptation strategies at the local level are predominantly based on existing resources and historical practices, linked closely to livelihoods of households, and are assisted by local institutions that have low levels of resources and capacity.** The repertoire of adaptation strategies is vast. It includes purchase and sale of animals depending on kind of disaster faced, storage

VULNERABILITY PROFILES OF HOUSEHOLD CLUSTERS IN WEST AFRICA

Country	Cluster characteristics	Avg. # of adaptation strategies used by cluster members	Key institutions accessed by cluster members
Burkina Faso	1. High adaptive capacity (AC) 2. High exposure and sensitivity	1 1.4	Similar levels of access for different institution types
Niger	3. High AC and exposure 4. High sensitivity	4.4 3.2	Agricultural coops. Community-based organizations
Senegal	5. High AC and exposure 6. Low AC and exposure	2.0 1.9	Similar levels of access for different institution types

of food, assets, and feed, greater reliance on natural resources such as forests or rangelands, remittances from relatives, loans, use of different varieties of seeds, crops, and various agricultural inputs, development of infrastructure, community cereal banks and savings and loan organizations, short and long distance migration, temporary and long term migration, search for new employment opportunities, new forms of investments including education, development of connections with different kinds of organizations, and insurance purchase, among others.

The table above shows clearly how the vulnerability, adaptation strategies, and institutional connections of households and communities vary across three of the studied countries.

These differences in the nature of vulnerability among those who are vulnerable means that **external interventions to support improved adaptations need to structure information and resource flows** to the needs of communities and households they seek to assist, and to do so through institutions to which households have access. In this context, **private sector organizations such as local grocery stores and businesses, and civil society organizations such as savings and credit societies have a key role to play in supporting adaptation:** they are widespread in much of the developing world, and most households interact with them daily. The example of community savings and loan societies in Michoacán shows that households used them regularly, and with increasing frequency for addressing their adaptation-related financing needs. Similarly, these organizations were key conduits for credit to households in post-disaster situations in the Dominican Republic. They can become even more useful as mobile-phone

based banking and credit services become more widely accessible. There is thus substantial room for using existing institutions to support new adaptation related financing needs through existing local organizations.

The relationships between specific adaptation strategies and types of climate impacts and exposure both provide key points of leverage to structure policy interventions. Thus, in the case of slow onset disasters – particularly those related to erratic rainfall or low levels of precipitation, adaptations focusing on market instruments such as insurance products, long term storage, and diversification of consumption goods, factor inputs, and products are more likely to be effective. In contrast, rapid onset disasters are likely to require support for adaptation strategies related to mobility and pooling of resources, and support from external actors. In the West African studies, for example, households with a high degree of exposure to climate stresses also had high levels of institutional access, but those with high sensitivity – because of either low levels of occupational diversification or few types of assets owned by the household – did not have high levels of institutional access. Finally, better information is likely to be of use in responding to all kinds of climate events, particularly when made available through multiple sources.

Information, Assets, and Institutional Access

Observed adaptation strategies are strongly associated with specific household characteristics. Both qualitative and quantitative evidence suggests that studied **households tend to deploy a larger portfolio of adaptation strategies when they possess more assets of different types, when they have access to diverse information**

sources, and when they have access to multiple local organizations and interact more frequently with these organizations.

The above finding points directly to the three key areas in which external support can improve adaptation effectiveness. Enabling households to pursue the range of adaptation strategies they want is likely to require interventions that improve access to institutions, reduce poverty through enhanced ownership of productive assets, and better distribute information about climate hazards through multiple sources.

However, decision makers need also to take into account the possibility of perverse incentives as a result of stronger support for adaptation. Enhanced external support for adaptation may, for some households and communities, displace their own efforts to adapt and address climate change impacts.

Therefore, **interventions that enhance institutional support and access, or improve information availability, may be more effective in promoting sustainable adaptations than those that lead to straightforward income transfers to vulnerable households.**

1. INTRODUCTION AND GOALS

The debate over how best to address climate change remains unsettled as recent climate-change related negotiations demonstrate. Continuing lack of urgent action to reduce emissions has led some climate scientists to declare that the thresholds beyond which dangerous climate change will become inevitable have either been crossed already or are close to being crossed (Solomon et al. 2009, Zickfeld et al. 2009). As the prospects of concerted political action to lower the likelihood of dangerous climate change recede into the future, improved knowledge about how adaptation to climate impacts can effectively be pursued and supported is increasingly important (Eriksen and O'Brien 2007).

Climate disasters share a key characteristic with social disasters: droughts, heat waves, floods, erratic rainfall, storms, coastal inundation and fires, like wars or faulty policies, tend to affect poorer populations more adversely than they do those who are well off. It is not surprising therefore that much of the scholarship on climate change is in broad agreement that the effects of climate change will exacerbate—in many situations intolerably so—a wide range of existing risks to the livelihoods of the poor and the vulnerable (Brainard et al. 2009, Hertel and Rosch 2009). Even those who suggest that climate impacts on poverty are likely to be more modest make a number of qualifications related to impacts of mitigation and long-term impacts, and agree that the impacts are likely to be regressive (Skoufias et al. 2011). It is highly likely that without urgent action, climate change will also introduce new, hard to predict, and potentially far

more dangerous threats in the long run, making the lives and livelihoods of vulnerable populations even more precarious than they are today (World Bank 2009). Finally, climate-related threats are likely to pose the greatest risks to those living in marginal environments.

This report on adaptation to climate variability and change draws together the conclusions of a series of comparative case studies undertaken for the Area-Based Development and Climate Change (ABDCC) project of the Social Development Department of the World Bank. The report contributes to a better understanding of pro-poor adaptation by addressing the growing need for systematic analyses of existing rural adaptation strategies in the face of climate variability. The analysis draws together lessons from comparative field-based research in West Africa (Niger, Burkina Faso, and Senegal) and Latin America (Mexico, Peru, and the Dominican Republic). The study shows 1) how different types of climate phenomena affect households that are already vulnerable owing to their political-economic and social circumstances, 2) the ways in which households cope with and adapt to climate hazards, and 3) the role of rural organizations and institutions in helping vulnerable households cope with climate impacts and other sources of vulnerability more effectively. The study does not focus on costs of adaptation at the macro or micro level, but complements other World Bank and Social Development Department studies that do undertake an economic assessment of adaptation (World Bank 2010a, World Bank 2011).

The study also complements other macro-level analyses in which the focus is primarily on government policies

in the context of adaptation (Brooks et al. 2005, Moss et al. 2001). To do so, it identifies what kinds of new policies and support for adaptation are likely to be most needed and which kinds of interventions are likely to be more effective at the local level where poor and vulnerable households reside and cope with climate impacts. It supplements the case-oriented research on adaptation by examining the territorial endowments and climatic characteristics of studied sites, their organizations and governance arrangements, household vulnerability, and advantages and limits of current coping strategies. The study also indicates the degree to which lessons from case studies of adaptation in specific communities and countries can be generalized more broadly (Bhattamishra and Barrett 2010, Dumarú 2010). Finally, by examining different kinds of climate hazards and impacts, it examines the extent to which different forms of adaptation are hazard-specific or more general in their adoption and effectiveness.

The need to address challenges resulting from increasing climate variability and change is recognized increasingly by the policy and scholarly community because of the fuzziness that continues to characterize the types of risks that are the most important to address, the mechanisms through which to address risks, and the costs of addressing risks and responses to them (Adger et al. 2007, Fankhauser 2010). One important reason for the lack of clarity is that climate risks differ both across space and among social groups. Those living in dry and semi-arid regions face very different risks from those in coastal locations, and different dry locations or different coastal stretches do not necessarily face the same risks. This obviously raises the question of the extent to which different kinds of climate impacts *vs.* different features and endowments of social groups generate differences in vulnerability. Taking these differences into account and designing adaptation policies that reduce the vulnerability of more marginal households and communities, and support the adaptation strategies of poorer people, is key to the adoption of pro-poor adaptation (Vernon 2008, Heltberg et al. 2010: 260).

The ABDCC study finds its motivation the need to address pervasive knowledge gaps about variations in climate and socio-political risks faced by vulnerable rural populations, and to describe and analyze the

effectiveness of different mechanisms decision makers can use to address climate and other environmental risks. The project builds on extensive original research with households and organizational decision makers in the six selected countries in Latin America and West Africa. It also uses available knowledge about variations in territorial endowments and institutional arrangements to examine how different behavioral strategies and organizations can help households and social groups cope with climate impacts. Using diverse sources of information and data, the project attempts to develop a more systematic understanding of the effectiveness of rural organizations. On the basis of the analysis of country and regional findings, this synthesis report examines the relationships of institutions and organizations to adaptation and highlights the gaps in existing institutional capacities in the studied cases and how they can be addressed.

The major findings in the report concern three key issues: cross-scale institutional coordination and capacity; the relationships among hazard exposure, vulnerability, and adaptation; and the relationship between different household characteristics and observed forms of adaptation. The report suggests that although households have some leverage over the types of adaptations they practice and the effectiveness of the adaptation strategies they use, contextual and institutional factors are critical in supporting or hindering adaptation. External interventions can therefore be focused on either households or the social-economic and institutional context, or both, to strengthen adaptations practiced by households.

The report first introduces the three conceptual building blocks for the study and its findings: territorial development, vulnerability profiles, and adaptation practices. It then briefly analyzes the different mechanisms through which climate and development policies influence outcomes at sub-national and local levels. This discussion sets the stage for the main findings of the research supported by the ABDCC project for Latin America (Mexico, Dominican Republic, and Peru) and West Africa (Burkina Faso, Niger, and Senegal). After examining the research results comparatively and the scope of the findings, the report ends with the major implications and recommendations based on the findings.

2. KEY ISSUES: TERRITORIAL DEVELOPMENT, VULNERABILITY PROFILES, ADAPTATION PRACTICES

Three key concepts undergird the project and its findings: territorial development and institutional/organizational relationships, vulnerability characteristics of households and communities, and adaptation practices in response to climate and other risks. This section provides a brief overview and introduction to these concepts – they are discussed at greater length in the appendices to this report.

2.1 TERRITORIAL DEVELOPMENT

Territorial development refers to area-based development approaches that rely on the analysis of available resources, institutional endowments, and development needs of different social groups in a given territory (Binder et al. 2007). Because development in a climate-challenged world needs to take into account relevant climate impacts and responses in a region, the territorial development approach is well suited to the proposed work. The approach highlights the need to attend to the relevant linkages of the local spatial, governance, and political-economic context in multiple sectors, among different actors and across levels, including higher levels relationships and actors (Schejtman and Berdegué, 2004). Territories were identified in this project using relevant administrative units as an entry point. Apart from being a convenient

starting point, administrative units also bring to the fore the specific decision makers whose actions influence policy and administrative choices.

2.2 VULNERABILITY PROFILES

The concept of vulnerability profiles builds on the familiar notion of vulnerability, defined in the climate change literature as broadly being a function of exposure (the physical threat from climate risks), sensitivity (the susceptibility to damage, given a level of physical threat), and adaptive capacity (the capacity to return to the pre-hazard state of functioning and well-being). Although this is a useful starting point, vulnerability levels are of limited use in structuring policy interventions because they do not provide sufficient information about the reasons why some households or communities are vulnerable, and because the distinction between sensitivity and adaptive capacity – while clear conceptually – is difficult to implement operationally. In contrast, the vulnerability profiles approach focuses on the distinctive determinants of the vulnerability of different social groups and locations. Although the literature on vulnerability profiles is limited, some recent work provides useful hints about how the concept can be used (Christiaensen and Subbarao 2005, Morrow 1999). As used in the project, the combinations of factors that generate similar kinds of vulnerability for clusters of households, and the relative contributions of different factors to vulnerability are an important area of analysis in understanding how and why different groups are vulnerable, and thereby to identify the most important leverage points for external interventions (see appendix 3).

2.3 ADAPTATION PRACTICES

Adaptation is the set of actions and adjustments undertaken to maintain and recover the capacity to deal with stresses induced as a result of current and future external changes (Nelson et al. 2007: 396, Alland 1975). In the context of climate variability and change, adaptation by households, communities, and social systems occurs in relation to experienced and anticipated climate and associated risks. The most important risks that the poor face as a result of climate impacts are distributed across space, over time, across assets owned, and across households. The corresponding four adaptive responses used by rural poor households are mobility, storage, diversification, and communal pooling. In addition, poor households can also use market-based exchanges to address risks if they have access to markets or when risk-reducing and risk transfer instruments are traded through market exchange opportunities (e.g. consider insurance products for dealing with agricultural or crop risks or with risks that affect livestock). But because markets are imperfect and many market instruments are too costly or physically inaccessible to especially vulnerable and poor groups, the other four classes of adaptive responses remain critically important for poor vulnerable households (Halstead and O'Shea 1999, Agrawal 2010).

Income and asset increases can also help households, social groups, communities, and nations cope better with risks associated with climate change and variability. However, the mechanisms through which households cope with risks using increased incomes and assets are often likely to translate into one of the five adaptation strategies described above. In this sense, the strategies of mobility, storage, diversification, communal pooling, and market exchange are specifically oriented to address different risks faced by households (see also appendix 4). In addition, rural communities and different social groups – whether rural or urban – can also improve their ability to cope with risks through new innovations, infrastructure development, and investments in institution building (Agrawal 2010).

Table 1 (based on Agrawal 2010) illustrates how the categories of coping strategies correspond to many of the adaptation practices encountered during field work.

TABLE 1. ADAPTATION PRACTICES CORRESPONDING TO BASIC TYPES OF ADAPTATION

<i>Basic adaptation forms</i>	<i>Corresponding adaptation practices</i>
Mobility	Agropastoral migration; wage labor migration; involuntary migration; remittances (together with market exchange)
Storage	Water storage; food storage (crops, seeds, forest products); animal/live storage; pest control
Diversification	Asset portfolio diversification; skills and occupational training; occupational diversification ; crop choices; production technologies ; consumption choices; animal breeding; EWS; dikes; embankments
Communal pooling	Forestry; infrastructure development; information gathering; disaster preparation; social safety nets, transfer payments
Market exchange	Improved market access; insurance provision; product sales; seeds, animal, and other input purchases; remittances (in conjunction with mobility)

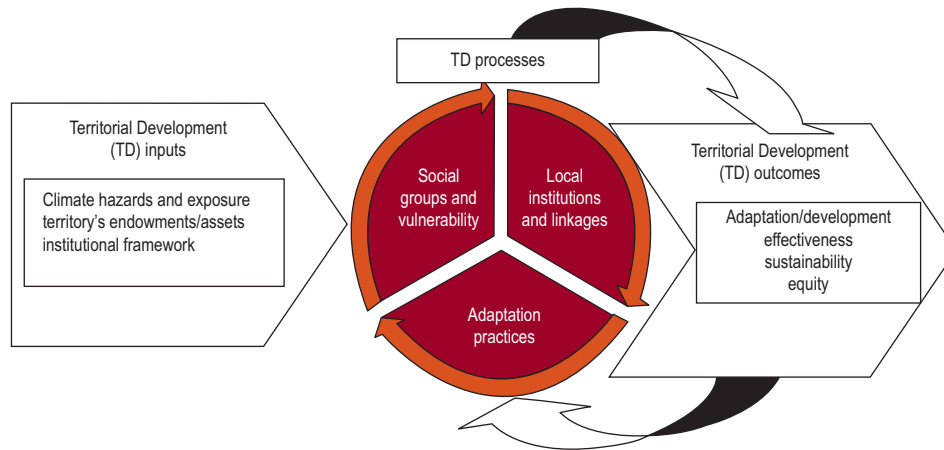
Many of the above forms of adaptation also contribute to enhancements in average incomes. Indeed, for those households and communities that face regular climate and other risks, the adoption of the above practices is likely to buffer their well-being in times of stress and scarcities, and thereby work synergistically with development outcomes. In this sense, adaptation and development strategies are related to each other along a continuum (McGray et al. 2007, Mearns and Norton 2010: 31–32), even if it is possible to make a conceptually important distinction between them – that related to how well a particular strategy helps address risks.

2.4 ANALYTICAL APPROACH

Figure 1 brings together the above three elements and situates them in relation to each other in the context of the ABDCC project.

The figure underscores the underlying analytical approach of the project, and the relationship among the building blocks that together constitute the approach. It essentially suggests that different territorial institutions, assets, and physical characteristics (including climate) shape the vulnerability of different groups and

FIGURE 1. TERRITORIAL DEVELOPMENT AND CLIMATE ADAPTATION APPROACH



communities, their adaptation practices, and the local organizations and their interactions. Local organizations, social groups with their vulnerability characteristics, and adaptation practices are also related to each other. Their interactions produce the observed development outcomes in a given territory. These outcomes are multi-dimensional - they can be evaluated along different development criteria - among them, effectiveness, sustainability, and equity. The two bold arrows in the right half of the figure indicate that policy actions can be undertaken in response to observed outcomes if the outcomes prove undesirable for local residents or higher level decision makers.

2.5 CHANNELS FOR POLICY INFLUENCE ON LOCAL OUTCOMES

An analysis of the links between territorial endowments, vulnerability and adaptation - as these are shaped by institutions and governance arrangements - also provides insights into the key leverage points for enhancing development outcomes, and helps identify how policy action can be used to change incentives, information, or institutions so as to change adaptation practices and outcomes.

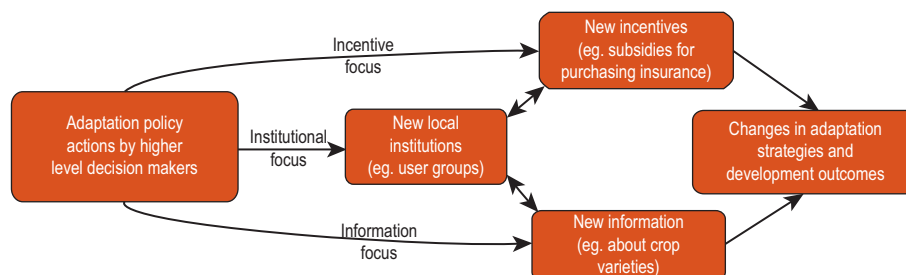
Indeed, one of the key areas of current and future research on climate impacts adaptation and policies relates to the means through which decision made by higher level actors in an administrative or political

capacity affect behaviors and outcomes at lower levels. The mechanisms of policy influence are highly varied, but they can be broadly grouped into three types - policies that seek to change behavior and actions at the local level by changing i) incentives, ii) information, and/or iii) institutions.

