



Costing Adaptation through Local Institutions Village Survey Results: Yemen





SOCIAL DEVELOPMENT DEPARTMENT | SOCIAL DIMENSIONS OF CLIMATE CHANGE

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SUMMARY

The objectives of the Costing Adaptation through Local Institutions (CALI) study were (a) to identify the costs of adaptation through local institutions, and (b) to investigate which institutions help households adapt to climate variability, which efforts and costs are needed to realize the adaptation options, and how they facilitate adaptation to climate variability. The study was carried out in Ethiopia, Mali, and Yemen. This report discusses the results for Yemen.

Structure of the Study

In Yemen, village surveys were conducted in six villages and two expert workshops were organized to discuss the main framework of the study and to evaluate the draft results. The study assessed household vulnerability, analyzed the strategies households adopt to reduce the impacts of climate hazards, and evaluated the assistance households receive from different institutions. The analysis was based on household surveys, focus group discussions, and institutional stakeholder interviews. Vulnerability profiles, developed on the basis of field survey results, show that household vulnerability differs substantially between and within villages. The size and diversity of income and the ability to flexibly decide on alternative measures to mitigate the adverse climate effects—which depends on factors such as level of education and dependency ratio—have effects on the adaptation options households adopt and the type of institutional assistance they receive.

MAIN RESULTS

Highly Exposed Villages are not Necessarily Vulnerable

The results show that the vulnerability and agroecological potential in Yemen are related to rainfall, which is related to altitude. For example, Arraheebah (Taiz) in the coastal plains—which scores low on agroecological capacity and high on its dependency on agriculture—is most exposed. The three study sites with an arid subtropical climate are somewhat less exposed. With relatively high precipitation, the two sites in the highlands are the least exposed to climate variability. The highly exposed villages, however, are not necessarily the most vulnerable.

The households in the drylands area show low cash-crop earnings, low income diversification, and relatively low educational levels for the households. Due to low soil fertility, their higher landholdings do not result in high yields. For households in the rainfed areas, the results are mixed. Despite the high exposure to climate change, households in rainfed areas show low and high vulnerability. The vulnerability of households decreases with coping capacity, which increases with higher cash crop earnings (both from qat and fruits and vegetables), higher landholdings, more livestock, more assets, and higher educational levels. Moreover, a substantial part of income is coming from civil servant activities. Their sensitivity to climate variability seems to be relatively low and their coping capacity good. Both highland villages score very differently. Vulnerability in the Yemeni study sites seems to be less dependent on

climate exposure but more on other factors like proximity to urban areas like Sana'a, which offer potential alternative income sources. These income sources make households less vulnerable.

Other Hazards also have Impacts on Climate Change Adaptation

In almost all villages, the increased occurrence of human and animal diseases was mentioned frequently during the focus group discussions. In addition, water collection is taking more time (one of the reasons why girls are dropping out of school), and water prices have risen. As a result of higher disease incidence and the increased price of water, households spend more effort and means on medicines and water. In consequence, animals and personal jewelry were sold to buy medicine or water. This development also has consequences for the implementation of adaptation strategies. Households simply lack the financial means to apply adaptation strategies, particularly the more expensive ones such as irrigation.

Only a Few Strategies are Currently Being Used

In Yemen only a few adaptation strategies are used by households (1.7 on average). About 40 percent of the households in the survey did not adopt any of the strategies listed. Furthermore, there is a large difference in the number of strategies adopted between the sites. Among the villages, the percentage of responding households that did not adopt any strategy also varied significantly. In general, water management techniques—the use of irrigation and the improvement, construction, or rehabilitation of terraces—and agricultural techniques are most frequently adopted. Income diversification techniques—such as temporary migration to urban areas or abroad—or communal techniques are applied, but less frequently.

Adaptation Strategies Differ Across Farming Systems

Households in rainfed areas—Al Wathan, Magahem Asha'abi Dhi-Shraq, and Muáneet—have the highest average of adaptation strategies. Households in drylands put most of their effort on agricultural and water management strategies because they have been dealing with scarce water resources for a long time. They hardly

use income diversification strategies. In the highlands, households use a mix of adaptation strategies. The average number of strategies, however, is low.

Strategies Mostly aim at Reducing Sensitivity to Climate Variability

Most strategies aim at reducing sensitivity to climate variability through irrigation, fertilizer/pesticide application, or the improvement, construction or rehabilitation of terraces. The only strategy focusing on improving coping capacity is short term or permanent migration. Differences between villages are remarkable. In the vulnerable villages in rainfed or dryland areas, only a few households adopt some strategies. The households in highland villages focus on migration and prevention of soil erosion (terracing and reforestation), whereas in the dryland area households focus on irrigation and adapting farming practices.

Strategies to Improve Coping Capacity are Hardly Applied

For all villages, coping capacity strategies are restricted to migration to urban areas or abroad. Other possible strategies, like migration to other rural areas, home-garden agriculture, increased market sales, or handicrafts are rarely used, although some households cultivate fruits and vegetables.

Female-Dominated Households Apply More Strategies

In 13 percent of households, two-thirds or more of adults are female. On average, female-dominated households apply more adaptation strategies than other households. Female-dominated households choose the same adaptation strategies as male-dominated households, such as use of irrigation, construction of terraces, fertilizer use, and crop selection. Furthermore, female-dominated households tend to apply measures to reduce sensitivity to climate variability more often than coping strategies.

Institutions Play a Minor Role in Preparing for Climate Change

In the study sites, institutions only play a minor role in the adoption of adaptation strategies by households. In general there is very limited contact between households

and institutions. Only 7 percent of households have had contact with institutions. About half of these households judge these contacts as being useful in the adoption of adaptation strategies. Extension agencies are the institutions mentioned most frequently. Furthermore, national authorities, regional authorities, local authorities, and seed production authorities are contacted for assistance, but only by a few households. In addition to the few outsiders providing help to households, the respondents indicated that they received some help or cooperation from neighbors or people from the clan group. Even though these are community institutions, the respondents apparently do not judge these to be an institution. The low institutional coverage and dependence on kinship is well-known in Yemen. In rural Yemen, the role of the national government is often contested and officials lack trust within the communities, so setting up national extension services is difficult.

Institutions Hardly Provide any Assistance

Most of the adaptation strategies adopted by the households were financed and realized by the households themselves using their own resources. Even if institutions are present, they are not associated with assistance for climate change adaptation according to the stakeholder analysis. Formal institutions hardly provided any assistance in terms of training, inputs, or cash. Only people from the community helped each other through the provision of labor for rehabilitating terraces and setting up irrigation or water management measures. The low number of strategies adopted may partly be explained by this low institutional coverage. Households especially adopt strategies they already know for decades and adopt only a few modern strategies. Households may lack the knowledge to judge the expected net benefits of more innovative strategies. Households also often lack the knowledge, awareness, and financial means to adopt such strategies. Moreover, it is often difficult to adopt them due to malfunctioning markets. Because of the virtual absence of formal institutions, reducing market problems is difficult.

POLICY RECOMMENDATIONS

More Emphasis on Coping Strategies

There is little attention given to strategies to reduce external stress, such as improving education or

diversifying income. This is particularly the case for households in the dryland sites that are most exposed to climate change hazards. Except for migration, many of the income diversification options are constrained by institutional, market, and financial constraints.

Improve Water Resource Management

Although the emphasis of Yemeni farmers is already more on sensitivity reducing strategies such as irrigation and water harvesting techniques, there is still a need to expand the implementation of such strategies to improve water resource management. Groundwater levels are going down rapidly; in order to stop this process, water resource management should be improved. Adaptation of more water management strategies should be advocated.

Financial Burden of Yemeni Households

Financial constraints for applying more adaptation strategies for Yemeni farmers are urgent for two reasons. On the one hand, households spent their money on medicines for the diseases of family members and on water collection with high prices. On the other hand, the costs for water resource management strategies such as irrigation are extremely high for Yemeni citizens. Financial assistance such as micro-financing is needed to help farmers improve their water resource management. This will require a more explicit role for institutions and micro-financing organizations.

Increase Ownership to Implement Community Strategies

Communal actions seem to be difficult to initiate. Yemeni farmers seem to focus on applying strategies on their own. Communal strategies could be less costly per farmer. These actions need investments and training from external institutions, which are virtually absent in many regions. Moreover, in order to create a sense of urgency and a feeling of ownership on the part of households, relationships between external institutions and the community (clan) should be improved. This requires the long-term presence by these institutions. Investments in training and emphasis on creating adequate ownership by the households could be beneficial to implement these strategies. This can be facilitated

by institutions taking into account Yemen's clan and neighborhood orientation.

Institutions Should put More Emphasis on Climate Change Adaptation Strategies

According to stakeholders, there are institutions present in most villages. According to stakeholders, however, the assistance of these institutions is not associated with climate change mitigation by households. In the sites selected for the RALP project, a minor share of the stakeholders mention that extension agents are present, but the respondents in the survey rarely mention any assistance from them. This would be a first step toward the use of institutions for adaptation strategies and an opportunity to extend the services of institutions for adaptation strategies as well.

Building on Existing Community-Based Initiatives, Such as the RALP Project

In the study, the sites in the RALP districts do not show significantly better results than the other sites in terms of number of coping strategies adopted, which could possibly be explained by the fact that the project is relatively new. However, in terms of institutions and networks, the community-based approach of the RALP project shows progress in the institutional presence (e.g. extension agencies) and the creation of networks for market access (e.g. cooperatives). The framework provided by the project could also be used to facilitate training for innovative adaptation strategies and the improvement of an enabling environment (e.g. market access) in the process of reducing the vulnerability of households.

1. INTRODUCTION

BACKGROUND AND OBJECTIVES OF THE CALI PROJECT

Climate change is a global phenomenon. Observations across countries show that people perceive recent changes in their environment as an impact of climate change, and in particular changes in temperature, rainfall, and other weather patterns such as the timing and occurrence of seasons. Although a lot of this “evidence” is anecdotal and needs scientific confirmation, we can assume that most people are making rational statements and therefore do relate the changes to their life experiences. It is also becoming clearer that the people most affected by the immediate impacts of climate change are the world’s most vulnerable people, and that the people and countries that are the least responsible for the occurrence of climate change carry most of its burden, at least in the short run.

Costing Adaptation Through Local Institutions (CALI)—Objectives

The World Bank Social Development Department commissioned a study on costing of climate change adaptation in Yemen, Mali, and Ethiopia to provide recommendations to decision makers in development projects and government agencies regarding the risks, costs, and benefits of adaptation options in the rural context, and the institutional investments necessary to facilitate cost-effective adaptation.

This study is a reflection of the insights that (a) poor, rural households are facing most of the climate variability-related hazards; (b) adaptation also has socio-economic aspects; (c) understanding local adaptation processes is important for informing macro-policies; and (d) for prioritizing future adaptation, it is crucial to analyze historical adaptation strategies.

The CALI study is part of the Social Development Department’s work program on climate change. The research is more specifically focused on achieving the following objectives:

1. Identifying the main adaptation strategies currently adopted by the households.
2. Investigating which institutions help households adapt to climate variability, and how the institutions facilitate adaptation to climate variability.
3. Identifying important adaptation cost elements (labor, material, and cash) borne by households and institutions.

The Structure of the CALI Study

The study involves an assessment of the adaptation options rural household pursue. The study also considers the differential access of various vulnerability groups, as well as the drivers for adopting particular strategies or constraints for not adopting other strategies. For this, households and institutional stakeholders were interviewed in six villages in Yemen, focus group discussions were organized, and experts were consulted.

Data Were Collected on Strategies Adopted...

In order to obtain information about the strategies adopted, respondents were asked to indicate use of particular techniques or adaptation options. The importance of each option was then judged based on the number of households that adopted them. Adoption of particular adaptation options depends on the importance of perceived climate hazards—such as drought, rainfall variability, flood, and increasing heat—versus other hazards related to issues such as prices, markets, and health. In doing so, visual aids were used to help respondents rank potential hazards.

... the Role of Institutions...

To obtain more insight into the role of institutions, we investigated the institutions that help households to adapt to climate variability. We specifically looked at the efforts and inputs they provided for the adoption of different coping strategies and how they facilitate adaptation to climate variability. We considered institutions such as local authorities, extension agencies, NGOs, cooperatives, religious institutions, and informal village groups. Respondents were asked to indicate the institutions with which they have contact and those which have been helpful in climate adaptation. For the identified institutions, respondents indicated the duration and purpose of contact and type of assistance obtained from the institutions.

... and Costs of Adaptation Options

To obtain more information about the costing of adaptation options, we asked for the costs that the households incurred for each of the strategies adopted. A costing framework has been developed to capture the labor, material, and cash cost that the households and institutions incurred.

The Focus is on Past Household Behavior

For decades, farmers have been facing severe climate-related hazards like extreme droughts and rainfall, rainfall fluctuations, and temperature fluctuations. These hazards are likely to intensify in the future. The focus of

this study is not on how households will respond to these climate hazards, but on how they have responded in the past through the various adaptation strategies and the costs of these adaptation strategies. As a result, some strategies, which households would be expected to adopt, may not come forward as being important in this study. For example, small-scale irrigation is an adaptation strategy that is often initiated or channeled through external institutions, but which is rationed among the households based on various criteria. It is therefore inaccessible for some households even though they would like to benefit from irrigation as well. As a result, the list of strategies presented in this report should not be interpreted as being the best or most wanted strategies to cope with climate variability. It reflects current practice in Yemen and shows what households currently do by themselves or with institutional assistance.

REPORT OBJECTIVES

The structure of the CALI study is the outcome of a series of meetings, consultation workshops, and institutional contacts concerning the study design, data collection, and the interpretation of the results. Primary and secondary data were collected in order to achieve the research objectives. Primary data was collected from six villages in different climate zones in Yemen using a household questionnaire, focus group discussion, and stakeholder interviews. A quantitative estimation was carried out of data obtained from these sources. Primary data were complemented with secondary data such as documentation from related projects. There are two World Bank-supported initiatives in Yemen relevant to the CALI study. First, the Rainfed Agriculture and Livestock Project (RALP) conducted by the Ministry of Agriculture and Irrigation (MAI) and Social Fund for Development invests resources in terrace rehabilitation and development of the livestock sector. Two of the villages in the CALI study also participate in the RALP project. Second, the Pilot Programme for Climate Resilience (PPCR) (under preparation) is a strategic program for climate resilience and is identifying and preparing potential interventions for making the Yemeni population less vulnerable to climate change (PPCR 2010).

This report is the final country report for Yemen that has been prepared within the framework of the Costing Adaptation through Local Institutions Project (CALI) as implemented by Royal Haskoning and LEI Wageningen UR in the Netherlands and several national consultants in Ethiopia, Mali, and Yemen. The objective of this report is to present an overview of the main findings of the CALI study in Yemen and to provide policy recommendations.

STRUCTURE OF THE REPORT

Chapter 2 presents a brief description of climate change, its effects, adaptations, and climate change actions in Yemen. Chapter 3 describes the methodological issues, including the location of the research sites, the approaches, and the contents of the questionnaires. Chapter 4 presents the main findings of the study. Chapter 5 provides the main conclusions drawn from the analysis and policy recommendations.

2. COUNTRY CONTEXT: YEMEN

There is an increasing global focus on the effect of climate variability and change on rural livelihoods and food security. There are indications that some of the impacts of climate change are irreversible and hence adaptation—particularly in the most vulnerable regions—must be put into action soon (EPC 2001). Understanding the effects of climate change, the adaptation strategies in place, and the stakeholders involved is an important step in addressing this issue.

HISTORIC BACKGROUND OF VULNERABILITY TO CLIMATE VARIABILITY

Yemen is a semi-arid to arid country in the Middle East at the southern end of the Arabian Peninsula. It is bordered to the north by Saudi Arabia and to the east by Oman. In the south and the west, there is a 2,200 km coastline along the Gulf of Aden, Arabian Sea, and the Red Sea. Yemen has a surface area of 528,000 square kilometers. In 2007, Yemen's population amounted to more than 22 million, which means there are more than 40 persons per square kilometer. In the period from 2000 to 2007, the population of Yemen increased by more than 4 million people. Yemen has an annual growth rate of 3 percent, one of the highest in the world (World Bank 2009). Figure 1 shows that the majority of the population lives in the Western Highlands. Over the same period, poverty increased nearly threefold, particularly in rural areas, where more

than three-quarters of Yemenis live (Republic of Yemen 2002; PPCR 2010).

Climate in Yemen is Characterized by Large Regional Differences

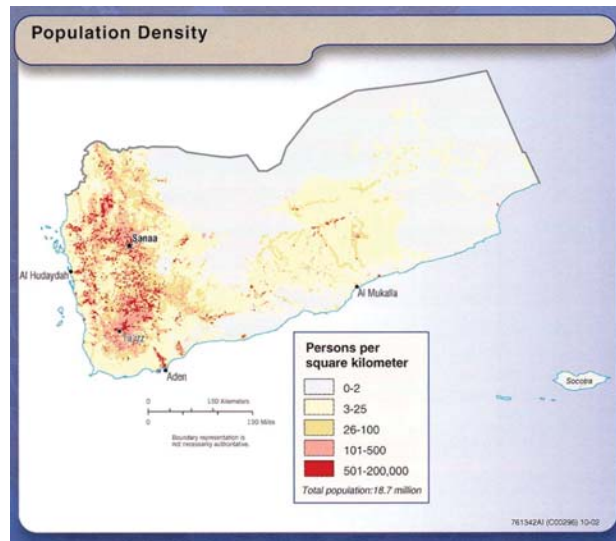
Rainfall in Yemen varies widely across the country (PPCR 2010). Along the coast, rainfall is less than 50 mm per year. The highest rainfall occurs in the Western Highlands and ranges from 500 to 800 mm per year. In the interior desert, rainfall is less than 50 mm per year. Precipitation occurs primarily in the spring and summer seasons. The temperature primarily depends on the elevation. In the highlands, the average annual temperature is 12°C, while in the coastal areas, close to the sea, the average annual temperature is 30°C. Temperatures in the coastal plains have increased in recent years. As a result, the occurrence of frequent prolonged droughts during the last three decades has increased. These droughts have been interrupted by occasional floods. During the 1970s and 1980s, Yemen characteristically had a dry climate with low rainfall and high temperatures. Figure 2 shows the annual rainfall in the period 1985–91 in Yemen; Figure 3 shows annual rainfall in 2002. Although it is difficult to compare these maps, the areas of higher rainfall seem to be smaller in 2002 than in the period 1985–91.

To illustrate the decline in rainfall observed by EPC (2001), Figure 3 shows that there is a downward trend in rainfall at Sana'a airport since 1930, as indicated by the red line in Figure 4.

Land Use Systems Depend on Geographical Characteristics

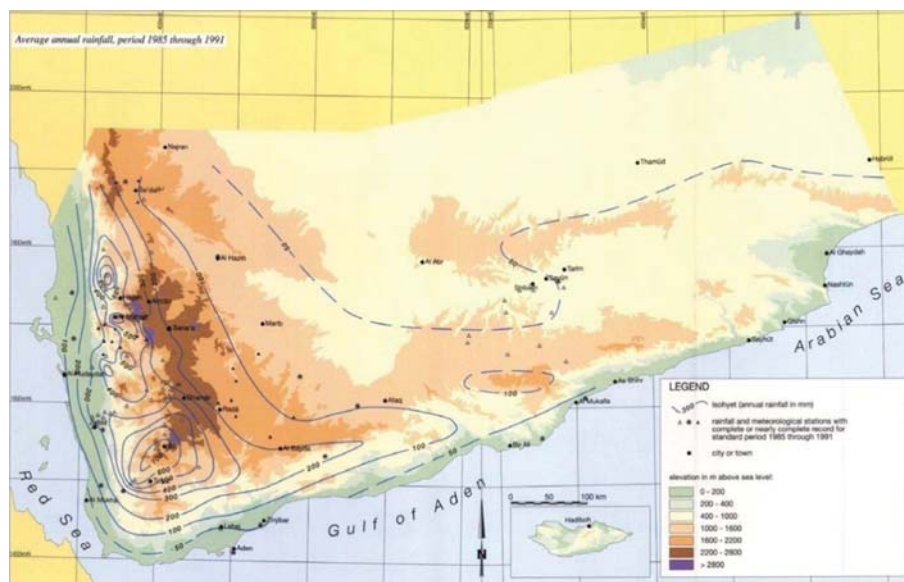
Yemen is characterized by five major land systems (Noaman et al. 2008; NAPA 2009):

FIGURE 1. POPULATION DENSITY, 2002



- The Coastal Plains are located in the west and southwest and are flat to slightly sloping with maximum elevations of only a few hundred meters above sea level. They have a hot and humid climate with generally low to very low rainfall (< 50 mm/year). Despite the low rainfall, the Coastal Plains include agricultural zones due to the numerous *wadis* that drain the adjoining mountainous and hilly hinterland.
- The Yemen Mountain Massif (Temperate Highlands) constitutes a high zone of very irregular and dissected topography with elevations ranging from a few hundred meters to 3,760 m above sea level. The climate varies from hot at lower elevations to cool at the highest altitudes. The western and southern slopes are the steepest and enjoy moderate to rather high rainfall. On average, rainfall is 300–500 mm per year, but in some places it exceeds 1,000 mm per year. The eastern slopes show a comparatively smoother topography and average rainfall decreases rapidly from west to east.
- The Eastern Plateau Region (Hadramawt and Mahra Uplands) covers the eastern half of the

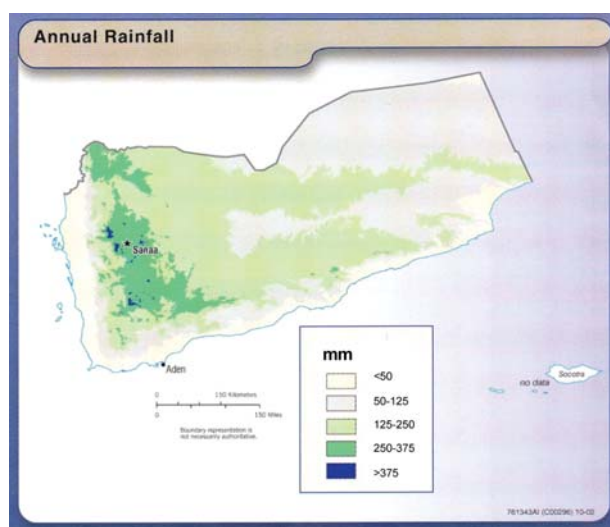
FIGURE 2. AVERAGE ANNUAL RAINFALL IN YEMEN, 1985–91



Source: NCAP (2008) and NAPA (2009).

country. Elevations range from 1,200–1,800 m at the major watershed lines to 900 m on the northern desert border and to sea level on the coast. The climate in general is hot and dry. The average annual rainfall is below 100 mm except for the higher parts of the plateau region. In this region, rare rainfall often causes devastating floods.

FIGURE 3. AVERAGE ANNUAL RAINFALL IN YEMEN, 2002.



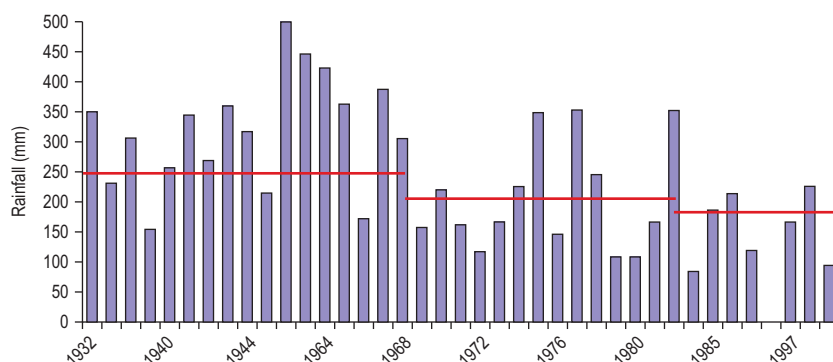
Source: University of Texas, accessible at: <<http://www.lib.utexas.edu/maps/middle_east_and_asia/yemen_rainfall_2002.jpg>>.

- Between the Yemen Mountain Massif and the Eastern Plateau lies the Ramlat as Sabatayn, a sand desert. Rainfall and vegetation are nearly absent, except along its margins where rivers bring water from adjacent mountain and upland zones. In the north lies the Rub Al Khali desert, which extends far into Saudi Arabia and is approximately 500,000 km² in area.
- Yemen has more than 100 small islands along its coast. The most important of all the islands is Socotra, where more exuberant flora and fauna can be found than in any other region in Yemen.

Climate is Expected to Become More Variable

Yemen is prone to various types of disasters such as earthquakes, floods (coastal storm surges and tsunamis), and landslides. One of the observed impacts of climate change is the increased occurrence and intensity of natural disasters (PPCR 2010). There is no consensus among the 21 global climate models in the IPCC Fourth Assessment Report about the sign of the projected changes in winter, summer, or annual rainfall or its distribution pattern over Yemen (Wilby 2008). According to the results of three climate modeling exercises for Yemen in the period until 2050, however, scenarios show that rainfall is expected to decrease across the northern regions (see Annex 3 of NAPA

FIGURE 4. ANNUAL RAINFALL AT SANA'A AIRPORT, 1932–99



Source: NCAP (2008) and NAPA (2009).

2009). This will lead to an increased pressure on the country's delicate agriculture and water resources sectors. In recent decades, Yemen's rainfall patterns have shown increasing extremes (PPCR 2010). On the one hand, rainfall has decreased considerably, leading to major agricultural losses, losses of animals, and water shortages. On the other hand, increased flooding probabilities were clearly observed in 1996 and during the period 2005–08. Under a warmer climate, these features are likely to be further aggravated. Regional downscaling efforts were undertaken to further explore local climatic regimes. In addition to the likelihood that rainfall may decrease over a large part of Yemen, the timing of rainfall, the intensity of individual storms, the delay between falls and the frequency of inter-annual variability may all change. Rainfall changes will be accompanied by changes in the intensity of wind, frequency of high temperatures, and changes in cloud cover. When projected annual changes in rainfall are combined with changes in potential evaporation, a new climate regime for Yemen is likely to exist by 2050.

Climate Change will Negatively Affect Livelihoods...

The Initial National Communication (INC) under the UNFCCC (EPC 2001) reported findings concerning the vulnerability of the social and biophysical environment from climate variability and climate change. The major impacts of climate change in Yemen, as reported in the INC, represented the starting point for the NAPA effort (NAPA 2009). The major impacts with respect to the social environment from climate variability and climate change are:

- Increased water scarcity and reduced water quality, which leads to increased hardship on rural livelihoods.
- Increased drought frequency, increased temperatures, and changes in precipitation patterns, which leads to degradation of agricultural lands, soils, and terraces.
- Reduced agricultural productivity, which leads to increased food insecurity and to a reduction in income generating activities.
- Increased climatic variability, which might lead to the spread of vectorborne and waterborne diseases.

As a consequence, the human capital (labor) of households will decline.

... and the Biophysical Environment

In addition, EPC (2001) recognizes impacts on the biophysical environment as well:

- Increased sea levels – leading to deterioration of wetlands, coastal mangrove migration, erosion, infrastructure damage, and seawater groundwater intrusion. Aden, for instance, is cited as one of the top 20 cities in the world in terms of vulnerability to sea level rise (PPCR, 2010).
- Deterioration of habitats and biodiversity, leading to expansion of desertification.
- Impacts on coastal zones, leading to a loss of tourism activity due to sea level rise, including loss of beaches.

These impacts indirectly affect livelihoods. For example, damage to infrastructure might form an obstacle for households to sell their agricultural products at a local market. Another example is that the intrusion of groundwater by salty seawater makes the groundwater unusable for crop irrigation.

Even without climate change hazards, Yemen suffers from low human and economic development (PPCR 2010) and serious environmental challenges (Noaman et al. 2008). As a consequence, Yemen has a high degree of vulnerability to current climatic variability and to fluctuations in weather patterns over the long term (NAPA 2009). Yemen's major environmental problems are water scarcity, soil erosion, and desertification. In the city of Taiz, for instance, running water is available for only a few hours per week (PPCR 2010). These environmental problems are likely to worsen under climate change, and future climate change is expected to see these hazards intensify.

Poverty is Persistent, Especially in the Rural Areas

Although Yemen has made significant development progress over the past 30 years, poverty and inequality are still widespread. In 2007, GDP per capita was

TABLE 1. DEVELOPMENT INDICATORS FOR YEMEN

Indicator description	Year	Value and unit of indicator	Source
GNP	2007	\$1,000	WDI (2009)
Population growth rate	2000–2007	3.0 %	WDI (2009)
Adult literacy	1995–2005	54.1%	UNDP (2007)
Total fertility rate	1990s	7.6%	NAPA (2009)
	2000	6.3%	WDI (2009)
	2007	5.5%	WDI (2009)
Malnutrition prevalence, i.e. the share of children under five years of age that is underweight	1996–2005	46%	UNDP (2007)

\$1,000, but the inflation rate exceeds the economic growth rate (World Bank 2009) (Table 1).

Table 1 shows that factors such as high adult illiteracy (significantly higher for females than for males) and the high total fertility rate continue to put high pressure on land, food, and water resources even without the presence of climate change (NAPA 2009). Due to high population growth and high fertility rates, the demand for water increases rapidly. This demand places a high pressure on the availability of water resources. In 2006, one-third of the country did not have access to improved water sources, and this share has been growing since 2000 (World Bank 2009). In addition, 46 percent of all children under five years of age are underweight (UNDP 2007).

Water Resources are Overexploited

Irrigation of agricultural land boosts growth and reduces poverty directly and indirectly, benefiting the poor in several ways (World Bank 2006a). Farmers can improve agricultural production and the quality of their crops or crop mix. As a consequence, farmers can sell more products at local or regional markets. This boost might also lead to more employment in the agricultural sector (World Bank 2006a). However, water for irrigation has to be available for these benefits. Currently, 90 percent of available water is used for irrigation (PPCR 2010).

TABLE 2. WATER AVAILABILITY IN YEMEN

Year	Water availability per capita per year (m ³)
1955	1,089
1990	460
2005	120*
2025	150

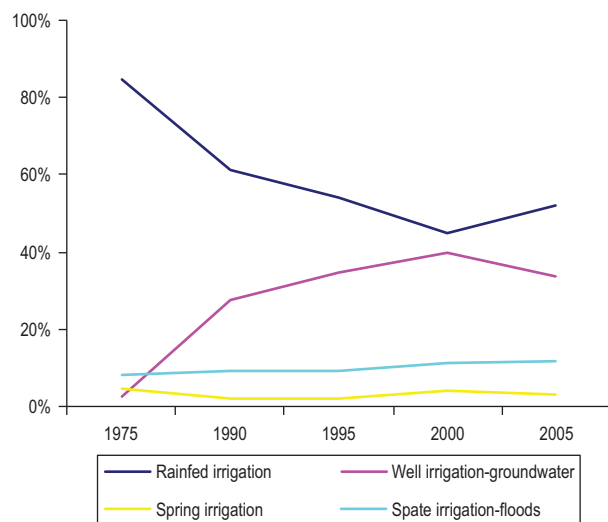
Source: NAPA (2009) and Hellegers et al. (2008).

In Yemen, water resources have become increasingly precious in the period 1955–90, as per capita water availability is falling steadily with growing population. Per capita water availability in 1990 was less than half of the water availability in 1955 (Table 2). In the future, the per capita availability of water will further drop to 150 m³ in 2025 under the business-as-usual scenario. In this scenario, demand continues to increase due to expected population growth and no action is undertaken to mitigate future climate impacts (NAPA 2009). This drop in water availability is one-third of the water availability per person compared to the amount in 1990. Whereas surface water is largely seasonal and unreliable, groundwater is being simultaneously polluted and extracted in excess of recharge. Currently, water abstraction is 125 percent of total recharge (World Bank 2006b).

Figure 5 shows that from 1975 to 2005 the share of farms depending on groundwater resources increased from zero to almost 40 percent in 2000. The share of farms relying on rainfall for irrigation dropped from more than 80 percent in 1975 to almost 40 percent in 2000. One of the explanations for this drop in the share of rainfed farming systems is the decline in rainfall. In 2005, the share of groundwater declined compared to the share in 2000.

According to Republic of Yemen (2001), agricultural land in Yemen amounts to 1.66 million hectares, which is 3 percent of Yemen's area. The amount of agricultural land that is cultivated varies from 0.98 million ha to 1.5 million ha, depending on the amount of annual rainfall (Hellegers et al. 2008). In 2005, roughly two-thirds of this arable land was used for crops or livestock. Arable land is primarily located in the highlands or the coastal plain area.

