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ABBREVIATIONS

AKDN	Aga Khan Development Network
CC	Climate change
CCTs	Conditional Cash Transfers
CEM	Country Economic Memorandum
COES	Committee of Emergency Situations and Civil Defense
CRED	Centre for Research on the Epidemiology of Disasters
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECA	Europe and Central Asia
FDI	Foreign Direct Investment
GBAO	Gorno-Badakhshan Autonomous Oblast
GDP	Gross Domestic Product
ICARDA	International Center for Agricultural Research in Dry Areas
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
LITS	Life in Transition Survey
MFI	Microfinance Institution
NBT	National Bank of Tajikistan
NGO	Non-governmental organization
OFDA	Office of Foreign Disaster Assistance (US Agency for International Development)
PPCR	Pilot Program for Climate Resilience
PRSP	Poverty Reduction Strategy Paper
RRS	Rayons of Republican Subordination
TLSS	Tajikistan Living Standards Survey
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations Human Development Report
UNICEF	United Nations International Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
USAID	United States Agency for International Development
VDC	Village Development Committee
WB	World Bank
WFP	World Food Program
WHO	World Health Organization
WUA	Water User Association

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PREFACE AND ACKNOWLEDGEMENTS

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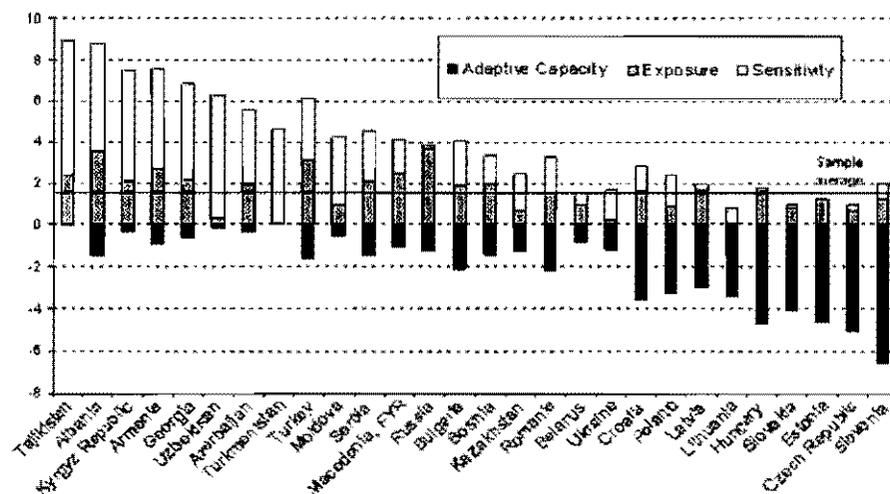
EXECUTIVE SUMMARY

Is Tajikistan at-risk from climate change? If so, how should it adapt, given the many other pressing challenges it faces? Can long-term adaptation be reconciled with near-term development priorities? This report advances three main propositions in response, and provides supporting arguments and evidence to buttress them. First, it warns that households in Tajikistan are significantly threatened by climate change, and illustrates the main transmission channels through which they will likely be impacted. Second, the report shows how, far from being in conflict, Tajikistan's climate adaptation priorities are in fact in close conformance with key development objectives, and highlights the strong public support for more government spending on agriculture, water management and public infrastructure, disaster management, and public health—four key areas identified in the country's latest poverty reduction strategy as being especially important from both climate-change and development perspectives. It presents a regional vulnerability index for Tajikistan, which could help direct climate change adaptation investments towards areas of highest vulnerability. Finally, the report argues that it is imperative that project-based climate-related interventions be supported by an enabling environment and overall policy framework that is conducive to facilitating faster climate adaptation.

1. The 2006 Stern Review on the economics of climate change marked a watershed in attracting widespread public attention to the effects of climate change on the global economy. As the study highlights, an overwhelming body of scientific evidence indicates that climate change resulting from increased accumulation of greenhouse gases is a serious and urgent issue. Global mean temperatures may rise between 2-5 degrees Celsius over the next 2-3 decades, exacerbating existing patterns of water shortages and excesses and increasing the risk of drought and floods. Climate change impacts will be felt differentially across regions: while some countries may benefit from modest rises in temperature, most are expected to suffer heavily, especially some of the world's poorest countries.