Local-level actions and outcomes can be changed by focusing directly on, and creating, new incentives. Policy actors can reward or penalize households or communities for the kind of actions or behaviors they adopt. Subsidies or taxes, and different kinds of sanctions are examples of direct incentives that can be used to change local behavior and actions so that desired forms of adaptation and adaptive practices can be encouraged. For example, if occupational diversification is an effective adaptation strategy in a given context, decision makers can encourage occupation diversification by providing incentives for the acquisition of new occupational skills, or subsidize learning new trades.

Lack of information about different adaptation options or available opportunities can be a substantial deterrent to specific forms of adaptation. In such situations, greater awareness through new information and training can effectively address existing obstacles to adaptation. For such training and/or information to be effective, it is important to address the costs of acquiring new information on the part of target households and organizations.

FIGURE 2. INSTITUTIONS, INCENTIVES, INFORMATION: THE THREE I'S POLICY INFLUENCE



Decision makers at higher levels can also create or facilitate new local institutions or organizations to enable adaptation strategies that require collective mobilization and action by different social actors. The literature on adaptation tends to use institutions in a number of different ways – to refer to policies, organizations, rules, governance and programs (Dovers and Hezri 2010). But in this report, institutions refers to rules and norms through which expectations about behavior are structured, and organizations refers to specific manifestations of institutions in the civic, public, or private domains with persons and resources through which organizational goals are met. Decentralization reforms are an obvious example of institutional changes undertaken through legislative, policy, or executive action but which depend for their effectiveness on local organizations as well. User groups or savings and credit societies are local organizations that either take over specific governance functions or help mobilize people to overcome obstacles to effective adaptation.

Further, institutions, information, and incentives are often closely related to each other. Direct provision of new information or incentives can lead to the creation of new institutions. Sometimes, even when the focus of a policy mechanism is to bring about changes through incentives or information, it is helpful to alter the

institutions through which information and incentives are delivered. And new kinds of local institutions nearly always also provide new incentives or information to their constituents. Figure 2 illustrates the relationship between policy actions and their influence over local behaviors and outcomes.

According to Figure 2, governments can use adaptation policies to shape local actions and outcomes through direct action to change institutions, incentives, or information available to local actors and decision makers. And, they can also empower local organizations to change incentives and information relevant to the adaptation practices of their citizens. Finally, the double-headed arrows connecting new information and incentive to local institutions and organizations indicate that the relationship between (a) incentives and institutions and (b) information and institutions can comprise reciprocal effects over time.

The extant literature on climate variability and change tends to focus substantially on analysis of adaptive capacity and vulnerability (Smit and Wandel 2006). In this context, the focus on the ABDCC study and work on institutions, local organizations, and their role in more effective adaptations constitutes a small departure from the common concern with adaptive capacity.

3. STUDY METHODS

The ABDCC study relied on four strategies for its implementation, data collection, and capacity building efforts: 1) review of secondary information and the selection of study sites; 2) data collection through household, focus group, and expert interviews; 3) data analysis and identification of feasible policy options; and 4) capacity building and dissemination of results (see Figure 3).

3.1 PRIMARY AND SECONDARY DATA

The research partners involved in the study – RIMISP and in-country partners in West Africa and Latin America (see acknowledgements) – reviewed primary and secondary information to identify the study sites based on different features of climate threats in the selected countries, and characteristics of vulnerability and institutional capacity in selected study sites. In addition, secondary materials on national policies, local government legislation and institutions, local adaptation strategies, and operational documents related to local climate predictions and institutions were reviewed before undertaking original data collection. Although the use of downscaled climate information had been envisaged in the data collection, the project did not make use of such data (Van Vuuren 2010). The review of available information on the policy and institutional environment also enabled a better understanding of institutional relationships, and about the role of institutions in territorial

development and responses to climate threats (Appendix 1 provides information on all the selected sites in the six countries).

3.2 DATA COLLECTION

Fieldwork for household interviews in the selected territories was complemented by interviews with national level experts and local institutional stakeholders to aid the development of vulnerability profiles of different social groups. The fieldwork consisted of three elements: key informant interviews with representatives from local organizations and other leaders; focus group discussions with men and women from different socio-economic groups; and, household surveys. In West Africa, household surveys were conducted in four locations in each country, with approximately 120 households selected in each location. In Latin America, household surveys covered 240 households in each country, divided into eight locations. The household survey facilitated data collection on the livelihood and adaptation strategies of households in different income tiers; factors associated with the exposure, sensitivity, and adaptive capacity of different households including information on gender, age, and institutional access; and the activities of different formal and informal organizations in the selected study sites.

3.3 DATA ANALYSIS

The study generated data both from secondary sources as well as primary research. The data was used to

FIGURE 3. DATA COLLECTION STEPS AND STRATEGIES



prepare country reports and policy notes but has also been analyzed using basic statistical methods to understand the relationship between institutions, adaptation strategies, and social groups within communities and territories.

3.4 WORKSHOPS AND SEMINARS

The project utilized workshops and seminars as a critical means of ensuring that the case study analysis is understood by decision makers and researchers in the respective countries and regionally and other stakeholders in the private sector and civil society. A series of participatory workshops and training seminars helped bring together the above stakeholders, and allowed the findings of the project to be shared with local as well as national decision makers (for information on each workshop and participants, see <http://go.worldbank.org/X0BFK90GX0>).

Throughout the project, task team leaders of relevant World Bank-supported projects were also engaged to ensure that research questions were operationally relevant, and that the research findings would be taken up to inform future operational support in those country contexts. A list of the relevant operations is provided in Appendix 2.

3.5 QUALITATIVE AND QUANTITATIVE ANALYSIS

The study relied more on a qualitative analysis of data from Latin America vs a more quantitative approach to examining the data from West Africa. The combination of quantitative and qualitative methods has one chief strength. It provides a way of cross-checking findings derived using one approach – descriptive methods and qualitative analysis for Latin America – against findings that emerged from the use of another approach – more quantitative and analytical methods used for data from West Africa. The development of vulnerability profiles and the use of regression analysis for the West African data, and the use of a more descriptive approach for the Latin American data suggests that both methods are valuable in efforts to understand how best to address the stresses of climate impacts in low-income rural areas. However, the use of these different methods also means that the power of statistical analysis was weakened because of fewer cases (only from West Africa). The attempt to combine different methods can also raise questions about consistency of the approach used and therefore the degree to which the findings may be an artifact of the methods used. To guard against such a criticism, the report has focused more on the common findings across the two study regions rather than highlighting their differences.

4. TERRITORIAL DEVELOPMENT IN THE STUDY COUNTRIES: CLIMATE AND INSTITUTIONAL CONTEXT

The selected six countries and the study sites within them vary substantially in their territorial and institutional endowments, household vulnerability and institutional capacity, and commonly deployed adaptation strategies. These differences also provide the opportunity to develop specific insights and lessons about the gaps in the ability of vulnerable populations to address climate threats, the sources of their vulnerability, the political economy of institutional relationships, the role of institutions in supporting adaptations, and the arenas where external interventions can help improve rural adaptations. After briefly describing the likely climate change impacts in the study countries, this section characterizes the general physical and social sources of vulnerability in the two regions, and uses the territorial development and adaptation framework presented earlier to examine the interactions and gaps between institutions and adaptation strategies in the studied sites.

4.1 CLIMATE PROJECTIONS AND LIKELY IMPACTS


Climate models can provide at best only rough guidance about the likely impacts of future climate change on specific locations in the selected regions – both because of the relatively fine scale of the studied sites in

comparison to the scale of climate model predictions, and because the relevant time period for development interventions is closer in the future in comparison to the projected information about future temperature and rainfall changes based on existing climate models. The available evidence on likely climate changes is summarized in Table 2 for the six countries in which the studies were carried out.

Table 2 suggests that projected climate changes in all six countries will have significant adverse impacts on the primary sectors particularly because of increased volatility in rainfall and temperature, with attendant negative consequences for the poor and the more vulnerable. The West African countries, in common with the rest of the Sahel, have witnessed substantially lower rainfall in the post-1970 period compared to the preceding half century.

Although all the study sites are likely to witness higher temperatures, more erratic rainfall, and lower water availability, the Dominican Republic is distinguished by substantial additional risks of sudden onset disasters such as storms and hurricanes. Sea level rise will affect the Dominican Republic the most, and Mexico and Senegal to some extent. Even with higher rainfall, increasing temperatures and greater variability of precipitation mean that less water is likely to be available to humans and animals. These threats to livelihoods, coupled with other source of social vulnerability, have major implications for the kinds of adaptation strategies that can be adopted widely.

TABLE 2. PROJECTED CLIMATE IMPACTS FOR THE SELECTED COUNTRIES

<i>Projected Impacts Countries</i> 	<i>Temperature</i>	<i>Rainfall</i>	<i>Other</i>
Mexico (Michoacán)	Rise in temperatures	Reduced rainfall, increase in frequency of extreme events	Sea level rise
Peru (Mantaro valley)	Rise in temperatures	Reduced rainfall, higher frosts	Increased risks of crop diseases, reduced agricultural output
Dominican Republic	Rise in temperatures	Higher intensity hurricanes and storms	Sea level rise
Burkina Faso	Rise in temperature, more extreme events	Reduced rainfall, more erratic rainfall	Shift in ecological and agricultural zones, greater vulnerability of agriculture, water, and livestock sectors
Niger	Small rise in temperatures, more extreme events	Reduced rainfall and droughts, higher risks of drought, sand storms, more erratic rainfall	Bushfires, pest outbreaks, adverse impacts on primary sectors
Senegal	Rise in temperature, more extreme events	Lower and more erratic rainfall	Increased vulnerability of agriculture and water systems, as also for coastal areas

4.2 COUNTRY AND INSTITUTIONAL CONTEXT

The West African countries included in the study are among the poorest in the world with populations dependent on a narrow resource base. Nearly 85% of Niger's population lives on less than \$2.00 a day, and the rural population is even poorer than that in urban areas. Senegal's economy has been affected adversely by external shocks and droughts since 2006 that have reduced growth and made poverty in rural areas even more intractable. Burkina Faso's economy is heavily dependent on cotton exports and more than 85% of the population is dependent on agriculture. About half or more of the population in each country lives below the poverty line.

Few countries, including even in the developed world, have powerful agencies or well-coordinated efforts to manage adaptation to climate change. This is also the case in much of the developing world, and certainly in the six study countries. The three West African countries have concluded their National Adaptation Plans of Action, and in the process, the problem of adaptation to

climate change has received both institutional and policy attention. But for the most part, adaptation to climate change and its interactions with social development must be managed in these countries within the existing institutional context and framework for social development.

A substantial proportion of the population in all six countries and the study sites in the countries is employed in primary sector occupations. Therefore, it is all the more vulnerable to increasing variations in future climate phenomena – particularly extremes of temperature and/or rainfall. In addition, as the National Adaptation Plans of Action (NAPAs) in the West African countries and climate change agencies in the Latin American countries point out, future climate impacts are likely to create greater distress because of the already existing high level of social vulnerability of much of the population in these countries. Thus, the vulnerability of different social groups stems from their exposure to climate hazards, but also from a lack of access to resources and institutions, and limited capacity to recover from the impacts of climate or other hazards.

5. TERRITORIAL DEVELOPMENT, VULNERABILITY, AND ADAPTATION IN WEST AFRICA

Burkina Faso, Niger, and Senegal already witness high temperatures and substantial variability in precipitation and climate change impacts. There is some debate over the extent to which observed declines in precipitation and changes in the ecology and landscapes of countries in the Sahel can be attributed to climate change versus large scale temporal variations. But the impacts of lower rainfall on households relying on agriculture and other forms of primary production have been quite adverse in the last several decades, particularly for West Africa (Anderson et al. 2010: 202). Although climate model projections remain imprecise at the fine resolutions needed for development policy (Van Vuuren et al. 2010), it is likely that future climate impacts will vary substantially across different localities in the semi-arid areas of the three countries. At the aggregate levels, regional climate impacts are projected to increase both the spatial and temporal variability of precipitation, the incidence of extreme events including droughts and seasonal flooding, and higher evapo-transpiration owing to higher temperatures.

The three countries have each developed their own National Adaptation Plans of Action, but their populations' responses to climate change impacts will be strongly shaped by existing rural and local development institutions at the national, subnational, and local levels.

Burkina Faso's rural development strategy has been implemented along with recent efforts to decentralize through its Strategic Framework for Decentralization, adopted in 2006. The Strategic Framework as well as the Rural Development Strategy are expected to be carried out by 2015, and involve a host of public institutional stakeholders at local, regional, and national scales. These include a number of ministries and the Ministry of Territorial Administration and Decentralization is in charge of coordinating territorial issues in the country. As these different agencies attempt to manage problems related to a declining forest cover, food insecurity, and high levels of rural vulnerability, future climate impacts are likely to complicate their efforts. Local organizations, especially the 351 councils in Burkina Faso's 13 regions, can play a determining role in translating national policies into local action and assessing local adaptation needs. In addition to the councils, Burkina Faso also has a variety of community institutions and village development commissions that are relevant for improved articulation among different institutional entities (World Bank 2010c).

Niger's "Poverty Reduction and Accelerated Development Strategy" encompasses the different policies and programs intended to enhance economic growth and investments, and reduce poverty. It is also implementing a Rural Development Strategy that focuses on sectoral interventions, and is expected to be the main reference framework to ensure consistency of development interventions. Finally, it is participating in the Pilot Program for Climate Resilience (PPCR) that has been informed by the country level findings

associated with the research for the ABDCC project in its design together with the earlier work that occurred in the context of Niger NAPA (see PPCR document at http://www.climateinvestmentfunds.org/cif/Pilot_Programs). As in Burkina Faso, a number of ministries are involved in implementing policy guidelines and strategies for decentralization, development, and more sectorally oriented agendas in Niger. Local arms of central agencies – such as the 213 rural councils – can be key partners in climate related implementation efforts because the councils are responsible for territorial planning and development. Other local organizations such as the local development committees, land management committees, and inter-village associations can be found in different forms at the community level depending on the region (World Bank 2010d).

Of the three countries in West Africa, Senegal has the longest experience with decentralized development, dating back at least to the early 1970s with the creation of the Rural Councils. The Ministry of Decentralization and Local Authorities is most directly involved in implementing decentralization. A number of other ministries also play important roles in the pursuit of reforms through which Senegal is seeking to involve local communities in social and economic development and poverty alleviation. The two pillars of Senegal's territorial institutional architecture are decentralization and devolution structures – with elected and appointed decision makers (World Bank 2010e).

Local organizations in all three countries include a number of formal as well as informal agencies such as customary chieftainships, religious groups and authorities, self help groups, informal youth and women's groups, market organizations such as banks, formal producers' organizations such as cooperatives, and government agencies in charge of providing a number of different development and extension services.

5.1 SELECTED STUDY LOCATIONS

Data collection in Burkina Faso occurred in four villages in three regions: Houet (Bama village), Kouritenga (Kando village), and Soum (Pobe Mengao and Baraboulé villages). These three regions are distributed across the country (see Figure 4) and cover a range of climate risks – high levels of risks for the villages in

Soum, and lower to moderate risks in Houet and Kouritenga villages. Agriculture is the major economic activity in all regions. In addition, animal husbandry and petty trade and handicrafts are also important in Soum and Kouritenga. Proximity to a large trading center and high levels of resource degradation have led to high levels of migration out of Kouritenga. The major ethnic group in Soum are the Fulanis; both Bama and Kando are ethnically more diverse.

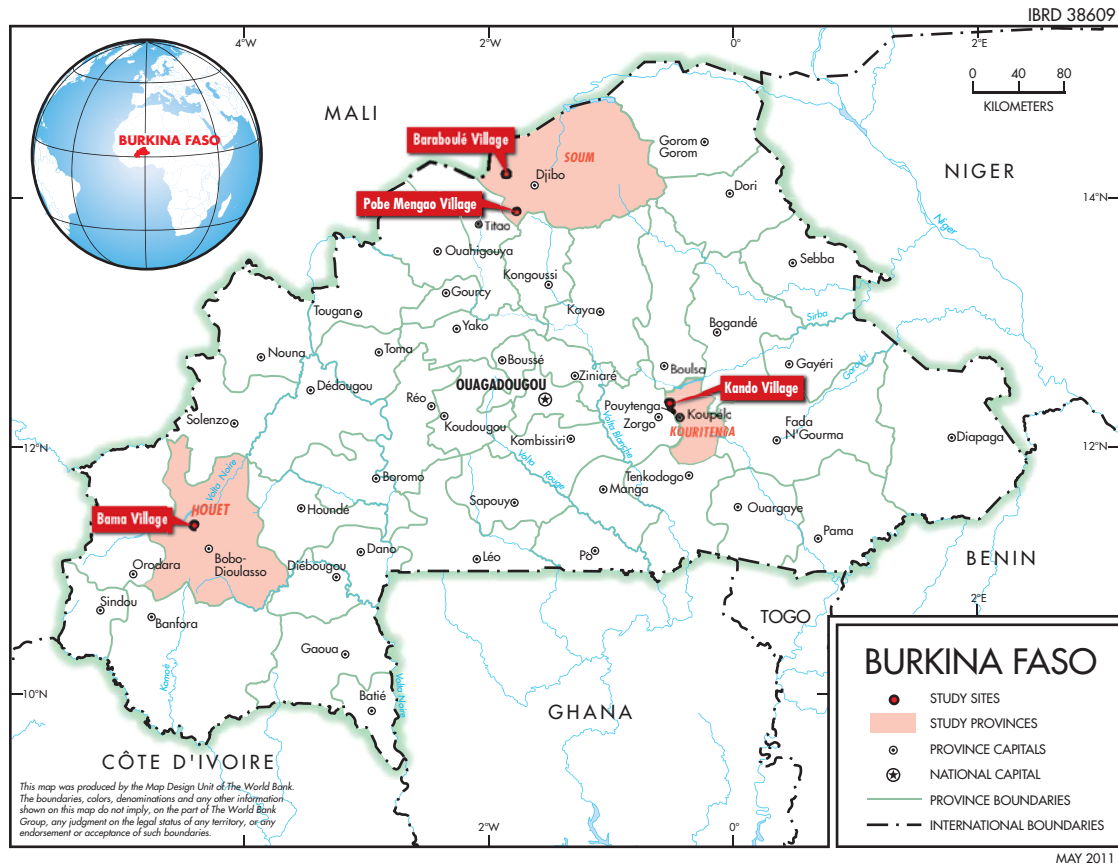
In Niger, two administrative regions – Maradi and Dosso – were selected for village level data collection on institutions and households. Maradi is in south-central Niger whereas Dosso is in the South-West (see Figure 5). Maradi's economy is relatively diversified compared with Dosso, but in both the major occupations are agriculture and some livestock grazing. Maradi is also known as the breadbasket of Senegal, despite several severe droughts in recent years. The two regions are ethnically different, with the Hausa in Maradi and the Zerma in Dosso. Two villages each in Maradi (Majirgui and Dakoro) and Dosso (Guecheme and Loga) were surveyed for the study. The household surveys were carried out in both agricultural and agro-pastoral zones in the two regions.