FIGURE 5. SHARE OF CULTIVATED LAND PER FARMING SYSTEM, 1975–2000



Source: Hellegers et al. (2008).

Farming systems in Yemen are based on the provision of water for irrigation. There are four farming systems: rainfed agriculture, spate irrigation, well irrigation, and spring irrigation. Rainfed agricultural production depends on capturing and retaining rainfall. Spate irrigation involves constructing dams across riverbeds, and building associated distribution systems to carry floodwaters to nearby fields. Spring irrigation depends on flows from naturally occurring areas where the groundwater from surrounding hills reaches the surface. Well irrigation from shallow aquifers has also developed, providing a controlled source of water based on pumping.

Yemen's Economy is Vulnerable

About 90 percent of all food in Yemen is imported from abroad. The contribution of agriculture to Yemen's GDP declined from 21.7 percent in 1994 (EPC 2001; NAPA 2009) to 10 percent in 2000 (World Bank 2009). In addition, NAPA (2009) reports that 53 percent of the workforce is employed in agriculture, where traditional subsistence agriculture dominates production. Addressing poverty through improved agricultural production is among Yemen's development objectives.

Yet production is consistently quite low, in part due to the vulnerability of rainfed agriculture to rainfall variability and prolonged drought.

Yemen's Initial National Communication (EPC 2001) identified the vulnerable economic sectors and livelihoods. The three main areas vulnerable to climate change are (1) water resources, (2) agriculture, and (3) coastal zones. Due to changing patterns of rainfall, water resources will further decline, while the demand for water will increase due to population growth. As a consequence, water availability as well as water quality will decline rapidly in the future. This has a direct impact on livelihoods. In addition, groundwater resources are at risk from seawater intrusion induced by the sea level rise.

Increasing Climate Variability will Make it More Difficult to Find Solutions

Climate variability and change will most likely lead to more droughts, more temperature variability, and changes in the precipitation regime, which can lead to disastrous consequences for agriculture and food security (NAPA 2009). This will cause degradation of agricultural land, soils, and terraces and lead to more desertification. This in turn will lead to lower levels of agricultural production, and consequently put downward pressure on income from agriculture. Rural communities relying mainly on agricultural income will be affected severely. At the national level, lower levels of agricultural production will lead to higher levels of food insecurity.

Flooding of low-lying areas and coastal erosion threatens local communities and their livelihoods. Communities may experience damage to household assets and property, constraints on services such as water supply and quality, and damage to agriculture. In addition, flooding can damage infrastructural assets in coastal cities, so that local communities might be isolated and unable to go to local markets to buy food or sell agricultural products.

POLICY FRAMEWORK RELATED TO CLIMATE VARIABILITY

NAPA (2009) summarizes a number of barriers for the implementation of the NAPA process. Two barriers

relate to the institutional framework in Yemen. First, decision makers have a low awareness of climate change hazards. Shortages of water resources are structural in Yemen, according to the water tables in Hellegers et al. (2008), although shortages are expected to increase in the future (Noaman et al. 2008). Second, there is inadequate institutional, technical, and financial capacity to develop, modify, or interpret existing models and methodologies. In addition, financial resources are insufficient to implement the adaptation measures due to the high levels of poverty, especially in the rural areas.

For the NAPA implementation process, NAPA (2009) recognizes that the institutional structures and environmental legislations in Yemen are weak. For instance, the implementation of environmental legislation is poor, and there is hardly any enforcement of legislation. At the CALI workshop organized in June 2010, the Yemeni participants mentioned that agricultural extension agencies are rated as relatively unimportant. The institutional framework in Yemen depends much on informal contact and is based on mouth-to-mouth communications.

Despite the opportunities offered by World Bank projects, there are no projects on water resources management with a significant breakthrough in the institutional structure for improved efficiency in

corporate management (World Bank 2006b). However, the institutional structure of the Sana'a basin project is still in progress and could achieve an efficient corporate management.

CLIMATE ADAPTATION INITIATIVES IN YEMEN

NAPA (2009) summarizes the opportunities for more effective integration of climate change adaptation within development activities. These opportunities can be summarized as follows: (a) improvements in governance, institutional frameworks, and enforcement of policies; (b) integration of climate adaptation strategies into different policies (poverty reduction and environmental policy) at different aggregation levels (local to national); (c) provision and dissemination of climate change-related information; and (d) integration of indigenous and climate change knowledge at higher administrative levels.

In addition, NAPA (2009) listed practical adaptation strategies for different economic sectors (Table 3).

From the NCAP study of Noaman et al. (2008), a number of adaptation strategies were formulated for three river basins based on stakeholder consultation. The adaptation strategies relate to urban and rural areas.

TABLE 3. PRACTICAL ADAPTATION ACTIVITIES

<i>Sectors</i>	<i>Adaptation activity</i>
Water	Rainwater harvesting through various techniques, including traditional methods.
	Water conservation through reuse of treated waste water and grey water from mosques, and irrigation saving techniques.
	Rehabilitation and maintenance of mountainous terraces.
Agriculture	Promotion of research on drought-resistant and heat- and salinity-tolerant crops.
	Develop and implement sustainable land management strategies to combat desertification and land degradation.
Coastal zones	Planting and re-planting mangroves and palms for adaptation to sea level rise.
	Sustainable management of fisheries resources.
	Develop and implement Integrated coastal zone management programs.
Cross-sectoral	Develop and implement an awareness raising program on adaptation to the potential impacts of climate change on vulnerable sectors.
	Incorporate climate change and adaptation into school education.
	Develop and implement programs to improve Yemen's preparedness to cope with extreme weather events.
	Establish and maintain a climate change database.

Source: NAPA (2009).

TABLE 4. PROPOSED ADAPTATION STRATEGIES FOR THREE RIVER BASINS

	<i>Sadah</i>	<i>Sana'a</i>	<i>Aden</i>
Demand for water			
• Improve irrigation efficiency			
• Introduce drip irrigation techniques	✓	✓	✓
• Convey irrigation water through plastic piping			✓
• Rehabilitation of traditional earth and sand irrigation channels used with spate irrigation			✓
• Use of grey water from wastewater treatment plant (WWTP) for irrigated agriculture (with recharge)	✓ - WWTP plant under construction	✓	✓ - treated water is stored in aquifer
• Improve water distribution systems (reduces losses)		✓	✓
• Promote lower population growth		✓	
• Alternative crop production; shift from Qat production to a less water-intensive crop that can enhance local food security		✓	
• Improve indigenous methods for wadi flow use/infiltration		✓	
Supply of water			
• Increase storage capacity of water harvesting technologies	✓		
• Desalinization—supply of desalinated water from hydropower plant			✓

Sources: Noaman et al. (2008); Ali Ohtman (2007); Mansour (2007); and Noaman (2007).

Table 4 presents the list of adaptation strategies to overcome current and future shortages of water.

The analysis in the NCAP project revealed that a collapse of water supply systems will likely take place toward the end of the next decade in several important aquifers, suggesting that timely interventions are urgently needed. At the technological level, improved efficiencies through drip irrigation and improved water distribution systems will have demonstrable effects when combined with other supporting adaptation initiatives.

Projects Related to Climate Change Adaptation in Yemen

Currently, there are a number of initiatives related to climate change adaptation in Yemen. Yemen is involved in three multilateral environmental agreements (MEAs) that relate directly or indirectly to climate change in Yemen: the Framework Convention on Climate Change (UNFCCC), Framework Convention on Biological Diversity (UNCBD), and Framework Convention to Combat Desertification (UNCCD) (Linderhof et al. 2009).

Several Other Initiatives Currently Taking Place

Three World Bank-supported initiatives related to the CALI project are RALP, ACAP, and PPCR.

Rainfed Agriculture & Livestock project (RALP). The RALP project addresses the growing stress on available natural resources caused by a rapidly increasing population with greater demands and expectations. The project is intended to (a) halt and reverse the accelerating trend of resource degradation through participatory natural resource management initiatives; (b) upgrade and diversify rainfed agricultural and livestock production; and (c) promote microfinance and microenterprise development, marketing, and partnerships with the private sector.

The project has four components: (1) a farmer-based system of seed improvement and management; (2) livestock husbandry and health services; (3) productive rural development; and (4) project management. MAI is involved in components 1 and 2, and SFD is involved in component 3.

Rural poor households will benefit from the RALP project by increasing incomes, agricultural and livestock production and food security, and by creating on- and off-farm jobs. These gains will stem from improved production technology, water management, seed for rain-fed agriculture, and veterinary and livestock services; higher on- and off-farm investments; and better margins on sales of produce, as producer groups help members achieve the scale of production necessary to exploit economies of scale and strengthen their bargaining power.

RALP is one of the activities of the International Fund for Agricultural Development (IFAD), a specialized agency of the United Nations. The objective of IFAD is to ensure that poor rural people have the skills and organization they need to take advantage of the preservation of natural resources, and have access to improved agricultural technologies, among others (Linderhof et al. 2009).

Agrobiodiversity and Climate Adaptation Project (ACAP). The Agrobiodiversity and Climate Adaptation Project (ACAP) is a GEF-funded project that is particularly interesting as it relates to the objectives of the CALI project in Yemen (World Bank 2010). ACAP aims to (a) enhance capacity and awareness at key national agencies and at local levels to respond to climate variability and change; and (b) better equip local communities to cope with climate change through the conservation and use of agrobiodiversity (World Bank 2010). The overall investigation strategy aims at the conservation and utilization of agrobiodiversity resources for climate change adaptation and the integration of these strategies in the socioeconomic system. This shall be achieved by (a) bringing together local/traditional knowledge, particularly that of female farmers, with modern farming techniques and practices; (b) developing initial local predictive capacity of weather patterns, climatic changes, and longer term climate change scenarios for the rain fed areas of Yemen; (c) developing vulnerability profiles at the community, district, or governorate level for target species/varieties; and (d) developing a menu of adequate and appropriate coping mechanisms as well as policy, institutional, and technology options.

Pilot Program for Climate Resilience (PPCR). The Pilot Program for Climate Resilience (PPCR 2010), through

its preparatory and investment phases, will also be directly relevant. The primary objective of the PPCR is to demonstrate ways to integrate climate risk and resilience into core development planning while complementing other ongoing activities. The areas of a strategic program for climate resilience (SPCR) (indicative) in Yemen are (a) climate change information systems and awareness raising; (b) mainstreaming climate change resilience into national development planning; (c) formulation of Yemen's SPCR and identification of Phase II interventions; and (d) PPCR program coordination.

COSTS OF ADAPTATION TO CLIMATE CHANGE

The costing framework used in this study is presented in Appendix 1. Three challenges in the estimation of the cost of climate adaptation are clear from the outset. First, it is difficult to disentangle the cost incurred for the adaptation strategies per se and those incurred for normal activities; for example, the labor spent on climate adaptation strategies and other daily farming activities. The problem is further complicated where labor is a key input for many of the adaptation strategies in a setting where the daily working time for normal and adaptive farming activities is flexible and is increasingly driven by weather variability. Second, rural households do not keep records of how much labor, material, and cash they invested when they adopted a strategy due to lack of information and education. As a result, this study relies on households' recollections for estimating adaptation costs. Reliability of these cost estimates based on households' recollections decreases as the number of years since the introduction of a strategy increases. Third, the current household respondents may have little or no information about the household adaptation activities and inputs used during the first year of adopting the strategy and hence are unable to give a reasonable estimate of the cost incurred for the specific strategy.

The Costing Estimates are a First Step and Should be Interpreted with Care

In order to obtain reasonable cost estimates for the climate adaptation efforts for rural households, the actual and less precise cost estimates could be complemented with estimates from valuation techniques for non-market

goods. As the latter are not covered in this study, further investigation is needed to obtain a more accurate estimation of adaptation costs. The adaptation cost estimates obtained through household recollection can only be considered as a good indicator of the degree of importance of the various inputs for a given adaptation strategy. This approach is even more important where there is a need to differentiate between the costs of the adaptation strategies farmers prefer to practice in the future (given the necessary inputs and services) and the costs of continuing the adaptation strategies that households are currently practicing. Thus, the adaptation costs estimated through applying household recollections only provide the costs incurred by the strategies the households have adopted given their current constraints (e.g. market,

services, and information) but not what the households would prefer to practice in the future if the constraints were eased. Hence, caution needs to be exercised in the interpretation of the estimates and making recommendations and extrapolations based on such estimates.

It is also important to note that—apart from the variation of climate-related hazards and consequent adaptation responses across regions—households' access to inputs, services, and information varies across regions due to infrastructural and institutional factors. This is particularly the case in many parts of the country where institutions play important roles in initiating some of the adaptation strategies. As a result, adaptation strategies and associated costs vary across regions.

3. DATA COLLECTION AND STUDY AREA CHARACTERISTICS

In this chapter, the methodological structure of the CALI study is briefly discussed. A detailed description and background of the methodology adopted is given in the CALI inception report (Ruijs et al. 2009; Linderhof et al. 2009). In Chapter 4, we investigate the extent to which adoption of adaptation strategies depends on the level of vulnerability of households. Prior to that discussion, this chapter explains the definition of vulnerability adopted in this report. It also describes the study area, including some general characteristics of the villages and the households in the study villages.

METHODOLOGY

As discussed in chapter 1, the objective of the CALI study is (1) to identify the costs of adaptation through local institutions, and (2) to investigate which institutions support households to adapt to climate variability, which efforts and costs have to be made for realizing the adaptation options, how these institutions interact, and how they facilitate adaptation to climate variability. The focus of the research is on the adaptation options households currently use or have adopted in the past in order to reduce the hazards from climate variability. These hazards—such as the risk of a delayed start to the rainy season, prolonged periods of drought, flood risk, and temperature changes—are expected to become more severe and occur more frequently in the future.

Four Categories of Adaptation Strategies

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

- *Agricultural techniques* to adapt to changes in rainfall regime, including seed selection, planting dates, fertilizer application, feed techniques, improved food storage facilities, and changes in pastoral systems.
- *Water management techniques* to adapt to changes in rainfall regime, including the use of water harvesting techniques, rehabilitating terraces, improving irrigation techniques, and improving watering sites in pastoral areas.
- *Diversification techniques* to diversify income sources, including short-term or permanent migration, use of alternative sources for fuelwood, home-garden

agriculture, changing consumption patterns, or drawing down livestock.

- *Communal pooling techniques*, including reforestation, rangeland preservation, communal food storage facilities, or local water management rules.

In the analysis, special attention is paid to the question of whether adaptation is policy- or community-driven and initiated with institutional assistance, or whether it is an autonomous choice made by the households themselves (Stringer et al. 2009).

Costing Elements

In the costing framework, different costs required for the implementation of adaptation options are indicated. These refer to (a) monetary costs that have to be made by the household; (b) household labor requirements; (c) household training requirements; (d) required help from the community; (e) required help from institutions like authorities or NGOs; and (f) financial needs by institutions necessary to implement their work.

Using a range of interview techniques, ranges of costs households have made in the past to adapt their strategies to climate-related hazards are assessed. For the institutions, we assessed which institutions rural households most frequently contact and to what extent they assist households to reduce their hazards. Next, we evaluated what type of resources these institutions need in order to perform their tasks. This assessment will serve as a basis for considering the investments or support that is needed to promote particular adaptation interventions. It will show which entry points can be selected in order to promote particular strategies.

The costing framework is shown in Appendix 1. This appendix describes the envisaged cost elements of the different adaptation options. The structure of the household questionnaire and the focus group discussion is based on this framework.

VULNERABILITY

We investigated the extent to which households have different vulnerability profiles. Next, we assessed whether adoption of adaptation strategies, costs of adaptation

strategies, and institutions that assist the households differ among the different clusters of vulnerability. Several definitions of vulnerability exist; depending on the scale and focus of the system analyzed, different elements are part of the definition of vulnerability.

Vulnerability Depends on Exposure, Sensitivity, and Coping Capacity

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

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

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

Individual households are not able to affect exposure to climate variability. Sensitivity and coping capacity can be affected. Table 5 gives examples of sensitivity-reducing or coping-capacity-increasing strategies. The capability

TABLE 5. STRATEGIES TO REDUCE SENSITIVITY OR INCREASE COPING CAPACITY

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

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

Institutions

For the purposes of this study, institutions are defined as structured, formal or informal organizations that are the means through which central governments and donors channel resources for local development (Agrawal and Perrin 2009). The focus is on groups of people who are organized formally or informally and can be approached as a group. For understanding why particular strategies

are not adopted or why assistance structures may differ by country, use is made of the broader definition of institutions as adopted in the new institutional economics literature (North 1990; Williamson 2000) in which institutions also cover norms and rules that govern the behavior of households and organizations. In particular, the role of kinship (clan, ethnic group), factors affecting commitment among community members, and factors affecting market functioning are important.

DATA COLLECTION

Criteria for the Selection of the Villages

For the selection of the study sites, we have taken into account the following criteria as previously defined in the country inception report (Linderhof et al. 2009).

The selection of villages is based on the representation of farming systems in Yemen.

- For site selection, the research process focused on rainfed systems. About 80 percent of the rainfed areas can be found in the highlands.
- The study area comprised four governorates: Sana'a and Al-Mahweet (Northern highland region) and Taiz and Ibb (Southern upland region). Those four governorates include the different farming systems (see Table 3-1 in Linderhof et al. 2009). The study area was further narrowed down to specific subareas to represent the dominant rainfed farming systems.
- The major farming systems in the highland region can be distinguished based on annual rainfall, altitude, crops cultivated, and access to supplementary or full irrigation. The main farming systems in Yemen are rainfed, highland mixed, dryland mixed, and small-scale irrigation farming. The focus of this study was on the first three farming systems, as those farming systems are directly affected by changing climatological conditions.
- The selected areas are representative of the north and south of the country and are characterized by topographic diversity such as mountains, terraces, valleys, plains, and coast.
- Two sites are located in the districts covered by the RALP project, which can provide some indication of the assistance provided through RALP.

Organization of the Fieldwork

The village studies took place between January and April 2010. All interview activities were conducted simultaneously within each village. In Appendix 1, the questionnaires and structure of the focus group discussions used in Yemen are presented.

For the household interviews, within each village, 50 households were selected randomly in coordination with the representatives of the local authorities. The questionnaire contained three main categories of questions. The first category consisted of general questions on household size, level of education, main activities, crops cultivated, livestock raised, and assets owned. These questions are used for analyzing whether different clusters of households can be distinguished. The second category consisted of questions related to the climate and non-climate related hazards households face and their vulnerability with respect to food shortages. The third category of questions is related to the costing framework. Households were asked which adaptation strategies have been adopted, which investments were required, which hazards have been reduced (if any), which institutions have been helpful, and what type of assistance they received from these institutions.

DESCRIPTION OF STUDY AREA AND STUDY VILLAGES

As discussed during the launch workshop in April 2009, the site selection was based on the representation of the farming systems in Yemen, namely:

- *Rainfed*. The major farming system is primarily rainfed agriculture, although in some

areas supplementary irrigation on summer intensive cereals and full irrigation for winter cash crops is developing rapidly. Rainfall is generally between 300mm to 500mm. This could be found in all selected governorates.

- *Highland mixed*. Locations at high elevation enjoy significant amounts of rainfall and allow for supplementary irrigation from springs and boreholes. This system is dominated by rainfed cereals and legume cropping. The production of qat and coffee are the most important cash crops. This farming system is especially located in Sana'a governorate (Bani Matar District) and Taiz governorate (Sabir district).
- *Dryland mixed*. This farming system is dry subhumid; annual rainfall is usually between 150mm to 300mm. The system is found in the southwest of Taiz governorate toward the coast. Rain is often supplementary to irrigation from surface water.
- *Small-scale irrigated systems*. In this farming system, rain supplements irrigation from groundwater.

Table 6 presents the list of study sites. The selected sites largely represent the farming systems in Yemen. The sites are presented in Figure 6.

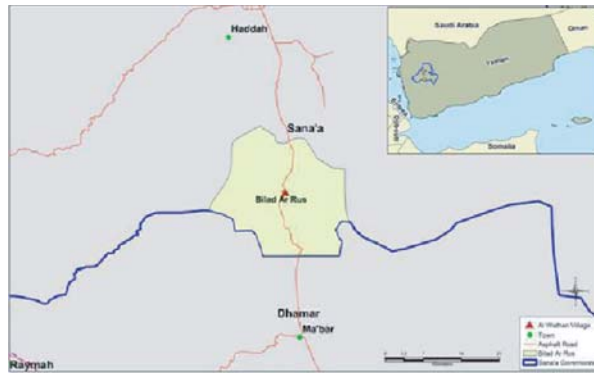
Characteristics of the Study Sites

Table 7 shows a number of characteristics of the study sites. The three northern study sites (Al Wathan, Mu'aneet, and Al Masajed all have an altitude of more than 2,000 meters. Arraheebah (Taiz) has the lowest altitude. From all six study sites, Magahem Asha'abi Dhi-Shraq is closest to a larger town namely Assayani. The road to Assayani is mixed gravel and asphalt. Al

TABLE 6. SELECTION OF SITES FOR THE HOUSEHOLD SURVEY

Sites	District	Governorate	Farming system	RALP district
Al Wathan	Bilad Ar Rus	Sana'a	Rainfed	No
Arraheebah	Dimnat Khadeer	Taiz	Dryland mixed	No
Magahem Asha'abi Dhi-Shraq	As-Sayyani	Ibb	Rainfed	No
Mu'aneet	Ar Rujum	Al Mahweet	Rainfed	Yes
Al Mehraq	Al Mawadim	Taiz	Highland mixed	No
Al Masajed	Bani Matar	Sana'a	Highland mixed	Yes

FIGURE 6. LOCATION OF STUDY VILLAGES IN YEMEN (VILLAGE NAME, DISTRICT NAME AND GOVERNORATE NAME)



Al Wathan (Bilad Ar Rus, Sana'a)



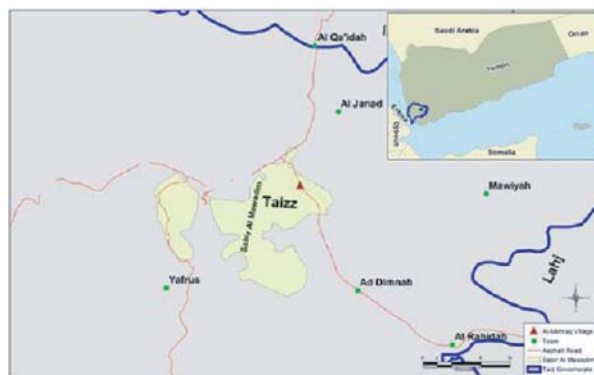
Arraheebah (Dimnat Khadir, Taizz)



Magahem Asha'abi Dhi-Shraq (As-Sayyani, Ibb)



Mu'aneet (Ar Rujum, Al Mahwit)



Al Mehraq (Sabir Al Mawadim, Taizz)



Al Masajed (Bani Matar, Sana'a)

Wathan is located close to the asphalt road between Sana'a and Maber. The distance between Al Wathan and Mabar is 29 km, and Mabar is more than 60 km from at the South of Sana'a). Both study sites in Sana'a (Al Wathan and Al Masajed) are located by asphalt

roads. Furthermore, Arraheebah is rather close to Al Radhidah, but the road is made of gravel, which makes Arraheebah more difficult to reach by car. In neither of the study sites is there any form of public transportation.

TABLE 7. SELECTION OF SITES FOR THE HOUSEHOLD SURVEY

<i>Sites</i>	<i>Altitude (m)</i>	<i>Distance to nearest town (km)</i>	<i>Nearest town</i>	<i>Type of road</i>
Al Wathan	2,512	29.0	Mabar	Asphalt
Arraheebah	1,018	6.7	Al Rahidah	Gravel
Magahem Asha'abi Dhi-Shraq	1,769	3.5	Assayani	Gravel/asphalt
Mu'aneet	2,216	14.5	Al Mahweet	Gravel/asphalt
Al Mehraq	1,479	12.6	Taiz	Gravel/asphalt
Al Masajed	2,570	8.7	Matnah	Asphalt

TABLE 8. POPULATION AND AREA INFORMATION OF THE SELECTED SITES

<i>District</i>	<i>Governorate</i>	<i>Area km²</i>	<i>Population density x 1,000</i>	<i>Number of households x 1,000</i>	<i>Population x 1,000</i>	<i>Share of males %</i>
Bilad Ar-Rus	Sana'a	1127	8.3	12.0	100.0	51.1
Dimnat Khadeer	Taiz	460	244.9	18.4	112.7	48.2
As-Sayyani	Ibb	238	464.3	15.4	110.5	49.1
Al Rujum	Al-Mahweet	76,589	1.0	9.2	75.7	49.7
Al Mawadim	Taiz	202	542.0	16.4	109.5	47.2
Bani Matar	Sana'a	398	78.5	4.2	31.3	50.7

Characteristics of the Districts of the Study Sites

Population. The birth rate is 43 births for every 1,000 persons. The total fertility rate is 6.7 children per woman. The growth rate of the population is around 3.2 percent per year, while life expectancy is 57 years. The mortality rate for girls is 15 percent higher than for boys. Table 8 lists the population in each district.

Poverty. Some 45 percent of the people in rural areas live below the poverty line. For the nation as a whole, 50 percent live below the poverty line, with as many living on less than \$2/day, and 18 percent living on less than \$1/day.

Health. Around 18 percent of the population cannot afford adequate nutrition and some 46 percent of

children under five are malnourished. As much as 90 percent of the population has less than the minimum standard of domestic water supply. Infant mortality, the number of children dying before reaching the age of one, is high.

Education. The overall primary education rate is 78 percent, but only 55 percent of primary school-aged girls attend school (with even less in rural areas at 24 percent). The overall literacy rate is 50 percent. Male literacy is 70 percent and female literacy 30 percent, which is typical for these areas.

Employment. The overall unemployment rate in Yemen is 39 percent, with the employment rate for women being less than one-third that of men. Typically, women are employed in low-productivity rainfed agriculture and small livestock activities. Access to credit is limited generally, but especially for women.

TABLE 9. TOTAL AND CULTIVATED AREAS FOR GOVERNORATES OF STUDY VILLAGES

Governorate	Total area km ²	Cultivated Areas (1,000 ha)	Share of Crops in total cultivated area %
Ibb	5,344	88.7	16.6
Taiz	10,009	87.9	8.8
Al-Mahweet	2,332	30.5	13.1
Sana'a	11,961	176.5	14.8

Source: CSO (2008) for all data except total areas of governorates, which has been taken from Republic of Yemen (2006).

Access to services. Large parts of the rainfed area, especially those located in the mountains and remote regions, are inaccessible, with only limited connection via roads. Most villages in the hinterland can be reached only with 4-wheel drive vehicles. Few villages have electricity; however, the use of cell phones is widespread.

Farmers and livestock owners. Villages are dominated by households farming on terraces. Both female and male farmers share the responsibility of farming activities in addition to the household activities for women. The areas contain several types of livestock such as goats, cows, and sheep. There are also camels and donkeys, which are used for carrying materials and for plowing. Yemeni cultural traditions have kept women in the rural areas at a lower status and prevented them from gaining control over important household resources.

Area cultivated. Most fields are cultivated with cereals and fodder crops. There are a few areas cultivated with legumes, vegetables, and fruits. The most widely cultivated crop is sorghum, followed by qat and wheat.

Table 9 shows that the total cultivated areas in the four governorates covered in the study ranges from 8 to 17 percent of the total area.

OBSERVATIONS FROM THE VILLAGE STUDIES

Farmers Observe Increasing Temperatures and Decreasing Rainfall

During the field visits to the six sites, the general impression of the day-to-day and climate-related problems were similar in all villages. Villagers talked about increasing climate variability, especially about increasing temperatures and decreasing rainfall. They also observed a number of general problems, mostly related to the fact that markets are thin or missing, resulting in a lack of agricultural inputs and strong variation in prices for agricultural products.

Major Occupations are the Same for Almost all Households in the Sample

In general, cultivation of cereals is the principal activity for all households, followed by livestock keeping and fishing if the village is close to a river. Most important crops grown are cereals (maize, sorghum, millet, and rice) followed by a wide range of cash crops, of which qat and vegetables are the most important. Most households practice some form of homestead vegetable growing. Farm sizes vary between 0.2 and 2.4 ha. Most household dwellings are made of dried mud brick.

The most adopted adaptation measures observed during the field visits were:

- Improved seeds
- Use of fertiliser and pesticides
- Organic manure
- Migration
- Improved storage techniques
- Intercropping
- Vegetable growing
- Sale of agricultural products
- Irrigation
- Drainage
- Handicrafts

Detailed results from the fieldwork are presented in the next chapter.

4. VULNERABILITY PROFILES AND ADAPTATION PRACTICES

In this chapter, the main results obtained from the data analysis are discussed. Detailed tables presenting the data are presented in Appendix 2. The current chapter focuses on the key messages obtained from these data. First, clusters of households are distinguished based on common vulnerability characteristics. Also for the villages, their average level of vulnerability is discussed. Next, once the main characteristics affecting coping capacity are identified, for the different clusters and for the different villages, the following elements are discussed in more detail. First, which characteristics explain adoption of particular adaptation strategies? Do different types of households adopt different adaptation strategies and why? Do costs of adopting a strategy differ between groups of households? Are strategies adopted for different reasons? Second, do particular institutions focus on particular types of households or facilitate particular types of adaptation strategies? What resources do institutions need for properly targeting their work? These analyses are done both for the clusters and for the village. By focusing on the clusters, we can determine whether particular household types adopt particular types of strategies or need particular types of assistance. By focusing on the village, we can determine whether particular villages need more or different types of assistance. Both conclusions are relevant for targeting assistance.

HOUSEHOLD VULNERABILITY: VILLAGE VULNERABILITY PROFILES

In Appendix 2, differences between the different villages are discussed in detail. The main messages from this analysis are discussed below.

Key Similarities: Households are Large and Have a Low Average Age

As can be seen from Table A.1 in Appendix 2, the households in the villages all have similar demographic characteristics. The average household size is 8.6 members. In Al Wathan, the average household size is almost 10 members. The percentage of male members is slightly higher than that of women except for Al Wathan (48 percent). In Magahem Asha'abi Dhi-Shraq, the share of males exceeds 60 percent. The dependency ratio is not high, averaging 0.76. Only in Arraheebah is the dependency ratio larger than one, which means that for each adult member (male or female between 15 and 60 years) there is at least one child or elderly member (older than 60 years). In Magahem Asha'abi Dhi-Shraq, the dependency ratio is below 0.5. The average age within the households is 23 years, ranging from 19 years in Arraheebah to 26 years in Magahem Asha'abi Dhi-Shraq.

School Enrollment is Low and Gender Differences are Substantial

The people in the sites studied had access to formal education, although there is a large difference between

males and females. On average, males have eight years of education, while females have less than three years of education. In Arraheebah, both males and females are fewer educated, where males have less than six years of education and females slightly more than one year. Males from Magahem Asha'abi Dhi-Shraq have almost ten years of education, while females are relatively well-educated with five years of education. In Al Wathan females have less than one year of education.

Gender differences in school enrollment are marked in the study sites, although the difference in years of education between boys and girls is much smaller than for males and females. In Al Masajed, girls have more education than boys. In Al Wathan and Al Masajed, girls have more years of education than females, which indicates that education for girls is improving. According to the focus group discussions, the number of girls dropping out of school increased in the last decade, because girls have to help in the household by fetching water for drinking and irrigation. Due to increasing water scarcity, getting water takes more time and effort.

For Many Households, Some Members Have Migrated

Table A.2 shows that migration is present within all the sites studied. In the survey, only temporary migration was asked, because permanent migration is not considered in Yemen. On average, one quarter of the households in the survey have members that migrate temporarily. In Al Wathan, almost half of the households have migrated members, which might be due to the fact that Al Wathan is close to the capital of Yemen, Sana'a. In Arraheebah, only 10 percent of the households have temporarily migrated members. Almost all migrated members are male, and the age of the migrated members is 38 years.

Migration is a useful strategy for diversifying household income and is seen as contributing towards increasing the coping capacity of the households. Women migrate less often than men, which is culturally determined with women staying within the household until they get married. Furthermore, in general there are fewer job opportunities for women, making it more difficult to find income generating activities. Most financial and

employment decisions are made by men, giving the women few opportunities to improve their own situation.