2. **Tajikistan is highly vulnerable to the adverse impacts of global climate change.** A recent World Bank study warns that countries in the Europe and Central Asia (ECA) region are significantly threatened by climate change, with serious risks—e.g. floods, drought, and melting of glaciers—already in evidence across the region. Over the next two decades, vulnerability to climate change and adaptive capacity are likely to be dominated by socio-economic factors and legacy issues. Based on the analysis carried out, Tajikistan emerges as the most vulnerable country in ECA using three key indicators of countries' exposure, sensitivity, and adaptive capacity to climate change (figure). In large part this is because it has social and productive structures that make it very sensitive to the impact of a changing climate, as well as has amongst the lowest low adaptive capacity among countries in the region.

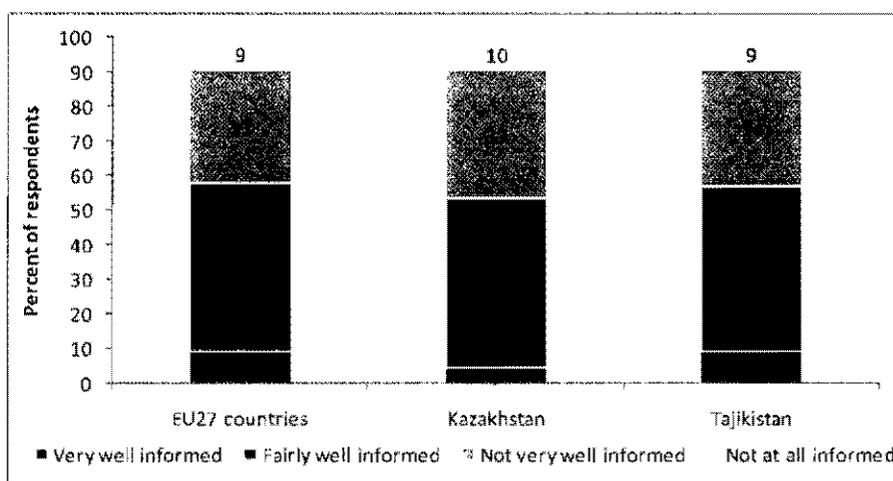
ECA countries ranked by vulnerability to the adverse impacts of climate change



Source: World Bank (2009): *Adapting to Climate Change in Europe and Central Asia*

3. *Awareness of the different consequences of climate change is quite high in Tajikistan, with potential impacts on health, natural disasters, and agriculture of greatest public concern.* The findings of a nationally representative household survey commissioned for the report (P-LITS) show that public awareness of the different consequences of climate change is quite high, and is comparable to prevailing levels in much richer countries (figure): a majority of respondents felt they were either very well-informed, or fairly well-informed, (9 and 48 percent respectively), about the different consequences of climate change.

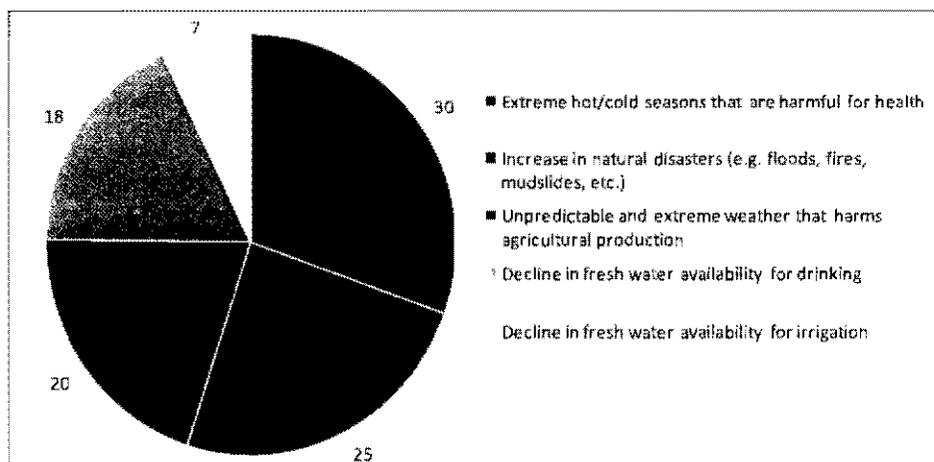
Public awareness of the different consequences of climate change



Source: World Bank staff estimates based on 2010 P-LITS. Data for the 27 European Union member countries are from *Europeans' attitude towards climate change* Special Eurobarometer 300, Wave 69.2, September 2008.