In Senegal, the data collection occurred in three regions – the Groundnut Basin (which included four districts – Diourbel, Fatick, Kaolack, Kaffrine), the Niaays zone (Thies district), and northwestern Senegal (Louga district). The Groundnut Basin has experienced repeated droughts in the past few years, and is viewed as having suffered significant levels of ecosystem degradation. Niaays is located along the shoreline, and is densely populated with more than 20% of the country's population in 1% of its area. Louga district is a major cattle breeding area. All three regions confront similar ecological issues with problems of soil erosion and salinity in addition to erratic rainfall.

5.2 FINDINGS

The findings from the study are described below in terms of the nature of institutions and institutional arrangements in the studied sites, followed by information about the vulnerability of households and communities, and their institutional arrangements and adaptation strategies. The data suggest that Burkina Faso, Niger, and Senegal are similar in a number of ways

FIGURE 4. STUDY SITES IN BURKINA FASO



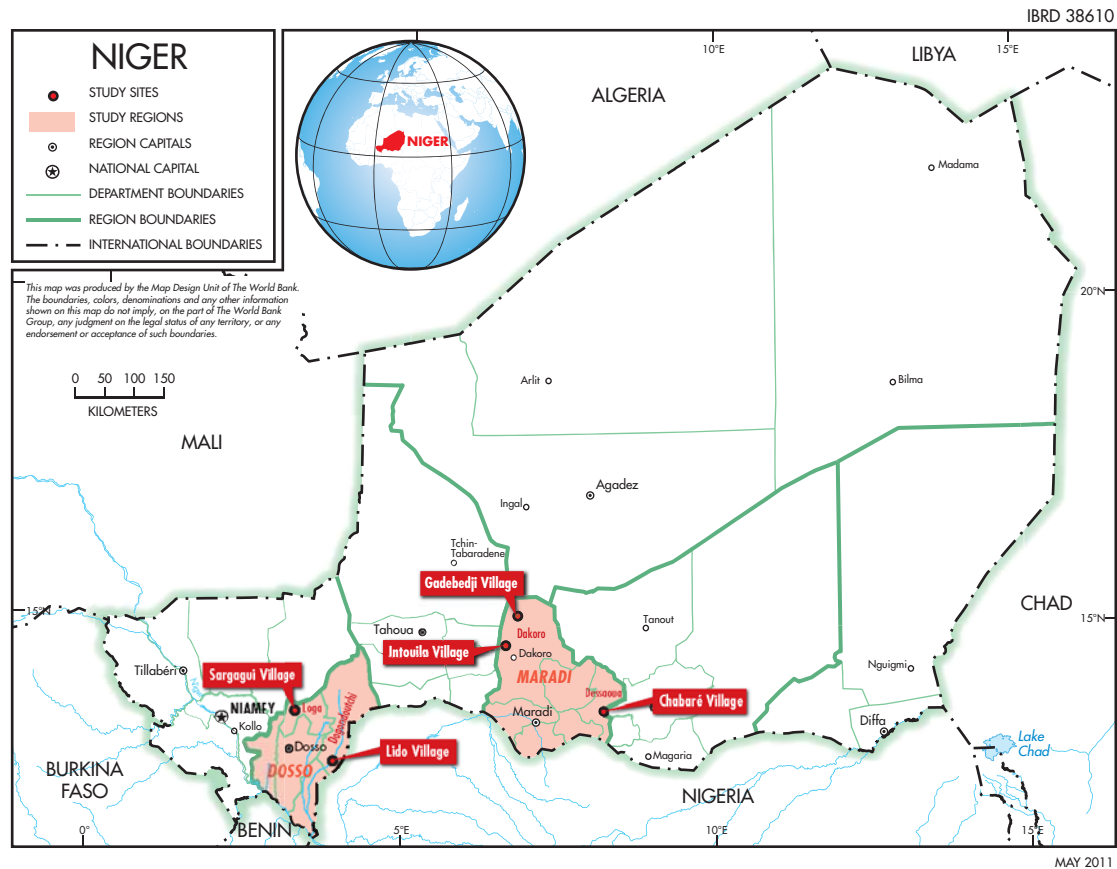
in terms of the types of institutions and governance arrangements they have as also the perceptions of interviewed households regarding exposure to hazards, levels of poverty, and the nature of national and local institutional arrangements. This section then examines how vulnerability is distributed across different household clusters. Respondent households in each country confront temporary, persistent, and chronic risks. To respond to these risks, they depend upon a large number and range of adaptive strategies (World Bank 2010c, 2010d, 2010e). The role of local institutions in facilitating adaptation is substantial, and the different dimensions of their role in promoting adaptation leads to several implications regarding future adaptation policies, particularly at the local level. Finally, the section examines how different household level and contextual factors are associated with adaptation strategies used by households.

5.3 INSTITUTIONS AND GOVERNANCE ARRANGEMENTS

Ongoing decentralization processes and the resulting strengthening of local authorities in Burkina Faso, Niger, and Senegal in comparison to the past means that there is a greater overall density of rural institutions and organizations to which households can appeal when needed. Nonetheless, there are gaps in the implementation of decentralization efforts, and concomitantly, in the distribution, visibility, and presence of institutions in the different study sites.

Conventionally, institutions in the private, public, and communal domains have been viewed as having distinctive advantages and limits. Central state agencies – among them sectoral ministries and line agencies, executive and legislative offices, and national public

FIGURE 5. STUDY SITES IN NIGER



bodies – can set agendas and rules, create far reaching programs to provide assistance to households and communities, craft new strategies for development or to address climate change, generate and disseminate needed climate information as a public good, and pursue the development of new climate resilient infrastructure.

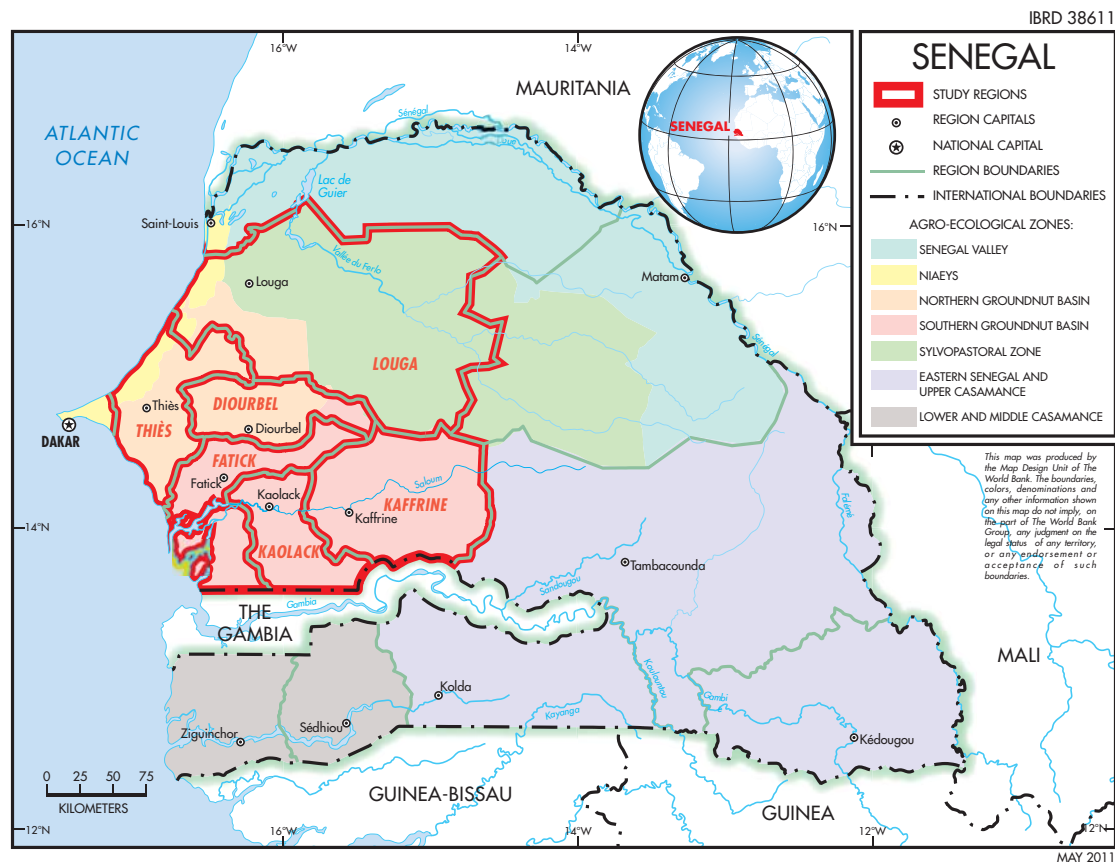
Local arms of government agencies, elected leaders, traditional chiefs, and new decision making bodies created by central governments are the first line of contact between rural households and the government. Despite limited capacity, they often have more resources than most civil society organizations, and are responsible for providing basic services, undertaking development planning and integration of climate responses into existing plans, managing natural resources and agricultural lands, and resolving conflicts. Their capacity to assist local households and rural residents is critically important precisely because of the fact that local governmental

agencies are the first point of contact between citizens and governments.

Private sector organizations and institutions have been identified as playing a relatively small role in adaptation to climate change, but their potential role as climate impacts worsen can be immense. Many of the adaptation strategies used for coping with climate risks rely on market exchanges – especially strategies involving trading or commoditization of risks such as insurance. In addition, private market institutions have a substantial role to play in assisting in increased production and trade, delivery of services, providing greater mobility, and generating employment – all important aspects of adaptation.

Finally, civil society organizations – those based in communities such as different kinds of self help groups and non-government organizations, and hybrid organizations such as cooperatives – perform major functions

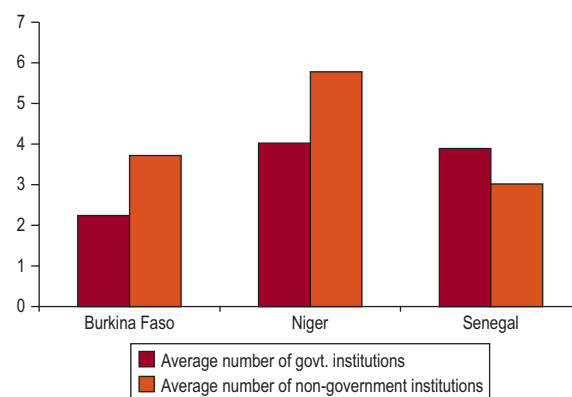
FIGURE 6. STUDY SITES IN SENEGAL



related to provision of support during times of crises, facilitating social and cultural interactions and promoting social capital, helping mobilize collective action, and supporting the provision of social services and information. In this context, it is important to attend as well to organizations such as religious groups, youth networks and women's groups because of the role they can play in enhancing financial safety, promoting livelihood opportunities, and helping with land management. Although they do not have similar levels of resources as government agencies and organizations, their influence permeates rural life and interactions.

Local institutions are being accessed by many households, and more by better off households: In all the studied sites and countries, local institutions were present in significant numbers, and supported the provision of benefits to interviewed households (see Figure 7). This is true both

FIGURE 7. AVERAGE NUMBER OF INSTITUTIONS ACCESSED BY HOUSEHOLDS IN WEST AFRICA



for government and non-government organizations. Resource management and civil society institutions provide somewhat more equitable access to households compared to market and public institutions (World Bank 2010c). Furthermore, there is a strong association between the capacity of households to access government and non-government institutions ($r=0.69$). This strong association suggests that households use similar skills to access different kinds of institutions that are present in their settlements, and that both types of institutions provide some benefits to households.

We also collected data on how often households were contacted by the institutions in question. We find that the same households that attempt to access institutions are also more likely to be contacted by institutional staff ($r=0.59$). Further, the better off households are more likely to be contacted by the institutions in a settlement ($r=0.21$), as also to contact existing institutions ($r=0.25$).

Institutions have low capacity, and the level of coordination across sectors and scales is weak: In all the three countries, there is a large number of local level, supra-community level, and national and regional organizations that has some responsibility and or capacity to address climate change impacts on surveyed households. These institutions often serve as substitutes for the different services and benefits they can provide households. However, their actions continue to be uncoordinated across both sectors and scales. Such a lack of coordination is not necessarily a negative attribute of existing institutional arrangements. Existing institutions tend to be accessed by those who are better off – lack of coordination across institutions thus also means that the tendency to serve richer households is not strengthened through institutional coordination, and poorer households can also often gain access to institutional services. Indeed, we find below that households that are more vulnerable owing to higher levels of exposure to climate events tend also to have greater institutional access.

However, the low capacity of institutions to serve their constituents is a cause for concern for those interested in strengthening adaptations and the capacity of households to undertake adaptation strategies. Indeed, despite each of the three countries engaging in the NAPA process, the results of that process have not trickled down to the institutional and household levels at which the study was

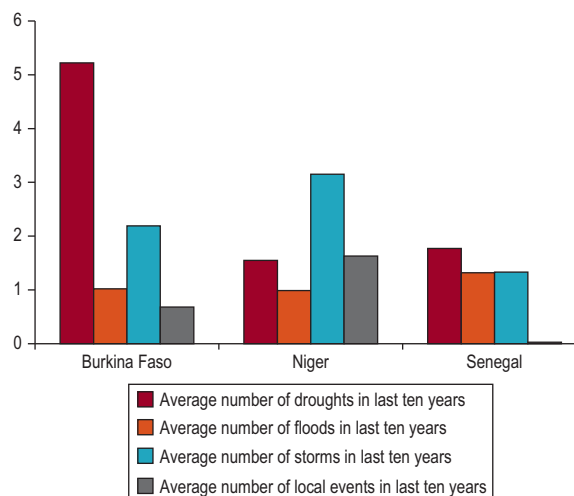
carried out. Although the NAPA planning identified institutions and better coordination among institutions as a key target for improved adaptation effectiveness, this goal is yet to be translated into outcomes on the ground.

5.4 VULNERABILITY AND ADAPTATION STRATEGIES

Exposure and vulnerability: communities experience and recall droughts and storms most often: Rather than asking community members and households to provide information about how the climate had changed in their village or region, the study focused on their recollections of the most prominent recent hazards in a) the previous decade, and b) the decade prior to that. When asked about experienced hazards, interviewed households focused more on droughts and storms as the ones that affected their livelihoods most commonly. Figure 8 indicates the variation in the types of hazards recalled by households in the past decade. Although local climate phenomena other than droughts and hazards are the least mentioned (respondents in Senegal did not mention these as important), floods are also mentioned only by a few households.

In contrast, the mean number of drought events recalled is particularly high in Burkina Faso. The prominence of droughts in memory is brought out

FIGURE 8. RECENT HAZARDS EXPERIENCED BY HOUSEHOLDS IN WEST AFRICA



particularly clearly when households were asked about hazards in the decade prior to the last one. Figure 9 shows that droughts live much longer in the memory of respondents. In fact, two points are evident from Figure 9. The first concerns the likely greater impact and occurrence of droughts, leading to the mention of droughts as the climate hazard recalled most frequently. The second is that as households are asked to recall more distant events, the number of events they remember is lower. For hazards during the past 10–20 years (Figure 9), the number of events recalled is much smaller compared with hazards in the past decade (Figure 8). The actual numbers are seven hazards recalled for the past decade on the average, and 3 for the decade prior to that. The distribution of average number of hazards recalled across the three countries is roughly similar.

Education and poverty: studied communities are broadly similar in their characteristics: The project collected information on a number of different variables related to household socio-economic status as an indicator of the sensitivity of the different households to climate impacts. Household income sources and asset types are two important determinants of poverty. For education,

we collected information on basic literacy as well as higher levels of education.

Average household size and literacy levels across the three countries are comparable. Household size is highest in Senegal and lowest in Niger. The range varies between eleven to seventeen persons.

The proportion of literate individuals is approximately 0.4 for surveyed households and again, the numbers are similar for the three countries – between 4 literate individuals in each household in Niger to 6.5 individuals for Senegalese households (see Figure 10). Finally, the numbers of individuals who have received any education beyond 12 years is exceedingly small – less than 0.2 individuals per household on the average, and low enough that the bar is not even visible for Burkina Faso and Niger. However, the average level of college level education is relatively high for Senegal – one individual in every five households has received some college education in the interviewed Senegalese households.

To gain a sense of the income and asset-holding of households in the three countries, we collected information on both the number of different income sources as well as asset types (see Figure 11). Once again, the data

FIGURE 9. MAJOR CLIMATE HAZARDS EXPERIENCED BY HOUSEHOLDS IN THE PERIOD 10–20 YEARS AGO

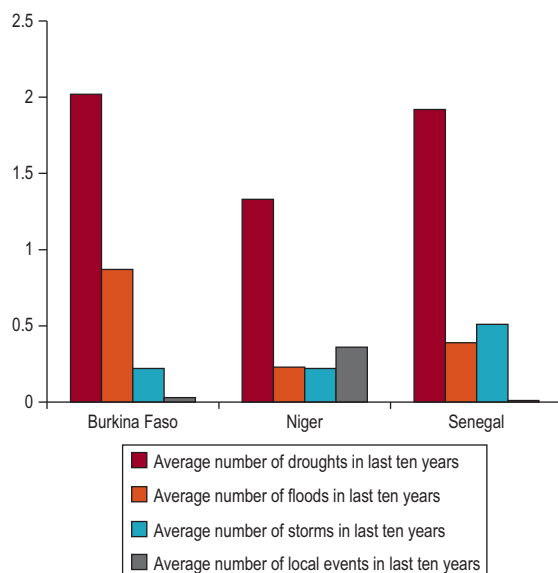


FIGURE 10. LITERACY AND HOUSEHOLD SIZE (WEST AFRICA)

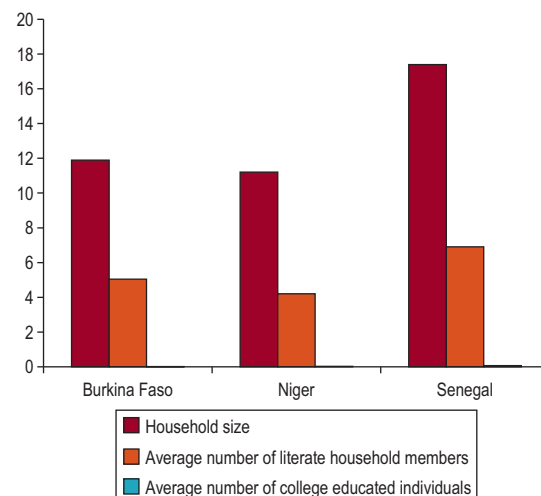
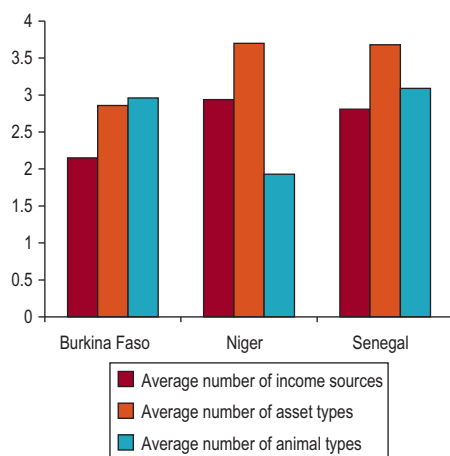


FIGURE 11. DIVERSITY OF INCOME SOURCES AND ASSET HOLDING AMONG WEST AFRICAN HOUSEHOLDS

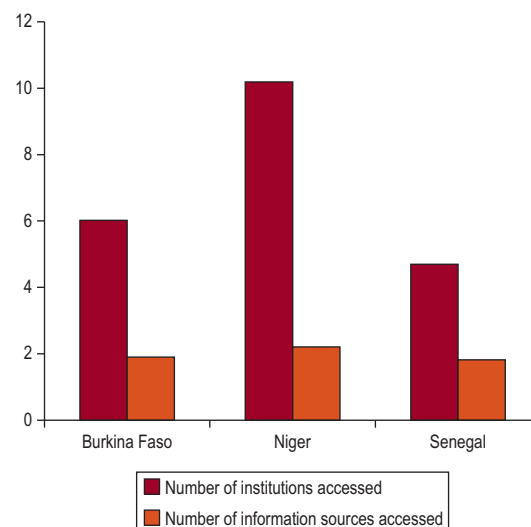


on average numbers of income sources and asset types suggest that households in all three countries are similar. There is some variability in the number of different kinds of animals owned by households, with Niger households owning less than two types of animals on the average compared to approximately 3 for the other two countries.