Agriculture is the Main Activity for the Majority of Households

Appendix Table A.3 presents the main activities of the households in the study sites. For more than 60 percent of the households, agriculture is clearly the main source of income. For 21 percent of the households, employment as a civil servant is the main activity. In Al Wathan, located near Sana'a, 40 percent of households report that work in the civil service is their main activity. About 9 percent of the households report that daily labor is their main activity. These households are primarily located in Al Mehraq and Arraheebah in Taiz governorate (22 percent and 14 percent respectively).

Furthermore, where agriculture is not the main activity, it is the activity with the second priority for 36 percent of households. In addition, livestock keeping is the most important second or third priority activity in almost all households. Other activities such as daily labor and trade and commerce are of less importance for most of the households.

Next to Cereals, Almost all Households Grow Cash Crops

Cereals are the main crops grown by all households, although all sites also grow cash crops (qat and coffee), legumes, vegetables, and fruits (Table A.4). Cereals are similar for all sites with an important focus on grains, maize, sorghum, or millet. Sorghum and millet are mainly grown in the drylands of Arraheebah. In Al Wathan and Magahem Asha'abi Dhi-Shraq, about half of the households also grow qat. Three-quarters of the households in Al Masajed grow legumes, as well as almost half of the households in Al Wathan and Mu'aneet. Vegetables are grown by a significant share of households in Al Wathan (58 percent), Arraheebah (37 percent), and Al Masajed (20 percent).

In three sites, an important number of households sell part of their crop yields. Two-thirds of the households

in Al Wathan sell part of their crops, mainly vegetables, cash crops, and cereals. Forty percent of the households in Arraheebah sell part of the yields (mainly vegetables, cash crops, onions, garlic, and cereals). One-third of the households in Magahem Asha'abi Dhi-Shraq sell part of their yields (cash crops). Selling parts of the vegetable and cash crop yields make these crops important cash earners for the households. A minority of households in Mu'aneet, Al Mehraq, and Al Masajed, the more remote villages in the sample, sell part of their yields.

Table A.4b presents the details on area cultivated in the six sites. The average acreage is lowest in Magahem Asha'abi Dhi-Shraq (0.2 ha) and highest in Al Masajed (2.4 ha). More land owned does not necessarily mean that households are wealthier. Yield differences between the different rainfall zones are so large, that one hectare in Al Wathan will be much more productive than one hectare in Arraheebah (dryland). On the basis of the survey data, it cannot be analyzed whether fallow periods decreased due to, for example, climate variability or population pressure.

Most Households Own Livestock

In all six sites a large majority of the households report that they own livestock (see Table A.5a). In Magahem Asha'abi Dhi-Shraq and Al Mehraq (both in Taiz), just under two-thirds of the households report that they own livestock. In Al Wathan, 92 percent of the households own livestock. The amount of livestock is significantly higher in Al Wathan than the average in the survey. The amount of livestock of households in Magahem Asha'abi Dhi-Shraq is rather low. There are some households in Arraheebah and Al Masajed that own rabbits. Yet, loss of livestock was a general tendency in the last 12 months. Livestock reductions range from 25 percent for households in Al Wathan to 55 percent in Magahem Asha'abi Dhi-Shraq.

The Roles of Men and Women in Income Earning Activities Differ

Daily labor and civil servant activities are almost exclusively done by men, while women play a role in agriculture and livestock jointly with the men. Usually, agricultural activities are gender specific, where the men

do the heavier tasks like land preparation and women and children take care of the weeding activities and water transportation. Furthermore, in Al Wathan there is an important share of households where females take care of livestock.

Wealth Differences Between Households are Large

The households also indicated the ownership of productive and luxury assets. A weighted sum of assets owned was determined in which the weights depend on average prices (see Table A.6). There is a big gap between the richest and poorest asset owners in most sites. A few households own a large number of assets. However, the number of rich asset owners is low compared to the other quartiles. Except for Arraheebah, more than 80–90 percent of households own a television. In Arraheebah, 60 percent of households own a television.

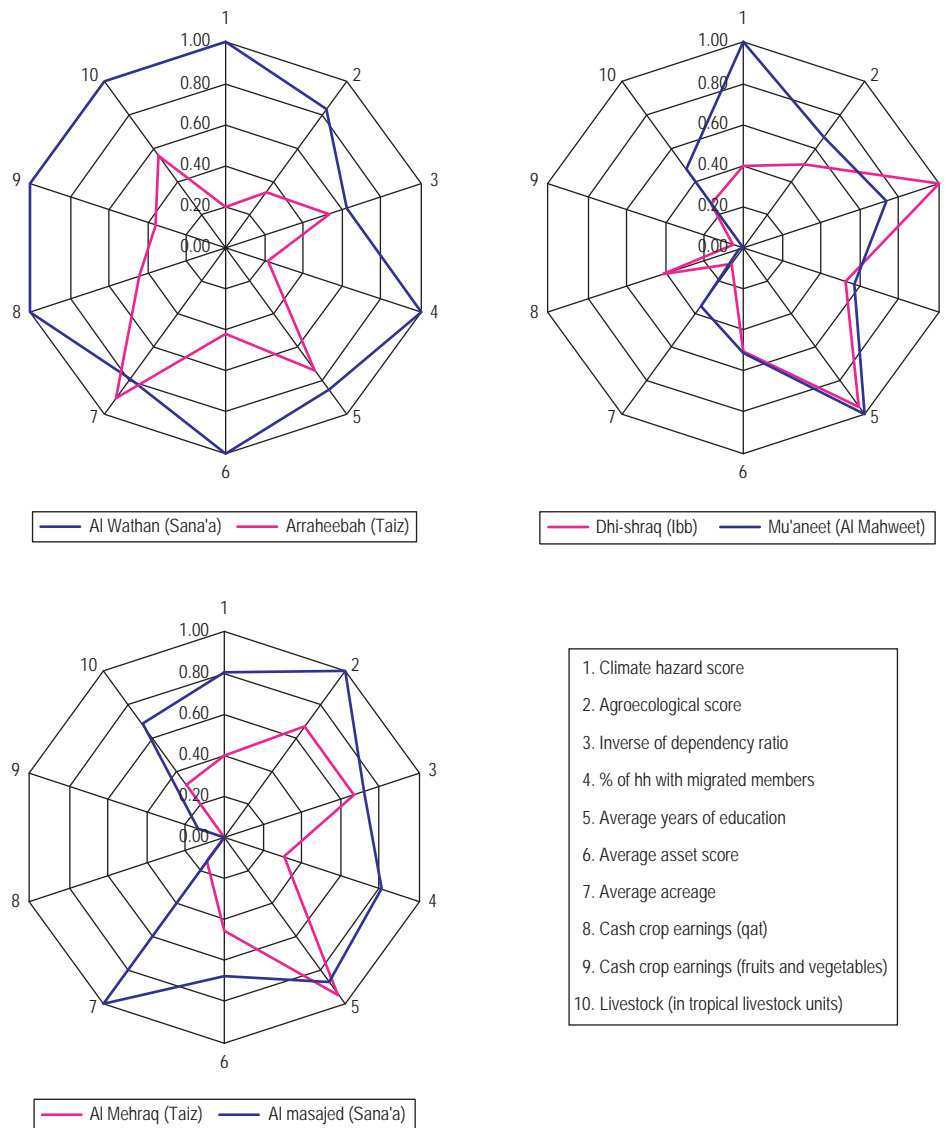
Moreover, it was noted that cell phones are becoming more common; currently, about 50 percent of households own a cellphone. It is most common in Al Wathan, where 66 percent of families owned a cell phone. Also, one out of six households own a car in the survey. In Al Masajed (Sana'a), 45 percent of the households have a car. In the sample, there are no households with cars in the remote village of Mu'aneet.

Vulnerability Profiles Differ Substantially Between the Villages

Figure 7 summarizes in a spider diagram the main vulnerability characteristics for the different villages as discussed above – see also Table 10. (Chapter 3 explains which characteristics are considered in the vulnerability analysis.) The results have been scaled such that they are all on a 0 to 1 scale, in which a score of 1 indicates being least vulnerable. The smaller the area of the spider web, the more vulnerable the village. Illustrating vulnerability by using a spider web diagram clearly shows the multifaceted character of vulnerability.

The spider diagrams give an indication of the vulnerability of the households toward climate change. The site of Arraheebah has high exposure to climate hazards due to low amounts of rainfall. It also has a relatively low

FIGURE 7. SPIDER DIAGRAMS OF THE VILLAGE SCORES ON THE VULNERABILITY CHARACTERISTICS



agroecological score and high dependency on agriculture, which makes it very sensitive to climate hazards. The fact that this village also has a relatively low score on migration gives this village a low coping capacity, although it has cash crop production. Given the combination of these different factors, Arraheebah is considered to be in a vulnerable situation. The households in the site of Al Mehraq, despite its relatively low level of exposure, also are in a vulnerable situation as it has limited coping

capacity with a strong focus on agriculture with low land-holdings and without any cash crop earnings. Migration of household members is also low in Al Mehraq.

The sites of Mu'aneet and Al Masajed currently have a medium to high exposure. Households in both sites are primarily focused on agriculture, but a reasonable share of households have migrated members and livestock holdings. Their coping capacity is still rather low as they

TABLE 10. VULNERABILITY SCORES FOR THE DIFFERENT VILLAGES

Villages	1	2	3	4	5	6	7	8	9	10
Al Wathan	1.00	0.83	0.61	1.00	0.85	1.00	0.79	1.00	1.00	1.00
Arraheebah	0.20	0.33	0.53	0.21	0.74	0.42	0.90	0.44	0.35	0.56
Dhi-Shraq	0.40	0.50	1.00	0.52	0.96	0.50	0.09	0.41	0.05	0.26
Mu'aneet	1.00	0.67	0.73	0.57	1.00	0.51	0.36	0.02	0.00	0.48
Al Mehraq	0.40	0.67	0.67	0.30	0.95	0.45	0.14	0.00	0.00	0.31
Al Masajed	0.80	1.00	0.72	0.81	0.86	0.68	1.00	0.00	0.14	0.68

TABLE 11. OVERVIEW OF MONTHS IN WHICH HOUSEHOLDS FACE A FOOD SHORTAGE (%)

		Households with food shortages	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	Al Wathan	14	2	2	0	0	0	2	2	6	0	2	0	0
2	Arraheebah	55	14	10	14	8	6	0	2	4	0	6	10	14
3	Dhi-Shraq	32	8	4	4	6	6	4	2	2	0	0	2	10
4	Mu'aneet	32	4	0	0	2	0	2	2	2	0	6	0	10
5	Al Mehraq	42	8	8	8	0	2	4	0	2	0	4	8	12
6	Al Masajed	29	4	6	2	0	0	0	0	4	0	6	8	2
Total		34	7	5	5	3	2	2	1	3	0	4	5	8

only have small earnings from cash crops. The sites of Magahem Asha'abi Dhi-Shraq and Al Wathan have medium exposure. Households in Al Wathan have diversified income sources, so their coping capacity is relatively good. Al Wathan scores high on livestock, migration, and cash crop production. In addition, 40 percent of the households in Al Wathan also have members as civil servants. Households in Magahem Asha'abi Dhi-Shraq have cash crop production and livestock. The general favorable position of these villages is illustrated by the relatively high assets scores, confirming the general prosperity of these villages.

Vulnerability Levels are Illustrated by the Hunger Period

Households in Arraheebah (dryland area with low rainfall) are most affected by food shortages (Table 11). This corresponds with the above observation that households in Arraheebah are the most vulnerable among the six villages. In Arraheebah, 55 percent of households suffer from food shortages, although the food shortages are

spread out over the period March–July. This hunger period is also observed at the other sites at the end of the rainy season, before the crops are harvested. The wider annual fluctuations and the onset of the rainy season seem to be important vulnerability determinants. If climate change will have a worsening impact on this annual cycle—for example, by lengthening the dry season—this is likely to result in a lengthening of the food shortage period.

High Exposed Villages are not Necessarily Vulnerable

Vulnerability and agroecological potential in Yemen are related to altitude, which is related to rainfall. The study village in the coastal plains (Arraheebah in Taiz) is the most exposed. This village scores low on agroecological capacity, whereas the households are highly dependent on agriculture. The three study villages with an arid subtropical climate are somewhat less exposed. The two villages in the highlands with a relatively high precipitation are the least exposed to climate variability. The highly exposed

villages, however, are not necessarily the most vulnerable. Arraheebah, the most exposed village, has vulnerable households. Those households have low cash crop earnings, low income diversification, and relatively low educational levels. Due to low soil fertility, their higher landholdings do not result in high yields. The site with the least vulnerable households seems to be the rainfed agriculture village Al Wathan in Sana'a governorate. They are highly exposed but compared to most other villages, they also have higher cash crop earnings (both from qat and fruits and vegetables), higher land holdings, more livestock, more assets, and higher education levels. Their sensitivity to climate variability seems to be relatively low and their coping capacity good. Both highland villages show important differences. Households in Al Masajed in Sana'a governorate have relatively good landholdings, income from livestock and migration, and relatively good levels of education. The highland village of Al Mehraq in Taiz governorate has households with lower landholdings and also lower income levels, so they are more vulnerable. Vulnerability in the Yemeni study villages seems to be less dependent on climate exposure but more on other factors. Proximity to Sana'a seems to make the villages in the Sana'a governorate less vulnerable.

HOUSEHOLD VULNERABILITY PROFILES

In the previous section, vulnerability profiles of the different villages have been compared. In this section, clusters of households are formed across all study villages, each having similar sensitivity and coping capacity characteristics. If the exposure characteristics were included in the cluster

analysis as well, six clusters would emerge, each again consisting of the households of each individual village. This shows that exposure is an important characteristic of vulnerability. By comparing sensitivity and coping capacity of the households, we gain insights about which households are better equipped to deal with hazards themselves and which households will need more assistance.

Household Clusters Show Vulnerability Classes

Table 12 presents the distribution of households from the different villages in the clusters.

Appendix 2 presents some general household characteristics of the clusters. The main vulnerability characteristics distinguished in this report are presented in Table 13 and in Tables B.1 to B.3 in Appendix 2. The results are also presented in Figure 8.

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

1. *Diversified, wealthy farmers with livestock* who are better educated, own large herds of cattle, and produce cereals and cash crops (qat).
2. *Highland smallholders* in the southern highlands and rainfed areas with relatively low landholdings, moderate in asset ownership, and who mainly produce grains.
3. *Diversified households* with a relatively high share of females and low dependency ratio, rich in landhold-

TABLE 12. DISTRIBUTION OF CLUSTERS OVER THE DIFFERENT VILLAGES

Village	Cluster						Total
	1	2	3	4	5	6	
Al Wathan	31	9	5	2	3	0	50
Arraheebah	5	7	3	3	11	22	51
Dhi-Shraq	9	35	2	4	0	0	50
Mu'aneet	18	11	9	8	0	4	50
Al Mehraq	11	28	3	5	0	3	50
Al Masajed	14	10	21	2	4	0	51
Total	88	100	43	24	18	29	302

Note: See text above for key to cluster types.

TABLE 13. CHARACTERISTICS OF CLUSTERS

Cluster	Dependency ratio	% hh with temp. migration	Average years of education	Mean asset score	Average acreage per hh	Cash crop earnings (qat)	Cash crop earnings (fruit and vegetables)	Livestock (in TLU)	% hh involved civil servnt
1	0.62	0.70	0.48	0.90	0.59	1.00	0.27	1.00	0.00
2	0.53	0.37	0.44	0.49	0.21	0.20	0.04	0.18	1.00
3	0.45	1.00	0.42	0.55	0.66	0.10	0.03	0.69	0.98
4	1.00	0.26	1.00	1.00	0.33	0.63	0.08	0.16	0.12
5	0.74	0.57	0.43	0.75	0.61	0.14	1.00	0.46	0.00
6	0.77	0.14	0.34	0.45	1.00	0.00	0.11	0.60	0.02

Notes: (1) The size of the land cultivated and the size of the land occupied with trees is aggregated into one acreage indicator. For converting trees to hectares, it is assumed that 1 tree takes 0.015625 ha (or 64 trees per ha – see also Table B.2 in Appendix 2). (2) TLU = tropical livestock units. TLU conversion factors: Cattle in herd: 0.7, Cows: 1.0, Sheep: 0.1, Goat: 0.08, Poultry: 0.01 (Kassam et al. 1991).

ings, producing herbs and legumes, and a high share of migration.

4. *Highly educated cash-crop growing farmers* with a high dependency ratio, with high share of other occupations such as civil servant, small landholdings, relatively many assets, and producing cereals and cash crops (qat).
5. *Fruit and vegetable farmers* producing cereals, vegetables, and fruits, with some livestock, a relatively high dependency ratio, and relatively low levels of education.
6. *Dryland farmers with large landholdings*, producing cereals but no cash crops, low in education, owning only few animals, and having a high dependency ratio.

Villages Exhibit Signs of a Social Divide

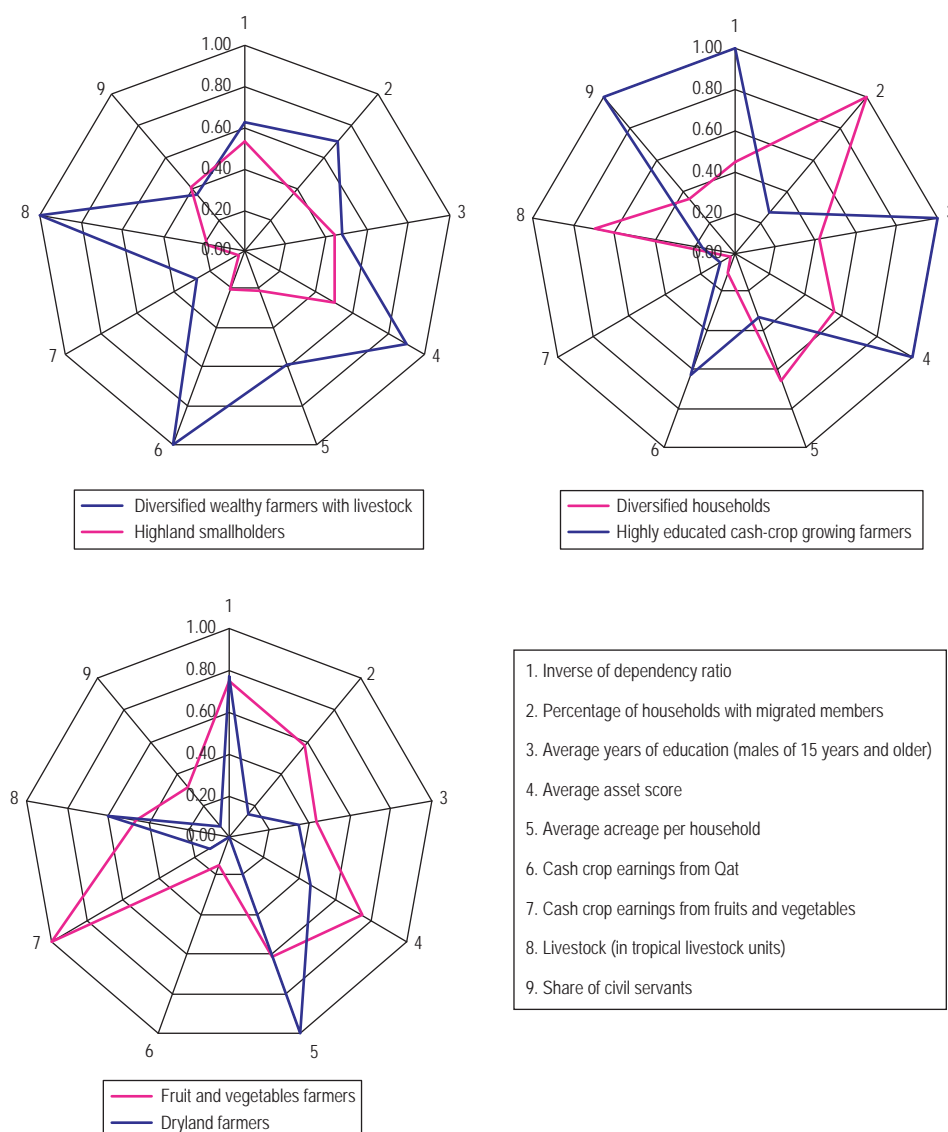
The cluster analysis shows that the clusters vary across the villages.

1. The “diversified, wealthy livestock farmers” (cluster 1) and the “Highland smallholders” (cluster 2) account for two-thirds of the respondents in the survey.
2. The “diversified, wealthy livestock farmers” (cluster 1) are the least vulnerable. They are present in all six villages, although villagers of Al Wathan

(Sana’a) are most frequently present and those from Arraheebah the least frequently. Note that Al Wathan was also the least vulnerable village and Arraheebah the most vulnerable.

3. The “highland smallholders” are most vulnerable. About half of them live in Magahem Asha’abi Dhi-Shraq (Ibb) and Al Mehraq (Taiz). They score much lower on all characteristics. The observation that the best scoring (cluster 1) and least scoring (cluster 2) households live in all villages is a sign that villages are divided in better-off and worse-off households.
4. Most households in the dryland village of Arraheebah in Taiz are from clusters 5 and 6. They are in a vulnerable situation. The fruit and vegetable farmers are somewhat better off as they have a higher and more diversified income. Both household types, however, have low education levels, which gives them a low capability of improving their livelihoods themselves.
5. The situation of the “highly educated cash-crop growing farmers” (cluster 4) is difficult to assess. Their low dependency ratio and high levels of education and assets indicate they are more capable of deciding about adaptation themselves. Low landholdings and income earning capacities, however, put them in a vulnerable situation.

FIGURE 8. SPIDER DIAGRAMS OF THE CLUSTER SCORES ON THE VULNERABILITY CHARACTERISTICS



The Cluster Analysis Confirms the Village Analyses

If we use the cluster analysis to further evaluate the sites, the initial findings are confirmed that the negative situation for Arraheebah is caused by a high exposure of the sites, combined with a high sensitivity and poor coping capacity. The coping strategies include cash crop

production (as in cluster 5) or livestock holdings (as in cluster 6). Cluster 3 has a high exposure, but households in this cluster have a good coping capacity (migration) and relatively low sensitivity to climate variability, as observed for Al Mehraq. The households in Magahem Asha'abi Dhi-Shraq (mainly in cluster 2) currently have a relatively good position because they have a low exposure but are sensitive to future climate

change and have limited coping capacity. The cluster analysis furthermore reveals that most households of Al Wathan are in cluster 1, confirming their relative resilience in the face of climate change. Cluster 4 shows medium exposure with households showing a high dependency ratio and low landholdings and livestock. Migration is low, but the households are relatively wealthy and grow cash crops (qat in most cases). From all sites, there are a few households present in cluster 4, which are characterized by their high education levels and high asset ownership.

Climate-Related Hazards are Significant for The Households

Table 14 shows which hazards are identified by the households themselves as being the most significant in terms of the risks that these households face (see also Table B.4). Drought, due to decreased rainfall, and higher food prices are identified by all clusters as the single most important hazards. Droughts during the rainy season are also important hazards. Problems in purchasing inputs or selling the output are considered as important hazards. Diseases in general (human, animal and crop) and extreme temperatures are considered of average importance to all households. Hazards caused by an abundance of rainfall or floods and loss of soil

fertility are considered by all clusters to be of minor importance, even though soil erosion is a known problem in Yemen.

The main hazards identified are partly climate-related and economic hazards. Most households indicate that many of the climate and non-climate hazards have become more threatening over the past years.

VULNERABILITY AND ADAPTATION

In the village study, households were asked which strategies they had adopted in order to reduce some of the hazards they face. Four categories of strategies were distinguished:

- *Agricultural techniques.* These include the adoption of drought-tolerant or resistant crops, changing planting dates, changing cropping densities, changing fertilizer and pesticide application, changing the pastoral system, changing the herd composition, and applying different feed techniques.
- *Water management techniques.* These include the use of water harvesting techniques, improvement or rehabilitation of terraces, the use of irrigation techniques, and improvements to watering sites in pastoral areas.

TABLE 14. AVERAGE RANKING OF HAZARDS FOR THE DIFFERENT CLUSTERS (1 = MOST IMPORTANT; 10 = LEAST IMPORTANT)

Cluster	1. Drought due to less rainfall during the rainy season	2. Drought due to periods of drought during the rainy season	3. Floods due to excessive rainfall	4. Damage due to excessively heavy showers	5. Changed average and extreme temperatures	6. Human diseases	7. Animal or crop pests and diseases	8. Decreasing soil fertility	9. Problems with input purchase or output sales	10. High food prices
1	2	3	10	8	6	7	4	9	5	1
2	1	3	10	8	6	7	5	8	4	2
3	1	3	10	8	5	6	7	9	4	2
4	1	3	10	9	6	7	5	8	4	2
5	1	2	10	5	4	9	7	6	8	3
6	1	3	10	8	7	6	5	9	4	2
Overall	1	3	10	8	6	7	5	9	4	2

- *Income diversification techniques.* These include temporary or permanent migration, non-timber forest product commercialization, home-garden agriculture, increase in market sales, charcoal or timber sales, changing consumption patterns, and draw-down of livestock or savings.
- *Communal pooling techniques.* These include restoration of homestead or mountain forests, rangeland preservation, soil erosion prevention programs, communal water harvesting techniques, or communal irrigation schemes.

On Average, 1.7 Strategies Per Household

On average, each household adopted 1.7 strategies. (For the other countries included in the CALI-study, the average number of strategies adopted was 8.5 for the Ethiopian sample and 3.5 for the Malian sample.) Households in Al Wathan use 3.7 strategies, which is more than twice as much than in Mu'aneet, while households in Al Mehraq only use on average 0.8 strategies. In Al Wathan three-quarters of the households and in Al Mehraq about 50 percent of the

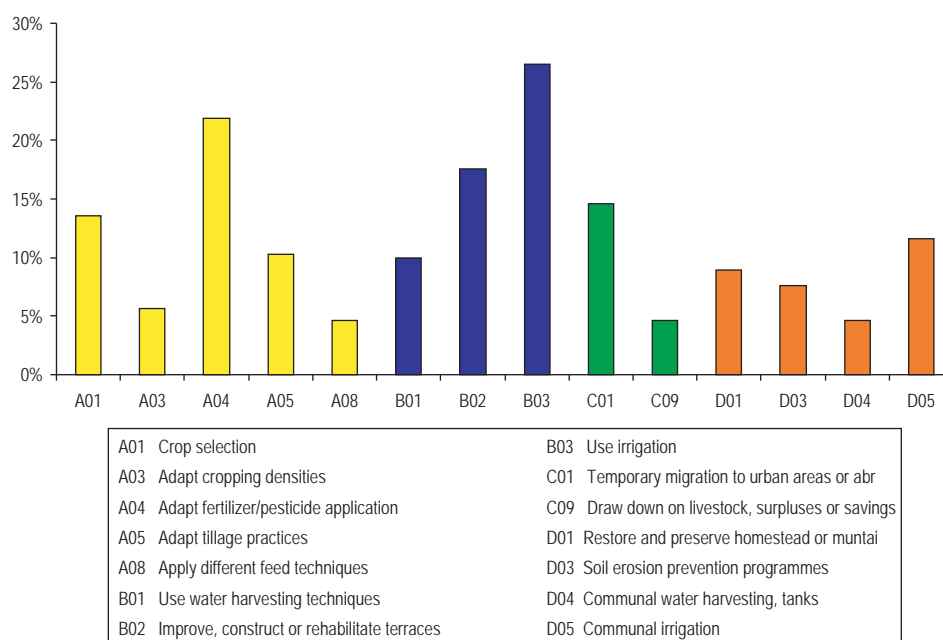
households apply one or more strategies. In the other sites, approximately 65 percent of the households apply strategies.

Agricultural techniques have the highest share in the total number of strategies (35 percent). Water management techniques account for 32 percent of the strategies. Communal pooling strategies have a share of 20 percent, and the income diversification techniques have a share of 13 percent.

Top Six Strategies Adopted Contain Four Individual Strategies

Figure 9 (and Tables C.1 and C.2) show which strategies are chosen by the different household types and the different villages. For all households together, the top six most important strategies are (1) use irrigation (26 percent), (2) adapt fertilizer/pesticide applications (22 percent), (3) improve, construct, or rehabilitate terraces (18 percent), (4) temporary migration to urban areas or abroad (15 percent), (5) crop selection (14 percent), and (6) communal irrigation (12 percent).

FIGURE 9. PERCENTAGE OF HOUSEHOLDS CHOOSING A PARTICULAR ADAPTATION OPTION



Note that these are the only strategies that are adopted by more than 10 percent of the households in the sample. The most selected strategies do include one communal strategy, which has to be implemented and operated with the community. Two of the top six strategies are water management strategies. The use of irrigation is the most important strategy adopted, and the construction of terraces is ranked as third. Both strategies usually require community action as the labor inputs cannot be borne by individual households. Agricultural techniques such as fertilizer and pesticide use and crop selection are two important strategies. Finally, temporary migration, as an income diversification strategy, is particularly relevant on sites when there is a large city nearby.

Communal actions seem to be difficult to establish in the study villages. Communal actions need on the one hand investments and training from external institutions, but on the other hand a sense of urgency and a feeling of ownership from the side of the households, sufficient to outweigh the transaction costs of collective action.

Villages Select Different Strategies

The most important strategy selected is the use of irrigation. However, this strategy is not chosen by households in Mu'aneet and Al Mehraq. In addition, the households from these sites do not choose communal irrigation strategies either (see Tables C.1 and C.2). Improvement, reconstruction, and rehabilitation of terraces are the most important strategy in Mu'aneet and Al Mehraq. Despite the similar preferences for strategies, the agroecological potential and climate hazard differs across both sites. Mu'aneet has rainfed agriculture, while Al Mehraq has highland mixed agriculture. Both villages are in remote areas, which may explain why irrigation techniques are difficult to obtain.

For the other four sites, the preferences for strategies are similar to the overall preference although each site has a different emphasis on particular strategies:

- For Al Wathan, the most important strategy, even slightly more important than the use of irrigation, is to adapt fertilizer application (adopted by 60 percent of the household);
- In Arraheebah, the use of irrigation is the most important strategy, followed by agricultural

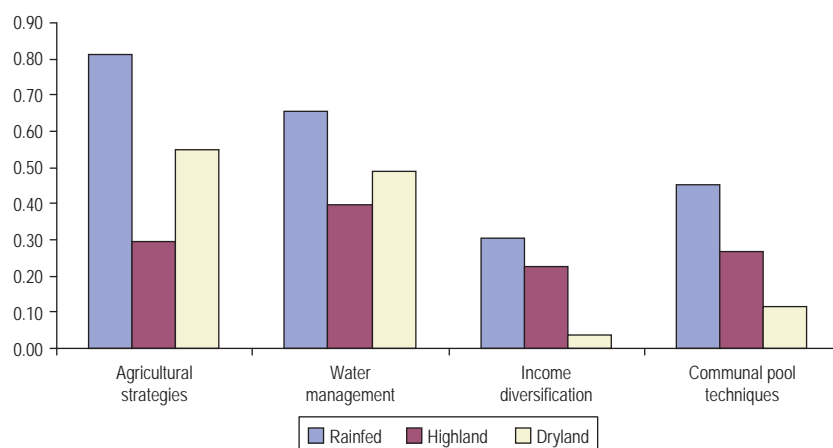
techniques such as crop selection, adapting fertilizer use, and adapting tillage practices, which are adopted by 15–20 percent of the households.

- Unlike the other sites, Arraheebah hardly uses income diversification strategies. Apparently, the distance to urban areas (such as the city of Taiz) is an obstacle to apply this strategy.
- Households in Magahem Asha'abi Dhi-Shraq use irrigation (30 percent), adapt fertilizer use (24 percent), or adapt tillage practices (20 percent).
- Strategies adopted in Al Masajed are similar to the overall preference of strategies. Application of irrigation and of communal irrigation are two of the most important strategies. A significant share of households in Al Masajed also choose to migrate to urban areas.
- As mentioned above, irrigation (either individual or communal) is not chosen by households in the highlands of Mu'aneet. Agriculture in Mu'aneet is mainly rainfed. Not surprisingly, about half of the households opted for the improvement, construction, or rehabilitation of terraces, and 20 percent of the households apply communal water harvesting.
- Al Mehraq is the site with households with the lowest number of strategies per household (0.82 strategies per household). About half of the households in Al Mehraq did not adopt any adaptation strategy. The most important strategy was improvement, construction, or rehabilitation of terraces (20 percent).