4. When presented with a list of several possible adverse impacts of climate change, “dangers posed by extreme hot/cold seasons that are harmful for health” were cited as their most important concern by the highest share of respondents (30 percent), followed by “increase in natural disasters” (25 percent), and “unpredictable/extreme weather that harms agricultural production” (20 percent).

Potential impacts of climate change on health, natural disasters & agriculture are of greatest public concern



Source: 2010 P-LITS. Percent of survey respondents.

5. *The major health impacts of climate change in Tajikistan will likely be observed through the increased thermal stress, water-borne diseases and disaster effects.* These pressures will exacerbate

existing problems of the health sector, particularly high levels of water-borne diseases as well as the crumbling state of physical infrastructure—e.g. most rural health facilities do not have access to piped water and communication, and only limited supply of electricity and heating. The poor are more likely than the non-poor to suffer from increased health risks associated with climate change (see the box for more details on the distributional aspects of climate change).

Climate Change and Poverty in Tajikistan

Transmission Channels: The primary impact of climate change on the livelihoods of people will be observed through 1) the reduced water quantity and quality, which will affect agriculture and health (through the rise of water-borne diseases) as well as 2) the increased frequency and severity of disasters: mudflows, floods and droughts (2nd National communication of Tajikistan under UNFCCC). These physical impacts can potentially deepen poverty and increase the possibility of permanent poverty traps. Poor people already struggle with a number of stresses. They have limited resources and the least capacity to adapt their livelihoods to changing conditions.

Agriculture: There are three channels through which adverse climate conditions can affect people's livelihoods from agriculture: (1) decline in agricultural productivity (yields), (2) reduction in agricultural wages and (3) increase in relative food prices. Simulations based on household data show that a 20 percent decline in agricultural productivity can increase the national poverty rate by 13 percent and poverty gap by 24 percent respectively. A similar increase of relative food prices can lead to a rise in poverty rate by 16 percent and poverty gap by 25 percent. A drop of income from agricultural wages will have a much smaller impact on poverty (a 20% drop in agricultural wages increases poverty by 2 percent and poverty gap by 7 percent.) as their share in the total income of most households is insignificant. All of these effects will have a stronger impact in rural than in urban areas. This is because rural areas have a much greater concentration of population around the poverty line, so that even a modest decline in income/purchasing power will have a significant impact on poverty.

Health: The major health impacts of climate change in Tajikistan will be observed through the increased thermal stress, water-borne diseases and disaster effects. The poor are more likely to suffer from the increased health risks associated with climate change than the non-poor due to (1) inability to cover out-of-pocket expenditures for medical services, (2) higher prevalence of water-borne diseases among the poor than the non-poor and (3) weaker immune systems of the poor stemming from malnutrition and adverse living conditions. Analysis of the 2007 Tajikistan Living Standards Survey data shows that 46 percent in the poorest quintile of households found it impossible/very difficult to pay for health care, compared to 27 percent in the richest quintile. The incidence of diarrhea is 1.4 times higher among the poorest vs. richest quintile. There are also pronounced differences in calorie intake by welfare status and children from the poorest quintile are almost twice as likely to be severely underweight as those from the richest.

Disasters: While there is no sufficient survey data in Tajikistan to quantify the impact of disasters by welfare status, evidence from global studies shows that the poor tend to be disproportionately affected by disasters as their housing is of inferior quality and often constructed in hazardous locations. They also cannot afford the costs of migration to less hazard-prone locations. Lastly, after disasters occur, it takes them longer to restore their livelihoods as the poor tend to have non-diversified incomes and little savings.

For more information on climate change and poverty, see Chapter 1 of the report.