Contextual factors: institutions and information sources are used by most households: Recall that one of the main goals of the ABDCC project is to understand how institutions and relationship with institutions affects adaptation. To this end, we collected data on a variety of formal and informal institutions in the studied sites. Because information can provide timely warning about impending disasters as also allow more informed decisions, we also collected data on the presence of different information sources in the studied sites. Figure 12 shows that the average number of institutions present in the selected communities and accessed by households is quite high across the three countries, and that it is the highest in Niger.

Overall, the range of number of institutions accessed by interviewed households varies from approximately 5 different types of institutions in Senegal to more than 10 in Niger. Similarly, the average number of sources of information from which community residents learn

FIGURE 12. DIVERSITY OF ACCESS TO INSTITUTIONS AND INFORMATION SOURCES FOR WEST AFRICAN HOUSEHOLDS

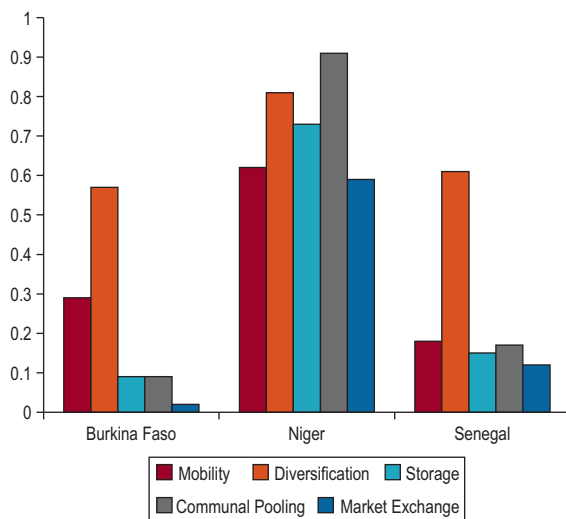


about hazards is the highest in Niger (2.5), whereas it is similar for Burkina Faso and Senegal.

Adaptation strategies: used commonly by most households, but Niger stands out: Finally, the data also indicate that although interviewed households use a number of different kinds of adaptation strategies, there are some households – approximately 50 – that do not report using any adaptation strategies. Figure 13 shows how adaptation practices are distributed across the three countries. The most interesting pattern that emerges is that adaptation strategies are reported most frequently in Niger. The average number of different types of adaptation strategies is the highest in Niger, as is the total number of adaptation strategies used by a household on the average.

The above discussion suggests that the three countries are broadly similar in terms of the different characteristics of households, villages, institutions accessed, and adaptation strategies used. However, there are also some grounds for believing that data collection in some countries may have been undertaken more carefully for some questions in comparison to other countries. This is particularly evident for information related to institutions and adaptation for

FIGURE 13. ADAPTATION STRATEGIES PRACTICED BY PROPORTION OF INTERVIEWED HOUSEHOLDS IN WEST AFRICAN COUNTRIES



which data collection in Niger may have been more carefully done. Such differences in data collection between the countries suggest that in the aggregate analysis of the data, it would be important to take these country differences into account.

5.5 VULNERABILITY PROFILES AND INSTITUTIONS

Although we find a number of interesting patterns above with respect to the different characteristics of households, the vulnerability profiles of respondents in the studied sites are also important to examine because they provide important information about the different ways in which households in the selected locations are vulnerable to climate and other stressors. To examine how groups of households are similar in terms of their exposure, sensitivity, and adaptive capacity, we carried out a cluster analysis of the data on these three components of vulnerability for selected households and communities. The analysis revealed a number of different clusters in each of the countries. Household clusters across the three countries did not exhibit the same patterns. Table 3 below summarizes the most distinctive clusters of households in the three countries.

Table 3 suggests that the two countries where the key characteristics of different clusters are also evident in clear differences in adaptation strategies used or institutions accessed are Burkina Faso and Niger. In Burkina Faso, two clusters are quite distinctive. One cluster has high adaptive capacity, but average levels of exposure and sensitivity, and the other has average levels of adaptive capacity, but high exposure/sensitivity. The cluster members with high adaptive capacity tend to rely on relatively few adaptation strategies. This is partly explained by the fact that the source of high adaptive capacity of this cluster in Burkina Faso is a high level of literacy. Higher levels of literacy have meant some degree of specialization, and therefore the use of fewer types of adaptation strategies. In the case of Niger, higher levels of adaptive capacity go together with high exposure to hazards, and households in this cluster already have substantial access to institutions and are also using a wide range of adaptation strategies. In comparison, households with high sensitivity have access to fewer institutions. Three major findings emerge from the analysis of the relationship between different clusters and institutions.

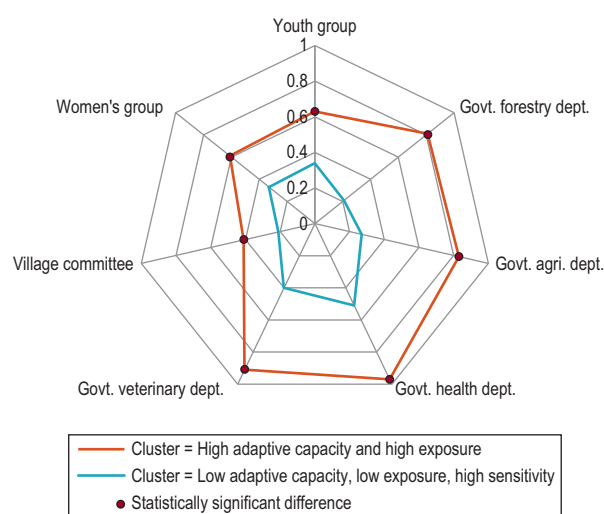
Households in clusters with greater institutional access are likely to employ a higher number and greater diversity of adaptation strategies: This relationship, further confirmed in the next section, suggests that institutions play an important role in facilitating adaptation (Adger 1999, Agrawal, Perrin, and McSweeney, 2008). Effective institutions provide a range of different resources that can facilitate adaptation. Although the study did not identify the specific types of support provided by institutions, it did identify a strong and statistically significant relationship between greater institutional access and use of adaptation strategies. Greater institutional access facilitates both greater use of and a greater diversity of adaptation strategies employed. Although there is a strong association between institutional access and the use of different adaptation strategies, the data do not provide sufficient detail on the extent to which the adaptation strategies used by households are effective.

Within specific country clusters, this relationship comes across particularly well. For example, in Burkina Faso, clusters with higher exposure and higher adaptive capacity access institutions far more frequently than clusters whose member households are highly sensitive to climate impacts, but also have low adaptive capacity and low

TABLE 3. VULNERABILITY PROFILES OF DIFFERENT HOUSEHOLD CLUSTERS IN WEST AFRICA

Country	Cluster characteristics	Avg. # of adaptation strategies used by cluster members	Key institutions accessed by cluster members
Burkina Faso	High adaptive capacity (AC) High exposure or sensitivity	1 1.4	Similar levels of access for different institution types
Niger	High AC and exposure High sensitivity	4.4 3.2	Agricultural coops. Community-based organizations
Senegal	High AC and exposure Low AC and exposure	2.0 1.9	Similar levels of access for different institution types

FIGURE 14. VARIATIONS IN SOURCES OF VULNERABILITY OF DIFFERENT CLUSTERS OF HOUSEHOLDS IN BURKINA FASO



exposure. Figure 14 indicates the substantial difference in institutional access for members of these two clusters.

Households with non-farm incomes tend to belong to clusters with higher adaptive capacity: Although non-farm income sources rarely provide more than 50 percent of total income, clusters whose households have such income sources are also more likely to rely on a greater number of adaptation strategies. This is particularly true in Senegal (where remittances account for a high proportion even for national income), as also in Niger (see Figure 15). Income from remittances, wage labor, and trade are buffered more from climate impacts compared to income from agriculture or livestock

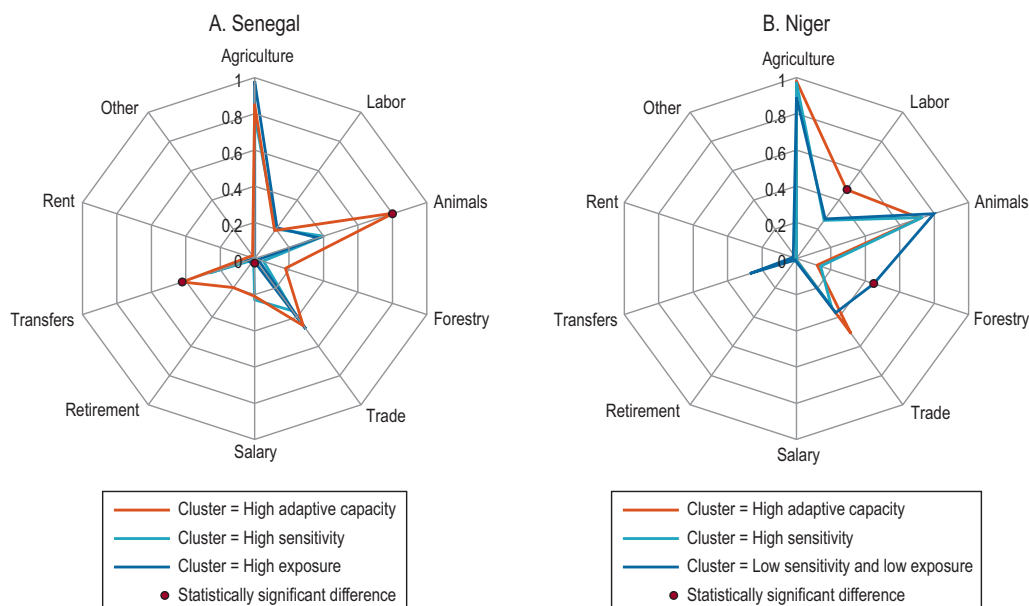
herding. Focus group discussions in Burkina Faso suggested a similar pattern in that villagers with a shop or in occupations such as blacksmithing are less sensitive to climate hazard impacts.

Households with greater sensitivity lag in institutional access and use of adaptation strategies: Smaller households with low income and few income sources and with a high disease burden are highly sensitive to climate impacts. These households also tend to use fewer adaptation strategies, own fewer types of assets, and have fewer income sources. This pattern was particularly evident in Burkina Faso but was also present in the other two countries. Because most such households also have lower exposure to climate hazards on the average, they have tended not to be affected drastically by climate impacts. But as climate hazards increase in intensity and/or frequency over time, these households are likely to suffer far more than other households that have experienced more hazards but are also more likely to be buffered by diversity of income sources, asset holdings, and institutional access.

5.6 EXPLAINING ADAPTATION CHOICES

Because the number of different adaptations used by households is one indicator of their ability to cope with different kinds of risks, we also examined how household adaptations are associated with different potential explanatory variables. These include the number of hazards to which households are exposed, different indicators of their socio-economic status such as income sources and assets, land ownership, education, and a series of contextual factors – in particular the number of institutions that they can access, the volume of interactions they have with the institutions they access, and the

FIGURE 15. VARIATIONS ACROSS CLUSTERS IN AVAILABILITY OF INCOME SOURCES IN SENEGAL AND NIGER



number of different sources from which they get information about climate and other environmental conditions.

To assess how these factors are associated with the number of adaptations used by households, we carried out a linear regression where the dependent variable is “number of adaptations,” and hazard exposure, household socio-economic status, and contextual variables are potential explanatory variables. Each of the variables included in the analysis has been viewed by different writings on adaptation and adaptive capacity to be important in contributing to household capacity to cope with climate risks. Indeed, the variables on hazards faced by households and those related to their socioeconomic status can be viewed as measures of exposure and sensitivity, and those representing contextual factors such as institutions and information can be viewed as summary measures of adaptive capacity.

Table 4 presents the results of the analysis using an OLS robust regression model with country dummy variables, where country2 is Niger and country3 is Senegal. (Appendix 5 provides information on the exact specification of each of the explanatory variables).

The analysis brings together much of the earlier discussion. It shows that after controlling for the effects of other variables, *hazards faced by households in the past ten years, the number of different assets owned by households, the number of different sources of information, the number of institutions that households access, and the total visits to these institutions in a year are all positively, and statistically significantly associated with the number of adaptations used.* Except for the positive association between number of hazards and number of adaptations, these relationships are as expected. The country dummy for Niger, as prefigured in the higher average number of adaptations/household in earlier graphs in the report, has a statistically significant and positive association with adaptations adopted by households. The regression analysis confirms the earlier evidence of reported use of a greater number of different adaptation strategies, and that the data collection in Niger was likely carried out more diligently in comparison to the two other countries. But the key point is that even after including the country-effects of Niger (and it is unclear how to attribute the higher numbers of adaptations per households in Niger), the key variables of information sources, asset ownership, institutions, and hazard exposure have a statistically significant relationship with observed use of

TABLE 4. EXPLAINING NUMBER OF ADAPTATIONS USED BY HOUSEHOLDS IN WEST AFRICA

<i>Variable name</i>	<i>Coefficient</i>	<i>Robust SE</i>	<i>t-statistic</i>	<i>P > t </i>
Number of Hazards during last decade	0.0323	0.0129	2.50	0.01**
Hazards during the prior decade (10–20 years)	−0.0102	0.0194	0.53	0.60
Sickness incidents per household member	0.1000	0.0923	1.08	0.28
Number of income sources	0.0525	0.0408	1.03	0.30
Number of types of assets owned	0.1305	0.0399	3.27	0.00***
Area land owned	0.0214	0.0598	0.36	0.72
College educated household members	−1.3247	1.1942	−1.11	0.27
Number of information sources about hazards	0.2216	0.0523	4.23	0.00***
Number of institutions accessed	0.0330	0.0157	2.11	0.00***
Total visits to different institutions/year	0.0020	0.0005	3.60	0.00***
Niger country dummy	0.9934	0.7948	12.5	0.00***
Senegal country dummy	0.0657	0.4062	1.62	0.110
Constant	−0.4365	0.2697	−1.62	0.110

N=367; F-Statistic(12, 354) = 134.09; Probability > F=0.0000; R-squared = 0.7202; Root MSE = .8441. “***”, and “****” signify statistical significance at the 0.01 and 0.001 levels.

adaptation strategies across the three countries in West Africa (see also World Bank 2011).

The above results have clear implications for policy: especially important here is the relationship between adaptation and diversity of information sources and the two different measures of institutional presence and access (number of institutions accessed, and number of interactions with different institutions/year).

Providing better information to households has been broadly viewed as an important element in helping improve their ability to deal with risks of climate variability and change (Tribbia and Moser 2008, Wilby et al. 2009). With reliable information on climate phenomena and the potential impacts of such phenomena, users can make better decisions about how to act in allocating their time and resources before the occurrence of a hazard, and respond better after the hazard has occurred. If such information is not available, user households are likely to assign some subjective probability to possible outcomes in any case (Schneider 2001).

However, there is also an interesting debate on the subject, with some scholars questioning the value of better information on climate impacts for better

adaptation policies or choices (Dessai and Hulme 2004). These scholars argue that better information to improve probabilistic estimates of future outcomes are likely to be misplaced because of deep uncertainties about specific impacts, the path-dependency of many future events, and the difficulties in knowing how different factors connected to future occurrences interact (Grubler and Nakicenovic 2001). Our analysis shows that although each side in the debate has strong conceptual grounds on which to stand, the empirical evidence suggests that better information does enable more comprehensive use of adaptation strategies and the selection of more adaptation strategies that might be effective in promoting adaptation.

For the results regarding institutions, it is important to note that the statistical analysis confirms the argument made by a number of other studies and scholars regarding the important and positive role of institutions in facilitating adaptations (Kelly and Adger 2000, O’Riordan and Jordan 1999, Thompson et al. 2006, World Bank 2011). Both variables we use in the analysis to represent the role of institutions in adaptation by community members – number of institutions accessed and the number of times existing institutions were accessed – are statistically significant. Although these

two variables are correlated with each other ($r=0.59$), we included them both in the analysis because we expected both the diversity of institutions to which households connect, and the frequency of institutional access of households to affect their ability to adopt different kinds of adaptations. Because of the collinearity between the two variables, we should expect that their coefficients are less likely to be statistically significant. Yet, both variables turn out to be statistically significant and positively associated with number of adaptations. This shows the strong role of institutions and institutional interactions in influencing the adoption of diverse adaptations by households to manage experienced climate hazards. The positive association between hazards and adaptations suggests that households experiencing more hazards try to use more types of adaptation strategies in an effort to find ways of coping with hazards.

Finally, it is worth noting that because these are not time-series data, and because we do not have appropriate instrumental variables, the results of the analysis in this section cannot be viewed as showing that the causal

arrow flows from institutions, or information, or assets to adaptations. But the statistical results are still important.