Adaptation Strategies Differ Across Farming Systems

Figure 10 shows that all types of adaptation measures are applied in the sites with rainfed farming system (Al Wathan, Magahem Asha'abi Dhi-Shraq, and Mu'aneet). One should keep in mind that households in Al Wathan have high average numbers of all strategies. Households in drylands put more effort into agricultural and water management strategies because they have faced water scarcity for a long time. Income diversification and communal pool techniques are hardly used in the drylands. In the highlands, households use a mix of adaptation strategies. Agricultural and water strategies are less applied than in rainfed or dryland areas, because the water resources in highlands are less scarce.

FIGURE 10. AVERAGE NUMBER OF STRATEGY TYPES FOR THE DIFFERENT FARMING SYSTEM (AND AGROECOLOGICAL ZONE)



The Number of Strategies Adopted Depends on Wealth

Differences in strategies adopted are relatively small between the clusters. The “diversified wealthy farmers” (cluster 1) have the highest average number of strategies, namely 2.4 per households. About 30 percent of these households either applied irrigation, adapted fertilizer/pesticides, or improved, constructed, or rehabilitated terraces. Almost half of these households applied either individual or communal irrigation. The “highly educated cash-crop growing farmers” (cluster 4) adopted on average two strategies, with a significant share of households choosing for many different strategies. After the strategies related to irrigation, terrace construction, and adapting fertilizer, an important share of households in this cluster also applied crop selection or soil erosion programs. Income diversification strategies play a minor role in this cluster.

The “fruit and vegetable farmers” (cluster 5) adopt 1.9 strategies per household. More than 60 percent of the households in this cluster apply irrigation. Other important strategies are crop selection and adapting fertilizer. The “farmers with diversified other income sources” (cluster 3) had 1.8 strategies; 30 percent of the households chose migration of household members. This is the most important strategy to

diversify income. Furthermore, irrigation use and terrace construction are important strategies for this cluster. The “highland smallholders” (cluster 2) applied 1.3 strategies per household; adapting fertilizer use is the most important strategy, applied by 20 percent of the households. Water management strategies are also relatively important. In 10 percent of the households in this village, household members migrated to other areas. Finally, The “dryland farmers” (cluster 6) only used 0.8 strategies per household. The strategies were either agricultural or water management techniques. Income diversification is hardly applied, which is not remarkable since this cluster is dominated by households from Arraheebah, with a low number of strategies.

The comparison between the clusters shows that the better-off households adopt more and the worse-off households adopt fewer strategies. This shows that wealth status is an important determinant in the adaptive capacity of households. Overall, households do not mention any assistance from institutions with respect to adaptation strategies. Households in most sites mention that institutions are not present. In addition, those institutions are often not associated with adaptation strategies. Many households claim that the information on adaptation strategies is based on personal information by informal institutions, for instance. In both RALP sites,

some of the local experts indicated that extension agencies were present (see Appendix 4).

Only in 4 percent of all strategies (23 strategies) do households mention contact with institutions. This is a sign that households are more or less on their own when it comes to decisions regarding adaptations of their livelihoods. In that case, it is more difficult for the more marginalized households to make changes in their lives. This issue is further discussed below.

Strategies Mostly Aim at Reducing Sensitivity

Most strategies aim at sensitivity reduction to climate variability through irrigation, fertilizer/pesticide application, or the improvement, construction, or rehabilitation of terraces. The only strategy focusing on improving coping capacity is migration. Differences between villages are remarkable. In the vulnerable villages of Al Mehraq and Arraheebah in Taiz governorate, only a few households adopt some strategies. The highland village of Al Mehraq focuses on migration and prevention of soil erosion (terracing and reforestation), whereas the dryland village of Arraheebah focuses on irrigation and adapting farming practices. For the villages participating in the Rainfed Agriculture and Livestock Project (RALP), Mu'aneet and Al Masajed, no significant differences in strategy adoption can be observed compared to the other four villages. Terrace rehabilitation and reforestation are important for them, as well as the use of water harvesting measures. The number of households adopting these strategies is not much higher in the RALP-villages than in the other villages.

Strategies for Improving Coping Capacity are Hardly Applied

For all villages, coping capacity strategies are restricted to migration to urban areas or abroad. Other possible strategies, like migration to other rural areas, home-garden agriculture, increased market sales, or handicrafts are hardly used. In addition, the focus group discussions pointed out that selling animals or savings is used as a strategy, but the money is spent on purchasing water or medicines for ill family members (or animals). It is noted, however, that as the cultivation of fruits and vegetables is already applied by many, home-garden agriculture as it is promoted in the other countries in

the CALI-study, Mali and Ethiopia, may be a less relevant strategy. In the focus group discussions, home gardening and migration to urban areas were frequently mentioned as new strategies (see Appendix A3). This lack of coping strategies may be caused by marketing constraints, political problems, and financial constraints. At the same time, market and political restrictions are the reason for generally low levels of use of adaptation strategies. Financial constraints cause even lower levels of strategy adoption for the marginalized groups. Moreover, political instability generally does not create receptive grounds for initiating new activities. In addition, one of the hazards mentioned in the focus group discussions is the increasing number of diseases. As a result, households spend a lot of money on medicines, which they cannot spend on other goods such as adaptation strategies.

Communal Strategies are Adopted Especially in the Least Vulnerable Villages

Even though communal strategies like terrace rehabilitation and communal irrigation are chosen regularly, the choice of communal strategies differs a lot between the villages. In the more vulnerable villages in Taiz, fewer households adopt communal strategies than in the other villages. This is a sign that the more marginalized groups not only do not adopt fewer strategies, but are also more on their own. They may be left aside by the better-off households, may be too busy with their daily tasks that there is not sufficient time for adaptation, or they lack the knowledge and resources to try new initiatives.

Gender Differences in Adaptation Strategies...

To see whether there are any gender differences in choosing adaptation strategies, female-dominated households were identified. Female-headed households are hardly present in the survey. Female-dominated households are those households where two-third of the adults are female. Table 15 shows that in the survey, 13 percent of the households were female-dominated, because it is a tradition in Yemen to marry off young females at an early age. The share of female-dominated households ranges from 6 percent in Al Mehraq to 20 percent in Al Wathan.

TABLE 15. NUMBER OF HOUSEHOLDS, AVERAGE NUMBER OF STRATEGIES, AND SHARE OF HOUSEHOLD WITH DIFFERENT ADAPTATION STRATEGIES FOR MALE- AND FEMALE-DOMINATED HOUSEHOLDS

<i>Statistic</i>	<i>Male-dominated households</i>	<i>Female-dominated households</i>
Number of households	262	40
Average number of strategies	1.61	2.33
Share of households with the top-five adaptation strategies	62.6%	72.5%
B03 Use irrigation	25.2%	35.0%
A04 Adapt fertilizer/ pesticide application	21.4%	25.0%
B02 Improve, construct or rehabilitate terraces	16.4%	25.0%
C01 Temporary migration to urban areas or abroad	14.1%	20.0%
A01 Crop selection	12.6%	17.5%

With respect to the number of adaptation strategies, female-dominated households have a higher average of adaptation strategies. A higher share of female-dominated households (72 percent) adopt strategies than male-dominated households (62 percent). There is no difference in the distribution of the types of adaptation strategies chosen. Female-dominated households also choose sensitivity reducing strategies more than coping strategies.

Cost Estimates are Difficult to Interpret

Information on the costs of the adaptation strategies is given in Table 16.¹ Interpretation of the cost estimates is difficult. Many of the people interviewed did not give an adequate cost estimate for the strategies adopted. For many of the strategies, the households did not list direct costs, possibly because people have difficulties in translating non-cash expenditures for strategies as costs incurred. Furthermore, for some strategies there are one-time investments costs, whereas other strategies have annually recurring costs. Moreover, for some strategies it is not immediately clear which costs have to be made especially for the specific strategy (for example, adapt planting dates or adapt cropping densities). It has to be concluded from the analysis of the cost data that it is difficult to provide reliable cost estimates. As the costing framework adopted in this study and

questionnaire was already very elaborate, it would have been difficult to ask even more details on the costing elements. This would have been too time-consuming. A follow-up study could put more emphasis on the different elements of these costs. This could shed more light on the costs households incur and on whether they can bear these costs themselves or need assistance from outside institutions.

Highest Costs are Associated with Irrigation

Taking into account the restrictions raised above, some careful observations can be made on the costs and time invested in the adaptation strategies. GDP per capita in Yemen was \$1,300 (i.e. YER 290,000) per year in 2008.² The use of irrigation is the most popular strategy, but it is also an expensive strategy. On average, the cost of irrigation is twice the annual GDP per capita. The standard deviation, however, is large, demonstrating that despite the careful way in which these issues were raised in the questionnaire, people have difficulties properly interpreting these questions or are reluctant to tell interviewers this type of information. It can be seen that water harvesting techniques and terrace rehabilitation are cheaper options than changes in agricultural techniques. From the costing data in Table C.4, it cannot be concluded that any of the clusters make more investments than others, because the number of observations is rather limited. The cost of using irrigation among the

1 Only for the strategies for which more than 10 positive cost estimates are given the averages have been calculated. For the others, the estimates are too unreliable and are therefore excluded from the analysis.

2 See <http://data.un.org/CountryProfile.aspx?crName=Yemen#Economic> (accessed on September 15, 2010).

TABLE 16. COST ESTIMATES (YER X 1,000) OF THE ADAPTATION STRATEGIES* (YER 1,000 = 4.48 US DOLLARS)

		<i>Mean</i>	<i>Min</i>	<i>Median</i>	<i>Max</i>	<i>Stdev</i>	<i># obs.</i>
Agricultural techniques							
A01	Crop selection	52.9	0.2	15.0	700.0	137.4	25
A02	Adapt planting dates						3
A03	Adapt cropping densities						6
A04	Adapt fertilizer/pesticide	28.8	1.5	11.0	200.0	39.7	32
A05	Adapt tillage practices	33.0	3.0	13.5	200.0	49.3	22
A08	Apply different feed techniques						9
A10	Improve food storage facilities						2
Water management techniques							
B01	Use water harvesting techniques	37.3	1.0	15.0	300.0	67.7	20
B02	Improve, construct or rehabilitate terraces	33.6	0.0	14.0	140.0	35.3	34
B03	Use irrigation	678.8	3.0	150.0	7000.0	1530.4	42
Income diversification techniques							
C01	Temporary migration urban areas						5
C04	Home-garden agriculture						1
C09	Draw down on livestock/savings						1
Communal pooling techniques							
D01	Restore and preserve homestead or mountain forests	56.5	5.0	30.0	200.0	57.4	15
D03	Soil erosion prevention programs	43.4	9.0	25.0	150.0	43.7	11
D04	Communal water harvesting, tanks						1
D05	Communal irrigation						8

Notes: * Only estimated if there are at least 10 observations. See also Tables C.3 and C.4.

diversified, wealthy farmers (cluster 1) is substantially lower than for the poorer “highland smallholders” (cluster 2). This is striking, as it might be expected that the poorer, more vulnerable households in cluster 2 make less investments. This might be due to a more favorable location with more rainfall and closer proximity to an urban area.

INSTITUTIONAL ACCESS AND CLIMATE ADAPTATION

In the study villages, institutions only play a minor role in the livelihoods of Yemeni households. According to the findings from the field survey, there is hardly any contact between households and institutions (see Table 17 and Appendix A2.D). Only 7 percent of the households reported having any contact with institutions. About half of these households consider these contacts useful in the

adoption of adaptation strategies. Extension agencies are the institution mentioned most frequently. Furthermore, national authorities, regional authorities, local authorities, and seed production authorities are contacted for assistance, but only by a few households. Due to the low level of institutional contacts, it is difficult to judge whether particular villages or clusters have more contacts than others. It seems as if the better-off clusters (1 and 5) have somewhat more contact with institutions than the worse-off households; these results, however, are not significant. Nevertheless, it confirms the previous observation that the more marginalized groups are more on their own than the better-off households and therefore adopt fewer strategies.

According to the findings of the household interviews, international donors, national authorities, banks, schools, and religious communities are not mentioned as

TABLE 17. ALLOCATION OF ASSISTANCE OVER THE DIFFERENT CLUSTERS AND VILLAGES (%)

Cluster	Training	Labor	Inputs	Cash	Food	Village	Training	Labor	Inputs	Cash	Food
1	0.0	0.0	0.0	0.0	0.0	Al Wathan	n.a.	n.a.	n.a.	n.a.	n.a.
2	0.0	0.0	0.0	0.0	0.0	Arraheebah	0.	0.4	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	Dhi-Shraq	0.0	0.0	0.0	0.0	0.0
4	0.4	0.8	0.0	0.0	0.0	Mu'aneet	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	Al Mehraq	0.4	0.0	0.0	0.0	0.0
6	0.0	0.4	0.0	0.0	0.0	Al Masajed	0.0	0.8	0.0	0.0	0.0

Note: Remark: not asked in Al Wathan, so that there are 250 observations used.

TABLE 18. TYPE OF ASSISTANCE RECEIVED BY THE HOUSEHOLDS FROM THE DIFFERENT INSTITUTIONS

	National authorities	Local authorities	International Donors	Seed production authority	Men's group	Women's groups	Self-help group	Unknown	Total
Training				1		1			2
Labor								1	1
Inputs	2			1					3
Cash									0
Food									0
not specified		1	8		7		1		17
Total	2	1	8	2	7	1	1	1	23

institutions that are in contact with households. However, from the interviews with the institutional stakeholders, we know there are institutions (national authorities and international donors) that are in contact with households and sometimes provide households with financial and/or technical support. Apparently, this is not seen by the households, or it is not perceived as assistance for giving people the means to improve their situation, as was mentioned in the institutional stakeholder analysis.

Household do not Get their Information from External Institutions

In the survey, households were asked where they received the information about adaptation strategies. For 73 percent of the strategies, the household used a personal source for implementing the strategy. How the personal source is exactly defined is not clear, but it is

not assistance from external institutions. Whether the more informal communal institution such as men's, women's, or self-help groups are involved is unclear. Four percent of the households talked to other farmers, and almost 3 percent used external sources. According to the stakeholders (see Appendix A4), institutions are hardly associated with support for climate change adaptation.

Household are Difficult to Reach

As follows from the survey, for external institutions, it is difficult to get into contact with households. Only 4 percent of the households claim to have had contact with an external institution with respect to adaptation strategies. Half of the assistance was realised within the community through more informal men's, women's or self help groups. In most of these cases, households could not indicate what kind of assistance was received – see Table 18.

Institutions Play A Minor Role in Preparing for Climate Change

Institutional assistance was not found to be significantly higher in Mu'aneet and Al Mehraq which are located in districts in which the World Bank-supported RALP project, focusing on community-based action, operates. This may be due to the fact that the RALP project is a rather new initiative or the fact that households included in the village survey were not familiar with it. For establishing networks of extension agencies, one of the activities of the RALP project, gaining trustworthy relationships with the village households takes time. In addition to the few 'outsiders' who provide help to the households, the respondents indicate that they receive some help or cooperation from neighbours or people from the clan group. Even though these are community institutions, the respondents apparently don't judge them to be an institution. The low institutional coverage and dependence on kinship is well known in Yemen. In rural Yemen, the role of the national government is often contested and officials are suspected, as a result of which setting up national extension services is difficult.

COSTING ADAPTATION

The survey provides evidence of the types of investments the stakeholders have to make for implementing adaptation strategies. For many strategies, households are not, or only to a limited extent, capable of choosing and implementing these themselves. Households may lack the knowledge, the skills, the labor, or the money. Figure 11 gives an overview of the investments needed to choose, and successfully implement, a strategy. The figure shows the type of resources needed by the households, the community institutions, and the governmental or nongovernmental institutions to implement a strategy.

A distinction is made between the following resources:

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

For each of the resources, Figure 11 indicates whether low, medium, or high investments are expected and what currently constrains the successful implementation of the strategy. Given the general lack of information about the costs of implementing adaptation strategies, the sensitivity to ask such information from households and the low response rate on these questions, it has not been possible to elicit reliable quantitative costing information. Reliable costing information from other sources is also almost nonexistent. Moreover, no distinction is made between assistance to be provided by governmental or by nongovernmental institutions. In principle, the same type of assistance can be provided by both types of institutions. It depends on the cultural and political situation whether governmental or nongovernmental institutions are preferable. Given the difficult political circumstances in Yemen, nongovernmental institutions may be able to reach the local population more easily than governmental institutions.

Some Modern Techniques are Necessary to be Able to Farm in Yemen

Table 16, Figure 11 and the above discussion on adaptation strategies show that it is not only the low-cost strategies that are adopted. Irrigation and terrace rehabilitation and maintenance are costly strategies for which households need sufficient money, labor, and knowledge. Irrigation and terrace rehabilitation seem to be necessary strategies for Yemen, without which farming is difficult. Terraces have been used for centuries as a well-functioning soil erosion and water management technique. Terrace maintenance has positive expected net benefits and without them, high rates of soil erosion will make farming nearly impossible.

Well irrigation is a relatively "modern" technique. Many farmers have individual wells, pumping groundwater from great depths below ground. Even though several sources stress the current unsustainable pattern of water management in Yemen (Hellegers 2008), in the short to medium term, individual irrigation systems have positive expected net benefits. Without it, farming would be difficult in many areas where dryland farming is practiced. As shown above, the better-off households and those living in the regions with better access have sufficient resources for adopting these strategies. Financial

FIGURE 11. OVERVIEW OF COSTS AND INVESTMENTS NEEDED TO IMPLEMENT ADAPTATION STRATEGIES

Strategy	Household					Community institutions					Governmental or non-governmental institutions					Constrained by
Action	M	L	T	C		M	L	T	C		M	L	T	C		
Top-6 strategies																
Use (private) irrigation																
Awareness creation																willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints for extension agencies
Install irrigation systems																constraint for commitment to assist with pump installation from community members and high financial needs by the household or formal institutions
Operate irrigation systems																constraint for financial needs (e.g. for pumps) and technical and managerial skills; high commitment needed to sustain operation
Maintain irrigation systems																constraint for financial needs (e.g. for pumps) and technical and managerial skills; high commitment needed to sustain operation
Adapt fertilizer/pesticide application																
Awareness creation																willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints for extension agencies
Implementation																credit constraints for farmers
Improve or rehabilitate terraces: rehabilitate existing or create new terraces along slopes of hills																
Awareness creation																willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints for extension agencies
Implementation																constraint for materials (and maybe labour) for party financing construction
Maintenance																constraint for materials and credit for party financing maintenance
Temporal migration																
Implementation																Adequate labour availability within the household that can be spared for migration and off-farm labour
Crop Selection: select more drought resistant crop types																
Awareness creation																willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints for extension agencies
Purchase and application																credit constraints for farmers
Use communal irrigation: installation and management of communal irrigation systems																
Awareness creation																willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints for extension agencies
Install irrigation systems																constraint for commitment from community, high labour input by households and high financial needs by extension agencies of NGO's
Operate irrigation systems																constraint for financial needs (e.g. for pumps) and managerial skills; high commitment needed to sustain operation
Maintain irrigation systems																constraint for financial needs (e.g. for pumps) and managerial skills; high commitment needed to sustain operation
Other relevant strategies																
Water harvesting techniques: installation of individual water harvesting equipment (e.g. tanks, small ponds)																
Awareness creation																willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints for extension agencies
Installation of water harvesting equipment																credit or financial constraints, depending on who finances equipment; labour constraints for farmers; managerial constraints for (NGO's)
Operation and maintenance of equipment																labour and knowledge constraints for farmers; commitment needed to sustain operation
Home garden agriculture: promote vegetable and fruit cultivation on home gardens																
Awareness creation																willingness and ability to set up suitable training activities by extension agencies or NGO's; budgetary and managerial constraints for extension agencies
Apply home garden agriculture																credit and labour constraints during some months for the farmers

constraints, which are an impediment for individual irrigation in many countries, may be less of a problem in some regions in Yemen because of the prevalence of cash crop production. This may explain why they need less institutional assistance for choosing such a strategy. The strong clan relationships may serve as a substitute for the training and assistance which in other countries are often provided by formal institutions. This strong clan relationship may also be a reason why terraces can be maintained without much outside assistance. Moreover, because terraces have been constructed and used for centuries, communities may have sufficient knowledge on how to construct them.

Low Cost, Sensitivity Reducing Strategies are Adopted

In addition to the above-mentioned strategies, a number of low-cost strategies are also adopted. Sensitivity-reducing agricultural strategies like crop selection and adoption of fertilizer and pesticide application have positive net benefits. For these strategies, little institutional assistance is required. Training, however, may improve efficiency of the farming systems, which may increase yields. As the results indicate that many households have not adopted any strategy, not even the low-cost strategies, institutions may assist these households in overcoming the constraints preventing them from adopting these strategies. These households currently are difficult to reach. The long-term presence of institutions and trustworthy relationships with these marginalized households are necessary to persuade households to adopt more innovative strategies. Moreover, institutions can play a role in mitigating some of the constraints, like poorly functioning markets, which constrain the purchase of inputs (see below).

Other low-cost strategies, such as handicrafts, charcoal sales, or non-timber forest product commercialization are selected by only a few households. Crop diversification (cultivation of fruits and vegetables) is applied already by many households and therefore not seen as an income diversification technique. There may be several reasons why expected benefits of some of these low-cost strategies turn out to be negative: (a) markets for these goods may be too thin or poorly functioning; (b) inputs may be difficult to acquire if markets are missing or villages difficult to reach; and

(c) households may lack the knowledge to implement the strategies.

Alternatively, households may not perceive the focus on coping capacities as being useful in reducing their vulnerability even if net benefits are positive. For most people, agriculture has been the main income source for decades and only migration has become a common strategy to diversify income. It is not evident that people easily initiate new income earning activities, especially if there is not an enabling environment for such activities and if education levels are low. Again, an important role in the adoption of these strategies is apparent for both formal and informal institutions. They can provide training, raise awareness, and promote good practices.

More Demanding Strategies Require Informal and Formal Assistance

Besides irrigation and terrace rehabilitation, in Yemen households seldom adopt communal and more demanding strategies because only a few formal institutions provide the support to initiate those more demanding communal strategies. Examples are water harvesting and cereal banks. Many of these strategies have positive expected net benefits but face financing constraints and require higher skills. Their adoption also introduces new risks, so expected returns on investment may turn out to be negative, which according to IFPRI (2010) is an important determinant for choosing strategies. It is interesting to see that the adoption of communal strategies does not seem to be hindered by a lack of cooperation between households from the community. Even though reported differently in the survey (probably due to a misinterpretation of the question), the strong clan links make it easier to mobilize households and assist neighbors or initiate joint activities. It is difficult to say whether the more demanding strategies can also be initiated with the help from these more informal institutional links or whether higher managerial skills are necessary for this. A difficulty with more communal strategies, from which all community members benefit, may be commitment among the participants. Especially if formal institutions that assist the households do not have long-term and trustworthy relationships with them, it may be difficult to implement such strategies.

Assistance from Formal and Informal Institutions May Relieve Adoption Constraints

From the above, three conclusions can be drawn. First, low-cost individual strategies, having low requirements for labor and skills, are already adopted even though many households haven't adopted any strategy. Formal institutions play a role in reaching these marginalized groups. Second, irrigation and terrace maintenance seem to be strategies without which farming would be difficult in Yemen. Many farmers have succeeded in implementing them even though the worse-off farmers have not. This puts them in a downward spiral with the risk that they become more marginalized in the future. The more

wealthy household types, usually having more cash income, more assets, more cash crop cultivation, and more diversified income sources, can adopt the more expensive strategies that reduce their sensitivity or increase their coping capacity. Better educated households, having a larger share of household members who attended at least primary education, are better able to choose the strategies that best fit their livelihoods. Intervention from formal and informal institutions may lessen some of these constraints. Thirdly, implementation of communal strategies requires back-up from formal and informal institutions. The informal, clan-based institutions seem to be relatively well-functioning, but their cooperation with more formal institutions could be improved.

5. CONCLUSIONS AND POLICY IMPLICATIONS

MAIN FINDINGS

As discussed above, the objectives of the CALI-study are (1) to identify the costs of adaptation through local institutions, and (2) to investigate which institutions support households to adapt to climate variability and which efforts and costs have to be made in order to realize the adaptation strategies. In this report, the results of the village studies—consisting of household interviews, stakeholder interviews, and focus group discussions—were presented. Vulnerability profiles were developed based on the exposure of households to climate variability, their sensitivity to climate variability, and their coping capacity to deal with it. These profiles show that household vulnerability differs substantially between and within villages. Household acreage, TLUs, diversity of income, and the ability to decide on alternative measures to mitigate adverse climate effects (which depends on factors such as level of education and dependency ratio) have effects on the adaptation options households adopt. The main conclusions from the field survey and data analysis are the following.³

³ It is stressed that for this study, surveys took place in six sites in Yemen. For that reason, the conclusions are not necessarily representative of the entire country and generalizing the main results and policy recommendations to other regions with different agroclimatological and socioeconomic characteristics should be done with care.

Households are Large Families

For all the studied sites, households have about eight to ten members. In general, men have reasonable access to formal education (schools are present in all villages). Women have substantially less access to education. Despite significant gender differences in education of adults, there are limited gender differences of boys and girls. Gender differences in education could be lower in the future as the schooling of girls has been increasing.

Agriculture is the Main Household Activity

Agriculture is the main source of income for almost all households that were interviewed. Cereals are the main crops grown in all villages, and in some villages (Al Wathan, Arraheebah, and Magahem Asha'abi Dhi-Shraq) substantial amounts of cash crops are also grown (either qat or vegetables and fruits). Cultivated land ranges from 0.2 to 2.4 ha per household. Livestock are present in all villages, although the number of households that actually have livestock is usually rather limited. Overall, livestock holdings per household have decreased significantly by more than 25 percent in the last year.

Another important source of income for households is temporary migration, especially in Al Wathan, where almost half of the households indicate that they have a migrated member. However, only 10 percent of the households in Arraheebah have migrated members. In Al Wathan, 40 percent of the households indicate

that they have civil servant activities as their main activity.

Highly Exposed Villages are not Necessarily the Most Vulnerable

Exposure and agroecological potential in Yemen are closely related to rainfall, which in turn is related to altitude. Arraheebah (Taiz) in the coastal plains is the most exposed. This site scores low on agroecological capacity, yet households are highly dependent on agriculture. The three study sites with an arid subtropical climate are somewhat less exposed. The two sites in the highlands with relatively high precipitation are the least exposed to climate variability. The highly exposed villages, however, are not necessarily the most vulnerable. Arraheebah (Taiz) in the coastal plains is vulnerable. They have low cash crop earnings, low income diversification, and relatively low educational levels. Due to low soil fertility, their higher landholdings do not result in high yields. The least vulnerable village seems to be the rainfed agriculture village Al Wathan in Sana'a governorate. They are highly exposed but compared to most other villages, they also have higher cash crop earnings (both from qat and fruits and vegetables), higher landholdings, more livestock, more assets, and higher education levels. Moreover, a substantial part of income is coming from civil servant activities. Their sensitivity to climate variability seems to be relatively low and their coping capacity good. Both highland villages score very differently. Al Masajed in Sana'a governorate has relatively good landholdings, income from livestock, migration, and relatively good levels of education. The highland village of Al Mehraq in Taiz governorate has lower landholdings and also a low income level, due to which they are more vulnerable. Vulnerability in the Yemeni study sites seems to be less dependent on climate exposure but more on other factors like proximity to urban areas (like Sana'a) with potential alternative income sources. These income sources could make sites less vulnerable.

Other Hazards also have Impacts on Climate Change Adaptation

In almost all villages, the increased occurrence of human and animal diseases was mentioned frequently during the focus group discussions. In addition, water collection is taking more time (one of the reasons why girls are

dropping out of school), and water is bought at higher prices. As a result of diseases and lack of water, households devote great effort and spending on medicines and water. In order to be able to do so, animals and personal jewelry were sold to buy medicine or water. This development has also consequences for the implementation of adaptation strategies. Households simply lack the financial means to apply adaptation strategies, and particularly the more expensive ones, such as irrigation.

Differences Between Household Types are Large

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

1. *Diversified, wealthy farmers with livestock* who are better educated, own large herds of cattle, and produce cereals and cash crops (qat).
2. *Highland smallholders* in the southern highlands that mainly produce grains, have relatively low landholdings, and moderate asset ownership.
3. *Diversified households* with a high share of females and low dependency ratio, rich in landholdings, producing herbs and legumes, and a high share of migration.
4. *Highly educated cash-crop growing farmers* with a high dependency ratio, small landholdings, relatively many assets, and producing cereals and cash crops (qat).
5. *Fruit and vegetables farmers* producing cereals, vegetable, and fruits, with some livestock, a relatively high dependency ratio, and relatively low levels of education.
6. *Dryland farmers with large landholdings*, producing cereals but no cash crops, low in education, owning only a few animals, and having a high dependency ratio.

The cluster analysis shows that the levels of vulnerability of the clusters vary and they are not equally distributed across the villages:

- The “diversified, wealthy livestock farmers” (cluster 1) and the “highland smallholders” (cluster 2) account for two-thirds of the respondents in the survey.
- The “diversified, wealthy livestock farmers” (cluster 1) are the least vulnerable. They are present in

all six villages, although households of Al Wathan (Sana'a) are most frequently from this cluster. Note that Al Wathan was also the least vulnerable village.

- The “highland smallholders” are most vulnerable. About half of them live in Magahem Asha’abi Dhi-Shraq (Ibb) and Al Mehraq (Taiz). Compared to the other households present in these villages, they score much lower on all characteristics, which is a sign that households in villages are divided in more and less vulnerable households.
- Most households in the dryland village of Arraheebah in Taiz are from the “fruit and vegetable farmers” and “dryland farmers” (cluster 5 and 6). They are in a vulnerable situation. The fruit and vegetable farmers are somewhat better off as they have a higher and more diversified income. Both household types, however, have low education levels, which gives them a low capability of improving their livelihoods themselves.
- The situation of the “highly educated cash-crop growing farmers” (cluster 4) is difficult to assess. Their low dependency ratio and high levels of education and assets indicate they are more capable of deciding about adaptation themselves. Low landholdings and limited income diversification, however, put them in a vulnerable situation.

Only a Few Strategies are Used

In Yemen only a few adaptation strategies are used (1.7 on average). About 40 percent of the households in the survey did not adopt any of the strategies listed in the questionnaire. Al Wathan has adopted 3.5 strategies on average, whereas Al Merhaq only adopted 0.7 strategies on average per household. Among the villages, the percentage of households that responded that they have not adopted any strategy also varies significantly. The top six most important climate adaptation strategies mentioned were:

1. Use irrigation (26 percent)
2. Adapt fertilizer/pesticide application (22 percent)
3. Improve, construct, or rehabilitate terraces (18 percent)
4. Temporary migration to urban areas or abroad (15 percent)
5. Crop selection (14 percent)
6. Communal irrigation (12 percent)

Three of the top six strategies require cooperation with neighbors or other households from the village. Some strategies are adopted in only one or two sites and many households have not adopted any strategy.

Adaptation Strategies Differ Across Farming Systems

Households in rainfed areas (Al Wathan, Magahem Asha’abi Dhi-Shraq, and Muáneet) have the highest average of adaptation strategies. Dryland households put most of their efforts into agricultural and water management strategies because they have been dealing with scarce water resources for a long time; income diversification strategies are hardly used. In the highlands, households use a mix of adaptation strategies. The average number of strategies is low.

Strategies Mostly Aim at Sensitivity Reduction

Most strategies aim at sensitivity reduction to climate variability through irrigation, fertilizer/pesticide application or the improvement, construction, or rehabilitation of terraces. The only strategy focusing on coping capacity is through temporary or permanent migration. Differences among villages are remarkable. In the vulnerable villages of Al Mehraq and Arraheebah in Taiz governorate, only a few households adopt some strategies. The highland village focused on migration and prevention of soil erosion (terracing and reforestation), whereas Arraheebah in the dryland area focused on irrigation and adapting farming practices. For the sites participating in the Rainfed Agriculture and Livestock Project (RALP), no significant differences in strategy adoption were observed. A possible explanation could be that the project is relatively new. Terrace rehabilitation and reforestation are important for them as well as the use of water harvesting measures, but not much higher than in the other sites. In the more vulnerable sites in Taiz, less households adopt communal strategies than in the other villages.