The analysis does not show that the use of diverse information sources, possession of diverse assets, and access to different institutions *leads to* the ability to use different adaptation strategies as needed. But it does show a substantial association between use of adaptation strategies and these characteristics of households. This association indicates at the very least that ***households relying on multiple adaptation strategies need more information, more institutional access, and the security conferred by different types of assets***. Policy interventions that target these areas of support, therefore, are likely at least to help enhance the ability of households to practice the adaptation strategies on which they rely to address risks of climate impacts. Indeed, given the relative paucity of quantitative analysis of field-based data from multiple countries, the analysis presented in table 4 points to important directions for future research as well as climate adaptation policy interventions.

6. TERRITORIAL DEVELOPMENT AND ADAPTATION IN LATIN AMERICA

Projected climate impacts in the three selected countries in Latin America are likely to differ substantially but there are important common points as well as key differences in the national and sub-national level institutional arrangements that structure responses to projected climate impacts.

In Mexico, the Inter-secretarial Commission on Climate Change, comprising seven national level secretariats, is responsible for coordinating planning and action on climate change, and it developed the National Strategy on Climate Change (ENACC 2007). However, responding to climate impacts will require a level of coordination across sectors and levels that is undermined by the high levels of governmental staff turnover that accompanies changes in government and the absence of dedicated provincial and lower level agencies that focus on climate change. A 2008 World Bank development policy loan to Mexico supported the adoption and implementation of the ENACC including helping to develop stronger state-level responses to address climate impacts. Another Development Policy Loan (DPL) for Social Resilience to Climate Change currently in preparation by Mexico promises to provide substantial support in enhancing the capacity of state and municipal governments to engage multiple stakeholders in planning for disaster risk reduction and climate change adaptation. In particular, this DPL also aims to help ameliorate some of the regressive distributional impacts expected in the context of a changing climate.

In Peru, the National Commission on Climate Change (CNCC) was created in 1993, and it prepared the National Strategy on Climate Change in 2003. Although implementation of the National Strategy is required and regional governments are expected to coordinate their climate change regional strategies with development plans, only 4 of the 25 departments in the country have prepared their strategies (with an additional three under preparation). The Ministry of the Environment (MINAM), created in 2008, is now the principal entity responsible for inter-sectoral coordination on climate change issues with the central, regional, and local governments.

The Dominican Republic is the only Latin American country included in the study that also prepared a National Adaptation Plan of Action under the framework of the UNFCCC. Its Ministry of Environment and Natural Resources (SEMARENA) has sought to work closely with municipal governments and communities in the country. The Dominican Republic also has a National System for the Prevention, Mitigation, and Response to Disasters that includes three different agencies to coordinate prevention, mitigation, response, and rehabilitation actions related to disasters.

Thus, in all the selected countries, there is evident policy movement to address climate change impacts. This movement is visible in the fact that a number of different agencies and ministries at the central level have been created to address climate impacts, and several have begun attempts to coordinate climate responses. However, despite the proliferation of laws, decrees, policies, and agencies, definitive action continues to be

needed. In part, this is because of the lack of coordination across sectors and levels of decision making, especially at the sub-national and local levels. In addition, the lack of definitive action is also a result of the complexity of adaptation and the difficulty in identifying exactly what improved adaptation to climate change would look like and how it can be accomplished. In contrast to mitigation where there is at least clarity about the actions that will reduce emissions, adaptation is often conflated with different strategies of sustainable development, or increases in welfare that can also equip different social groups and households to withstand greater climate impacts related stress.

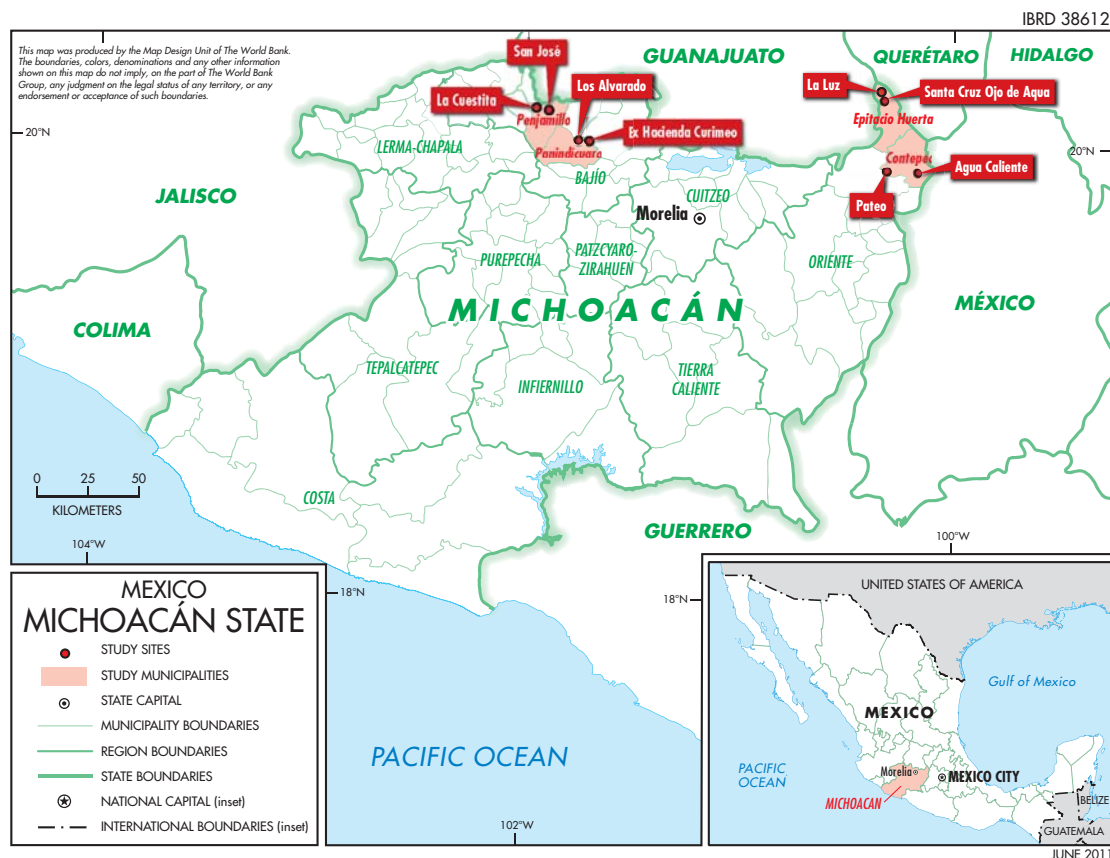
6.1 SELECTED STUDY LOCATIONS

In Mexico, two regions in the state of Michoacán were selected for the study: Bajío which is more exposed to flooding, and Oriente, which is periodically affected by

droughts (see Figure 16 for location). The study focused on specific climate events – floods in Bajío (particularly a recent major flood in 2003), and drought in Oriente (with particular focus on the drought of 2005). The way these different climate extreme events have been experienced by residents concerns the severity and spread of their impacts.

Droughts unfold more slowly, have not led to complete devastation of assets in the communities that experience them, and affect large areas. In comparison, flooding is more concentrated – both in its spread and in its effects, and tends to affect fewer people. Flooding events are remembered as being more devastating, and lead to state and local government responses that provide assistance to more people and at higher levels in comparison to drought responses. Both Bajío and Oriente are poor, and so are their residents. But Oriente has a greater level of marginalization in comparison to Bajío. In contrast to

FIGURE 16. STUDY SITES IN MEXICO



increasing population levels for Mexico as a whole, both regions and Michoacán as a whole have seen little population growth. Bajío and Oriente have high levels of migration to the US, and Oriente also sees substantial internal emigration.

In Peru, the study focused on the Mantaro valley; more specifically, it focused on the mountains of Jauja province in the valley. A strong territorial identity, reliance on agriculture, administrative fragmentation, and limited population growth with high levels of emigration are characteristic of the study area. Within the valley, the study identified the Yanamarca and the Yacus sub-basins for more detailed data collection and study.

The two sub-basins are similar in their physical and ecological characteristics but differ in that community organizations are stronger and have greater capacity in the Yacus sub-basin (see Figure 17 for location). Because

the two sub-basins are also close to each other, their exposure to predicted and ongoing climate impacts is also similar. They are both thus expected to suffer from lower water availability and rising temperatures – some of the effects of these changes are already being felt by farmers.

The Dominican Republic has 31 provinces and 155 municipalities. Because the governance structure in the country has led to a stronger level of territorial identification at the municipal rather than the provincial level, the research design focused on selection of study sites at the municipality level. Four municipalities with differing climate-related impacts were selected for in depth study (see Figure 18).

Two of the selected municipalities - Castañuelas and Villa Riva - are both flood prone. Their agricultural activities have been drastically affected by floods in the past few years, with substantial losses of crops,

FIGURE 17. STUDY SITES IN PERU

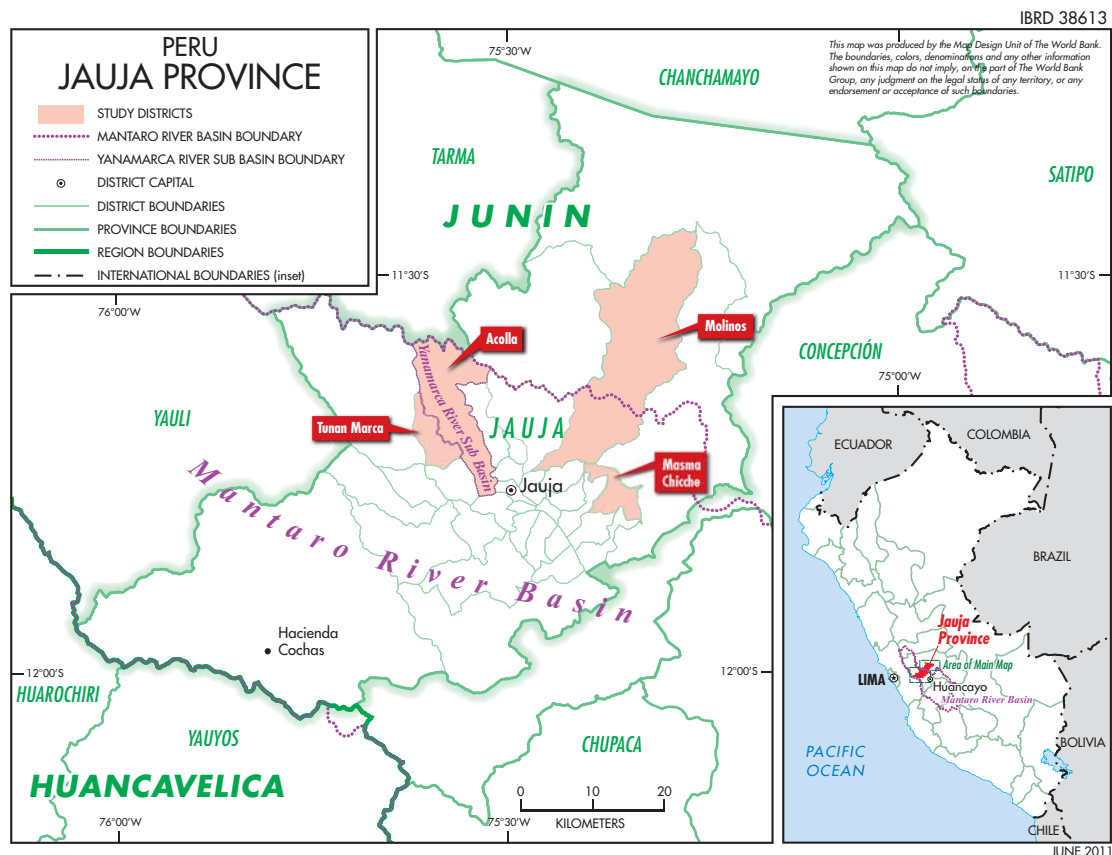
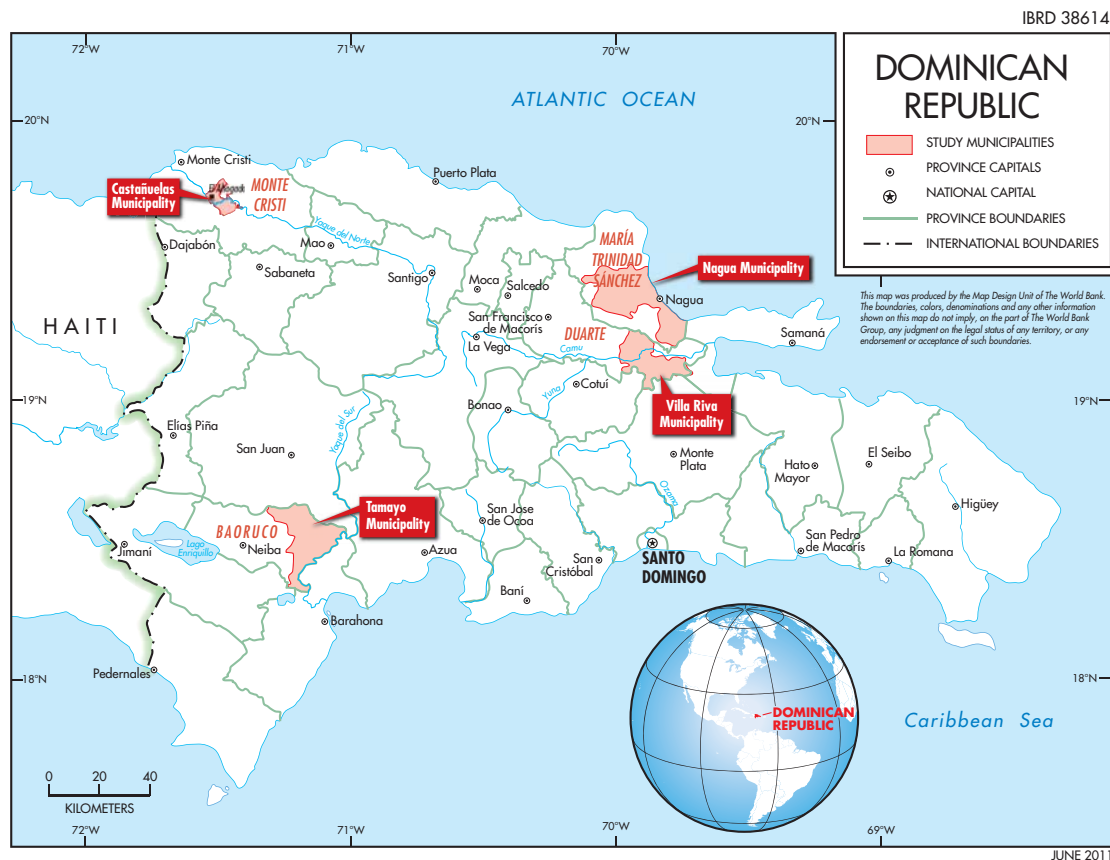


FIGURE 18. STUDY SITES IN THE DOMINICAN REPUBLIC



infrastructure, and livelihoods. Tamayo and Nagua, on the other hand are more affected by hurricanes, with Nagua also suffering the effects of sea level rise and changes in marine ecosystems that have impacted fishing activities. Within each municipality, two rural settlements were selected for household data collection. All the eight rural areas have high levels of poverty with the proportion of poor households ranging between 40 and 90 percent of the population. The rural areas are relatively close – 3 to 15 kilometers – from the municipal center.

6.2 FINDINGS

Low capacity of local institutions and governance arrangements: In the Latin American studies, the prominent features of institutions arrangements in the three countries concern the attributes of local governments in terms

of their capacity to accomplish goals, the level of articulation across levels and sectors, and the ways in which institutions in different countries respond to climate impacts and hazards. There is significant territorial heterogeneity in the distribution of these features of institutions, and as a result institutions at different levels in the three countries play different roles in facilitating adaptation.

In Peru and Mexico, local governments are expected to play a key role in responding to climate events. And indeed, in Peru, the existence of local governments that can implement strategies for the formation of district municipalities means that they can obtain significant resources from the central government to facilitate adaptation. They use these resources to invest in major projects that enhance the territorial adaptive capacity in the areas they are expected to manage. But the same is not true for Mexico. In Mexico, municipalities are officially

identified as the main intermediary between the supply of aid from the central government of the nation and the affected communities. However, often the local governments are the ones receiving the demands from the communities affected by the events, such as floods. This lack of articulation between the channels of assistance and the channels of demand often generates a sense of precariousness and vulnerability in the households even when there is plentiful aid during the emergency. In general, when local governments have low capacity to aggregate local demands, gain resources, or distribute available resources speedily, community members are unlikely to view local governance arrangements as effective. In the Mexican case, there were repeated complaints from decision makers interviewed about the late arrival of assistance from the federal level, and from households about the inadequate distribution of available resources.

These problems regarding capacity and coordination among different institutions were particularly visible in the Dominican Republic. It is at the other extreme compared to Peru, and municipalities and local governments do not play a significant role in the other extreme with regard to the role of local governments. It seems that these entities are unable to provide much support for adaptation strategies used by interviewed households. Limited fiscal resources and equally limited ability to cater to the needs of their constituents make Dominican Republic's local governments a virtually irrelevant actor in climate adaptation.

Substantial country-level variations: The three countries also differ from one another on other dimensions in terms of the contextual and institutions-related variables in the studied sites. Thus there are stronger informal organizations in the Dominican Republic that tend to pick some of the slack resulting from the limited capacity of formal local government organizations. The limited coordination between different levels of institutions in Mexico means that although overall resource availability is higher for institutions there, it is not translated into higher levels of benefits from institutions to households. Finally, the different characteristics of climate hazards in the three countries also have implications for adaptation strategies as discussed later. More of the climate impacts on livelihoods in Peru are through

slower-onset hazards in comparison to the Dominican Republic and Mexico.

Use of diversification strategies associated with greater institutional diversity: As discussed earlier, there is a wide range of different institutional types and forms in the selected study sites, but limited coordination across institutions and institutional levels. Therefore variation in local institutional capacity is an important determinant of the support institutions can provide for local adaptation and the effectiveness of adaptation efforts. In examining the role of institutions in facilitating adaptation, we looked at three types of institutions at different levels, and also whether institutions are formal or informal. In different study countries, these specific categories of institutions have an important effect on how institutions support which forms of adaptation. Table 5 summarizes the principal strategies found in the case studies supported by the different types of institutions operating at each level.

Table 5 suggests that adaptation strategies involving diversification are most commonly deployed across the range of institutional forms. Public institutions at the national and local levels, formal and informal civil society organizations, and those related to markets all turn out to be relevant for diversification-related strategies. For example, in Peru and Mexico, wage and salary employment provides an alternative income to livestock producers, and is made possible by local governments. In Peru the diversification of production is supported by civil society organizations such as research institutions, such as universities. A whole range of diversification strategies – development of irrigation systems, identification and use of improved varieties of potato crops, reforestation, the use of conservation practices, marketing of firewood and mushrooms—are examples of the different forms diversification takes in Peru. They are supported by market as well as public institutions.

Informal and local institutions key substitutes where market forces or government agencies are weak: Local governments and local arms of state agencies are key institutional actors in rural areas. In many several of the selected sites in Peru, as also in Michoacán, the weak development of market forces and/or inaccessibility of the study sites meant that market actors were absent or not very strong. In such a situation,

TABLE 5. RELATIONSHIP BETWEEN ADAPTATION STRATEGIES AND INSTITUTIONAL TYPE AND LEVEL IN LATIN AMERICAN SITES

<i>Type of Institution</i>		<i>Strategies they support</i>	<i>Applicable Cases</i>
Public	National	a. Market-based strategies b. Diversification strategies	Dominican Republic and Mexico
	Local	a. Storage strategies b. Diversification strategies c. Market-based strategies	Dominican republic, Mexico, and Peru
Civil society	Formal	a. Storage strategies b. Diversification strategies	Dominican Republic, Mexico, Peru
	Informal	a. Mobility strategies b. Storage strategies c. Diversification strategies d. Market-based strategies	Dominican Republic, Mexico, Peru
Market	Formal	a. Mobility strategies b. Diversification strategies	Dominican Republic and Mexico
	Informal	a. Mobility strategies b. Diversification strategies c. Market-based strategies	Dominican Republic and Mexico

Source: Case Studies of Mexico, Peru, and Dominican Republic.

households and community decision makers typically look to local governments, particularly during periods of stress. In Peru, local municipalities often tried to improve their capacity to respond to stress associated with climate events by trying to collaborate with each other. But civil society actors, in the shape of informal or formal local organizations play a necessary role where formal state or market institutions are weak or absent. Thus, in the Dominican Republic, civil society organizations are the first to respond to help communities cope with the effects of hurricanes. We already saw how local, informal credit institutions help the recovery of agricultural production by providing coverage in isolated and poorer areas. In both Peru and Mexico, similar informal credit arrangements are critical in supporting migration, particularly when it occurs over longer distances.

It is also important to note how efforts to create greater interactions among local organizations and agencies can help enhance the prospects for improved adaptation and development. In Peru, in the Yacus sub-basin, the creation of a commonwealth of municipalities has allowed municipalities preferential access to central financing for implementing infrastructure projects in the region (Escobal and Ponce 2010). In the Dominican Republic, there is substantial variation in the degree of

articulation among institutions. But greater interaction and coordination is also associated with the ability to meet the needs of constituents (Ramirez and Rosario 2010).

6.3 VULNERABILITY AND ADAPTATION STRATEGIES

Different sources of vulnerability lead to different strategies of adaptation: The adaptation strategies implemented by the households in response to environmental shocks depend in part on the types of events they experience, and the difference in adaptation strategies in response to slow-onset hazards (such as droughts or sea level rise) vs. sudden-onset hazards (such as hurricanes or floods) is brought out clearly in the Latin American regional study. Consider Peru as an example of the first situation: households adapt to changes in rainfall patterns by diversifying their production portfolio and by taking recourse to non-agricultural rural employment. These responses can be viewed as more proactive adaptation efforts. In the Dominican Republic, on the other hand, is an example of the second case. The greater unpredictability and sudden onset of storms and hurricanes means that households often rely on mobility as a key mechanism to cope with climate hazards. In this sense, responses to sudden-onset hazards inevitably have

an element of reaction to them, and tend to be deployed after the occurrence of the hazard.

The household surveys in each country indicated the frequency of the five basic adaptation strategies and their distribution in each country as indicated in Figure 19.

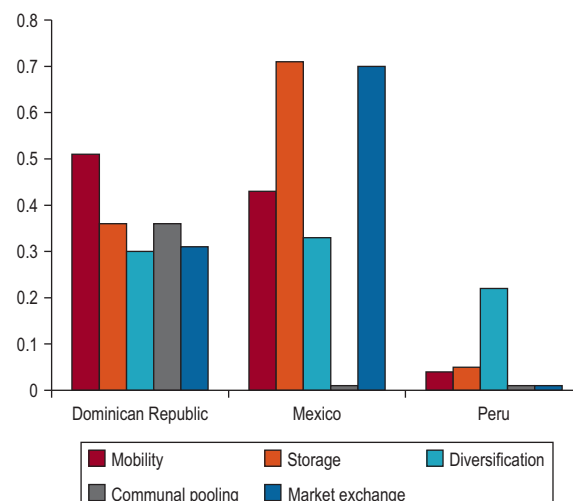
The information in Figure 19 confirms the association between types of climate hazards and the choice of adaptation strategies. In Mexico and the Dominican Republic, where there is a greater incidence of sudden onset hazards, adaptation strategies tend to be related to mobility, whether temporary or more permanent; recourse to non-farm labor; and storage and market exchange. Diversification is less important in both countries in comparison to other adaptation strategies. In Peru on the other hand, diversification is the most important adaptation strategies, and includes diversification of productive activities, adoption of new technologies, and improved protection of resources.

Lower numbers of adaptation for slower-onset hazards:

A second pattern visible in Figure 19 for the Peru case is the overall lower numbers of adaptation strategies used by households. There can be two explanations for the low numbers of adaptation strategies used by households. One possibility is that the interviewed households

indeed practice fewer adaptations because they do not need to modify their daily activities much owing to lower intensity of experienced climate impacts. Thus, in Peru, diversification is implemented only by 25% of the households, and other strategies are implemented only by a marginal number of households. In contrast, in Mexico and Dominican Republic the vast majority of interviewed households reported using the full range of adaptation strategies (except communal pooling in Mexico). But another explanation may be that although households are practicing different forms of adaptations, they do not view these as adaptations because they are undertaken proactively and routinely. The difference in the number of households that recognize concrete actions (strategies) to face the changes in Peru in comparison with Mexico and the Dominican Republic may thus be alternatively explained by the fact that when undertaking gradual changes, people do not view their actions to be adaptations. In this case, the information collected through surveys is underestimating the incidence of adaptations in Peru. Finally, the case studies also show that preventive adaptation strategies are less frequent than reactive adaptation strategies. The likely explanation is that interviewed households as well as institutional actors have limited resources at their command and immediate needs typically take precedence over long term adjustments.

FIGURE 19. ADAPTATION STRATEGIES PRACTICED BY PERCENTAGE OF RESPONDENT HOUSEHOLDS IN LATIN AMERICAN STUDY SITES



6.4 HOUSEHOLDS AND ADAPTATION

Greater access to assets such as land and credit is associated with greater ability to adapt: The case studies focused on four types of relevant assets for households and communities, and the relationship between the presence of assets and the use of adaptation strategies. The assets included credit, land, social capital, and natural capital of the territory. One of the key findings of the regional study, in common with findings for West Africa, is that greater access to or ownership of assets is associated with greater use of adaptation strategies.

One of the most important factors relevant to the use of adaptation strategies is access to credit. Access to credit, in all the three sets of cases, is one of the major financial assets of surveyed households. Greater access to credit allows improvements in recovery of agricultural activity, but also reduces the vulnerability of agricultural, migrant, and landless households. In the selected cases, access to credit was available through formal credit institutions such as savings and loans associations in Mexico and through agencies specializing in micro credit as in Peru. Informal sources such as convenience stores in the Dominican Republic and retail as well as wholesale grocery stores and businesses in Mexico and Peru also served as important sources of credit for households that could not access more formal credit institutions. But those households that could get access to credit were likely to use adaptation strategies with greater frequency.

Access to land is also an important determinant of use of adaptation strategies. In Mexico and the Dominican

Republic, households with access to land use more adaptation strategies, especially those related to market exchange. Indeed, credit and land interact – credit is critical for those with land because it enables faster recovery of agricultural activities in the wake of a disaster. For more vulnerable households, lack of access to land and credit often leads to a change in occupation after the experience of a hazard. Households whose principal source of income is a small business or wage labor are more likely to be rendered vulnerable as a result of adverse climate events as compared to those with access to land and credit. In Mexico, for example, climate hazards are often associated with greater mobility for landless households. Mobility again appears as a major coping strategy for those without the resources to undertake proactive adaptation or without access to high levels of credit or large areas of land.

If access to land and credit facilitate individually oriented adaptation strategies, higher levels of social capital and institutional access are more likely to facilitate adaptation strategies requiring collective action and investments. Thus, in Peru, community level coordination improves water collection and control for agricultural use. Greater access to irrigation water has helped many households cope better with drought conditions. In the Dominican Republic, family networks have facilitated both temporary and permanent migration to escape the worst impacts of hurricanes. Thus, social capital, understood as the networks and contacts that facilitate access to information or resources provided by institutions, facilitates the deployment of collective adaptation strategies.

7. CROSS-REGIONAL SYNTHESIS

This study led to substantial local-level field research, more than 100 on-the-ground consultations and interviews with government officials and other decision makers, and an examination of key secondary documents for six countries. The research enables a series of regional and cross-regional inferences about institutional, contextual, and household level characteristics that support more comprehensive approaches to adaptation. In particular, these patterns of findings pertain to cross-scale institutional coordination and institutional capacity; the relationship between vulnerability, vulnerability profiles, and adaptation; and the influence of different household, local, and physical factors on the likelihood of adaptation.

In summarizing the above discussion to elaborate on the cross-regional patterns revealed by the study, it is worth noting two points. As already indicated, the implementation of data collection and analysis in the two regions diverged from the initial plan. Local institutions and households level adaptations became a greater focus for the West Africa country studies, and national policies and community level outcomes and actions were a stronger focus for the work in Latin American countries. Further, although similar data was gathered in each country and region, insufficient coordination across the regions meant that the data were analyzed using different approaches.

Despite these differences, a review of the findings from the two regions and the three countries in each region

demonstrates several common patterns. The existence of these common patterns, despite differences in the data collection and analysis, suggests that biases specific to particular data collection strategies or a single field research partner are not replicated across the research effort in the different countries. In this sense, the findings from each region serve as a check against related findings from the other region. In summarizing cross-regional patterns below, the report particularly highlights those that are similar across the two regions despite the regional variation and the differences in the data collection and analysis.

7.1 INSTITUTIONAL COORDINATION AND CAPACITY

Cross-scale relationships are critical for supporting adaptations by local populations and decision makers: The study shows the importance of cross-scale relationships for effective adaptation in the countries where research took place. In nearly all countries some national level efforts are under way to improve country-wide plans for adaptation to climate change. Such planning aims to create decision-making arrangements that can address climate impact concerns in current development strategies. In Latin America, these efforts specifically target climate change. They include the Inter-secretarial Commission on Climate Change in Mexico, the National Commission on Climate Change in Peru, and National Adaptation Plan of Action in the Dominican Republic. Similarly, Niger, Burkina Faso, and Senegal all participated in the NAPA process. This involvement underscored the interest in climate adaptation planning in the three countries.

The field level research for this project also shows the ubiquity and widespread nature of climate adaptation strategies among households and communities. Climate variability has been a constant feature of studied communities, and they have developed a wide variety of strategies through which to address the risks they face. Indeed, in several of the studied communities, there is some evidence that recent climate phenomena have had major impacts, and at least some respondents recollect more recent climate phenomena – both droughts and floods – as producing impacts that exceed those of similar phenomena in the past.

But missing in many of the studied cases is a connection between local-level adaptation actions and national-level planning. For example, although the research in Dominican Republic suggests that strong community organizations make the provision of external assistance more effective, such organizations are missing in several study sites, or they are not well connected to higher level organizations. Similarly, lack of effective local organizations means that assistance for those suffering from floods is much higher in Michoacán in comparison to what is available for those affected by droughts, even though the effects of droughts can last much longer. Effectively, this suggests that household adaptation strategies have not coalesced to produce pressures for higher level organizations owing to familiar problems of collective action. At the same time, national discussions have also not generated the political pressure to create such boundary organizations. As a result, there is little or no articulation between national and local levels around adaptation. It remains critically important to fill this gap. Local adaptations to the greater risks posed by future climate change are likely to be inadequate in the absence of meso-level institutional arrangements, organizational support, and material resources.

Substantial coordination gaps also exist among sectoral agencies and decision makers: Because climate change impacts are likely to affect the majority of economic sectors and social domains in developing countries, the absence of coordination across sectoral agencies limits the effectiveness of adaptation responses at the household and decision making levels. For example, migration to avoid the worst effects of hurricanes and floods is common in the Dominican Republic. But post-disaster reconstruction is often made more difficult by

low availability of labor. Such migration can also have negative impacts on literacy and education because schools in receiving areas often serve as shelter for those forced to move owing to hurricanes.

Information sharing and close interactions among agricultural, forestry, environmental, rural development, energy, and infrastructure ministries and their line departments are likely to make adaptation responses more effective. In particular, stronger coordination among such ministries and meteorological departments is necessary to take advantage of available information and to establish early warning systems for climate impacts such as floods and droughts. In Michoacán, local organizations receive a variety of advice and resources from different state agencies, often with specific objectives that may be at cross-purposes. Similarly, community savings and loan organizations are important to the activities of households in all the studied locations, but they are not well connected to the municipalities through which nearly all federal transfers are channeled. The lack of coordination among institutions and agencies even at the same level – whether local or national – means that available resources and information are not put to uses that can best support adaptation.

The emergence and increasing urgency of action on climate change also generates its own stresses on governance relationships and agencies. The need to address climate change impacts generates stronger pressures for inter-sectoral and cross-hierarchical coordination, but the resources available for undertaking these actions remain limited or non-existent. As the next section describes, local organizational capacities suffer pervasive limits and weaknesses across the study regions and countries.

Limited capacity of local organizations and inadequate support from national and subnational agencies to local governments: Local organizations play a critical role in adaptation. In different locations, they provide emergency assistance such as food delivery, donations, and evacuations and rescue operations. They also assist with more day-to-day needs such as those related to training and guidance, infrastructure development, provision of financial assistance, or post-disaster reconstruction. These activities are typically complementary to those of national institutions. Despite the critical role of local

organizations in supporting adaptation to climate stresses, most have limited resources at best and are not well connected to higher level decision making bodies (see also Agrawal and Perrin 2009).

In the studied countries and villages, in fact there is a wide variety of institutions and local organizations that structure how households respond to climatic phenomena. Although such organizations are linked to households across all strata of income and asset holding, their ability to help households is constrained because they have limited technical resources for making informed decisions and for implementing their decisions, they have low levels of funding, and they cannot raise funds independently to substitute for the limited support from higher levels. Indeed, this is one of the key reasons for limitations on the extent to which the extent of adaptation to climatic phenomena is likely to be lower than what may theoretically be possible (Adger et al. 2009).

7.2 CONTEXT AND VULNERABILITY

Reliance on agricultural vs. other sources of income leads to differences in structures and patterns of vulnerability: One of the key findings and insights of the ABDCC project is that although most rural households in the studied locations are highly vulnerable, their vulnerability stems from very different sources of risks and stresses on livelihoods (see also Mearns and Norton 2010). This finding holds across the different countries and villages, and is likely to be relevant to other developing contexts as well.

Thus, in Burkina Faso, there are some household clusters that have high levels of exposure to climate impacts and that is their key source of vulnerability. But there are other households that are vulnerable despite low levels of exposure – their incomes are more likely to be affected adversely by climate impacts, but they remain vulnerable because they have low adaptive capacity. Similarly, in Niger, there are households that are more vulnerable to repeated droughts because of their reliance on cattle *vs.* others who are poor, but rely more on income from trade and wage labor.

The studies also show that substantial shifts in livelihood strategies and relative dependence of vulnerable social groups on different livelihood resources are under way. In Peru's Yanamarca sub-basin, for example,

remittances have become a major source of household income and livelihoods, displacing agriculture as the key income source. The same is true of households in Michoacán, and for that matter in the studied areas in Senegal and Burkina Faso. The rural realities in the developing world are not static; rather, they are rapidly changing, even before climate impacts begin to be felt in a widespread manner. External adaptation interventions therefore must take into account the changing structure of livelihoods in the rural areas of the developing world, mainly by recognizing the need for adaptive shifts in focus in parallel with changing livelihoods and needs in target regions.

The basic issue is familiar – the nature and structure of livelihoods of households and communities, the distribution of assets and occupations, and the nature of links to organizations and external resources is as consequential for determining vulnerability as the overall level of livelihoods, assets, or institutional connections. A household's level of vulnerability is not the final word on how that household will fare because of a specific climate-related disaster. Therefore, focusing only on average levels of vulnerability of a household or community can lead decision makers or donors to target resources mistakenly in the effort to support adaptation. Further, variations in the nature of vulnerability also mean that in different communities, different types of interventions are needed to address vulnerability and enhance adaptation responses. The specific content of these interventions depends on the nature of income sources, occupational and livelihoods strategies, types of adaptations practiced, and the institutions to which different groups of people seek recourse in response to climatic stresses.

Strong association between types of climate hazards and choice of reactive vs. proactive adaptation strategies: The West African as well as Latin American cases suggest on the one hand that households are more likely to report practicing reactive strategies as their adaptation strategies (mobility, and some forms of pooling and exchange) rather than proactive strategies as their response to climate impacts (e.g. diversification or storage). At the same time, the reactive strategies are reported to occur more often in response to rapid onset disasters and proactive strategies are correlated more with slow onset events.

These regularities make sense in the context of how households are likely to perceive their actions and also in relation to the rapidity with which they can be deployed. Mobility occurs in the context of both droughts and hurricanes for example, but is often viewed as an everyday adaptation in semi-arid environments whereas mobility in relation to hurricanes is more likely to be viewed as the result of a specific event. Similarly, diversification occurs over a long time and produces its outcomes over a similarly long stretch of time. In Peru, for example, perceptions of increasing water scarcity have led to increasing levels of diversification of occupations and income generation strategies among studied households.

7.3 HOUSEHOLD CHARACTERISTICS AND ADAPTATION: INSTITUTIONS, ASSETS, AND INFORMATION

Household and community level adaptations are clearly associated with a range of contextual and institutional factors. The options open to households are thus structured by the kinds of climate hazards they experience, the socio-economic context in which they are embedded, and the types of institutional relationships and access they enjoy. But the specific characteristics of studied households also affect the forms and breadth of adaptations they practice. In this sense, adaptation strategies are neither entirely structured, nor fully voluntary.