Coping Capacity Improvement Strategies are Hardly Applied

For all villages, coping capacity strategies are restricted to migration to urban areas or abroad. Other possible strategies, like migration to other rural

areas, home-garden agriculture, increased market sales, or handicrafts are hardly used. However, the cultivation of fruits and vegetables is already applied in some sites (Al Wathan and Arraheebah).

Female-Dominated Households Apply More Strategies

Thirteen percent of households are dominated by females; that is, the share of female adults is equal to or more than 66.6 percent. On average, households with a dominating number of female adults apply more adaptation strategies (2.3) than other households (1.7). More than 70 percent of the female-dominated households and 62 percent of the other households apply at least one adaptation strategy. There is no difference in the top-five most adopted strategies. Female-dominated households tend to use sensitivity reducing measures more often than coping strategies. Because the number of female-dominated households is rather low, it is not feasible to distinguish the gender issue at the level of individual villages.

Institutions Play a Minor Role in Preparing for Climate Change

In the study villages, institutions play only a minor role in the adoption of adaptation strategies by households. In general, there is very limited contact between households and institutions. Only 7 percent of the households have had contact with institutions. About half of these households judge these contacts as being useful in the adoption of adaptation strategies. Extension agencies are the institution mentioned most frequently. Furthermore, national authorities, regional authorities, local authorities, and seed production authorities are contacted for assistance, but only by a few households. Surprisingly, for the sites in the RALP districts, institutional assistance is not noticeably higher than in the other villages. This may be due to the fact that the RALP project is a rather new initiative, or the fact that households included in the village survey were not familiar with it. Setting up networks of extension agencies, as done in the RALP project, and gaining trustworthy relationships with the village households takes time. In addition, RALP also sets up cooperatives to improve the access to local markets. Next to the few “outsiders” who provided

help to the households, the respondents indicate that they receive some help or cooperation from neighbors or people from the clan group. Even though these are community institutions, the respondents apparently do not judge them to be an institution. Low institutional coverage and dependence on kinship relations is well known in Yemen. In rural Yemen, the role of the national government is often contested and officials lack trust within the communities, so setting up national extension services is difficult.

Institutions Hardly Provide any Assistance

Most of the adaptation strategies adopted by households were financed and realized by the households themselves using their own resources. Even if institutions are present, they are not associated with assistance for climate change adaptation, according to the stakeholder analysis. Formal institutions hardly provided any assistance in terms of training, inputs, or cash. Only people from the community helped each other through the provision of labor for rehabilitating terraces and setting up irrigation or water management measures. The low number of strategies adopted may partly be explained by this low institutional coverage. Households especially adopt strategies they have known for decades and adopt only a few modern strategies. For adopting more innovative strategies, households may lack the knowledge to judge their expected net benefits. Households often lack the knowledge, awareness, and financial means to adopt such strategies. Moreover, it often is difficult to adopt them due to poorly functioning markets. Because of the virtual absence of formal institutions, reducing market problems is difficult.

POLICY RECOMMENDATIONS

More Emphasis on Coping Strategies

There is little attention to strategies for coping with external stress, such as improving education or diversifying income. This is particularly the case for the sites that are most exposed to climate change hazards (Arraheebah in the drylands). Except for migration, many of the income diversification options are constrained by institutional, market, and financial factors.

Improve Water Resource Management

Although the emphasis of Yemeni farmers is already more on sensitivity reducing strategies such as irrigation and water harvesting techniques, there is still a need to expand the implementation of those strategies in order to improve water resource management. Groundwater levels are going down rapidly. In order to stop this development, water resource management should be improved. Adaptation of more water management strategies should be advocated.

Financial Burden of Yemeni Households

With respect to the promotion of applying more adaptation strategies, financial constraints for Yemeni farmers are pressing for two reasons. On the one hand, households spend their money on medicines to treat diseases among family members and on water collection with high prices. On the other hand, the costs of water resource management strategies such as irrigation are extremely high for Yemeni citizens. Promoting financial assistance such as micro-finance could help farmers improve their water resource management and secure crop growing seasons. This will require a more explicit role for institutions and micro-finance organizations.

Increase Ownership to Implement Community Strategies

Communal actions seem to be difficult to initiate. Yemeni farmers seem to focus on applying strategies on their own. Provided the transaction costs of collective action can be overcome, communal strategies could be less costly (per farmer) and can help farmers to adopt strategies themselves. These actions need investments and training from external institutions, which are virtually absent in many regions. Moreover, in order to create

a sense of urgency and a feeling of ownership from the side of the households, relationships between external institutions and the community (clan) should be good. This requires the long-term presence of these institutions. Investments in training and an emphasis on creating adequate ownership by the households could be beneficial to implement these strategies. This can be facilitated by institutions taking into account the clan and neighborhood orientation.

Institutions Should Put More Emphasis on Climate Change Adaptation Strategies

According to stakeholders, there are institutions present in most villages. However, the assistance of those institutions is not associated with climate change adaptation by households, according to the stakeholders. In the sites selected for the RALP project, a minor share of stakeholders mention that extension agents are present, but the respondents in the survey hardly mentioned any assistance from them. This would be a first step toward the use of institutions for adaptation strategies and an opportunity to extend the services of institutions for adaptation strategies as well.

Continuation of Community-Based Initiatives Such as the RALP Project

In the study, the villages in the RALP districts do not show noticeably better results than the other villages, which could possibly be explained by the fact that the project is relatively new. However, in terms of institutions and networks, the RALP project shows progress in the institutional presence (e.g. extension agencies) and the creation of networks for market access (e.g. cooperatives). It is an interesting project that could be also be used to facilitate training for innovative adaptation strategies and built an enabling environment (e.g. market access) in the process of reducing household vulnerability.

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APPENDIX 1. METHODOLOGY AND RESEARCH FRAMEWORK

A1.A. METHODOLOGY AND COSTING FRAMEWORK

The study set out to answer the following research questions:

- Which adaptation strategies have been adopted in the past?
- For which hazards have these strategies been adopted and to what extent are the adaptations related to climate variability hazards rather than other hazards?
- Which inputs in terms of cash, materials, information, or labor were required in order to adapt to the changed circumstances?
- Which household and livelihood characteristics explain why certain households adopt particular strategies?
- Which formal or informal institutions are most relevant for assisting or stimulating households to adopt certain strategies?

The study was conducted in Yemen with a reasonable representation of major agroecological regions. Both primary and secondary data were collected for the analysis. The primary data were collected through a household questionnaire, focus group discussions, and institutional stakeholder interviews. The household

questionnaires aim at obtaining information on (1) household composition, (2) demographic characteristics, (3) resource endowments, (4) perceived climate hazards, (5) adaptation strategies, (6) institutional contacts, and (7) costs associated with the strategies. The focus group discussion aims at obtaining hands-on and detailed information on (1) concepts, perceptions, ideas of a group on perceived climate related hazards and their effect on livelihoods of the different social groups, (2) the adaptation strategies, (3) the type of institutional support obtained to deal with climate related hazards and (4) the costs associated with the adaptation strategies. Institutional stakeholder interviews focus on (1) the types of services provided by the various institutions, (2) their role in assisting households with adaptation, (3) their linkages with authorities, and (4) the costs used for performing their tasks as well as identifying their constraints.

The household data were analyzed to explore whether clusters of households, livelihood or vulnerability profiles can be distinguished in order to see the linkages between adaptations, and clusters. Furthermore, a costing framework was set up (see below) to identify important cost elements of the different adaptation strategies. The use of a combination of household questionnaire, focus group discussions, and institutional stakeholder/expert interviews helps to increase the reliability of data by increasing the tools for triangulation, among other things. Moreover, data on some of the questions involving community activities were verified in focus group discussions. Finally, the results were cross-checked with experts working in related areas. We are aware of the limitation

of the number of research villages for representation and wider generalization. However, the issue of representation cannot be addressed by just increasing the number of regions by one or the number of villages within the regions. This would only reduce the errors. Rather, the

study represents a case study of the selected regions and the results should be interpreted in that light.

The questionnaire was pre-tested to judge if it is comprehensible to the average respondent.

COSTING FRAMEWORK

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

Improve, construct or rehabilitate terraces	materials needed for terrace construction and renovation	labor time for construction, maintenance and rehabilitation	training on farming on terraces	land for terraces	labor time for construction, maintenance and rehabilitation	materials needed for terrace construction and renovation	training on terrace construction and maintenance and on farming on terraces
Use irrigation	materials for construction and maintenance of irrigation systems; costs for water; costs for pumping	labor for construction of irrigation systems; time for communal water management	training on the use of irrigation facilities and water management	land for irrigation canals and systems	labor for construction of irrigation systems; set up of water user association or a comparable organization	materials needed for set up of irrigation systems; legal documents for organizing water user associations	training on setting up and maintaining irrigation; training on communal water management
Reuse treated wastewater	systems to redistribute water from waste water facility to plots	labor for managing waste water treatment and for applying treated waste water		set up of wastewater storage and treatment facility	labor to set up, maintain and manage wastewater treatment facility; training on wastewater treatment and management	materials for wastewater storage and treatment facility	training on wastewater treatment facilities and management
Improve watering sites in pastoral areas		labor for well and pond construction		land for ponds; materials for designing, constructing and maintaining ponds	labor for pond construction; set up of water user association	materials for designing, constructing and maintaining ponds	determination of optimal location and design of ponds; assistance with water user association
Diversification							
Use alternative sources for fuel wood.	costs for new cooking facilities and fuel		training on alternative cooking facilities.			new cooking facilities and fuels	capacity building on cooking, fuelwood problems, etc.
Temporary migration to urban areas or abroad	investments in transport costs and living expenditures	reduced on-farm labor availability during off-season		dependence of those staying at home on neighbors			awareness raising on (dis) advantages of migration

(continued next page)

COSTING FRAMEWORK

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

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

A1.B. HOUSEHOLD QUESTIONNAIRE

Rationale of the Questionnaire

Compared to the household questionnaire as presented in the inception report, the questionnaire as used in the villages contains a number of changes. The changes were made in response to comments received during the three launching workshops, lessons learned from the missions to the three project countries, observations from the members of the project team, and lessons learned during the pilot interviews.

The objective of the household questionnaire was to learn about the following issues (in order of importance):

- Which adaptation strategies do rural households adopt? Which climate-related hazards explain why households choose these strategies?
- What are the costs the households have to make when they adopt a particular strategy?
- Which institutions are most helpful to assist the households adopting particular adaptation strategies?
- Are there differences in the adaptation strategies adopted by particular household types or wealth classes; which livelihood characteristics best explain which strategies are adopted?

In order to reach these objectives, information was collected on four issues:

1. Factors explaining livelihood type and wealth class: this contains information on e.g. primary activity (e.g. farming type), household characteristics (size of household, level of education, ...), assets owned, land cultivated, crops cultivated, livestock owned, and access to financial resources.
2. Information on perceptions regarding climate related hazards.
3. Information on the adaptation strategies adopted and the costs made to apply the strategies in terms of money, time and in-kind inputs.
4. Information on the institutions with whom households have contacts.

Compared with the household questionnaire in the inception report, the order of some questions was changed, questions 2 through 6 have changed and some

of the costing elements asked for and the way they are asked for have changed. The main reason for simplifying and shortening the questions 2 through 6 is that for the purpose of this study, it is not necessary to obtain detailed information on individual household member characteristics and household activities. For example, it is not necessary to know:

- for each household member how many years of education they have;
- what is the exact relation between land cultivated, yields and sales;
- the exact number of each possible type of livestock owned and the exact sales of animals;
- the exact catch and sales of fish.

In these questions we ask for information in such a level of detail that it allows us to define different types of households and livelihoods and to be able to analyze which characteristics explain the choice of a particular strategy. More detailed information on the above issues is interesting and relevant for farming systems studies or household analyses. For the purpose of our study, however, this information is not necessary and would distract us from the main objective. Moreover, much of the information that is not asked for (e.g. on the amount harvested and the number of animals owned) is sensitive information for which it can be wondered whether reliable answers will be given. Furthermore, in the questionnaire, a number of additional questions were raised in order to obtain gender specific information on adaptation. Below, the questions are discussed in order.

1. The first question is necessary in order to obtain general information about the respondent and the type of household the respondent is representing. An important determinant of the adaptation strategies adopted will be the main activity of the household. For that reason, the respondent is asked to rank using a participatory approach (using cards indicating the possible occupations, if possible using pictures) the importance of the different activities for their household. For small households, it is possible that they are only involved in one or two activities. Larger households and especially extended families are probably involved in multiple activities. Here, it is also asked whether the activity is performed especially by the men or women in the

household, in order to learn more about the gender issues.

2. In the second question, we ask for information about household composition and household characteristics. The way this question is asked may differ per country. In principle, it is preferable and easier for the interviewer to ask each individual member about their age, years of education and relation to the household head. However, for example for Yemen, it may be preferable to ask for more aggregate information for two reasons. First, Yemen extended families may have a too large number of household members, making this question too time consuming. The country teams have the choice to ask one of the two questions, as long as all household within one country receive the same question. The question also contains a sub-question on migration. This is for double-checking the adoption of the adaptation strategy to permanently or temporarily migrate.
3. The third question elicits information about land and crops cultivated. In the draft version of the questionnaire, we also asked for information about the amount harvested and the amount sold. Moreover, it was proposed by some people to add questions about the date since when particular crops are cultivated and on whether cultivation of particular crop has increased or decreased. This last question would give information about the effect of changing climate characteristics on crops cultivated. We decided not to add this question as it is already part of question 8. Moreover, it is difficult for respondents to indicate how much of each crop was harvested and how much was sold. Moreover, this level of detail is not necessary. In order to know more about household type and wealth class, it is sufficient to know how much land is cultivated with the different types of crops and whether or not they sold part of their harvest on the market. The size of the land cultivated with particular crops tells us which type of farming system we are dealing with (small-middle-large farm, subsistence-mixed-cash crop oriented farm). The yes-no question on sales tells us whether households take part in the money economy. We also ask information about ownership status of land to see whether land ownership has an effect on the adaptation strategies adopted. For countries for which it is sure that the entire household budget is managed by the men, this question can be deleted.
4. The fourth question only applies for households owning livestock. Livestock is an important savings source for many households. For pastoralists, it is their primary source of income. Different from the draft version, we do not ask for detailed information on the amount of animals owned and sold for a large number of possible types of animals. The main reason for this is that people are usually not willing to give exact insights in the number of animals owned and sold. Moreover, in order to learn more about the wealth class of the household, it is sufficient to have information in a more aggregate manner. For that reason, we ask for information per livestock category: breeding cattle, dairy cattle, traction animals (oxen, mule, horse), small ruminants (goats/sheep) and poultry. Moreover, we ask about the number of animals currently owned and the number owned 12 months ago. This gives information on changes in wealth class. This information is also meant to double check some of the questions related to the adaptation options, to indicate whether wealth has increased or decreased and to indicate whether households are participating in the money economy.
5. The fifth question only applies for households engaged in fishing activities. We ask which types of fish are caught and whether they sold fresh or produced fish. Like in the previous question, we do not ask for the amount of fish caught because it is too difficult to answer such a question.
6. The sixth question deals with asset ownership. The types of assets owned are an important determinant of wealth class. The more or more luxury assets owned, the wealthier the household will be. It is expected that wealth class partly explains the types of adaptation strategies adopted. In the analysis, we distinguish four types of assets: basic necessary assets (especially equipment), basic non-essential assets (like radio, jewellery, bicycle/moped, ...), luxury assets (like a cell phone, gas/petrol stove, refrigerator), and top-level assets (including a television, car, and house built of bricks). For the basic necessary and non-essential assets, also the number of assets owned is asked for. For the other types of assets it is asked when they are purchased in order to learn more about changes in wealth class.

7. The seventh question deals with the hazards households experience and their perceptions on the importance of these hazards. First, it is asked which climate related hazards they have experienced in the past and when they experienced them. In a narrative manner, the respondent is asked in what period the hazard was experienced and whether they can recall any major climate related events that have taken place in the last 30 years and that have caused substantial changes in livelihoods. Based on that, it is attempted to link it to a particular year. Next to that, it is asked whether the households have any specific difficult periods throughout the year in order to learn more about the vulnerability of the household. It is also asked to what extent these hazards affected their activities and who is affected the most. Thirdly, it is asked which hazards are considered most threatening and whether they have changed. Using a participatory approach (by ordering cards with possible hazards) it is elicited how households perceive the importance of climate and non-climate related hazards. Here, it is also asked whether the hazards especially affect men or women, in order to learn more about gender differences in hazard perception.
8. In Question 8 more information is elicited about the types of institutions households have contacts with. Moreover, it is attempted to link the reason for contacting a particular institution with the hazards they are facing (as asked for in question 7). This learns us whether particular institutions have a certain focus on particular climate hazards. If they are not related to any climate hazard, this is also indicated.
9. Question 8 is one of the most important questions of the questionnaire. Compared to the draft version, we have slightly changed the order and types of questions. We first ask for the types of adaptation options they have adopted, whether they are adopted by the men or women in the household, and why (which hazard is reduced). Secondly, for those options adopted, we ask for detailed information about the costs. We distinguish between monetary costs, time input and in-kind input that were not purchased. In the draft questionnaire, a participatory approach was proposed to ask for the monetary costs. The rationale for this was that it was thought to be difficult to memorize the costs made for a particular option. We decided to change this approach

based on discussions with several people. For households who are only partially integrated in the monetary economy, it can be expected that if they actually have to spend money for adopting a strategy, they know the amount. Next, for the time and money spent on the strategy, it is asked who has to make the expenses: men-women, individual-communal-external. This gives information on the gender perspective of adaptation and the importance of communal and external aid to adopt particular strategies. For the in-kind inputs, it is asked what type and how much of each input is used. In the data analysis phase, it will be attempted to monetize these inputs in order to learn more about the implicit costs of the options. Thirdly, it is also asked what type of benefit is envisaged if an option is chosen. We distinguish between earning additional cash income, reducing risk and increasing non-cash income. Fourthly, it is asked whether the household received help from institutions. This question is important in order to be better able to target assistance to institutions. It shows which entry points are important and what type of help the institutions need.

In the first village in which the questionnaire is used, it is evaluated whether the questionnaire works as expected. If some questions are too difficult or are misinterpreted, they will be reformulated. It is attempted to keep these reformulations as small as possible, such that only the formulation changes but not the rationale and its position with the questionnaire.

Notes on How to Conduct the Questionnaire

These notes give tips about how to ask for some of the questions when conducting the questionnaire.

Question 1:

- Not all questions have to be asked to the respondent. Village name and code, household code and sex of the respondent can be filled in without asking it to the respondent.
- i. Rank occupations of the household in order of importance: Use the cards as given at the end of the questionnaire and ask the respondent to lay them down in such a way that the most important

occupation of the household is put on the left side and the least important occupation on the right side. Activities not performed can be put on a separate pile. Once the options are ranked, ask whether the activities are especially performed by men or by women. An alternative way of ranking is to give the respondent 15 stones and ask them to put stones on the cards indicating how important they are. The interviewer has to write down the number of stones put on each card. Make sure that for all villages within one country the same approach is adopted.

Question 2:

First, the country team has to choose whether option 1 or option 2 is chosen. In case of option 1 aggregate information will be asked for on household composition. In option 2, questions will have to be asked for per household member.

- a. within each cell, fill in the number of men or women within a certain age class. Ask the respondent how many boys/girls under the age of 15 live in the household, how many men/women in between 15 and 30 live in the household, etc. Permanently migrated people must not be included. Temporarily migrated members should only be included if they live in the household at the time of the interview.
- b. first ask whether household members have temporarily migrated to another village, city or abroad in the last 12 months; secondly ask for the age of the migrated household members. In the cells, fill in the number of people of a certain age class who have temporarily migrated.
- c. first ask whether household members have permanently migrated from the village. If people have migrated, then ask the age and sex of the people migrated. In the cells, fill in the number of people of a certain age class of have permanently migrated.
- d. ask how many boys/girls/men/women have had education in one of the indicated classes. In the cells, fill in the number of household members who were in school for a particular number of years.

Question 3:

- a. first ask which crops the household cultivated in the last 12 months. Fill in the names of the crops in

column a. When the questionnaires are finished, the interviewer has to fill in the crop codes in the first column of the table.

- b. Ask for each crop how much land was cultivated with that crop. In the cells, fill in the amount of land cultivated in the last 12 months. Make sure that for all households within a village the same unit of measurement is used.
- c. ask for each crop whether the household sold a part of its stock on the market in the last 12 months. Tick yes or no. If a crop is sold, ask whether the earnings from the sales are managed by the men or the women. If the household budget is managed by both equally, tick both M and W. If it is sure that the entire budget is managed by the men (e.g. in Yemen), this question can be deleted.
- d. ask for how much land the household has ownership rights or permanent or long-term use rights. Use the same unit of measurement as in question b.
- e. ask how much land was rented or sharecropped in. Land sharecropped in is land cultivated by the household that is owned by another household.

Question 4:

- a. First ask whether the household owns livestock. If the answer is no, look around to see whether indeed there are no signs that not even poultry is owned. If the household indeed does not own any livestock, move to question 5.
- b. for the types of livestock indicated in the first column of the table, ask whether the number of animals owned is in one of the classes indicated. Tick the cell indicating the number of animals they own. Check whether the answer given is plausible. If a large number of animals are observed close to the dwelling, ask more questions about who owns these animals. The distinction made between cattle and dairy cattle refers to livestock owned especially for purpose of meat or reproduction or for the purpose of milk production and sales.
- c. similarly to question 4b, ask how much livestock was owned 12 months ago.

Question 5:

- a. first ask whether the household engages in fishing activities. Tick the correct answer. Secondly, if they

engage in fishing activities, ask whether they do it individually or as a member of a fishing group. If the answer to the first question is no, move to question 6.

- b. indicate the type of fish people catch. When the questionnaire is finished, the interviewer has to fill in the fish codes in the first column of the table.
- c. ask whether the household sells any freshly caught fish during the last 12 months. Tick the correct answer.
- d. ask whether the household has sold any processed fish. Processed fish is cleaned, smoked or dried. Tick the correct answer.

Question 6:

- in the table a list is given of possible assets households can own. For the first list of assets it has to be asked whether they own these assets. Tick yes or no. If they own them, ask for the number of the asset they own.
- For the second list of assets, it has to be asked whether they own the asset. Tick yes or no. If they own the asset, ask when they purchased the asset.

Question 7:

- a. For the five hazards indicated in the first table of question 7, ask whether people experienced in their lifetime periods of more than one year that can be characterized as
 1. being more unfavourable than normal years with lower amounts of rainfall than normal during the rainy season, leading to droughts, and which they remember as being distinctly different from other periods;
 2. being more unfavourable than normal years with more irregular rainfall, e.g. because it was dry for a long time after the first rains or because the first rains started later or because there were too long periods without rain during the farming season, leading to droughts and reduced yields;
 3. being more unfavourable than normal years because it had periods of excessive rainfall due to which fields flooded;
 4. being more unfavourable than normal years because it knew excessive showers leading to damage to crops, livestock or property (e.g. destroyed roofs);

5. being unfavourable than normal years with higher than average temperatures which combined with long periods without rainfall resulted in scorched crops.

- b. If they experienced one of the hazard described above, ask when the period took place. If they don't know the year ask for events that have taken place in that period that can be traced back to a year(s).
- c. Ask whether people can recall whether there are any periods in the past 30 years, that can be characterized by major droughts, major floods or major shifts in rainfall pattern and that have caused substantial changes in the way people make a living.
- d. Ask people to describe in their own words the major weather related hazard they are facing in their daily activities. Is it related to the amount of rainfall, the variability (spread of showers over the rainy period), the temperature,....
- e. Ask the respondent whether in the last 12 months they had a period in which they experienced problems to sufficiently feed all household members. Also ask the months in which they experience these problems.
- f. for the hazards for which the respondent indicated that they have experienced it, ask how it affected
 1. crop production (were yields less??) –
 2. area cultivated (did they cultivate less fields??) –
 3. livestock owned (did animals die or did they sell animals??) –
 4. fish landed (did it affect catch) –
 5. assets owned (were assets sold to get cash??) –
 6. cash income (did they own less cash??)
- g. ask whether the effect had a larger effect on the men or the women of the household, or whether there is no difference.
- h. For the 10 hazards given in the table (and on cards) ask the respondent to order the cards in such a way that the most important hazard is put on the left side and the least important on the right side. Hazards that are not at all deemed to be important can be put on a separate pile and scored 0.
- i. ask the respondent whether the hazards indicated in the table have become more or less threatening than in the past. Compared to the past, do they affect production, income and consumption more than in the past?

Question 8:

- a. Ask with which organizations listed in the table the household holds contacts with

- b. If they have contacts with the organizations, ask how often they have contacts with the organizations.
- c. If they have contacts with the organizations, ask for how long they are in contact with the organization.
- d. The interviewer has to check whether the moment since when they are in touch with an organization is related to any of the climate events as listed in question 7.
- e. ask whether the assistance given by the organizations is useful to reduce the weather related hazards as discussed in question 7.

Question 9:

- This question is the most important question of the questionnaire. It is important to get a full overview of the strategies people have adopted to reduce the effects of the different hazards asked for in the previous question.
 - a/b. For the different strategies listed ask whether people have made these changes in their activities in order to reduce their dependence on weather. If they adopted a strategy ask whether the decision to adopt the strategy was made by one of the men or women in the household. Moreover, in that case ask which of the hazards listed in question 7 was the main reason for changing their activities. If none of these hazards was the reason, give the score 6.
 - c. fill in the strategies asked for in question a were adopted to reduce any of the climate related hazards.
 - d. in this question, we have to ask which investments had to be made for adopting the strategy. This refers to cash expenditures that had to be made, time needed to make the change and in-kind inputs that were needed. Moreover, it is asked whether the time spent or cash expenditures made are done by men, by women, by the community or by external organizations.
1. ask whether in first year after adopting the strategy, adoption cost them more time compared to their normal activities and how much time (days).
 - For agricultural activities, this may be clear: do the new activities cost more time than the usual practice;
 - for water management techniques, setting up and maintaining the systems asks for time;
 - for diversification techniques relating to migration, people migrating probably have to spent time on preparing their trip and it takes time before they start earning a living (ask for how much time it takes to find work); for diversification techniques relating to new activities, it takes time make handicrafts, collect timber or produce charcoal.
 - For communal pooling, the activities indicated take time to build.
 2. Also ask who did the work: 1. men from the household, 2. women from the household, 3. men jointly with other men from the community, 4. women jointly with other women from the community, 5 people from other organizations.
 3. Ask whether people had to make cash expenditures to start the activity.
 - For agricultural activities, cash expenditures refer to seeds, equipment, inputs, building materials and other cash expenditures
 - For water management techniques, cash expenditures refer to investments in water collection systems, inputs, equipment, materials, etc.
 - For diversification techniques related to migration, cash expenditures refer to travel costs and money needed to cover the first period in which people don't earn an income yet. For techniques referring to other activities, cash expenditures refer to equipment and materials needed to start these activities.
 - For communal pooling techniques, cash expenditures refer to expenditures on inputs and equipment that have to be made by the household.
 4. If people had to make cash expenditures, how much money did it cost them in the first year after they adopted the strategy.
 5. Like for question d.3, ask who had to make the expenditures
 6. Ask the type of in-kind input they needed and how much. This has to be filled in in a separate table. In-kind inputs may include equipment or materials that are available in the household or in the village. It refers to all inputs

- except for the inputs they purchased and labor input.
- e. Ask which benefits they obtained from adopting the strategy;
 - 1. did they earn more cash income,
 - 2. did they have less risk to lose production or animals; did they have less risk on income or food shortages; did they have less risk to water shortages?
 - 3. did their non-cash income increase (higher production, more livestock)
- f. ask whether they were assisted, advised, trained or supported by organizations or institutions working in the village.
- g. if they were assisted by any organization, ask what type of input they received: training, labor, inputs, cash or food.

1. Village and household characteristics**V101. Village Name:****V103. Household code****V102. Village code:**

1

2

3

4

5

6

V104. Respondent name:**V105. Sex of respondent:**☐ Male☐ Female**V106. Relation of respondent to household head**

1. Household head

2. Wife of household head

3. Other, namely

V107. Number of years the family of the household members is living in the village:**V108. Number of years, household occupies this residence:****V109. Rank occupations of the household in order of importance**

Use cards indicating the possible activities and ask the respondent to indicate the importance of the activities by allocating 5 stones over the seven items, for which they allocate more stones to the more important activities)

V110. Indicate whether the activity is especially performed by men or women; if there's no difference, tick both answers.

(V109) Main activities of the household		(V110) Performed by men or women		
		Men	Women	No difference
Crop farming				
Animal husbandry				
Off-farm labor (non-agricultural)				
Trade and commerce				
Civil servant				
Other:				

V111 Observations:

.....

2. Household composition and household characteristics

This question deals with the household members who are currently living within the household and those who migrated for less than 12 months.

V201 What are the names of the household members? Tick male or female

V202 What is the sex of each member of the household?

V203 What is the relation of the household members to the household head?

V204 What is the age of each member the household?

V205 How many years of education did the household member receive?

V206 Did the household member migrate for a period of less than 12 months during the last year?
Tick yes or no.

V200 No.	V201. Name household member	V202. Sex	V203. Relation to household head	V204. Age	V205. Years of education	V206. Temporarily migrated
1						
2						
3						
4						
5						
.						
.						
.						
20						
		1 = Male 2 = Female	1 = Household head 2 = Wife 3 = son - daughter 4 = brother-sister 5 = Parents (in law) 6 = Brother/sister (in law) 7 = Uncle/aunt 8 = Nephew/niece 9 = Migrated household member 10 = Other.....			1 = Yes 2 = No

V207 Are there any household members who belong to the household but who have migrated permanently?
Yes/No

Note that these do not refer to household members who left the household to start their own household somewhere else. It refers eg. to husbands or wives who have migrated permanently with the objective to cent cash to the village.

V208 If there are household members that migrated permanently. . how many household members have migrated permanently?.....

V209 Observations:.....
.....

3. Crops cultivated last year

V301 Did you cultivate any of the crops listed below during the last 12 month (tick if the crop is grown)

V302 How much land have you cultivated with each of these crops?

V303 From which crops harvested during the last 12 months did you sell a part? (tick 'yes' or 'no').

V304 If crops are sold, ask whether the money earned is managed by the men or women. If the household budget is managed equally by the men and women, tick both cells 'men' and 'women'.

V300 Crop code	V301 Crops cultivate during the last 12 months		V302 Land cultivated		V303 Sold	V304 Income I by Income managed by whom?	
			Amount	Unit	1 = Yes 2 = No	Men	Women
1							
2							
3							
.							
Up to							
.							
20							

V305 How much land do you own or have permanent or for? (unit)

V306 How much land do you rent or sharecrop in? (unit)

V307 Observations:.....
.....

Cell phone			
Television			
Boat			
House built of stones/bricks			
Car			
Other			

V605 Observations:
.....

4. Livestock

V401 Does the household currently own livestock or animals? Yes/no

If the answer to V401 is yes, continue with question V402, otherwise continue with V403.

V402 How much livestock does the household currently own? (mark the category indicating the number of livestock owned in the table below)

Livestock	V402 How much livestock does the household currently own?			
	1–2	3–5	6–10	More than 10
1. Cattle				
2. Traction livestock (e.g. camels, mules, horses, oxen)				
3. Goats				
4. Sheep				
5. Rabbits				
6. Poultry				

V403 Did the household own livestock or animals one year ago? Yes/no

If the answer to V403 is yes, continue with question V404, otherwise continue with V405.

V404 How much livestock did the household own 12 months ago (mark the category indicating the number of livestock owned in the table below)

Livestock	V404 How much livestock did the household own one year ago?			
	1–2	3–5	6–10	More than 10
1. Cattle				
2. Traction livestock (e.g. mule, horse, oxen)				
3. Goats				
4. Sheep				
5. Rabbits				
6. Poultry				

V405 **Observations:**.....

Note to interviewers: check to what extent this corresponds with the hazards given in the previous table.

V705 In the last 12 months, were there any periods in which the household experienced difficulties to sufficiently feed all household members? If there were such periods, which months were difficult? Yes/No

V706 If there were difficulties to sufficiently feed all household members in the last 12 months, can you indicate in which months this occurred?

V706. e.2 Which months were difficult?

Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec

V707 Due to climate related hazards, to what extent did you experience effects in crop production?

V708 Due to climate related hazards, to what extent did you experience effects in cultivated areas?

V709 Due to climate related hazards, to what extent did you experience effects in livestock?

V710 Due to climate related hazards, to what extent did you experience effects in Fisheries?

V711 Due to climate related hazards, to what extent did you experience effects in Assets Owned?

V712 Due to climate related hazards, to what extent did you experience effects in income cash?

V713 Are male and female household member equally, affected by the climate related hazards?

<i>Effect of hazard on livelihoods</i>	<i>V707 Crop production</i>	<i>V708 Area cultivated</i>	<i>V709 Livestock owned</i>	<i>V710 Fish landed</i>	<i>V711 Assets owned</i>	<i>V712 Cash income</i>	<i>V713 Gender effect</i>
							<i>1 = Male 2 = Female 3 = No difference</i>
Unfavorable years with less rainfall during the rainy season leading to droughts							
Unfavorable years in which the rainy season has periods of prolonged drought, leading to crops drying out or livestock dieing because not having sufficient water.							
Unfavorable periods, within a year with excess rainfall leading to floods							
Unfavourable periods within 3 year with too heavy showers leading to damage to crops, livestock, and property							
Unfavorable periods characterized by periods in a year of extreme temperatures, leading to scorched crops							

V714 Rank the hazards given below from the least important (1) to most important (10).

V715 If you compare the situation in the last five years with the period before. Have the hazards become more threatening in the last 5 years?

<i>Hazards</i>	<i>V714 Hazard ranking</i>	<i>V715 More or less threatening than in the past?</i>
		1 = Yes 2 = No
Drought due to less, rainfall during the rainy season		
Draught due to periods of draught during the rainy reason		
Floods as due to excessive rainfall		
Damage due to excessively heavy showers		
Changed average and extreme temperatures		
Human diseases		
Animal or crop pests and diseases		
Decreasing soil fertility		
Problems with input purchase or output sales		
High food prices		
Others:		

V716 Observations:

.....

8. Institutions

- V801** With which organizations or groups does your household have contact?
- V802** If you have been in contact with an organization, how often do you have contacts?
- V803** If you have been in contact with an organization, since when have you been contacting the specific institution?
- V804** Is it possible to link the date since households are in contact with an institution with the date since a hazard is experienced as discussed in question V701 (numbered 1 to 5).
- V805** If you have been in contact with the organization, has the help or assistance obtained been helpful to prepare your household for hazards which are a danger for your household? Yes/No

	V801 <i>In contact</i> 1 = Yes 2 = No	V802 <i>Frequency of contacts with institutions</i> 1 = Never 2 = Occasionally 3 = Once a year 4 = A few times per year 5 = Every month 6 = Every week	V803 <i>Have been in contact since</i>	V804 <i>Link to hazards in question 7</i> 1. Drought 2. Rainfall variability 3. Floods 4. Changed temperature 5. Human diseases 6. Other.....	V806 <i>Helpful for adaptation</i> 1 = Yes 2 = No
<i>Organization hazards</i>					
1. National Authorities (central)					
2. Regional Authorities at governorate levels					
3. Local authorities at district levels					
4. Extension centers					
5. International Donors					
6. Non-Governmental Organization					
7. Cooperatives					
8. Schools					
9. Banks					
10. Village communities					
11. Religious communities					
12. Women's groups					
13. Micro-finance groups					
14. Self-help groups					
15. Unions					
16. Other.....					

List of Adaptation Strategies

<i>Agricultural techniques</i>
A1. Crop selection
A2. Adapt planting fruits (olives and peanuts....etc)
A3. Adapt cropping densities
A4. Adapt fertilizer/pesticide application
A5. Adapt tillage practices
A6. Change the posture system (distance and frequency mobility)
A7. Change the herd composition
A8. Apply different feed techniques, like e.g. zero grazing
A9. Change from pastoral to sedentary agricultural system
A10. Improve food storage facilities
A11. Others
<i>Water management techniques</i>
B1. Use water harvesting techniques: roof water collection tanks
B2. Improve, construct or rehabilitate terraces
B3. Use groundwater irrigation
B4. Improve watering sites in pastoral areas
B5. Other....
C. DIVERSIFICATION
C1. Temporal migration to urban areas or abroad
C2. Temporal migration to other rural areas (e.g. plantations)
C3. Permanent migration (to other rural areas, urban areas or abroad)
C4. Home-garden agriculture
C5. Increase market sales
C6. Handicrafts
C7. Charcoal or timber sales
C8. Reduce expenses by changing consumption (type and number of meals)
C9. Draw down on livestock, surpluses or savings
C10. others
<i>C. Communal techniques</i>
D1. Restore and preserve homestead or mountain forests to reduce erosion
D2. Rangeland preservation and grazing restrictions
D3. Soil erosion prevention programmes (e.g. community terracing)
D4. Communal water harvesting, tanks
D5. Communal irrigation
D6. Others.....

9. Major strategies of the household to cope with hazards

V901 Do you apply the adaptation options given below in order to adapt to the hazards given in the previous question? If No, go to the next item

V901b If V901b = Yes, from where do you get this TECHNIQUE (1 = Self-resource 2 = Mouth-to-mouth 3 = From external resource)

V902 Who decided about the strategy change; men, women or both?

V903 If the adaptation strategy is adopted, which of the hazards are reduced?

(1 = Drought due to less rainfall during the rainy season; 2 = Drought due to periods of drought during the rainy season; 3 = Floods due to excessive rainfall; 4 = Damage due to excessively heavy showers; 5 = Changed average and extreme temperature; 6 = other)

Strategy type*	V901 Is the strategy is adopted	If V901b = Yes, from where do you get this TECHNIQUE	V902 Who decides to adopt?	V903 Which hazards are reduced?					
	1 = yes 2 = no	1 = Self-resource 2 = Mouth-to-mouth 3 = From external resource	1 = male 2 = female 3 = both	1 = Drought as a result of less rainfall during the rainy season.	2 = Drought due to periods of drought during the rainy season	3 = Floods due to excessive rainfall	4 = Damage due to excessively heavy showers	5 = Changed average and extreme temperature and others	6 = other
1									
2									
3									
4									
5									
-									
-									
-									
-									
-									

*See list below

Interviewer: Only FILL out these questions for ALL adopted STRATEGIES FROM QUESTION V901

What are inputs did you need for this strategy:

V904 How much time did you have to allocate the activity in the first year after which you adopted the strategy?

V905 If time had been allocated to the task, who had to spent these hours on the activity?

V906 Did the strategy cost you a certain amount of money in the first year after you adopted it ?

V907 If the strategy did cost you money, for how many rals. Did you purchase inputs or materials in the first year after which you adopted the strategy?

V908 In the strategy cost money, who has to estimate these costs?

V909 Did you need any kind of (in-kind) inputs such as equipment, manure, seeds, other inputs) for the adaptation strategy? → If yes, fill out the next table as well.

V910 What kind of benefits did you obtained from adopting the strategy?

V911 Which institutions provided help in terms of training, inputs and assistance relevant for the hazards mentioned under (b)?

- | | | |
|-------------------------|----------------------------------|---------------------------|
| 1. National authorities | 6. Non Governmental Organization | 11. Religious communities |
| 2. Regional authorities | 7. Cooperatives | 12. Women's groups |
| 3. Local authorities | 8. Schools | 13. Micro-finance groups |
| 4. Extension Agency | 9. Banks | 14. Self-help groups |
| 5. International donors | 10. Village Communities | 15. Unions |

V912 What kind of inputs did you obtain from these Institutions?

Strategy type*	V804 Time spent (Days)	806 Who did the work? 1 = Individual men 2 = Individual women 3 = Men from the community 4 = Women from the community 5 = Other organizations	V808 Did you estimate costs? 1 = Yes 2 = No	V807 Costs (Yemen Real)	V808 Who did estimate the costs? 1 = Individual men 2 = Individual women 3 = Men from the community 4 = Women from community 5 = Other organizations	V809 Did you need inputs 1 = Yes 2 = No	V810 Benefits 1 = additional cash income; 2 = loan risk; 3 = increased non-cash income	V811 Institutions See that	V812 Inputs from Institutions 1 = training 2 = labor 3 = Inputs (seeds, equipment, wood, machinery, bricks...) 4 = cash 5 = food
1									
2									
3									
4									
5									
-									
-									
-									
-									
-									

*See list above

If respondents received assistance from organizations for a particular adaptation strategy, please ask the following question on the assistance organizations:

- V820 Did you get training/advice?
- V821 How many days of training did you get?
- V822 From which institution did you receive training?
- V823 Did you get labor (hired or for free)?
- V824 How many days of labor did you get?
- V825 From which institution did you receive labor?
- V826 Did you get inputs such as seeds, equipment, manure, wood, machinery, bricks etc.?
- V827 How many inputs did you get?
- V828 From which institution did you receive inputs?
- V829 Did you get cash?
- V830 How many cash did you get?
- V831 From which institution did you receive cash?
- V832 Did you get food?
- V833 How much food did you get?
- V834 From which institution did you receive food?

Strategy*	V920 Did you get training/ advice?	V921 How many days of training did you get?	V922 From which institution did you receive training?	V923 Did you get labor (hired or for free)?	V924 How many days of labor did you get	V925 From which institution did you receive labor?	V926 Did you get inputs such as seeds, equipment, manure, wood, machinery, bricks etc.?	V927 How many inputs did you get?	V928 From which institu- tion did you receive inputs?	V929 Did you get cash?	V930 How many cash did you get?	V931 From which institution did you receive cash?	V932 Did you get food?	V933 How many food did you get?	V934 From which institu- tion did you receive food?
c.a FILL IN THE ADOPTED STRATATEGIES FROM QUESTION V901 (PREVIOUS PAGES)	1 = Yes 2 = No if "no", go to V923			1 = Yes 2 = No if "no", go to V926			1 = Yes 2 = No if "no", go to V927			1 = Yes 2 = No if "no", go to V930					
1															
2															
3															
4															
5															
..															
..															
..															
..															
..															

* see list above

Observation:

.....

.....

.....

.....

A1.C. INSTITUTIONAL STAKEHOLDER QUESTIONNAIRE

Part 1: General Questions for all Institutional Stakeholders

0. Administrative

	<i>Answer</i>
Village name	
Region	
Date of interview	

1. General statistics of respondent.

	<i>Answer</i>
1a. What is your main activity/position/profession in the village (please describe)?	
1b. How long have you held this position?	years
1c. Age	
1d. Education (number of years)	years

2. Livelihoods in villages continuously change because of many outside changes. Improvement of livelihoods is threatened by many different hazards

- Rank the hazards given below from the least important (1) to most important (10)¹
- To what extent have the hazards become more or less threatening for the village compared to the past?

<i>Hazards</i>	<i>(a) Hazard ranking</i>	<i>(b) More or less threatening than in the past?</i>
Drought due to less rainfall during the rainy season		
Drought due to periods of drought during the rainy season		
Floods due to excessive rainfall		
Damage due to excessively heavy showers		
Changed average and extreme temperatures		
Human diseases		
Animal or crop pests and diseases		
Decreasing soil fertility		
Problems with input purchase or output sales		
High food prices		
Other:		
	↑	↑
	1 = least important 10 = most important	1 = lot less 2 = less 3 = same 4 = more 5 = lot more.

¹ See note at the end of the questionnaire.

3. a. What kinds of organizations are present in your village?
 b. Which of these organizations deals with assisting the population to adapt to changing weather characteristics?
 c. How important are these organizations for helping the population to adapt to changing weather characteristics in terms of how good they help the population and how many people they reach?

Services	Present?		If present, deals with adaptation strategies		Importance of institution? 1 = not at all important 5 = very important
	Yes	No	Yes	No	
Extension agents					1 – 2 – 3 – 4 – 5
International donors and development organizations					1 – 2 – 3 – 4 – 5
Nongovernmental organizations					1 – 2 – 3 – 4 – 5
National authorities					1 – 2 – 3 – 4 – 5
Regional authorities (regional administration)					1 – 2 – 3 – 4 – 5
Local authorities (local administration)					1 – 2 – 3 – 4 – 5
Cooperatives					1 – 2 – 3 – 4 – 5
Schools					1 – 2 – 3 – 4 – 5
Banks					1 – 2 – 3 – 4 – 5
Village communities					1 – 2 – 3 – 4 – 5
Religious communities					1 – 2 – 3 – 4 – 5
Women's groups					1 – 2 – 3 – 4 – 5
Micro-financing groups					1 – 2 – 3 – 4 – 5
Self-help groups					1 – 2 – 3 – 4 – 5
Unions					1 – 2 – 3 – 4 – 5
Other:					1 – 2 – 3 – 4 – 5
Other:					1 – 2 – 3 – 4 – 5

4. Discussion question: (type of service needed)
- Which organization(s) are in your opinion most helpful or best to help the population adapting to the risks of weather variability?
 - What type of assistance do households need in order to adapt to the risks of weather variability? Training, knowledge, inputs, financial aid, communal projects on e.g. irrigation, soil erosion prevention or water harvesting,?
 - What kind of problems hamper to your opinion the activities of the organizations who are assisting the population to adapt to changing weather variability.
 - What kind of external assistance or help do organizations who are working in this field need in order to improve their results? Financial help, knowledge/training, inputs/material, back-up from governmental or international organizations,?

PART 2: Questions only for stakeholders representing an institution/organization.

5. General questions on organization
- Name of organization
 - Geographical area served by the institution (villages/areas)
 - Number of full-time staff employed by the institution
 - Number of part-time staff employed by the institution

- Gender of the staff: % female.
 - Estimation of average age of staff (years)
 - Number of years institution is in operation (years).
6. Type of institution
- What is the goal/objective of the institutions?
 - What type of service does your institutions provide? What are the activities of the institution?
 - What is the benefit that members get from joining/participating in your institution?
7. Membership/clients of institution
- Who can become member or receive services?
 - What are the criteria for becoming a member or for receiving services (Is this dependent on social standing, on economic standing or on geographic area?)
 - Are there any restrictions on becoming member or receiving services?
 - Are there any limitations for membership or services (i.e. only a certain number of years that members can receive service)
 - Does the institution provide the same type of service to all members? (Is the service dependent on social group or level of need?)
8. Funding
- Where do the institutions get funding from?
 - For formal institutions: What is the annual budget of your organization? How is the budget allocated over personnel expenses and activities initiated?
 - For formal and informal institutions: Assume that your institution has a budget of 100 'tokens'. If you would allocate this budget over the services you provide, how would you allocate it? Moreover, if this budget would have to be allocated over different types of members or different groups within the community, how would you allocate it?
9. Climate impacts
- Has there been an extreme weather event that has impacted the type of service you provide or the demand for the type of service you are providing?
 - Was the service still applicable or effective during the weather event?
 - What strategies were employed to adapt to the change in conditions?
 - During extreme weather events in the past, were there different forms of distribution (either physical route or social connections) of the services?
 - Were the same number of people served? Were there more people seeking assistance? Fewer people seeking assistance?
 - What role do you see organizations playing in implementing or promoting adaptation strategies? Capacity building? Funding?
8. What government policies support institutions?
- What government policies are restrictive to institutions?
 - Do supportive or restrictive government policies play a role in determining whether you work with institutions in the country?

Hint on Question 2:

In order to ask respondents to rank the different hazards from most to least important, it is possible to give them cards like the ones given below and ask them to order them on the basis of their importance. Afterwards, the interviewer can number them and fill in the form.

ILLUSTRATIVE PHOTOS

PHOTO 1: DROUGHT DUE TO LESS RAINFALL
DURING RAINY SEASON



PHOTO 2: HUMAN DISEASE



PHOTO 3: PROLONGED PERIODS OF DROUGHT
DURING RAINY SEASON



PHOTO 4: ANIMAL OR CROP PESTS
AND DISEASES



PHOTO 5: FLOODS DUE TO EXCESSIVE RAINFALL



PHOTO 6: DECREASING SOIL FERTILITY



PHOTO 7: DAMAGE DUE TO EXCESSIVELY HEAVY SHOWERS



PHOTO 8: PROBLEMS WITH INPUT PURCHASE OR OUTPUT SALES



PHOTO 9: EXTREME TEMPERATURES LEADING TO E.G. SCORCHED CROPS



PHOTO 10: HIGH FOOD PRICES



A1.D. FOCUS GROUP DISCUSSION

Within each village, one focus group discussion is organized. The focus group discussion is a qualitative method with the objective to obtain hands-on and detailed information on concepts, perceptions and ideas of a group. The results from the discussion complement results and insights obtained from the household questionnaires, institutional stakeholder interviews and expert interviews. The main objectives of these group discussions are:

- to obtain more insights into the perceptions on the main (climate) hazards communities and households are facing;
- to obtain more information about the changes in hazards and adaptation options;
- to obtain more information about the reasons for adoption or non-adoption of the different adaptation options;
- to obtain more information about the advantages/disadvantages/bottlenecks/strong points/weak points of the different adaptation options;
- to obtain more information about the institutions facilitating the adoption of certain adaptation options;
- to obtain more information about the bottlenecks preventing institutions to give useful help;
- to obtain more information about differences in strategy adoption between socio-economic groups with the community

In the focus group discussions, a group of 15 to 20 people from the village is invited and with the help of a facilitator are stimulated to talk freely and spontaneously about the issues mentioned above. A 'recorder' keeps a record of the discussion as well as the emotional reactions and important aspects of the group interaction. An assessment of the emotional tone of the meeting and the group process enables us to judge the validity of the information collected.

The length of each of the discussions takes approximately two hours. Mixed groups of men and women are invited or held separately, as appropriate to the context. The groups contain different age classes and have to contain as well people who experienced the droughts in the 1970s. Moreover, people from different wealth classes are included in order to get a good representation

of the composition of the community. The list of people invited is set up jointly with the local authorities and representatives from the projects active in the villages.

Using images and pictures from different hazards, climate risks and adaptation options, the following discussion questions are brought forward:

- Which climate or rainfall related hazards do you face in your daily life?
- For drought hazards: to what extent has the start of the rainy season and the amount of rain fallen during the rainy season varied over the last decades? Do you adapt farming strategies if you have experienced drought problems over the past years? Are there differences in crops grown, tillage techniques, planting dates, activities performed, equipment used,....? Did you change the composition of your livestock owned, livestock management, ...?
- For flood hazards: to what extent has the amount of rainfall or the intensity with which it rains changed over the last decades? Do you change farming and livelihood strategies if you have experienced regular flooding problems over the past years? Are there differences in crops grown, tillage techniques, planting dates, activities performed, equipment used,....? Did you change the composition of your livestock owned, livestock management, ...?
- How much do these changes cost you in terms in resources used, labor requirements, etc.?
- Which organizations, authorities or people are most helpful to learn more about how to prepare for these hazards? How can these organizations perform there tasks better?
- To what extent are choices dependent on ethnicity, wealth class, gender?

Depending on the direction in which the discussion is going, questions are phrased in a certain way or emphasis is put on particular topics. It is attempted to cover all the above questions during the discussion. During the discussion, the recorder pays particular attention to whether representatives from different socio-economic groups answer the questions differently, whether they have different perceptions, use different adaptation options or are dependent on different institutions.

APPENDIX 2. DATA ANALYSIS

A2.A. DESCRIPTIVE ANALYSIS OF THE HOUSEHOLDS

TABLE A.1. MAIN DEMOGRAPHIC CHARACTERISTICS OF THE STUDY SITES – SEE ALSO TABLE A2.1B BELOW

	<i>Village</i>	<i>Average household size</i>	<i>% male members</i>	<i>Dependency ratio</i>	<i>Average age</i>
1	Al Wathan	9.8	48	0.89	22.2
2	Arraheebah	8.2	51	1.17	19.2
3	Dhi-Shraq	8.2	61	0.46	26.0
4	Mu'aneet	8.3	58	0.65	24.7
5	Al Mehraq	8.4	52	0.78	23.4
6	Al Masajed	8.8	56	0.72	23.8
	Total	8.6	54	0.76	23.2

Notes: 1. Dependency ratio = (number of children under the age of 16 plus elderly people above 60) / (number of adults in between 16 and 60 years)

TABLE A.2. DIFFERENCES IN EDUCATION AND MIGRATION – SEE ALSO TABLE A2.2B BELOW

		<i>Average years of education</i>				<i>Temporary migration</i>	
		<i>Boys</i>	<i>Girls</i>	<i>Men</i>	<i>Women</i>	<i>% hh with temp. migr.</i>	<i>Average age of migration</i>
							<i>Men</i> <i>Women</i>
1	Al Wathan	2.8	2.3	7.6	0.9	6.7	36.2 18.0
2	Arraheebah	2.7	1.2	5.9	1.2	1.2	31.2
3	Dhi-Shraq	4.4	3.6	9.9	5.0	4.6	33.2
4	Mu'aneet	3.6	1.9	8.5	2.3	4.6	39.6
5	Al Mehraq	3.2	2.8	8.7	2.7	1.7	50.6
6	Al Masajed	2.6	3.9	8.1	3.6	5.8	42.4
	Total	3.2	2.6	8.1	2.6	4.1	38.5 18.0

TABLE A.3. MAIN ACTIVITIES OF HOUSEHOLDS IN THE STUDY SITES

		<i>share of the hh for whom the activity is the 1st, 2nd or 3d important activity (in %)</i>														
		<i>Agriculture</i>			<i>Livestock raising</i>			<i>Daily labor</i>			<i>Trade and commerce</i>			<i>Civil servant</i>		
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
1	Al Wathan	60	40	0	0	30	48	0	0	0	0	2	4	42	28	8
2	Arraheebah	67	33	0	0	49	20	14	6	4	2	0	0	10	0	0
3	Dhi-Shraq	62	38	0	0	32	14	8	2	0	2	0	0	18	4	0
4	Mu'aneet	80	18	2	0	48	22	0	8	6	4	0	0	16	18	6
5	Al Mehraq	54	44	2	0	28	26	22	16	6	0	0	0	14	4	0
6	Al Masajed	55	43	0	0	37	31	8	0	2	4	2	2	27	14	14
Total		63	36	1	0	37	27	9	5	3	2	1	1	21	11	5

		<i>Share of work especially done by (in %)*</i>									
		<i>Men</i>		<i>Women</i>		<i>Men</i>		<i>Women</i>		<i>Men</i>	
		Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
1	Al Wathan		66	44	76	0	0	10	0	80	0
2	Arraheebah	100	92	69	69	24	0	2	0	10	0
3	Dhi-Shraq	100	84	46	44	10	0	2	0	22	0
4	Mu'aneet	100	88	70	68	14	0	4	0	40	0
5	Al Mehraq	100	94	52	56	44	0	0	0	18	0
6	Al Masajed	98	73	67	63	10	0	8	0	55	2
Total		100	83	58	63	17	0	4	0	37	0

Note: If the sum of the shares of men and women is larger than 100, it means that for a part of the households the work load is equally divided over men and women

TABLE A.4. MAIN TYPES OF CROPS GROWN

		Average area per household				Average acreage planted with (ha)			
		Cereals	Legumes	Millet	Sorghum	Vegetables	Herbs	Cash crops	
1	Al Wathan	1.85	1.15	0.18	0.00	0.33	0.01	0.13	
2	Arraheebah	2.12	0.70	0.00	0.66	0.12	0.09	0.05	
3	Dhi-Shraq	0.22	0.14	0.00	0.00	0.02	0.00	0.06	
4	Mu'aneet	0.84	0.65	0.09	0.02	0.00	0.01	0.01	
5	Al Mehraq	0.33	0.26	0.01	0.03	0.00	0.00	0.00	
6	Al Masajed	2.35	1.55	0.45	0.00	0.07	0.16	0.00	
Total		1.29	0.74	0.12	0.12	0.09	0.05	0.04	
Share of households cultivating (%)									
		Cereals	Legumes	Millet	Sorghum	Vegetables	Herbs	Cash crops	
1	Al Wathan	98	46	0	0	58	10	44	
2	Arraheebah	78	0	55	35	37	6	10	
3	Dhi-Shraq	90	0	0	2	8	4	52	
4	Mu'aneet	90	42	16	22	0	12	8	
5	Al Mehraq	94	8	16	30	0	2	10	
6	Al Masajed	100	78	0	0	20	51	0	
Total		92	29	15	15	21	14	21	
Share of producing households (%) who sold any of their									
Crop		Cereals	Legumes	Millet	Sorghum	Vegetables	Herbs	Cash crop	
1	Al Wathan	14	8	0	50	6	38	14	
2	Arraheebah	10	0	8	27	2	10	10	
3	Dhi-Shraq	2	0	0	8	4	34	2	
4	Mu'aneet	4	0	0	0	0	2	4	
5	Al Mehraq	0	0	0	0	0	2	0	
6	Al Masajed	6	2	0	8	4	0	6	
Total		6	1	0	16	3	14	6	

Note: All information on crops was measured in surface units. In the questionnaires conducted in AI Wathan (Sana'a), AI Masajed (Sana'a) and Marenet (AI Mahweet) land was measured in Libna (44.4 m²). For AI Rahaliba (Taiz), Thy Yashreq (Ibb), and AI Mehraq (Taiz) cultivated land was measured in Osaba (20 m²).

TABLE A.4B. DETAILS ON AREA CULTIVATED AND LAND OWNED

		Average acreage	Standard deviation	Minimum acreage	Quartiles			
					25%	50% = median	75%	100% = max
1	Al Wathan	1.84	1.63	1.21		1.21		6.84
2	Arraheebah	2.12	4.44	1.00		1.00		24.00
3	Dhi-Shraq	0.22	0.32	0.13		0.13		2.00
4	Mu'aneet	0.86	0.84	0.67		0.67		5.33
5	Al Mehraq	0.33	0.65	0.12		0.12		3.24
6	Al Masajed	2.36	1.77	1.78		1.78		6.78
Total		1.29	2.27	0.58		0.58		24.00

TABLE A.5. LIVESTOCK OWNERSHIP

		Average heads of livestock per household							
		Share of hh (%) owning livestock	Breeding and dairy cattle	Traction livestock	Goats	Sheep	Rabbits	Poultry	Tlu
1	Al Wathan	92	1.5	1.5	3.5	4.0	0.0	3.4	3.2
2	Arraheebah	76	0.9	0.7	2.5	2.5	0.3	0.4	1.8
3	Dhi-Shraq	64	0.8	0.2	1.7	0.2	0.0	0.3	0.8
4	Mu'aneet	86	1.2	0.4	1.8	1.5	0.0	1.0	1.5
5	Al Mehraq	64	0.7	0.2	2.6	1.5	0.0	0.9	1.0
6	Al Masajed	84	0.9	1.1	2.2	2.6	0.5	2.3	2.2
Total		78	1.0	0.7	2.4	2.1	0.2	1.4	1.8

		Average heads of livestock last year							
		Breeding and dairy cattle	Traction livestock	Goats	Sheep	Rabbits	Poultry	Tlu	
1	Al Wathan	2.0	1.9	5.2	6.1	0.0	4.5	4.4	
2	Arraheebah	1.4	0.9	4.7	4.7	0.6	1.9	2.8	
3	Dhi-Shraq	1.7	0.3	3.7	1.0	0.0	0.8	1.9	
4	Mu'aneet	1.7	0.5	2.8	2.4	0.0	1.3	2.2	
5	Al Mehraq	1.3	0.2	4.4	3.7	0.1	2.8	1.8	
6	Al Masajed	1.2	1.4	3.4	4.5	1.2	4.7	3.0	
Total		1.5	0.9	4.0	3.7	0.3	2.7	2.7	

		Change in livestock holdings compared to last year (in %)							
		Breeding and dairy cattle	Traction livestock	Goats	Sheep	Rabbits	Poultry	Tlu	
1	Al Wathan	-26	-24	-32	-34		-23	-26	
2	Arraheebah	-38	-22	-46	-47	-48	-80	-35	
3	Dhi-Shraq	-55	-53	-52	-78		-57	-55	
4	Mu'aneet	-31	-18	-37	-38		-26	-30	
5	Al Mehraq	-46	-28	-41	-59	-100	-69	-46	
6	Al Masajed	-26	-24	-34	-42	-52	-52	-28	
Total		-37	-25	-40	-45	-52	-48	-34	

Note: 1. TLU = tropical livestock units. TLU conversion factors: Cattle in herd: 0.7, Cows: 1.0, Sheep: 0.1, Goat: 0.08, Poultry: 0.01 and Rabbits: 0.01 (see Kassam et al., 1991).

Note 2. In Al Wathan there are also two bee keeping households.

TABLE A.6. ASSET OWNERSHIP

		Mean	Standard deviation	Quartiles				
				Min.	25%	50%	75%	Max.
1	Al Wathan	76	111	18		41		661
2	Arraheebah	32	12	9		28		68
3	Dhi-Shraq	38	24	19		33		168
4	Mu'aneet	39	25	14		32		160
5	Al Mehraq	34	24	10		29		173
6	Al Masajed	51	42	17		41		257
Total		45	40	14		34		247

Notes: 1. Four types of assets were distinguished, which were weighted from 1 till 4 to calculate a household specific asset ownership indicator. The four of assets were: 1) basic farming equipment including a plow, hoe, axe, sickle, shovel and fishing equipment; 2) basic assets including jewelry, cart, improved stove, radio and bicycle; 3) more luxury assets including iron roofed house, separate kitchen house, gas or petrol stove, refrigerator, stable for livestock and mobile phone; and 4) tv, boat, house built of cement, and car.

FIGURE A.1. HISTOGRAM OF ASSET OWNERSHIP PER VILLAGE

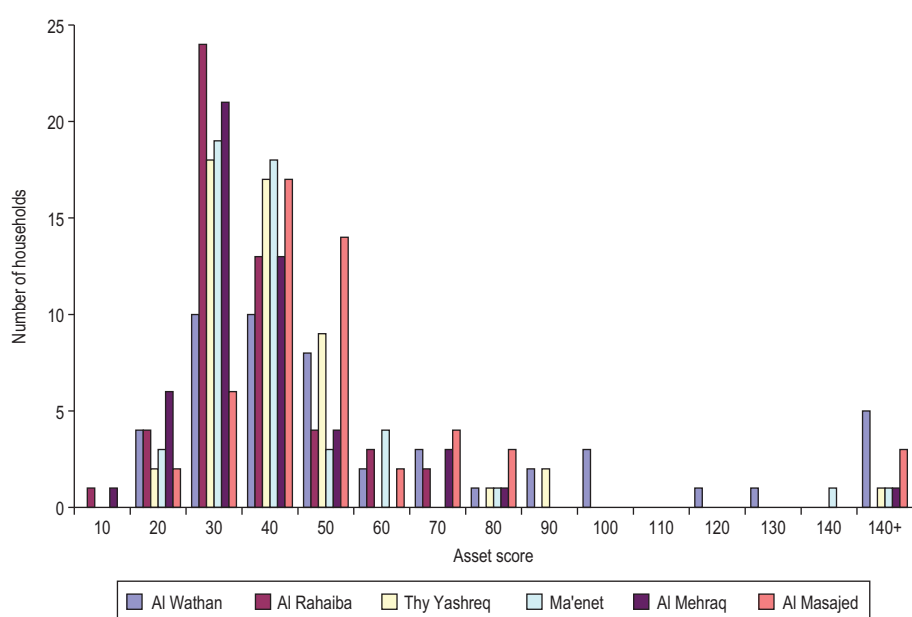


TABLE A.1B. DETAILED DEMOGRAPHIC CHARACTERISTICS OF THE STUDY SITES

Village	Average household size	Minimum household size	Median household size	Maximum household size	Standard deviation household size	Average number of household members per age class											
						0-15		15-30		30-45		45-60		60+		Total	
						Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1 Al Wathan	9.8	2	10	21	3.49	2.1	2.2	1.5	1.8	0.5	0.6	0.4	0.4	0.2	0.1	4.7	5.1
2 Arraheebah	8.2	2	8	20	3.63	2.1	2.2	1.3	1.1	0.5	0.5	0.3	0.1	0.1	0.1	4.2	4.0
3 Dhi-Shraq	8.2	3	8	15	2.86	1.3	1.0	2.3	1.2	0.7	0.5	0.6	0.4	0.2	0.1	5.0	3.2
4 Mu'aneet	8.3	2	8	18	3.08	1.5	1.3	2.1	1.3	0.6	0.5	0.3	0.3	0.3	0.1	4.8	3.5
5 Al Mehraq	8.4	2	8	16	2.96	1.6	1.7	1.7	1.3	0.5	0.7	0.3	0.2	0.2	0.2	4.3	4.1
6 Al Masajed	8.8	3	8	16	3.46	1.7	1.5	2.0	1.4	0.6	0.5	0.3	0.3	0.3	0.1	5.0	3.9
Total	8.6	2		21	3.28	1.7	1.7	1.8	1.3	0.6	0.5	0.4	0.3	0.2	0.1	4.7	4.0

TABLE A.2B. DETAILED EDUCATION CHARACTERISTICS OF THE STUDY SITES: SHARE OF EDUCATION CLASSES FOR AGE-SEX COMBINATIONS

	Boys < = 15						Girls < = 15						Men > 15 yrs						Women > 15 yrs					
	0-4		4-8		8-12		0-4		4-8		8-12		0-4		4-8		8-12		0-4		4-8		8-12	
	Total	12+	Total	12+	Total	12+	Total	12+	Total	12+	Total	12+	Total	12+	Total	12+	Total	12+	Total	12+	Total	12+	Total	12+
1 Al Wathan	66	22	12		100		72	24	4		100		27	9	56	7	100		89	5	6	0	100	
2 Arraheebah	72	23	5		100		90	10	0		100		45	23	20	12	100		86	13	1	0	100	
3 Dhi-Shraq	45	43	12		100		62	21	17		100		24	10	38	29	100		58	5	31	7	100	
4 Mu'aneet	57	32	11		100		84	13	3		100		28	12	37	22	100		77	10	11	2	100	
5 Al Mehraq	63	29	8		100		69	22	9		100		23	13	47	17	100		69	14	14	2	100	
6 Al Masajed	73	24	3		100		53	32	14		100		27	13	44	16	100		58	20	23	0	100	
Total	64	28	8		100		73	20	7		100		28	13	41	18	100		73	11	14	2	100	

A2.B. DESCRIPTIVE ANALYSIS OF THE CLUSTERS

TABLE B.1. HOUSEHOLD CHARACTERISTICS

	<i>hh per cluster</i>	<i>Share (%)</i>	<i>Number of hh members</i>		<i>Share of children in hh (<15 yrs)</i>		<i>Share of males in hh (>15 yrs)</i>		<i>Share of females in hh (>15 yrs)</i>		<i>Asset score</i>	
			<i>Mean</i>	<i>St.Dev.</i>	<i>Mean</i>	<i>St.Dev.</i>	<i>Mean</i>	<i>St.Dev.</i>	<i>Mean</i>	<i>St.Dev.</i>	<i>Mean</i>	<i>St.Dev.</i>
1	88	29.1	9.98	3.29	36.60	22.87	33.23	18.15	30.17	15.46	60.3	58.8
2	100	33.1	8.05	2.78	29.72	22.74	43.27	20.54	27.01	13.08	33.0	22.7
3	43	14.2	8.33	3.46	20.31	22.70	49.50	20.95	30.18	14.60	37.0	11.8
4	24	7.9	7.21	2.26	62.20	10.20	17.15	5.92	20.65	6.41	66.8	129.6
5	18	6.0	9.33	4.47	46.68	14.71	28.99	12.53	24.33	10.82	50.1	54.2
6	29	9.6	7.62	3.26	44.83	24.15	31.41	20.03	23.77	13.99	30.3	10.4
	302	100.0	8.62	3.28	35.43	24.18	37.16	20.54	27.41	13.86	45.0	53.2

Note: St.Dev. = standard deviation.