Studied households tend to deploy a larger portfolio of adaptation strategies when they possess more assets of

different types, when they have access to diverse information sources, and when they have access to multiple local organizations and interact more frequently with these organizations. These findings are particularly clear through quantitative analysis of data from Burkina Faso, Niger, and Senegal and robust to a variety of ways in which the quantitative analysis was carried out. But they are also evident in the more qualitative data through which household adaptation strategies were analyzed for the Latin American cases.

Thus, for example, household wealth, access to public goods, and organizational access are positively associated with use of different adaptation strategies in Peru, even when variation in biophysical factors is taken into account across the studied sites. In the Mexico study, the pattern of adaptation strategies was somewhat different - households in Michoacán were more likely to use exchange as a strategy if they owned land *vs.* storage or mobility if they did not have land ownership. But in the Dominican Republic, again, households with greater asset ownership, greater institutional access, and more information tended to adapt more comprehensively and effectively in comparison to those that did not have high capital endowments or institutional connections. Thus the qualitative as well as the quantitative analyses point in a similar direction as concerns the relationship between household access to local organizations and information, ownership of assets, and use of a broader portfolio of adaptation strategies.

8. IMPLICATIONS AND RECOMMENDATIONS

8.1 INSTITUTIONAL COORDINATION AND CAPACITY

The lack of coordination among agencies at the same level, and between higher and lower levels of decision making, is an important gap that hobbles effective adaptation responses. The absence of cross-scale coordination can undermine implementation of reforms, translation of decisions made at higher levels into action on the ground, and knowledge about impacts of such decisions. Gaps in interactions among different agencies can limit effectiveness of the independent strategies pursued in response to climate impacts.

Many studies and research projects have pointed to the need for more thorough-going coordination than currently exists. But its absence is typically owing to the fact that such coordination is costly: it is costly in terms of setting up arrangements that permit information sharing and promote interactions among information analysts and decision makers. It is also costly in terms of material resources needed to promote coordination. And finally, different agencies may often not be interested in working with others as they protect their activities and resources from others. Therefore, positive though the outcomes of coordinated decision making and information sharing might be, they are not very visible in practice owing to the likely costs they entail. Overcoming the barriers to institutional coordination is likely to require

substantial investments that show the benefits of such coordination and also reduce the costs. The development of boundary organizations, formulation of strategic policy coordination initiatives, improved information provision about climate threats and impacts, and provision of added material resources are all likely to be necessary to support greater interaction, coordination of decisions, and sharing of information about activities being undertaken by different agencies.

Limited capacity and support to local organizations is particularly distressing in the context of climate adaptation because climate impacts and how they will affect specific locations is often unpredictable. Such unpredictability means that in many situations, an appropriate response requires both information and resources to be available in a decentralized fashion. Centrally directed resources may not reach the places and households that most need them because of the absence of information. The mismatch between the information needed to direct resources (more available with local organizations and households themselves) and the availability of resources (with central agencies and decision makers) can be addressed either by developing mechanisms for more effective information flows or by making more resources available to local institutions.

In this context, it might be easier to promote improved coordination across scales than among organizations at the same level. This is because provision of resources to enhance coordination across scales is likely to help higher as well as lower level organizations: higher level organizations can seek more compliance and better

implementation in exchange for more resources and lower level decision makers achieve better support from their constituents in return for more resources as they promise enhanced compliance to their superiors. Achieving similar outcomes across agencies at the same level might be more difficult because of the competition over resources that are made available to improve cross-sectoral coordination.

8.2 CONTEXT AND VULNERABILITY

The use of vulnerability profiles in the research points to clear implications for external interventions to improve the effectiveness of adaptation strategies. Rather than examining and assessing overall levels of vulnerability and linking adaptation support interventions to levels of vulnerability, it would be more useful and productive to use assessments of levels of vulnerability as a starting point for structuring adaptation interventions. In addition, it is also necessary to carry out assessments of the ways in which different groups are vulnerable – for example, owing to their greater exposure, vs. occupational and livelihoods strategies vs. asset ownership – before specific adaptation interventions are structured.

The empirical regularity between the use of specific adaptation strategies and the types of climate impacts and exposure provides another point of leverage to structure interventions to facilitate adaptations. In the case of slow onset disasters – particularly those related to erratic rainfall or low levels of precipitation, adaptations focusing on market instruments such as insurance products, long term storage, and diversification of consumption goods, factor inputs, and products are more likely to be effective. In contrast, rapid onset disasters are likely to require support for adaptation strategies related to mobility and pooling of resources. Better information is likely to be of use in responding to all kinds of climate events, particularly when made available through multiple sources.

8.3 HOUSEHOLD CHARACTERISTICS AND ADAPTATION

The quantitative and qualitative analyses for this study point to clear areas in which external interventions can

support more comprehensive adaptation by households. Three key areas where external support will enable improved adaptation effectiveness and the use of a broader range of adaptation options concern improved access to institutions, poverty alleviation strategies that enhance asset ownership including non-material assets such as social capital and human capital, and better distribution of information about climate hazards. Certainly, these are already areas in which governments and donors are active. For example, a study supported by the World Bank in Peru recommends the development of a Geographic Information System (GIS) in Peru to map local vulnerabilities in the Mantaro Valley in relation to climate change (INIA 2009).

However, decision makers need also to take into account the possibility of perverse incentives as a result of higher material support for adaptation because of the problem of moral hazard (see also Urwin and Jordan 2007). A number of interviewed households indicated that a key adaptation strategy for them is to rely on central government transfers during periods of environmental stress rather than to rely entirely on their own efforts. Enhanced support for adaptation may, for some households and communities, displace their own efforts to adapt and address climate change impacts.

Ideally, external actors' or government support for adaptation, as channeled through local organizations, should provide additional resources to households to help them address climate risks better. It should not substitute for existing household adaptation efforts that would occur in the absence of government support. Although additivity in relation to adaptation support has been discussed extensively in the climate change literature, an analogous set of issues is also relevant in the case of government to household transfers and support strategies.

Therefore, in the long run interventions that enhance institutional support and access, or improve information availability, may be more effective in promoting the effectiveness of adaptation rather than those that lead to straightforward income transfers or asset development for vulnerable households.

9. CONCLUSION

This study of adaptation and climate variability in six countries of West Africa and Latin America has used a new conceptual framing and original data to analyze patterns of vulnerability to climate impacts and adaptation strategies used by households and communities in response to such impacts.

The key building blocks of the analysis presented in the report are the concepts of territorial development, vulnerability profiles, adaptation practices, and local institutions. These concepts are connected by hypothesized causal relationships that the research attempted to examine. Territorial endowments of communities and households – including the exposure to climate hazards and risks but also institutional arrangements and configurations – structure the ways in which different households and communities are vulnerable. An assessment of their vulnerability profiles and livelihoods and corresponding adaptation strategies provides entry points for external interventions and policy measures that seek to enhance the effectiveness of local adaptations.

In the studied countries and sites, the research finds that although national-level planning and local-level actions to adapt to risks are present, organizational mechanisms to link the two are missing or weak. If cross-scale coordination is weak in the studied sites, cross-sectoral coordination across different organizations and agencies is also missing in most cases – at both the local and national levels. Further, local organizations are crucial to households that pursue adaptation strategies, but most

existing local organizations have limited capacity to provide resources and information to their constituents.

These gaps point to obvious areas for external interventions to support adaptation, particularly to enhance cross-scale coordination. Overcoming barriers to institutional coordination will require substantial investments – the absence of such coordination at present indicates that there are major costs to promoting coordination. Investments in boundary organizations, formulation of strategic policy coordination initiatives, improved information provision about climate threats and impacts, and provision of added material resources can support greater interaction, coordination, and information sharing. These outcomes would also help realize more meaningfully an area-based approach to development with its emphasis on the analysis of territorial endowments, greater inter-sectoral and cross-scale coordination, and deployment of a cohesive strategy for strengthening partnerships.

The research finds that although most interviewed households and communities are vulnerable, they are vulnerable in different ways and for different reasons. At the most basic level, some are vulnerable because of greater exposure to climate hazards, and others because of greater sensitivity of their incomes to climate threats, and yet others because they are highly specialized in terms of their assets or occupations or have only limited access to the resources that local organizations can provide – especially in the wake of disasters. Households and communities also vary in their vulnerability profiles depending on their livelihood strategies, incomes and assets, connections with local organizations. Differences

in the nature of vulnerability among different clusters of households and villages mean that external interventions to support improved adaptations need to structure information and resource flows to the needs of communities and households that they seek to assist.

Indeed, the association between adaptation strategies and types of climate impacts and exposure also provides key points of leverage to structure external interventions. Slow onset disasters – particularly those related to erratic rainfall or low levels of precipitation – are often associated with adaptations focusing on market instruments such as insurance products, long-term storage, and diversification of consumption goods, factor inputs, and products sold by resource-dependent households. In contrast, rapid onset disasters require support for adaptation strategies related to mobility and pooling of resources. Better information seems to be useful in responding to all kinds of climate events, particularly when made available through multiple sources.

Both qualitative and quantitative data suggest that observed adaptation strategies are strongly associated with specific household characteristics. Both qualitative and quantitative evidence suggests that studied households tend to depend on a greater set of adaptation strategies when they have assets of different types, when they can take advantage of diverse information sources, and when they are connected to multiple local organizations and also interact more frequently with these organizations. This finding points to three key areas in which external support can improve local adaptation effectiveness. Enabling households to pursue the range of adaptation strategies they want is likely to require interventions that improve access to institutions, reduce poverty through enhanced ownership of productive assets, and better distribute information about climate hazards.

In structuring external interventions, decision makers need to take into account the possibility of perverse incentives as a result of stronger external support for adaptation. Enhanced external support for adaptation may, for some households and communities, displace their own efforts to adapt and address climate change impacts. Ideally, therefore, interventions that enhance institutional support and access, or improve information availability, may be more effective in promoting

sustainable adaptations than those that lead to straightforward income transfers to vulnerable households.

This report and the research project on which it is based meet a substantial gap in the existing literature on vulnerability and adaptation among poorer communities and how external interventions can enable local adaptations to be more effective. It shows the importance of contextual variations, the need to attend to variations in vulnerability of communities and households in a given territory as also to the institutional and other assets, and shows how adaptations are already occurring. It provides a framework for understanding the relationships among vulnerability, adaptations, institutions, and external interventions that can make responses to climate impacts more effective. There are few comparative, cross-national studies of adaptation and institutions at the local level. Therefore, the study is also valuable because it provides a comparative review of local-level vulnerabilities, adaptations, and institutions in six countries in two different regions of the world.

As decision makers and policy analysts try to understand how best to strengthen the abilities of households, communities, and governments to address the negative effects of climate phenomena, extreme events, and associated damages, they will need to take into account the relationships among and the distribution of vulnerability, adaptations, institutions, and potential external interventions. These relationships are highly likely to be region and country specific. A comprehensive picture of appropriate interventions requires contextually sensitive studies, theoretically informed analyses, and generalizable findings.

As such, the analyses and findings offered in this study constitute only a beginning. Although the field work, research, and subsequent analysis represented in this report contribute to a better understanding of local and regional patterns of relationships among vulnerability profiles, adaptation practices, and institutional configurations, the study also points to substantial needs for additional research to develop a more careful and systematic understanding of these relationships. New work will need to assess how well the study's conceptual approach is relevant to analyses of adaptation to climate variability and change; whether the patterns of relationships identified in the data hold for other cases and

regions; and finally, whether the recommendations for structuring external policies to support local actions are useful more broadly. Further, because the study relies on cross-sectional, observational data on household and community level actions and decisions, the hypothesized causal relationships are difficult to test. Information on

how adaptation strategies change in response to changes in vulnerability, institutional arrangements (including policy support), information, and new resources will help more rigorous tests of the arguments advanced in this study, and also thereby allow more effective targeting of external interventions.

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APPENDIX 1. LIST OF STUDY SITES

1. MEXICO

Eight study sites were located in two regions of the state of Michoacán, Mexico (see Figure 16):

<i>Region</i>	<i>Type of climatic shock</i>	<i>Degree of Marginalization¹</i>	<i>Municipality</i>	<i>Institutional Presence²</i>	<i>Villages</i>	<i>Population</i>
Oriente	Drought 2005	Average to Very High	Epitacio Huerta	Low	Santa Cruz Ojo de Agua	536
					La Luz	724
			Contepec	High	Pateo	948
					Agua Caliente	951
Bajío	Flood 2003	Low to Average	Panindícuaro	Low	Ex hacienda Curimeo	478
					Los Alvarado	226
			Penjamillo	High	San José	629
					La Cuestita	266

1 The degree of marginalization is based on the definition of the National Population Council (CONAPO), as a measure of the extent and intensity of deprivation and shortcomings in meeting those human basic needs established as constitutional rights: education, housing, income, and population distribution.

2 The level of institutional presence was evaluated in terms of the perception of representatives of the Secretariat of Rural Development of the State of Michoacán, based on the presence of government programs at the state level in the municipalities, as well as on the level of the relationship of the municipal council with the State Government.

2. PERU

In Peru the study targeted the middle part of the Mantaro Valley; specifically the mountains of Jauja province (see Figure 17)³. The study concentrated on two sub-basins of Mantaro River: the Yanamarca sub-basin and the Yacus sub-basin. The principal difference between the two sub-basins is the higher 'institutional density' observed in the Yacus sub-basin, expressed by the existence of more active community organizations and local governments with better professional competences and budgetary execution.

The following table shows the main criteria influencing site (district) selection in Peru's Mantaro River Valley basin, including one poorer and one richer district in each of the upper and lower catchment areas of the two sub-basins:

Upper watershed (high climate risk)	District of Acolla (Yanamarca)		District of Apata or Molinos (Yacus)	
	poor	rich	poor	rich
Lower watershed (lower climate risk)	District of Tunan Marca (Yanamarca)		District of Masma Chicche (Yacus)	
	poor	rich	poor	rich

3 A small part of the Jauja Province is located outside the territory: the Monobamba district (rainforest region) and the Canchayo district (where the Tupac Amaru SAIS is located, whose area of influence extends toward other districts of the Lima Region).

3. DOMINICAN REPUBLIC

In the Dominican Republic, the municipality was selected as the primary administrative unit of analysis because in territorial terms the Dominican Republic's governance structure rests with the municipality rather than with the province. Four municipalities

were selected for the study: Castañuelas in the North-West, Nagua and Villa Riva in the North-East, and Tamayo in the South-West (see Figure 18). The four municipalities have a high incidence of poverty. The basic socioeconomic characteristics of the eight sections selected for the case study are shown in the following table:

Municipality	Area	Density/km ²	Population	% of poor households	Distance to municipal seat of government (km.)
Castañuelas	El Ahogado	262	3148	52.4	6
	Magdalena	37	633	77.2	3
Nagua	La Playa	723	3276	70.1	3.5
	Los Yayales	71	2998	88.6	13
Villa Riva	Ceiba de Los Pájaros	54	2169	37.3	4.5
	Barraquito	129	2587	77.4	15.5
Tamayo	Mena	278	2224	87.2	7
	Monserrat	82	1066	73	3

4. BURKINA FASO

In Burkina Faso, data collection took place in three separate regions: Houet (Bama village), Soum (Pobe Mengao and Baraboulé villages) and Kouritenga (Kando village) (see Figure 4). The survey included both high climate risk zones (Soum Province) and average or moderate climate risk zones (villages in Kouritenga and Houet Provinces). The main economic activities are agriculture, animal husbandry, petty trade and handicrafts. The department is a departure zone due to high level of natural resource degradation and its proximity to a large trading center, Pouytenga.

Kando is situated to the North-West of Koupèlla, capital of Kouritenga Province, and around 160km from Ougadougou. Kando department comprises 4,117 households and 28,282 inhabitants, of which 12,927 are male and 15,355 are female. The Mossé are the dominant ethnic group, followed by the Peul. Livelihoods include agriculture, animal husbandry, small-scale commerce and craft industries. The availability of water is a major problem during the dry season. Firewood is the principal fuel. Kano is an area with out-migration due to the degradation of natural resources and its proximity to the major commercial centre of Pouytenga, and as a result it is often left to women, children and the elderly to manage village affairs. There are village groupings of farmers, fishermen, animal breeders and land owners. At the village level both men and women organize themselves into groups to fish, farm and raise animals.

Soum province contains 67 villages spread amongst several communes, including Baraboulé (13 villages) and Pobe-Mengao (13 villages). In total there are 5,452 households and a population of 29,883. The Peul ethnic group is the dominant ethnicity, followed by the Mossi, Rimaïbé, Fulsé, Bella and Sonrhaï. There are several local civil society organizations in the area which are primarily interested in agriculture and animal husbandry, including the GV, CVGT and the Baraboulé farmers union. Various NGOs and other projects and programs provide technical support for these village groups. Agriculture and animal husbandry are the main economic activities in this study zone and are supplemented by

small-scale crafts, gold-panning, hunting and fishing and commerce relating to these activities.

5. NIGER

Data collection in Niger focused on villages in the administrative regions of Dosso and Maradi (see Figure 5). Dosso is located in southwestern Niger and is the traditional home of the sedentary farmers known as the Zerma. Sedentary livestock rearing and subsistence agriculture dominate the economy in and around Dosso. Sahelian farmers do not use irrigation to the same extent as do farmers in other regions of Niger.

The Maradi region is located in south-central Niger, at the extreme northern edge of Niger's more Sahelian climate. The very southern edges along the border with Nigeria receive almost 600mm in average annual rainfall, with some areas receiving as much as 650-700mm in better years. Maradi's economy is more diversified than Dosso's, and is founded on the cultivation of groundnuts and cassava, artesian work (primarily leatherwork), and sheep and goat herding. The Hausa people – traditionally known as sedentary farmers and business people – dominate this region. While Maradi Region is the breadbasket of Niger, the twentieth century saw three severe Sahelian droughts which brought dramatic food insecurity to even the most fertile regions of Niger.

Surveys were conducted among a sample of 120 households in 4 villages (Maijirgui and Dakoro in Maradi Region, and Guecheme and Loga in Dosso Region), and interviews with 20 homogenous focus groups and 40 institutional/expert interviews were also conducted. The household survey was carried out in both agricultural and agro-pastoral zones within the two regions, thereby distinguishing zones prone to severe weather

<i>Regions</i>	<i>Departments</i>	<i>Rural communes</i>	<i>Sites (villages)</i>
Dosso	Loga Dogondoutchi	Loga Guéchémé	Sargagui Lido
Maradi	Dakora Dessaoua	Dakoro Gadabedji Maijirgui	Intouila Gadabedji Chabaré

risks (Loga in Dosso, Intaouila in Maradi) and zones with low to average climate-related risks.