TABLE B.2. AGRICULTURAL CHARACTERISTICS

	<i>average acreage per hh</i>	<i>Average acreage planted with (ha)</i>									
		<i>Cereals</i>	<i>Legumes</i>	<i>Millet</i>	<i>Sorghum</i>	<i>Vegetables</i>	<i>Herbs</i>	<i>Cash_crops</i>	<i>Union and garlic</i>	<i>Fruit</i>	<i>Rest</i>
1	1.54	76.8	6.5	1.5	1.3	5.9	0.5	7.3	0.0	0.0	0.1
2	0.55	81.4	2.3	0.2	2.1	1.9	0.6	11.3	0.2	0.0	0.0
3	1.72	58.5	20.7	2.5	3.2	1.3	9.3	0.4	0.1	0.0	1.7
4	0.86	62.7	6.3	4.3	8.2	7.4	0.4	10.6	0.0	0.0	0.0
5	1.60	31.1	2.3	1.3	7.3	44.2	1.5	1.4	7.8	2.5	0.6
6	2.62	20.0	0.0	28.6	46.2	1.5	0.6	0.0	3.2	0.0	0.0
	1.29	66.4	6.3	4.0	7.0	5.9	1.8	6.9	0.9	0.1	0.3
	<i>st.dev. of acreage per hh</i>	<i>% of households cultivating</i>									
		<i>Cereals</i>	<i>Legumes</i>	<i>Millet</i>	<i>Sorghum</i>	<i>Vegetables</i>	<i>Herbs</i>	<i>Cash_crops</i>	<i>Union and garlic</i>	<i>Fruit</i>	<i>Rest</i>
1	1.69	22.7	10.6	6.0	6.6	11.3	1.8	15.8	0.2	0.0	0.9
2	0.92	28.4	7.0	1.4	9.6	6.4	2.5	26.1	1.3	0.0	0.0
3	1.55	23.1	16.9	6.6	8.7	4.6	14.2	1.7	0.8	0.0	5.2
4	1.22	31.7	12.1	11.4	17.3	22.2	1.6	22.3	0.0	0.0	0.0
5	1.66	16.7	5.9	4.0	17.9	23.3	3.5	4.3	13.4	7.0	2.4
6	5.71	20.4	0.0	18.2	39.0	4.7	3.1	0.0	8.9	0.0	0.0
	2.27	31.9	11.9	11.2	20.1	14.9	6.5	18.9	4.7	1.8	2.1
	<i>Share of hh who sold (%)</i>	<i>Share of households selling (%)</i>									
		<i>Cereals</i>	<i>Legumes</i>	<i>Millet</i>	<i>Sorghum</i>	<i>Vegetables</i>	<i>Herbs</i>	<i>Cash_crops</i>	<i>Union and garlic</i>	<i>Fruit</i>	<i>Rest</i>
1	66	14	8	0	0	50	6	38	0	0	4
2	41	10	0	8	2	27	2	10	14	0	0
3	38	2	0	0	0	8	4	34	0	0	0
4	6	4	0	0	0	0	0	2	0	0	0
5	2	0	0	0	0	0	0	2	0	0	0
6	14	6	2	0	0	8	4	0	2	0	0
	28	6	2	1	0	16	3	14	3	0	1

TABLE B.2B. DETAILS ON AREA CULTIVATED

	<i>Average acreage (ha)</i>	<i>Standard deviation</i>	<i>Minimum acreage (ha)</i>	<i>Percentiles (ha)</i>			
				<i>25%</i>	<i>50%</i>	<i>75%</i>	<i>100%</i>
1	1.84	1.63	1.21		1.21		6.84
2	2.12	4.44	1.00		1.00		24.00
3	0.22	0.32	0.13		0.13		2.00
4	0.86	0.84	0.67		0.67		5.33
5	0.33	0.65	0.12		0.12		3.24
6	2.36	1.77	1.78		1.78		6.78
	1.29	2.27	0.58		0.58		24.00

TABLE B.3. LIVESTOCK CHARACTERISTICS

Large livestock										Small livestock										
No animals		1–2 animals		3–5 animals		6–10 animals		>10 animals		no animals		1–2 animals		3–5 animals		6–10 animals		>10 animals		
Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	
1	0	0	32	36	53	60	2	2	1	1	0	0	12	14	16	18	13	15	47	53
2	60	60	40	40	0	0	0	0	0	0	81	81	1	1	6	6	4	4	8	8
3	9	21	10	23	24	56	0	0	0	0	19	44	2	5	8	19	5	12	9	21
4	19	79	5	21	0	0	0	0	0	0	12	50	5	21	2	8	2	8	3	13
5	7	39	7	39	4	22	0	0	0	0	12	67	0	0	0	0	0	0	6	33
6	8	28	10	34	11	38	0	0	0	0	10	34	4	14	5	17	5	17	5	17
103	34		104	34	92	30	2	1	1	0	134	44	24	8	37	12	29	10	78	26

Note: Freq. = frequency

Note: Freq. = frequency

TABLE B.4. AVERAGE RANKING OF HAZARDS AND OBSERVATIONS ON WHETHER THE HAZARD HAS BECOME MORE THREATENING

1. Drought due to less rainfall during the rainy season			2. Drought due to periods of drought during the rainy season			3. Floods due to excessive rainfall			4. Damage due to excessively heavy showers			5. Changed average and extreme temperatures			6. Human diseases			7. Animal or crop pests and diseases			8. Decreasing soil fertility			9. Problems with input purchase or output sales			10. High food prices		
Rank	Higher threat		Rank	Higher threat		Rank	Higher threat		Rank	Higher threat		Rank	Higher threat		Rank	Higher threat		Rank	Higher threat		Rank	Higher threat		Rank	Higher threat		Rank	Higher threat	
1	7.8	93	6.5	68	2.1	14	4.4	25	5.3	57	4.4	38	5.7	63	4.0	36	5.5	65	8.2	89									
2	9.2	97	7.0	76	1.4	11	4.1	29	4.8	44	4.5	55	5.6	72	4.1	35	5.8	79	8.1	92									
3	8.3	86	6.0	60	2.8	9	4.5	19	5.6	65	5.0	51	4.9	51	3.6	30	6.0	67	8.1	88									
4	9.1	100	7.4	83	2.1	13	3.3	17	4.8	46	4.3	54	5.7	71	4.1	38	6.5	92	7.8	83									
5	8.9	94	7.5	94	1.1	22	5.2	44	5.3	78	4.3	67	4.6	78	4.7	67	4.5	78	7.4	89									
6	9.5	100	6.6	83	1.3	3	4.5	28	4.5	41	5.4	83	5.6	76	3.3	31	5.8	93	8.8	97									
8.8	95		6.8	78	1.8	12	4.3	27	5.1	55	4.7	58	5.3	68	4.0	39	5.7	79	8.1	90									

Notes: 1). The average rank is the average over all households from a cluster. The higher the number, the more important the hazard is perceived. 2) The columns 'higher threat' give the percentage of households from a cluster whom indicate the hazard has becoming more threatening in the last five years

TABLE B.5. PERCENTAGE HOUSEHOLDS FACING FOOD SHORTAGES IN PARTICULAR MONTHS

	<i>% of hh</i>	<i>Number of months</i>	<i>May</i>	<i>Jun</i>	<i>Jul</i>	<i>Aug</i>	<i>Sept</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>
1	34.1	1.2	5	6	2	2	0	3	1	7	0	6	1	7
2	41.0	1.2	8	5	6	2	3	2	1	3	0	2	7	12
3	18.6	1.1	2	2	2	0	0	0	2	0	0	5	5	2
4	16.7	2.0	8	4	4	4	4	4	0	0	0	0	0	4
5	50.0	1.4	22	6	6	6	6	0	0	0	0	11	6	11
6	37.9	1.6	3	7	10	7	7	0	3	3	0	3	10	7
	34.1	1.3	7	5	5	3	2	2	1	3	0	4	5	8

TABLE C.1. PERCENTAGE OF HOUSEHOLDS FROM CLUSTERS AND VILLAGES ADOPTING PARTICULAR STRATEGIES

		Share of hh from cluster adopting a strategy (%)						Share of households from villages adopting a strategy (%)						Total	
		1	2	3	4	5	6	Al Wathan	Arraheebah	Dhi-Shraq	Mu'aneet	Al Mehraq	Al Masajed		
A01	Crop selection	11	12	14	21	28	10	28	18	4	8	8	16	14	
A02	Adapt planting dates	2	0	0	4	6	0	0	2	0	0	0	6	1	
A03	Adapt cropping densities	9	3	5	17	0	0	18	2	0	8	0	6	6	
A04	Adapt fertilizer/ pesticide application	30	20	14	25	33	7	60	16	24	16	10	6	22	
A05	Adapt tillage practices	16	8	5	8	0	17	18	18	20	4	2	0	10	
A05	Change the pastoral system	1	0	0	0	0	0	2	0	0	0	0	0	0	
A08	Apply different feed techniques.	8	3	9	0	0	0	8	0	0	14	2	4	5	
A09	Change from pastoral to sedentary agricu	0	0	0	0	6	0	2	0	0	0	0	0	0	
A10	Improve food storage facilities	5	0	0	4	0	0	6	0	0	4	0	0	2	
B01	Use water harvesting techniques	13	9	12	13	11	0	12	8	10	14	4	12	10	
B02	Improve, construct or rehabilitate terra	30	13	16	25	0	3	26	2	2	46	20	10	18	
B03	Use irrigation	31	18	28	25	61	21	56	39	30	0	0	33	26	
C01	Temporary migration to urban areas or abr	16	11	30	8	17	3	20	4	16	16	14	18	15	
C02	Temporary migration to other rural areas	1	0	0	0	0	0	2	0	0	0	0	0	0	
C03	Permanent migration	0	1	0	0	0	3	2	0	0	2	0	0	1	
C04	Home-garden agriculture	1	1	0	0	0	0	2	0	0	0	2	0	1	
C05	Increase market sales	0	0	0	0	6	0	2	0	0	0	0	0	0	
C06	Handicrafts	5	2	0	0	0	0	6	0	2	0	2	2	2	
C08	Reduce expenses by changing consumption	0	0	0	0	6	0	2	0	0	0	0	0	0	
C09	Draw down on livestock, surpluses or sav	9	2	9	0	0	0	18	0	2	0	2	6	5	
D01	Restore and preserve homestead or muntai	13	8	7	17	0	3	16	2	0	14	10	12	9	
D02	Rangeland preservation and grazing restr	0	0	0	4	0	3	0	0	0	4	0	0	1	
D03	Soil erosion prevention programmes	10	5	7	21	0	3	16	4	0	10	6	10	8	
D04	Communal water harvesting, tanks	10	2	7	0	0	0	8	0	0	20	0	0	5	
D05	Communal irrigation	17	7	14	17	17	0	42	6	6	0	0	16	12	
Total															515

TABLE C.2. RANKING OF ADAPTATION OPTIONS FOR CLUSTERS AND VILLAGES

	Rank of strategy per cluster						Rank of strategy per site						Total
	1	2	3	4	5	6	Al Wathan	Arraheebah	Dhi-Shraq	Mu'aneet	Al Mehraq	Al Masajed	
A01 Crop selection	9	4	4	4	4	3	4	2	7	9	5	3	5
A02 Adapt planting dates	17			12	7			9				9	17
A03 Adapt cropping densities	12	11	13	6			7	9		9		9	11
A04 Adapt fertilizer/ pesticide application	2	1	4	1	2	4	1	4	2	3	3	9	2
A05 Adapt tillage practices	5	7	13	10		2	7	2	3	11	8		7
A05 Change the pastoral system	18						17						21
A08 Apply different feed techniques.	14	11	8				13			5	8	13	12
A09 Change from pastoral to sedentary ag.					7		17						21
A10 Improve food storage facilities	15			12			15			11			16
B01 Use water harvesting techniques	7	6	7	9	6		12	5	5	5	7	5	8
B02 Improve, construct or rehabilitate terra	2	3	3	1	5	5	5	9	8	1	1	7	3
B03 Use irrigation	1	2	2	1	1	1	2	1	1			1	1
C01 Temporary migration to urban areas or abr	5	5	1	10	4	5	6	7	4	3	2	2	4
C02 Temporary migration to other rural areas	18						17						21
C03 Permanent migration		16			5		17			14			18
C04 Home-garden agriculture	18	16					17				8		18
C05 Increase market sales					7		17						21
C06 Handicrafts	15	13					15		8		8	14	15
C08 Reduce expenses by changing consumption					7		17						21
C09 Draw down on livestock, surpluses or sav	12	13	8				7		8		8	9	12
D01 Restore and preserve homestead or mt. forests	7	7	10	6	5	5	10	9		5	3	5	9
D02 Rangeland preservation and grazing restoration				12	5					11			18
D03 Soil erosion prevention programs	10	10	10	4		5	10	7		8	6	7	10
D04 Communal water harvesting, tanks	10	13	10				13			2			12
D05 Communal irrigation	4	9	4	6	4		3	6	6		3		6

TABLE C.3. COST ESTIMATES (YER 1,000) OF ADAPTATION OPTIONS FOR THE OPTIONS THAT HAD A POSITIVE COST ESTIMATE FOR AT LEAST 10 OBSERVATIONS

		<i>if all observations are included</i>					<i>N</i>
		<i>Mean</i>	<i>Minimum</i>	<i>Median</i>	<i>Maximum</i>	<i>St.dev.</i>	
A01	Crop selection	52.9	0.2	15.0	700.0	137.4	25
A02	Adapt planting dates	1704.0	12.0	100.0	5000.0	2854.8	3
A03	Adapt cropping densities	22.1	1.0	12.3	80.0	29.0	6
A04	Adapt fertilizer/ pesticide application	28.8	1.5	11.0	200.0	39.7	32
A05	Adapt tillage practices	33.0	3.0	13.5	200.0	49.3	22
A05	Change the pastoral system						0
A08	Apply different feed techniques.	3.0	1.0	2.0	10.0	2.8	9
A09	Change from pastoral to sedentary agriculture						0
A10	Improve food storage facilities	6.5	3.0	6.5	10.0	4.9	2
B01	Use water harvesting techniques	37.3	1.0	15.0	300.0	67.7	20
B02	Improve, construct or rehabilitate terra	33.6	0.0	14.0	140.0	35.3	34
B03	Use irrigation	678.8	3.0	150.0	7000.0	1530.4	42
C01	Temporary migration to urban areas or abroad	51.0	5.0	30.0	100.0	45.6	5
C02	Temporary migration to other rural areas						0
C03	Permanent migration						0
C04	Home-garden agriculture	40.0	40.0	40.0	40.0		1
C05	Increase market sales						0
C06	Handicrafts						0
C08	Reduce expenses by changing consumption						0
C09	Draw down on livestock, surpluses, or savings	150.0	150.0	150.0	150.0		1
D01	Restore and preserve homestead or mountain forests	56.5	5.0	30.0	200.0	57.4	15
D02	Rangeland preservation and grazing restoration						0
D03	Soil erosion prevention programs	43.4	9.0	25.0	150.0	43.7	11
D04	Communal water harvesting. tanks	18.0	18.0	18.0	18.0		1
D05	Communal irrigation	46.8	1.0	35.0	150.0	49.4	8

Note: respondents claim to have had costs for 237 out of 515 adaptation strategies.

TABLE C.4. AVERAGE COST ESTIMATES (YER 1,000) OF ADAPTATION OPTIONS FOR THE CLUSTERS AND SITES FOR THE MOST IMPORTANT STRATEGIES

Code	Adaptation strategy	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Cluster 5		Cluster 6	
		Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
A01	Crop selection	21.0	2	26.5	10	147.2	5	36.3	3	28.3	3	42.5	2
A02	Adapt planting dates	100.0	1					12.0	1	5000.0	1		
A03	Adapt cropping densities	13.5	2	1.0	1	9.5	1	47.5	2				
A04	Adapt fertilizer/ pesticide application	7.9	7	31.9	15	2.8	2	12.5	4	100.0	3	33.0	1
A05	Adapt tillage practices	20.0	6	6.9	7	70.0	2	13.0	2			78.2	5
A08	Apply different feed techniques.	2.3	4	1.5	2	5.0	3						
A10	Improve food storage facilities	10.0	1					3.0	1				
B01	Use water harvesting techniques	14.4	7	71.6	8	14.5	2	14.3	3				
B02	Improve, construct or rehabilitate terra	29.3	18	48.9	8	8.0	4	48.3	4				
B03	Use irrigation	187.6	8	796.1	11	220.0	5	2087.5	4	668.8	8	575.0	6
C01	Temporary migration to urban areas or abroad			17.5	2	100.0	2	20.0	1				
C04	Home-garden agriculture			40.0	1								
C09	Draw down on livestock, surpluses or savings			150.0	1								
D01	Restore and preserve homestead or mountain forests	36.8	6	92.0	5	5.0	1	66.0	2			30.0	1
D03	Soil erosion prevention programs	51.4	5	62.5	2			26.7	3			15.0	1
D04	Communal water harvesting, tanks	18.0	1										
D05	Communal irrigation			93.3	3	8.0	3	20.0	1	50.0	1		

(continued next page)

TABLE C.4. AVERAGE COST ESTIMATES (YER 1,000) OF ADAPTATION OPTIONS FOR THE CLUSTERS AND SITES FOR THE MOST IMPORTANT STRATEGIES

Code	Adaptation strategy	Al Wathan		Arraheebah		Dhi-Shraq		Mu'aneet		Al Mehraq		Al Masajed	
		Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
A01	Crop selection			29.0	8	51.0	2	186.0	4	12.3	4	27.9	7
A02	Adapt planting dates			100.0	1							2506.0	2
A03	Adapt cropping densities			15.0	1			27.0	4			9.5	1
A04	Adapt fertilizer/ pesticide application			53.1	8	37.4	10	4.8	7	15.3	5	7.0	2
A05	Adapt tillage practices			53.8	9	7.6	10	67.5	2	30.0	1		
A08	Apply different feed techniques.							2.9	7	3.0	1	4.0	1
A10	Improve food storage facilities							6.5	2				
B01	Use water harvesting techniques			16.3	4	93.0	5	13.0	6	80.0	1	14.5	4
B02	Improve, construct or rehabilitate terra			9.0	1	75.0	1	25.0	22	61.0	8	11.0	2
B03	Use irrigation			493.6	20	1286.8	14					77.6	8
C01	Temporary migration to urban areas or abroad							60.0	2	17.5	2	100.0	1
C04	Home-garden agriculture									40.0	1		
C09	Draw down on livestock, surpluses or savings									150.0	1		
D01	Restore and preserve homestead or mountain forests			30.0	1			55.1	7	82.4	5	10.0	2
D03	Soil erosion prevention programs			12.5	2			50.8	5	61.7	3	13.0	1
D04	Communal water harvesting, tanks							18.0	1				
D05	Communal irrigation			73.3	3	65.0	2					8.0	3

Note: Questions on costing of adaptation strategies has not been asked to respondents in Al Wathan.

A2.D. INSTITUTIONAL ACCESS FOR SITES AND CLUSTERS

TABLE D.1. SHARE OF HOUSEHOLDS PER CLUSTER OR SITE THAT RECEIVES ASSISTANCE FROM A CERTAIN INSTITUTION

	<i>National authorities</i>	<i>Regional authorities</i>	<i>Local authorities</i>	<i>Extension agency</i>	<i>Seeds production authority</i>	<i>Non governmental organization</i>	<i>Religious communities</i>	<i>Number of contacts</i>
1	2	1	0	3	0	0	0	7
2	0	0	0	2	0	0	0	2
3	0	0	2	5	0	0	0	7
4	0	0	4	4	0	4	4	17
5	0	11	6	11	0	0	0	28
6	0	0	0	3	3	0	0	7
total	1	1	1	4	0	0	0	7
Al Wathan	4	0	2	0	0	0	0	6
Arraheebah	0	4	0	8	2	0	0	14
Dhi-Shraq	0	0	0	0	0	0	0	0
Mu'aneet	0	0	4	4	0	2	0	10
Al Mehraq	0	2	0	2	0	0	0	4
Al Masajed	0	0	0	8	0	0	2	10
total	1	1	1	4	0	0	0	7

TABLE D.2. ASSISTANCE FROM INSTITUTIONS FOR DIFFERENT ADAPTATION STRATEGIES

	<i>National authorities</i>	<i>Local authorities in Gov.</i>	<i>Guidance centers</i>	<i>International donors</i>	<i>Men groups</i>	<i>Self-help groups</i>	<i>Unknown</i>	<i>Total</i>
A01 Crop selection	0	0	0	0	0	0	1	1
A02 Adapt planting dates	1	0	0	0	0	0	0	1
A03 Adapt cropping densities	0	1	0	0	0	0	0	1
A04 Adapt fertilizer/ pesticide application	1	0	1	0	0	0	0	2
B02 Improve, construct or rehabilitate terraces	0	0	0	0	0	1	0	1
B03 Use irrigation	0	0	0	0	4	0	0	4
D02 Rangeland preservation and grazing restrictions	0	0	0	0	2	0	0	2
D04 Communal water harvesting, tanks	0	0	0	9	0	0	0	9
D05 Communal irrigation	0	0	0	0	2	0	0	2
Total	2	1	1	9	8	1	1	23

Note: no information on the site Al Wathan.

TABLE D.3. DISTRIBUTION OF INFORMATION SOURCES FOR APPLYING ADAPTATION STRATEGIES

<i>Code</i>	<i>Adaptation strategy</i>	<i>Personal source</i>	<i>Talking between the farmers</i>	<i>External source</i>	<i>Total</i>
A01	Crop selection	25	6	0	31
	Improve food storage facilities	3	0	0	3
A02	Adapt planting dates	3	0	1	4
A03	Adapt cropping densities	13	0	0	13
A04	Adapt fertilizer/ pesticide application	40	5	4	49
	Adapt tillage practices	24	0	0	24
	Apply different feed techniques.	11	0	0	11
	Use water harvesting techniques	26	0	0	26
B02	Improve, construct or rehabilitate terraces	46	0	0	46
B03	Use irrigation	58	5	1	64
	Temporary migration to urban areas or abroad	39	0	0	39
	permanent migration	2	0	0	2
	Home-garden agriculture	2	0	0	2
	Handicrafts	4	0	0	4
	Draw down on livestock, surpluses or savings	5	1	0	6
	Restore and preserve homestead or mountain forests	24	0	0	24
D02	Rangeland preservation and grazing restrictions	0	2	0	2
	Soil erosion prevention programs	20	0	0	20
D04	Communal water harvesting, tanks	5	0	8	13
D05	communal irrigation	28	2	0	30
	Total	378	21	14	413

TABLE D.3A. NUMBER OF TIMES A CERTAIN TYPE OF ASSISTANCE IS RECEIVED AS % OF THE TIMES ASSISTANCE IS GIVEN

A. TIMES A CERTAIN TYPE OF ASSISTANCE IS RECEIVED AS PERCENTAGE OF THE NUMBER OF CASES IN WHICH ASSISTANCE IS GIVEN

Clusters (%)						Villages (%)					
	Training	Labor	Inputs	Cash	Food		Training	Labor	Inputs	Cash	Food
1	0.0	0.0	57.9	10.5	31.6	Kandara	0.0	0.0	0.0	15.4	84.6
2	0.0	0.0	95.8	4.2	0.0	Touara	0.0	0.0	100.0	0.0	0.0
3	0.0	0.0	84.6	15.4	0.0	Kondogola	0.0	0.0	33.3	66.7	0.0
4	0.0	0.0	100.0	0.0	0.0	Fambougou	0.0	0.0	0.0	100.0	0.0
5	0.0	0.0	64.3	0.0	35.7	Togou	0.0	0.0	100.0	0.0	0.0
6	0.0	0.0	80.0	20.0	0.0	N'Tjila	0.0	0.0	0.0	100.0	0.0
total	0.0	0.0	78.5	7.6	13.9	total	0.0	0.0	78.5	7.6	13.9

Note: Inputs includes seeds, equipment, wood, machinery, bricks, etc

TABLE D.3B. TIMES A CERTAIN TYPE OF ASSISTANCE IS RECEIVED AS PERCENTAGE OF THE NUMBER OF THE NUMBER OF HOUSEHOLDS

Clusters (%)						Villages (%)					
	Training	Labor	Inputs	Cash	Food		Training	Labor	Inputs	Cash	Food
1	0.0	0.0	15.1	2.7	8.2	Kandara	0.0	0.0	0.0	4.0	22.0
2	0.0	0.0	65.7	2.9	0.0	Touara	0.0	0.0	68.0	0.0	0.0
3	0.0	0.0	25.6	4.7	0.0	Kondogola	0.0	0.0	2.0	4.0	0.0
4	0.0	0.0	23.5	0.0	0.0	Fambougou	0.0	0.0	0.0	2.0	0.0
5	0.0	0.0	11.5	0.0	6.4	Togou	0.0	0.0	54.0	0.0	0.0
6	0.0	0.0	8.2	2.0	0.0	N'Tjila	0.0	0.0	0.0	2.0	0.0
total	0.0	0.0	21.0	2.0	3.7	total	0.0	0.0	20.7	2.0	3.7

Note: Inputs includes seeds, equipment, wood, machinery, bricks, etc.

TABLE D.4. TYPE OF ASSISTANCE INSTITUTIONS ARE GIVING TO THE HOUSEHOLDS

	National Authorities (%)	Regional Authorities	Local authorities	Extension Agency (%)	International donors	NGO	Cooperatives (%)	Schools	Banks	Village community	Religious community	Women groups	Micro-finance institution
Training	0	n.a.	n.a.	0	n.a.	n.a.	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Labor	0	n.a.	n.a.	0	n.a.	n.a.	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Inputs	0	n.a.	n.a.	98	n.a.	n.a.	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Cash	0	n.a.	n.a.	0	n.a.	n.a.	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Food	0	n.a.	n.a.	0	n.a.	n.a.	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
No. of observ.	1	0	0	62	0	0	11	0	0	0	0	0	0

Note: Inputs includes seeds, equipment, wood, machinery, bricks, etc. N = number of observations.

TABLE D.5. TYPE OF ASSISTANCE HOUSEHOLDS RECEIVE, IF THEY ADOPT A CERTAIN STRATEGY

		<i>Training (%)</i>	<i>Labor (%)</i>	<i>Inputs (%)</i>	<i>Cash (%)</i>	<i>Food (%)</i>	<i>N</i>
A02	Adapt planting dates	0	0	0	0	0	6
A04	Adapt fertilizer/pesticide application	0	0	9.2	0	0	120
A08	Apply different feed techniques, like e.g. zero grazing	0	0	0	0	0	2
A10	Improve food storage facilities	0	0	0	0	0	21
A11	Improved seeds	0	0	0	0	0	233
A13	Change production practices	0	0	0	0	0	58
A15	Use manure of family herd on the field	0	0	0	0	0	206
B03	Use irrigation	0	0	95.8	0	0	48
B09	Drainage	0	0	0	0	0	21
C01	Temporary migration to urban areas or abroad	0	0	0	0	0	72
C02	Temporary migration to other rural areas	0	0	0	0	0	40
C05	Home-garden agriculture	0	0	28.6	0	0	7
C07	Handicrafts	0	0	0	60.0	0	10
C09	Start fisheries	0	0	0	0	0	3
C11	Draw down on livestock, surpluses or savings	0	0	0	0	4.3	47
D08	Cereal bank	0	0	0	0	14.5	62
D10	Communal support	0	0	0	0	0	11

APPENDIX 3. SUMMARY OF FOCUS GROUP DISCUSSIONS

A3.A. AL WATHAN

Date, time and place: 22/5/2010, 2:30 pm, Al Wathan, Bilad Ar Rus, Sana'a

<i>Occupation</i>	<i>Number</i>
Civil servant	3
Farmer	4
Farmer + Warden	1
Teacher	1
Total	9

Which Climate or Rainfall Related Hazards do you Face in your Daily Life?

Since 2000, Al Wathan experiences increasing periods of low rainfall during rainy seasons and periods of droughts. Rainfall in the year 2010 is till now very good. In the past, there were three planting seasons in one year with different crops per season. Currently, there is only one cropping season. Occasionally, two cropping seasons occur but often the planting seasons do not reach to the end. Families and livestock are more vulnerable to hazards and crops destroyed during the cold periods.

What are the Activities are Families Adapted to Overcome Droughts and Low Rainfall? And What the Impact?

All families are practicing all sorts of activities in the farms with good quality due to the experience. They

have and that in each season whether it is good season in rainfall or not. So they anticipate on the start of the rainy season does not come time, they shift to crops of short cropping season.

What are the Impacts and Risks Resulted from Climatic Changes?

Soil dryness and soil erosion due to unavailability of vegetation cover. Also, the low availability of water for animal feeding and grazing land results in animal death. In addition, families face high costs for buying animal feed and food since they have not harvested enough grains for own consumption. Families are facing these risks and problems on their own. Some families deepen the wells until the wells dry out, some families sell their animals, and some families immigrate to other villages. There were no floods during the past decade.

What are the Solutions Used to Adapt to Climatic Changes?

Buying animal feed and family food, take livestock to areas where water and grazing land is good.

Which Organizations, Authorities or People are Most Helpful to Learn More About How to Prepare for these Hazards? How can these Organizations Perform there Tasks Better?

Local council has helped the people of Al Wathan by planning to construct water cisterns and small dams for collecting water. Social Security Authority is helping the poor with little amounts of money but that is not enough.