6. SENEGAL

Data collection in Senegal was concentrated in six districts – Diourbel, Fatick, Kaolack, Kaffrine, Louga, and Thiés –covering three of the seven agro-ecological zones in Senegal: (i) the Senegal valley; (ii) the Niaeys; (iii) the Northern Groundnut Basin; (iv) the Southern Groundnut Basin; (v) the Sylvopastoral Zone; (vi) Eastern Senegal and Upper Casamance; and (vii) Lower and Middle Casamance (see Figure 6).

The Groundnut Basin (including its northern and southern parts), covering the districts of Diourbel, Fatick, Kaolack and Kaffrine, is highly populous; its agricultural production and village communities were adversely impacted by the groundnut crisis. Over the past few years, this zone was subjected to recurrent droughts. Weather conditions have worsened ecosystem degradation and depletion of land resources (soil fertility and timber resources) and reduced soil regeneration, due to upland soil acidification and lowland salinity, marine

incursion in Saloum River, and mangrove degradation and marine pollution along the coastline.

The Niaeys zone (a 5–10 km strip along the coastline), including Thiés district, is the major commercial vegetable producing area in Senegal. The city of Thiés is located 35 miles to the east of Dakar, the capital of Senegal. The city and regional proximity to the capital, as well as its location at the center of major transportation routes, has helped encourage the development of light industry, processing plants, and mining. It is a densely-populated area (more than 20% of the country's population live on less than 1% of the territory). The most significant climate change hazards are: shifting fixed and newly-formed dunes, soil salinity and sand bar formation in lowland soils, salinity of wells, coastal erosion and marine invasion.

Louga district, located in northwestern Senegal (part of the Sylvopastoral zone, Senegal's major cattle breeding area), is mainly populated by the nomadic Fulani ethnic group. It is characterized by a sharp decline in forest and fodder resources, soil degradation, destruction of the vegetation cover, and meager water resources.

APPENDIX 2. LIST OF RELEVANT WORLD BANK-SUPPORTED PROJECTS

1. MEXICO

- i. Mexico Indigenous and Community Biodiversity Project (COINBIO)
- ii. Proyecto Conservación y Manejo Sustentable de los Recursos Forestales en México (PROCYMAF II)
- iii. Strengthening Social Resilience to Climate Change Development Policy Loan

2. PERU

- i. Sierra Irrigation Subsector Project (PSI)
- ii. Climate Change and Agricultural Vulnerability across Mega-environments in Latin America

3. DOMINICAN REPUBLIC

- i. Emergency Recovery and Disaster Management Project
- ii. Municipal Development Project

4. BURKINA FASO

- i. The National Decentralized Rural Development Program (PNDRD)

- ii. Sahel Integrated Lowland Ecosystem Management Project (SILEM)
- iii. Forest Investment Program (FIP), under Climate Investment Funds (CIF)

5. NIGER

- i. Community Action Program (CAP)
 - a. CAP PHASE 1 (2004–2007)
 - b. CAP PHASE 2 (2008–2011)
- ii. Agro-sylvo-pastoral Exports and Markets Development Project (PRODEX)
- iii. Pilot Program on Climate Resilience (PPCR), under Climate Investment Funds (CIF)

6. SENEGAL

- i. The Participatory Local Development Project (PLDP)
- ii. The Senegal Agricultural Services and Producer Organizations Program (PSAOP)
 - a. Phase I (2000/2005)
 - b. Phase II (2007–2011)
- iii. Local Authorities Development Program (PRECOL)
- iv. The Sustainable Land Management Project

APPENDIX 3. VULNERABILITY PROFILES

VULNERABILITY

Vulnerability can be viewed as susceptibility of an agent/system to harm that impairs function as a result of the experience of stress. Stress can have deep structural causes – such as poverty and its determinants, or result from proximate causes such as hurricanes or droughts. The common conceptual scheme through which climate vulnerability is understood focuses on how different climate hazards affect agents and systems, and has three constituent elements: *exposure*, *sensitivity*, and *adaptive capacity*. Exposure and sensitivity stand respectively for the physical frequency, distribution, and magnitude of hazards experienced by agents/systems, and the effect of the hazard on agents (Adger 1999, Brooks et al. 2005, Yohe and Tol 2002). Adaptive capacity, particularly in the context of social systems, denotes the ability to return to or exceed functional capacity that existed prior to exposure to a hazard.

To determine future exposure, climate vulnerability analyses typically rely on outputs from climate models, or historical information about the intensity and frequency past hazards. Indicators of vulnerability typically couple exposure information with that on impacts of hazards, and the resources – material or institutional – that allow households, communities, and regions to overcome the adverse effects of impacts.

This is a valuable approach to understanding vulnerability and determining appropriate responses for vulnerable groups. In combination with approaches that focus on social vulnerability and emphasize the need for a more comprehensive and integrated approach that examines the multi-dimensional causal structure of vulnerability, the vulnerability analysis approach is a starting point to understand how to address vulnerability. However, as a guide to decision making, the analyses of climate vulnerability suffer from a number of problems – among them the difficulty of identifying how to operationalize sensitivity vs. adaptive capacity empirically, the determination of the distinct indicators of vulnerability, and the inattention to the causal processes through which vulnerability is shaped across time and space. Even a more systematic analysis of vulnerability leads only to a starting point for decision making: after all the causal, structural, and proximate factors affecting vulnerability are analyzed, it is still necessary to identify what can be done to reduce vulnerability and how.

VULNERABILITY PROFILES

An alternative approach, focusing on vulnerability profiles to identify common areas and determinants of vulnerability, can potentially serve as a more effective guide to decision making and investments to reduce vulnerability. Vulnerability profiles have typically provided descriptive information about the major characteristics of a particular location or social group that make the social group or location

vulnerable. The characteristics include but are not restricted to:

- physical (e.g. coastal, or semi-arid regions; agriculture, land degradation, deforestation)
- lack of access to resources (information, technology;
- socio-economic (e.g. level of urbanization, population growth rates, public health)
- cultural (indigenous, gender),
- institutional (limited access to representation, lack of social networks).

PROBLEMS WITH CURRENT VULNERABILITY PROFILES

Typically, current efforts to build vulnerability profiles have focused on the description of attributes of selected locations and groups related to their social and economic functioning. These descriptions focus on a household, group, or location's physical and structural characteristics, history of past hazards, ecology, economic and occupational structure, demographic and socio economic indicators, infrastructure, assets, and services, food and livelihood sources, health and disease history, and at times coping strategies. For the most part, current efforts to construct vulnerability profiles have inattentive to the analysis of different sets of forces and pathways that lead to greater or lesser vulnerability and more importantly, the ways in which different pathways can be influenced to a greater or lesser degree through external interventions, and the likely effectiveness of different types of interventions to reduce vulnerability.

VULNERABILITY PROFILE OF SAESI TSAEDAEMBA DISTRICT

The most vulnerable households in Saesi Tsaedaemba district the Eastern Zone of the Tigray region in Ethiopia are those with low agricultural production and an annual food deficit. They have low incomes, low labor availability, high illiteracy, small landholdings, and high risk of mortality. Their access to basic services is low (compiled from USAID 2000: viii–x).

The above profiling of vulnerable households in a vulnerable region is based on an extended discussion of

the features of the region and its population, and highlights the most important characteristics of those who are vulnerable. However, it does not attempt to identify the different ways in which these features combine in the case of different groups of vulnerable households, the relative contribution of different causal factors to the vulnerability of selected groups, and the different measures that are likely to be most effective in addressing the causal processes leading to vulnerability in the case of different groups of households. By listing the most prominent features of vulnerability, it ignores the combinations of causes that create vulnerability for different groups.

DEVELOPING VULNERABILITY PROFILES FOR ADAPTATION RESPONSE PURPOSES

Vulnerability profiles can be used, however, for diagnostic and prognostic purposes as well. Such an approach to building vulnerability would require analytical modifications to the current approaches. It would a) focus on the distinct combinations of factors that lead to vulnerability for different clusters of households and/or communities; b) potentially identify the relative contributions of different factors to vulnerability of the households and communities; and c) analyze the most important leverage points for external interventions and the form of such interventions.

CLUSTERING HOUSEHOLDS BASED ON VULNERABILITY PATHWAYS

This first step can be taken in a variety of ways – based on systematic statistical analysis of the major characteristics of households that are believed to lead to vulnerability; based on information collected in discussion groups, or an examination of available data and histories of households or communities. The starting point for this first step is still the basic information used to build current vulnerability profiles. The difference lies in identifying whether there is a single process that leads to all forms of witnessed vulnerability among studied households/communities, or if there are alternative pathways to greater and lesser vulnerability.

CLUSTERING HOUSEHOLDS/COMMUNITIES BY COMMON CAUSAL PATHWAYS OF VULNERABILITY

Reconsider the Saesi Tsaedaemba vulnerability profile example above. Undoubtedly, households that have low agricultural production, low incomes, high mortality, low literacy and so forth are highly vulnerable. But the point is to identify the distinct combinations of factors that generate different ways of being vulnerable. Three clusters of vulnerable households in Saesi Tsaedaemba that are each likely vulnerable to climate hazards, but for very different reasons may be:

- poor households with some land but low labor availability and low literacy;
- poor households with low land ownership, high labor availability and low literacy; and
- households relying on fishing with low literacy and low labor availability and a history of medical complications

The above examples identify only the structural features of vulnerability that are common to groups of households, but the processes through which these causal features combine can easily be imagined. The issue is that without identifying these distinct ways in which people are and become vulnerable, it would be very difficult if not impossible to develop strategies to address vulnerability.

Creation of clusters of social units from a population, rather than analyzing the vulnerability of the entire population, can be done either through (i) identification of hypothesized social characteristics (gender, identify, wealth, or income based), (ii) through statistical procedures such as cluster analysis, or (iii) through participatory methods such as PRA that emphasize local knowledge and enable people to make their own analysis and plans (this can be linked to the cluster analysis).

ASSESSING RELATIVE CONTRIBUTIONS OF CAUSAL FACTORS/PROCESSES WITHIN VULNERABILITY CLUSTERS

The assessment of relative contributions of different causal factors within a given cluster of vulnerability groups requires an examination and ranking of the most important causal factors leading to vulnerability for that group. Such an examination can be done informally,

perhaps in group discussions, or it can be done statistically, for example, through regression techniques. It requires creating a typology of vulnerability: analysis of the extent to which similar characteristics lead to common processes generating vulnerability, and the key contributing factors within the clusters.

For example, if the most important sources of vulnerability for a given group of households is their level of exposure to climate hazards, effective policy action to help reduce their vulnerability would have to be quite different from those whose vulnerability stems primarily from their lack of access to markets or supporting institutions. By focusing on specific sources of vulnerability rather than aggregate levels of vulnerability as determined through an index that combines dissimilar factors, the analysis carried out during the project can help identify better the kinds of supports that are more likely to be effective for vulnerable groups of households and communities.

APPENDIX 4. ADAPTATION STRATEGIES

To strengthen the effectiveness of adaptation strategies practiced by the rural poor, governments and other external actors need to understand, take advantage of, and strengthen already existing strategies that many households and social groups use singly or collectively. In different parts of the world, many rural communities already experience high levels of climate variability and have developed more or less effective responses to address such variability. Much of the Sahelian region, for example, faces extreme irregularity in rainfall with recurrent droughts.

Increases in environmental risks as a result of climate change can be classified in many ways: short term *vs.* long term, those resulting from sudden disasters *vs.* those resulting from slow but secular changes in trends, predictable *vs.* unpredictable, and the like. In looking at household livelihoods strategies particularly useful way to think about climate-related risks is to examine how they affect livelihoods capabilities over time, across space, across asset classes, and across households. These four types of risks to livelihoods comprise the major conceptual categories of the ways variability threatens the ability of households to secure a livelihood. Thinking of adaptation in relation to these four forms of climate risks thus allows an analytically connected approach to classifying adaptation practices.

The four classes of adaptation practices are: a) Mobility, which helps address risks across space; b) Storage, which

helps smooth fluctuations in resource availability across time, and thereby reduces risks over time; c)

Diversification, which reduces risks to flows of benefits from different assets to which a household has access and d) Communal pooling which permits households to pool risks across the entire portfolio of income-generating assets and skills.

When households and other economic agents do not have access to markets, the above four classes of adaptation practices constitute a full set of analytically distinct, but collectively exhaustive forms of adaptation. But when markets are accessible, risks can also be reduced through exchange – therefore, to the above four types of risk reduction adaptation practices one can add a final type — Market exchange. Market exchanges can substitute for each of the above four classes of risk reduction (Halstead and O'Shea 1989). The effectiveness of these five classes of adaptation strategies is in part a function of the social and institutional contexts in which they are pursued. Where successful, these responses pool uncorrelated risks associated with flows of benefits from different classes of assets owned by households and economic agents. They can also allow a shift away from more risky economic strategies to other, less risky ones.

The above classification of adaptation strategies is different from others that view adaptation as proactive or reactive, individual or collective, spontaneous or planned. Although these other ways of thinking about adaptation are useful, they are not related to the basic types of risks that climate hazards pose, and therefore analytically fuzzier than the classification proposed

above. It also undermines the often proposed distinction between coping⁴ and adaptation which is essentially dependent on the extent to which a given response to a climate hazard produces long-lasting effects on adaptive capacity – with coping referring to short term adjustments. When climate hazards are repeated, the distinction between short-term and long-term adaptation (coping *vs.* supposedly real adaptation) as also that between proactive and reactive adaptation breaks down. Further, the above five-fold classification of adaptation strategies is equally relevant to coping and adaptation since both are intended to address environmental risks and stresses.

Mobility is perhaps the most common and seemingly natural responses to environmental risks. It pools risks across space, and is especially successful in combination with clear information about the spatial and temporal distribution of precipitation. It is especially important as an adaptation strategy for agropastoralists in Sub-Saharan Africa, west and south Asia, and indeed most dry regions of the world (Niamir 1995).

In the context of climate change mobility has sometimes been viewed as a maladaptation, in which climatic stresses lead to involuntary migrations on a massive scale with attendant social and political instabilities. This is especially so in many policy briefings and papers (Purvis and Busby 2004, Schwartz and Randall 2003). However, mobility is also a way of life for large groups of people in semi-arid regions, and a long standing mechanism to deal with spatio-temporal variations in rainfall and range productivity. Mobility as an adaptation practice, therefore, is more or less desirable depending on the social groups being considered.

For agricultural populations, mobility can often be the last resort in the face of environmental risks and disruption of livelihoods (McGregor 1994). For pastoralist and agro-pastoralist populations, on the other hand, efforts to limit mobility have often led to greater vulnerability and lower adaptive capacity (Agrawal 1999). At the same time, frequent movement of people with their animals raise particularly intricate questions about the

role of institutions in facilitating adaptation. Most governance institutions are designed with sedentary populations as their target. To address the needs of mobile populations, the role of information in tracking human and livestock movements, and mobile provision of basic services such as health, education, credit, and marketing of animal products is especially important to reinforce adaptive capacity.

Storage pools and reduces risks across time. When combined with well constructed infrastructure, low levels of perishability, and high level of coordination across households and social groups, it is an effective measure against even complete livelihood failures at a given point in time. As an adaptation practice to address risks, storage is relevant to individual farmers and communities, and to address food as well as water scarcities. Indeed, in light of the significant losses of food and other perishable commodities all over the developing world, improvements in storage technologies and institutions have immense potential to improve rural livelihoods.

Diversification pools risks across assets and resources of households and collectives. Highly varied in form, it can occur in relation to productive and non-productive assets, consumption strategies, and employment opportunities. It is reliable to the extent benefit flows from assets are subject to uncorrelated risks (Behnke et al. 1993, Ellis 2000, Sandford 1983). Diversifying households typically give up some returns in exchange for the greater security provided by diversification. Davies and Bennett (2007) provide a striking example from the Afar pastoralists of Ethiopia where many of them would be willing to live with some level of poverty in exchange for reduction in vulnerability.

Communal pooling refers to adaptation responses involving joint ownership of assets and resources; sharing of wealth, labor, or incomes from particular activities across households, or mobilization and use of resources that are held collectively during times of scarcity. It pools risks across households. It is most effective when the benefits from assets owned by different households and livelihoods benefit streams are uncorrelated. When a group is affected in a similar manner by adverse climate hazards – e.g., floods or drought, communal pooling is less likely to be an effective response.

⁴ Coping refers to the use of existing resources to achieve various desired goals during and immediately after adverse conditions of a hazardous event or process.

Although communal pooling can occur in combination with the other three ways of addressing environmental risks mentioned above, its hallmark is joint action by members of a group with the objective of pooling their risks and resources. Joint action on the one hand increases the range of impacts in comparison to that with which households could have coped individually. It also requires functioning and viable institutions for coordination of activities across households. It is one way for social groups, especially those dependent on natural resources for livelihoods, to enhance their capacity to adapt to the impacts of future climate change (Adger 1999).

Market Exchange is perhaps the most versatile of adaptation responses. Indeed, markets and exchanges are a

characteristic of almost all human groups, and are a mechanism not just for adaptation to environmental risks but also critical for specialization, trade, and welfare gains that result from specialization and trade at multiple scales. Market exchange-based adaptation practices can substitute for the first four when rural poor have access to markets. But they are likely to do so mainly when there are well developed institutions to facilitate market access. Further, equity in adaptation practices based on market exchanges typically requires great attention to the institutional means through which access to markets and market products becomes available to households. In the absence of institutional mechanisms that can ensure equity, the rural poor are less likely to benefit from purely market exchange-based adaptation.

APPENDIX 5. DEFINITIONS OF VARIABLES USED IN THE STATISTICAL ANALYSIS

<i>Variable name</i>	<i>Variable definition</i>
Number of Hazards during last decade	Number of climate related hazards or threats reportedly experienced by interviewed household during the ten years preceding the interview
Hazards during the prior decade (11–20 years)	Number of climate-related hazards or threats reportedly experienced by interviewed household during the 11–20 years preceding the interview
Sickness incidents per household member	Number of incidents of illness recalled by household respondent during the year preceding the interview
Number of income sources	Number of different sources from which household members derive their income
Number of types of assets owned	Number of different types of materials assets that are owned by household
Area land owned	Area of land owned collectively by the members of household
College educated household members	Number of household members who have received any college education
Number of information sources about hazards	Number of different sources of information from which household members receive information about climate hazards
Number of institutions accessed	Number of different local and higher level public, private, and civic organizations with which household members are in contact
Total visits to different institutions/year	Number of times household members have interacted with different local and higher level institutions
Niger country dummy	This variable is coded 1 for all cases from Niger, and 0 for all other cases
Senegal country dummy	This variable is coded 1 for all cases from Senegal, and 0 for all other cases



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