A3.B. ARRAHEEBAH

Date, time and place: 17/5/2010, 4:00 pm, Arraheebah, Dimnat Khadeer, Taiz

Occupation	Number
Farmer	4
Laborer	2
Preacher	1
Student	3
School Head	1
Teacher	2
Total	13

What is the Climate Changes that Occurred in the Region During the Ten Previous Years?

Due to the lack of rain, there is

- a spread of diseases among the citizens, plants and animals;
- a change in the timing and parameters of agriculture.

What are the Effects and Consequences (Risks) Resulting from These Changes in Climate?

First: the lack of rain: -

- Drought of springs resulted in
 - a. low production of agricultural crops;
 - b. diminishing number of cropping seasons per year (season of corn, season of millet and sorghum and season barley throughout the year).
 - c. lack of cultivation of vegetables such as tomatoes, cucumber, potato and leek.
- Lack of vegetation cover for grazing: Animals die due to starvation or people sell their animals such as cows and sheep at low price. Food and grain is bought from the market at high prices.
- The people lost their source of livelihood or home products (ghee - milk - yoghurt - eggs - cheese)
- The transition from region to another for grazing sheep.
- There is a high unemployment rate among young people. People migrate from rural to urban areas in search of work.
- Get rid of all means of tillage.

- Hand drilling of wells for drinking and deepened from period to period due to drought, which led to an increase of salinity of water.
- Low per capita income led to inability to teach children in schools because children had to work to provide a living necessary for the family. The families disintegrated due to the low per capita income.
- The people had to sell land and savings to provide necessary sustenance for the family.
- Land Desertification led to decrease of tourism. Citizens of the city used to visit the village due to tourist attraction are not in more now.

Second: The State of the Climate (Weather)

Increase of the cold in the winter period had deployed diseases among children and the elderly that over expenditure for the purchase of medicines from the pharmacy without going to the doctor also spoke of some cases of death. Remaining crops were used as fuel for heating. Increase of the heat in the summer, diseases spread among children will increase the expenditures for the purchase of medicines, agricultural crops existing combustion, evaporation of water because of the high heat of the sun, excessive water consumption, drought and water scarcity and fetch water from remote areas outside the region.

Third: Diseases

The spread of diseases such plague in animals, led to loss of livestock. The diseases such as malaria, schistosomiasis, respiratory diseases, infections and allergies spread among children. In addition, the gynecologic diseases spread in women. The diseases spread in agricultural crops such as aphids and scabies.

What are the Solutions that have been used to Adapt to Climate Change?

Solutions Adopted to Cope with Lack of Rain

- Digging of artesian wells;
- Bring water from outside the area by tankers, cars and bikes;
- Prevent the irrigation from wells to maintain the drinking water;
- Internal and external migration;
- Sale of livestock;
- The sale of savings, such as gold and other; and

- Some citizens resort to the governmental jobs and militarism, while others resort to professional occupations such as construction and the drive and the others sell qat.

The reclamation of home gardens for the cultivation of some basic home vegetables. The use of fertilizers and pesticides, Reduce family expenses, Birth control.

Young people are reluctant to get married. Buy seeds from markets outside the region, Children stop going to schools. Buy food and vegetables from the city. Tilling the land by plowing. Requests the official authorities for the implementation of water projects, without success. Possession of a small number of sheep (goats) instead of cows to take advantage of their milk for children.

Solutions Exist to Adapt to Climate Change (Weather)

During the cold, people buy blankets and winter cloths to keep warm. Some people use the electric heater for heating water. Use coal for heating during the night. Use ways to protect children from being infected with a cold by preventing them from playing in the street after five in the evening. In the summer, the expansion of the windows, and put wire nets to prevent mosquitoes from entering homes, the use of clay to cool drinking water and others use electric refrigerators.

Solutions Adopted to Cope with the Diseases

Purchase of veterinary medicines for treating animals, the sale of animals at low prices for fear of disease, the transfer of animals to other areas to grazing. Purchase of treatment for patients from the pharmacies; use some of the traditional prescription to cure the disease. People did not use any solutions to address diseases that affect plants. All solutions that have been mentioned were adapted without any help from any agency, institution or organization.

What are the Institutions that Assisted you in Selecting and Applying these Solutions to Adapt the Climate Change? And What Kind of Aids were given to You?

There are no governmental, civil or support institutions providing assistance to adapt to the climate change.

What are the Reasons that Led to the Non-Existence/Success of Institutions in Providing Assistance to Adapt to Climate Change and Overcome the Risks?

- Personal conflicts between the influential figures of the region.
- Citizens do not know the donor communities that are implementing development projects and building the capacity of local communities.

What are the Benefits/Strengths that you Found in the Solutions for Adaptation to Climate Change?

- Adherence to livelihoods and to preserve the land from desertification or selling;
- Limit the spread of diseases and their prevention;
- Fighting against unemployment;
- Stability of the family because the costs of marriage; and
- Cooperation among the villagers.

What is the Damage/Weaknesses that you Found in Using of Solutions to Adapt to Climate Change?

- Illiteracy among the male and female evenly;
- Early marriage of girls;
- Bodies of people in the region became emaciated;
- Fires and suffocations are resulting from heating coal;
- The high rate of spinsterhood among young people; and
- The emergence of some diseases among women because of the use of birth control.

How was the Choice of Solutions to Adapt to Climate Change; is it on the Basis of Tribal or Customary, Economic or in General?

All solutions that have been used are generally without regard to any differences in rank, which resulted in cooperation between the people of the region.

A3.C. MAGAHEM ASHA'ABI DHI-SHRAQ

Date, time and place: 9/5/2010, 5:30 pm, Magahem Asha'abi Dhi-Shraq, As-Sayyani, Ibb

<i>Occupation</i>	<i>Number</i>
Civil Servant	2
Driver	1
Engineer	1
Farmer	4
Laborer	1
Soldier	2
Teacher	1
Total	12

What are the Climate Changes that Occurred in the Region During the Ten Previous Years?

Lack of rain, in the case of climate change in the four seasons of the year, the spread of diseases among the citizens and the plants and animals, a change in the timing and parameters of agriculture.

What are the Effects and Consequences (Risks) Resulting from These Changes in Climate?

First: the lack of rain: -

- Wells ran dry;
- Lack of underground water;
- Lack of agricultural crops dependent on rain;
- Increase the cost of water;
- The disappearance of vegetation;
- Desertification and soil erosion;
- Drought springs;
- Increase the salinity of underground water;
- Non-cultivation of vegetables;
- Decrease of the level of per capita income; and
- Environmental pollution.

Second: The State of the Climate (Weather)

Emissions from cars and pumps irrigating qat, and the quarries. The proliferation of remnants of poultry farms.

High temperature in the summer and increasing cold in winter, with the attendant spread of diseases among children, diseases such as malaria and infections of throats and mouths, and other blood infections that leads to increased household expenses in order to buy drugs from the pharmacy without going to the doctor, also spoke of some deaths.

Climatic changes have led to a change agriculture and harvestings. Burning of agricultural crops, evaporation of water because of the high heat of the sun, excessive water consumption.

Third: Diseases

Spread of disease such as plague, cowpox, foot and mouth disease (Aphthous fever), screwworm, and diarrhea. Alinvah in animals, leading to its death, the animals emaciated due to malnutrition. Diseases such as malaria, schistosomiasis, respiratory diseases, infections, allergies were spread in children and gynecologic, cancers, and anemia in women, as well as emaciation due to malnutrition. Spread of disease in agricultural crops such as fly embolism, and termites, aphids and armyworm.

What are the Solutions that have been used to Adapt to Climate Change?

Solutions adapted to cope with lack of rain:

- Fetching water from distant areas and at high prices;
- Keeping water in steel tanks;
- Collecting water from roofs of houses in the rainy season;
- Rationing in water consumption in homes;
- Cultivating qat as alternative and profitable crop;
- Drilling of wells and deepen from time to time;
- Selling livestock: cattle, sheep and goats;
- Selling valuables; like gold and others;
- Purchasing feed from local markets;
- Purchasing cereals, food, and vegetables from local markets;
- Buying gas ovens;
- Admitting to service in military and governmental jobs;
- Selling qat;
- Internal and external migration;

- Using poissons, pesticides and fertilizers;
- Having benefits from the Social Welfare Authority;
- Taking small loans to establish small income-generating;
- Reclaiming home gardens for the cultivation of what are necessary from vegetables; and
- Establishing water projects.

Solutions Adapted to Climate Change (Weather)

Buying Blankets and clothing in the winter, use the heater and electric stove by some people for heating water and rooms, the use of coal for heating during the night. Expanded windows when the heat becomes intense, install nets on the windows to prevent (mosquitoes) from entering homes, the use of clay to cool drinking water and others are using refrigerators, electric fans, electric use, planting trees alongside houses.

Solutions Adopted to Cope with the Diseases

- Buy veterinary treatment of animals, the sale of animals at low prices for fear of diseases. Buy the treatment for patients of people; use some of the popular prescription for overcoming the disease.
- Consulting some agronomists from the region, to describe the techniques needed to protect crops from damage or extinction.
- There are some solutions has been with participation of some institutions and the rest are solutions created by the local community and without any assistance from any institution or organization.

What are the Institutions that Assisted you in Selecting and Applying these Solutions to Adapt to the Climate Change, and any Kind of Aid was Given to You?

Institutions that provided assistance for the community to adapt to climate change are:-

<i>The type of assistance</i>	<i>The institution</i>	<i>No.</i>
Cash assistance each three month	Social Welfare Fund	1
Integrated water project	rural water projects	2
Small loans	Microfinance institutions	3
school	Social Fund for Development.	4
cows	Foreign organization	5

The related governmental and private institutions did not provide any assistance to adapt to climate change.

What are the Reasons that led to the Non-Existence/Success of Organizations in Providing Assistance to Adapt to Climate Change and Overcome the Risks?

- Lack of awareness among citizens about the essential duties of government institutions, and
- Lack of knowledge of the donor organizations that implement development projects and is building the capacity of local communities.

What are the Benefits/Strengths that you got when you used Solutions to Adapt to Climate Change?

- Stay at the region to preserve the land from desertification or sale;
- Limit the spread of diseases and their prevention;
- Fighting against unemployment;
- Family stability resulting of increase the costs of marriage;
- The villagers Cooperate among themselves;
- Get a steady income from employment;
- Availability of education for children;
- There are some projects that provide small income-generating;
- The availability of schools for boys and girls; and
- Career Level from inside the region, especially female teachers.

What is the Damage/Weaknesses of Applying the Solutions to Adapt to Climate Change?

- Illiteracy among families that have sold all their savings and their land.
- Early marriage of girls.
- Bodies of the people of the region became emaciated.

- Fires and suffocations resulting from using coal for heating
- The emergence of some diseases among women because of the use of birth control.
- The spread of diseases: cancers, kidney failure and cancers of the gum.
- Qat cultivation overshadowed all agricultural crops.
- Abandonment of terraces and left them without reclamation.

How was the Choice of Solutions to Adapt to Climate Change; is on the Basis of Tribal or Customary, Economic or in General?

All solutions that have been used were in general without discrimination of race or tribal, economic, or social rank. The participation of the people of the village have an effective interest in the topic, which has emerged through participation, asking questions and listening to everything going on with respect for different views among themselves. None participant showed any dominating on the debate.

A3.D. MU'ANEET

Date, time and place: 25/4/2010, 3:00 pm, Mu'aneet, Ar Rujum, Al mahweet

<i>Occupation</i>	<i>Number</i>
Accountant	2
Agricultural engineer/technician	3
Civil servant	3
Director	1
Farmer	7
IT specialist	1
Member local council	1
Total	18

Which Climate or Rainfall Related Hazards do you Face in your Daily Life?

Low rainfall and increasing variability in rainfall were not beneficial for us. In the past we used to crop 4 seasons. Also, we used to irrigate crops from springs but in the past decade the springs became dry. Soil fertility has decreased and the rainy seasons have been disturbed.

What are the Impacts and Risks Resulted from Climatic Changes?

Deterioration of seeds of grains and the production become very low. Animal reproduction is also low. Grazing land is decreasing because of the deterioration of vegetation cover due to low rainfall. Random and increase use of chemical fertilizers and reduction in local animal manure, immigration to other villages and nearby cities. The cropped land and livestock do not produce good revenues to farmers and as a result low economic return. Increase in labor costs, increase pressure on water for drinking affecting the water resources. Agricultural land and terraces are deteriorated due to input costs are higher than production costs. Some families have immigrated from the village. Low care of the land caused the spread of undesired vegetations that cause disease to animals and plants.

What are the Solutions used to Adapt to Climatic Changes?

Selling parts or all of the livestock, rent the agricultural land or leave it without agriculture, and change occupation from agriculture. Farmers also try to cultivate the land and do all necessary on farm management during each season and wait for the rain.

What are the Reasons that Lead to the Adaptation of these Strategies than Other Ones?

The reasons are: no available of institutions to support the villagers to better adaptation, no official adaptation strategies available especially strategies with the issues of economical, environmental and social impacts.

Which Organizations, Authorities or People are most Helpful to Learn More about How to Prepare for these Hazards? How can these Organizations Perform there Tasks Better?

No institutions are available that have the concern on climatic change. Recently Groundwater and Soil conservation Project are now interfering in the villages and we hope to benefit for it especially on the construction and rehabilitation of water cisterns.

A3.E. AL MEHRAQ

Date, time and place: 18/5/2010, 10:00 am, Al Mehraq, Sabar Al Mawadim, Taiz

Occupation	Number
Blind man	1
Farmer	3
Farmer, Extensionist	1
Laborer	3
Merchant	1
Social figure	1
(Big) Sheik	2
Total	12

What are the Climate Changes that Occurred in the Region During the Ten Previous Years?

Lack of rain, rain in some years, drought in other years, and heavy rains over the past two years. There was intense heat and extreme cold during the last three years. Fluctuations in climate were occurred. In one day, we found spring in the morning, summer at noon time an, autumn in the afternoon and winter in the evening. The emergence of diseases we had not known to the people, plants and animals, changes in the timing and parameters of Agriculture.

What are the Effects and Consequences (Risks) Resulting from these Changes in Climate?

First: The Lack of Rain

Lack of water, dry wells, low water table, dry springs, high salinity in the underground water, rise in the price of water, environmental pollution, internal and external migration, lack of agricultural crops dependent on rain, disappearance of vegetation cover, desertification and soil erosion, the low level of per capita income. Depending on imported agricultural crops. The cultural heritage and knowledge of the rainy seasons agriculture periods have been lost, no cooperation exist between people any more, citizens reduced the cultivation of vegetables that depend on irrigation from wells and increase the cultivation of Qat as an important high value alternative, use of forbidden fertilizers and pesticides, the use utensils plastic and steel to save drinking water, greenhouse gas emissions from cars and factories,

quarries, and the proliferation of remnants of poultry farms, and the high per capita expenditure.

Second: The State of the Climate (Weather)

The spread of diseases among the citizens, especially children and the elderly because of bad weather. In the winter, extreme cold, many deaths are occurred, especially among patients with heart disease. In the summer spread malaria, especially among children and cause the death of many. Increase the family expenses. Climatic changes have led to a change growing seasons and harvests. Evaporation of the water because of the increase of the sun heat. Excessive of the water consumption.

Third: Diseases

Spread of disease, plague, smallpox and diarrhea in animals, leading to her death and the frailty of animals because of malnutrition. The spread of diseases like malaria, schistosomiasis, respiratory diseases, infections and allergies in children. And gynecological cancers, and anemia in women, as well as emaciation due to malnutrition. Spread of disease in agricultural crops such as fly embolism, and termites, aphids and armyworm.

What are the Solutions that have been used to Adapt to Climate Change?

Solutions Adopted to Cope with Lack of Rain

Purchase water from outside the region and at higher prices, keep the water in the tanks of iron and plastic, water harvesting from the roofs of the houses in the rainy season, washing every week once. The cleaning cooking utensils leftovers water is used for watering livestock. Cultivating qat as alternative and profitable crop. Drilling wells and deepening them from time to time. The sale of cattle, goats and sheep. Sale of gold and land elsewhere, buy animal feeds from local markets, buying wheat, rice, millet and sorghum, corn, tomatoes, potatoes and onions from local markets to buy cookers gas. Work in factories and on the sale of Qat. And some have studied and worked in governmental jobs, migration to the city and Saudi Arabia for work, use of pesticides and fertilizer, and the poor received a pension from the Welfare Fund every three months.

Solutions in Place to Adapt to Climate Change (Weather)

In winter, people buy (blankets), and wool clothes, and heating the water, use stoves at night. In the summer people sleep in the roofs of houses, burn manure (animal waste fertilizers) in the night to ward off mosquitoes, we cool the water in bottles, water bottle and jars.

Solutions Adopted to Cope with Diseases

We brand the sick cow with branding kit. When diseases spread, we sell beef, lamb, and mutton at the cheapest price. In the past, we used to buy medicine for the patient from the pharmacy. However, nowadays there is a doctor at the hospital, who gives us the prescription medicine, we buy from the pharmacy, we use the soup, fennel, and the total of the glorious trees of abdominal pain and ironing (traditional medicine). Wisdom behind all these things from our parents and grandparents, no any other one taught us (without any help from any agency, institution or organization).

What are the Institutions that Assisted you in Selecting and Applying these Solutions to Adapt to Climate Change, and What Kind of Aid was Given to You?

Institutions that provided assistance for the community to adapt to climate change are:

No.	Institution	Type of assistance
1	Social Welfare Fund.	Cash assistance every three months
2	The local council directorate	Health center
3	Ministry of Education	Build a school

Other governmental and private organizations, in support of the relationship did not provide any valuable assistance to the region to adapt to climate change.

What are the Reasons that Led to the Non-Existence/Success of Institutions in Providing Assistance to Adapt to Climate Change and Overcome the Risks?

- Lack of awareness among parents the essential duties of government institutions, civil or support

and lack of knowledge of the donor community that implement development projects and is building the capacity of local communities.

- Lack of cooperation between the people.
- Envy among the people.
- There are no elders and officials try to help.
- All the projects owned by the government and the citizens did not cooperate between each other.

What are the Benefits/Strengths that you Found in Applying these Solutions to Adapt to Climate Change?

- Staying in the village so as not to loss the land or be sold.
- Limit the spread of diseases and their prevention.
- fighting against unemployment.
- A fixed monthly salary.
- Educating of children.
- The availability of school and health center.

What is the Damage/Weaknesses that you Found in Applying the Solutions to Adapt to Climate Change?

- Illiteracy, especially among girls.
- Early marriage of girls.
- Bodies of people in the region became emaciated.
- The emergence of some diseases among women because of use of the birth control.
- Various diseases spread among the citizens, such as infections, whooping cough, and schistosomiasis.
- The qat cultivation overshadowed on the other agricultural crops

How was the Choice of Solutions to Adapt to Climate Change is it on the Basis of Tribal or Customary, Economic or in General?

All solutions that have been used were in general without ethnic, tribal, economic, or social distinction.

A3.F. AL MASAJED

Date, time and place: 25/4/2010, 4:30 pm, Al Masajed, Banai Matar , Sana'a

<i>Occupation</i>	<i>Number</i>
Civil servant	2
Farmer	5
Farmer- civil servant	1
Farmer-soldier	1
Soldier	1
Student	1
Total	12

Which Climate or Rainfall Related Hazards do you Face in your Daily Life?

Droughts and reduction of rainfall, rainfall seasons are coming late, springs are becoming dry and groundwater levels drops very dramatically which in all have affected the agricultural.

For Drought Hazards: To What Extent Has the Start of the Rainy Season and the Amount of Rain Fallen During the Rainy Season Varied over the Last Decades?

Every year the rainy season comes late than the year before with rainfall amounts also becoming less, however this year the rainy season on time and is very good.

Do you Adapt Farming Strategies if you have Experienced Drought Problems over the Past Years?

Groundwater well drilling has increased, change to specific types of crops, shift to other activities and employment.

Are there Differences in Crops Grown, Tillage Techniques, Planting Dates, Activities Performed, Equipment Used?

Cares for the land have reduced, planting dates changed according to rainfall; animal and machinery are used as before.

Did you Change the Composition of Your Livestock Owned, Livestock Management?

Livestock has been reduced due to selling for more income and low rainfall.

How much do these Changes Cost you in Terms in Resources used, Labor Requirements, etc.?

Costs have increased for example drilling wells increased from 10,000YR/m – 150,000/m. Families are cooperating together to work on the field to reduce the high costs of labor.

Which Organizations, Authorities or People are most Helpful to Learn More About how to Prepare for these Hazards? How can these Organizations Perform there Tasks Better?

Agricultural office is available in the area but has limited capacities and financial resources.

To What Extent are Choices Dependent on Ethnicity, Wealth Class, Gender?

No choice because no adoption strategies are present.

APPENDIX 4. SUMMARY OF INSTITUTIONAL STAKEHOLDER INTERVIEWS

QUESTION 1. GENERAL STATISTICS OF RESPONDENTS

<i>Id</i>	<i>Site</i>		<i>District</i>	<i>Main activity/position of respondent in the village</i>	<i>Years person holds this position</i>
	<i>Code</i>	<i>Name</i>			
1	1	Al Wathan	Bilad Ar Rus	Village Warden, Farmer	8
2	1	Al Wathan	Bilad Ar Rus	Civil servant, Farmer	8
3	1	Al Wathan	Bilad Ar Rus	Teacher, Farmer	5
1	2	Arraheebah	Dimnat Khadeer	Religious man	4
2	2	Arraheebah	Dimnat Khadeer	School head	12
3	2	Arraheebah	Dimnat Khadeer	School teacher	2
1	3	Dhi-Shraq	As-Sayyani	Member of mothers council at girls' school	unknown
2	3	Dhi-Shraq	As-Sayyani	Member of mothers council at girls' school	unknown
3	3	Dhi-Shraq	As-Sayyani	Head of girls' school	3
4	3	Dhi-Shraq	As-Sayyani	Social expert at girls school	14
1	4	Mu'aneet	Ar Rujum	Civil servant in health sector	10
2	4	Mu'aneet	Ar Rujum	Civil servant at the office of teaching and education	23
3	4	Mu'aneet	Ar Rujum	Director of human resources, health department	17
4	4	Mu'aneet	Ar Rujum	Accountant	12
5	4	Mu'aneet	Ar Rujum	Health sector civil servant	15
6	4	Mu'aneet	Ar Rujum	Teacher	20
7	4	Mu'aneet	Ar Rujum	Village warden	20
1	5	Al Mehraq	Al Mawadim	Laboratories	<1
2	5	Al Mehraq	Al Mawadim	Sheik	2
3	5	Al Mehraq	Al Mawadim	Health doctor	21
4	5	Al Mehraq	Al Mawadim	Old farmer (80 years)	All his live
1	6	Al Masajed	Bani Matar	Nurse	15
2	6	Al Masajed	Bani Matar	Teacher of chemistry and Physics	6
3	6	Al Masajed	Bani Matar	Commercial + property + agriculture	10
4	6	Al Masajed	Bani Matar	Education and teaching + agriculture	8
5	6	Al Masajed	Bani Matar	Sheik	40
6	6	Al Masajed	Bani Matar	Civil servant + other activities + agriculture	20

QUESTION 2A. HAZARDS FACED BY VILLAGES

<i>Importance of hazards (1 = least important; 10 = most important)</i>										
<i>Village</i>	<i>Drought</i>	<i>Rainfall variability</i>	<i>Floods</i>	<i>Damage of heavy rains</i>	<i>Temperature change</i>	<i>Human diseases</i>	<i>Animal or crop pests</i>	<i>Decreased soil fertility</i>	<i>Sales problems</i>	<i>High food prices</i>
Al Wathan	9.3	9.7	1.0	3.3	4.7	2.7	7.7	2.7	8.0	7.0
Arraheebah	10.0	7.3	2.0	2.0	3.3	6.3	6.3	4.3	6.7	9.0
Dhi-Shraq	8.0	6.0	2.3	3.3	6.0	7.5	5.5	5.8	4.5	7.8
Mu'aneet	9.4	8.3	1.0	2.3	4.6	2.9	6.9	6.0	6.9	6.4
Al Mehraq	8.8	7.8	3.5	2.5	5.3	8.3	7.8	3.8	3.3	6.8
Al Masajed	9.2	9.5	1.2	1.7	5.7	5.7	6.3	4.5	4.7	4.2
Average	9.1	8.1	1.8	2.5	4.9	5.5	6.7	4.5	5.7	6.8
Rank	1	2	10	9	7	6	4	8	5	3

QUESTION 2B. HAZARDS BECOMING MORE THREATENING FACED BY VILLAGES

<i>Have hazards become more or less threatening (1 = a lot less; 5 = a lot more)</i>										
<i>Village</i>	<i>Drought</i>	<i>Rainfall variability</i>	<i>Floods</i>	<i>Damage of heavy rains</i>	<i>Temperature change</i>	<i>Human diseases</i>	<i>Animal or crop pests</i>	<i>Decreased soil fertility</i>	<i>Sales problems</i>	<i>High food prices</i>
Al Wathan	5.0	5.0	1.0	2.7	3.3	2.3	4.3	2.3	5.0	5.0
Arraheebah	5.0	4.0	1.0	1.7	2.3	4.0	3.3	3.0	4.7	5.0
Dhi-Shraq	2.5	2.0	1.5	1.8	2.0	2.8	3.0	2.3	2.8	4.5
Mu'aneet	4.9	4.4	1.3	1.7	3.7	3.1	4.3	4.1	4.9	5.0
Al Mehraq	3.0	3.8	0.8	0.8	2.5	2.8	2.8	2.8	1.8	1.8
Al Masajed	4.7	4.5	1.3	1.7	3.2	3.3	3.7	3.7	4.8	4.5
Average	4.2	3.9	1.1	1.7	2.8	3.1	3.6	3.0	4.0	4.3
Rank	2	4	10	9	8	6	5	7	3	1

QUESTION 3. ORGANIZATIONS PRESENT IN THE VILLAGES (%)

Organizations present in the village														
Village code	People interviewed	Local administration	Extension agency	International donor	NGO	Cooperative	School	Bank	Village community	Religious group	Women's group	Microcredit bank	Self-help group	Union
1	3	100	0	100	0	0	0	100	0	0	0	0	33	33
2	3	0	0	0	0	0	0	100	0	0	0	0	0	0
3	4	25	0	25	0	0	0	100	75	25	100	50	0	0
4	7	100	29	100	0	43	0	100	14	14	0	0	43	29
5	4	100	0	0	0	0	0	100	0	0	0	0	0	0
6	6	83	17	100	0	17	0	100	0	67	0	0	0	0
Total	27	74	11	63	0	15	0	100	15	22	15	7	15	11

1 Al Wathan, 2 Al Rahaiba, 3 Thy Yashreq, 4 Ma'enet, 5 Al Mehraq, and 6 Al Masajed.

Importance of the institutions for helping the population to adapt to climate change (1 = not at all important; 5 = very important)														
Village code	People interviewed	Local administration	Extension agency	International donor	NGO	Cooperative	School	Bank	Village community	Religious group	Women's group	Microcredit bank	Self-help group	Union
1	3	4.7	0.0	5.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	1.7	1.7
2	3	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.0	0.0	2.8	0.3	0.0	0.0
4	7	4.7	1.1	5.0	0.0	2.1	0.0	4.7	0.7	0.6	0.0	0.0	2.1	1.3
5	4	5.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
6	6	4.2	0.7	5.0	0.0	0.7	0.0	4.5	0.0	3.0	0.0	0.0	0.0	0.0
Total	27	3.4	0.4	3.0	0.0	0.7	0.0	4.6	0.6	0.8	0.4	0.0	0.7	0.5

1 Al Wathan, 2 Al Rahaiba, 3 Thy Yashreq, 4 Ma'enet, 5 Al Mehraq, and 6 Al Masajed.

QUESTION 4A. WHICH ORGANIZATION(S) ARE IN YOUR OPINION MOST HELPFUL OR BEST TO HELP THE POPULATION ADAPTING TO THE RISKS OF WEATHER VARIABILITY?

Village

1	<ul style="list-style-type: none"> • Health and agricultural authorities
2	<ul style="list-style-type: none"> • World Health Organization, and agricultural cooperative organization • Multiple agricultural cooperative union
3	<ul style="list-style-type: none"> • No organization available • Women's organizations • Development organizations
4	<ul style="list-style-type: none"> • Irrigation and agricultural authorities • Agricultural, industrial, public works and health authorities • Agricultural, water and water harvesting authorities • Agricultural, and health authorities • Agricultural, environment and health
5	<ul style="list-style-type: none"> • Health authorities • Health and environmental organizations
6	<ul style="list-style-type: none"> • Health and agricultural authorities • Agricultural authorities, but are not available in reality

1 Al Wathan, 2 Arraheebah, 3 Magahem Asha'abi Dhi-Shraq, 4 Mu'aneet, 5 Al Mehraq, and 6 Al Masajed.

QUESTION 4B. WHAT TYPE OF ASSISTANCE DO HOUSEHOLDS NEED IN ORDER TO ADAPT TO THE RISKS OF WEATHER VARIABILITY? TRAINING, KNOWLEDGE, INPUTS, FINANCIAL AID, COMMUNAL PROJECTS ON E.G. IRRIGATION, SOIL EROSION PREVENTION OR WATER HARVESTING

Village

1	<ul style="list-style-type: none"> • Training, knowledge, inputs, financial aid, communal projects on e.g. irrigation, soil erosion prevention or water harvesting
2	<ul style="list-style-type: none"> • Training, knowledge, inputs, financial aid, communal projects on e.g. irrigation, soil erosion prevention or water harvesting
3	<ul style="list-style-type: none"> • Need financial support from development organizations • Training, knowledge, inputs, financial aid, communal projects on e.g. irrigation, soil erosion prevention or water harvesting • Knowledge, financial, communal projects on e.g. irrigation, and community water harvesting
4	<ul style="list-style-type: none"> • Training, soil erosion, communal projects on e.g. irrigation, and community water harvesting • Communal projects on e.g. irrigation, and community water harvesting • Knowledge, input, communal projects on e.g. irrigation, and community water harvesting • Soil erosion, communal projects on e.g. irrigation, and community water harvesting
5	<ul style="list-style-type: none"> • Inputs, irrigation, soil erosion prevention or water harvesting • Financial support, soil erosion prevention and water harvesting • Training, knowledge, inputs, financial aid, communal projects on e.g. irrigation, soil erosion prevention or water harvesting
6	<ul style="list-style-type: none"> • Training, knowledge, inputs, financial aid, communal projects on e.g. irrigation, soil erosion prevention or water harvesting

1 Al Wathan, 2 Arraheebah, 3 Magahem Asha'abi Dhi-Shraq, 4 Mu'aneet, 5 Al Mehraq, and 6 Al Masajed.

QUESTION 4C. WHAT KIND OF PROBLEMS HAMPER TO YOUR OPINION THE ACTIVITIES OF THE ORGANIZATIONS WHO ARE ASSISTING THE POPULATION TO ADAPT TO CHANGING WEATHER VARIABILITY

Village

1	• Education and awareness
2	• Water scarcity problems and unavailable of funds • Some social figure, Influential people, local authorities • Local Council does not cooperate with people in the village
3	• No knowledge about organizations, no cooperation among people
4	• Sheiks, wardens and directors of authorities • No organizations available. • No organizations available so no problems.
5	• Local people are not cooperative
6	• Education and awareness, difficult roads, financial constraints • We do not know the problems since activities are not available • Recently no organizations are avialble

1 Al Wathan, 2 Arraheebah, 3 Magahem Asha'abi Dhi-Shraq, 4 Mu'aneet, 5 Al Mehraq, and 6 Al Masajed.

QUESTION 4D. WHAT KIND OF EXTERNAL ASSISTANCE OR HELP DO ORGANIZATIONS WHO ARE WORKING IN THIS FIELD NEED IN ORDER TO IMPROVE THEIR RESULTS? FINANCIAL HELP, KNOWLEDGE/TRAINING, INPUTS/MATERIAL, BACK-UP FROM GOVERNMENTAL OR INTERNATIONAL ORGANIZATIONS,?

Village

1	• Not available
2	• No local or international organizations available in the village
3	• Not available
4	• Not available
5	• Not available
6	• Not available

1 Al Wathan, 2 Arraheebah, 3 Magahem Asha'abi Dhi-Shraq, 4 Mu'aneet, 5 Al Mehraq, and 6 Al Masajed.



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