6. *Tajikistan is highly prone to natural disasters, whose frequency is expected to rise with impending climate change.* According to the UN Office for Coordination of Humanitarian Affairs, 85 percent of Tajikistan's area is threatened by mudflows. Landslides are also common, with some 50,000

reported across the country during the 1990s. Furthermore, the occurrence of droughts has increased. In the past 60 years, the country has suffered eight major droughts; with the expected rise in aridity, the frequency and severity of droughts is forecasted to increase. The frequency of floods will also go up as warming temperatures will increase the rate of snow melting and raise the level of water in the rivers. Natural disasters are already resulting in significant human and financial losses. Tajikistan has the largest number of casualties associated with disasters in ECA, with the annual cost of disasters estimated at 1.6 percent of GDP. The biggest damage was caused by floods and mudflows in Padjakent, Qubodiyon, Rudaki, Varzob, and Hamadoni rayons, which suffered total damage estimated at about 25-28 million Somoni during 1997-2008.

7. *The agricultural sector in Tajikistan is also highly vulnerable to climate change.* This vulnerability stems from negative physical impacts as well as the significant environmental challenges the sector currently faces. The major physical impacts of impending climate change will be manifested through increased water scarcity, worsening of soil conditions and desertification, and outbreaks of pests. Any shocks in the agricultural sector will have significant impacts on welfare, given that almost half the country's domestic labor force is employed in agriculture, and that food production and agricultural wages constitute about 48 percent of household incomes.

PUBLIC PERCEPTIONS OF THE SERIOUSNESS OF THE CLIMATE CHANGE PROBLEM

8. How serious a problem do citizens of Tajikistan perceive climate change to be? The answer to this question depends upon how the issue is posed to them. Respondents in the P-LITS were asked a series of questions regarding the extent to which they thought climate change is a very serious problem. When presented a list of various issues and asked which they considered to be "very serious problems" facing the world, "spread of infectious diseases", "poverty, lack of food and drinking water" and "international terrorism" received the highest share of votes (84, 76, and 47 percent respectively of respondents). At the same time, 41 percent of respondents also identified climate change to be a serious problem (table).

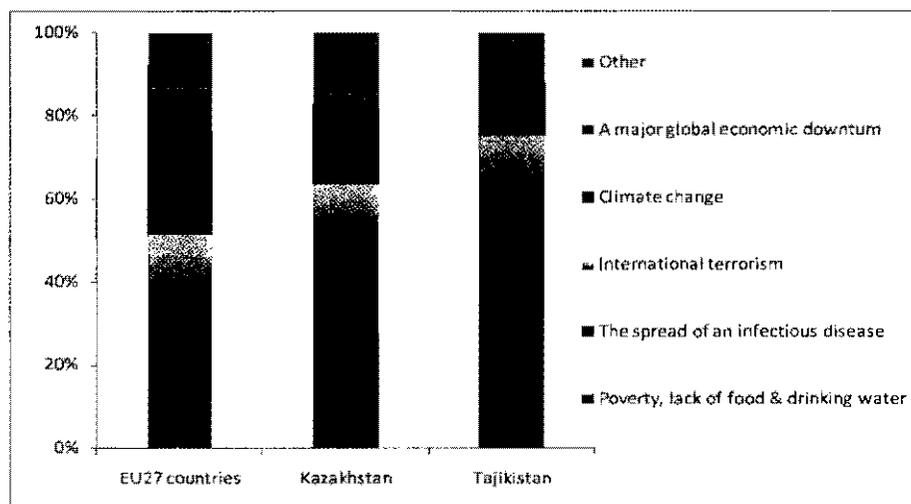
Respondent Opinions about Major Problems Currently Facing the World

Issue:	Percentage of respondents in the country that consider the issue to be a very serious problem		
	EU27 countries	Kazakhstan	Tajikistan
Poverty, lack of food and drinking water	70	66	76
The spread of an infectious disease	24	70	84
International terrorism	55	50	47
Climate change	64	36	41
A major global economic downturn	25	47	38
Proliferation of nuclear weapons	24	33	29
Armed conflicts	39	53	28
The increasing world population	20	12	17

Source: World Bank staff estimates based on 2010 P-LITS 2; Special EU Barometer 300/wave 69.2

9. However, when asked to select the single-most serious problem confronting the world, only 7 percent of respondents in Tajikistan chose climate change, much lower than in European Union countries (31 percent). Instead, Tajik respondents ranked "spread of infectious diseases" and "poverty, lack of food and drinking water" as the two most important problems facing the world (figure).

Respondents perceive poverty & infectious diseases to be the most serious problems facing the world



Source: World Bank staff estimates based on P-LITS data; Special EU Barometer 300/wave 69.2

ADAPTATION TO CLIMATE CHANGE: A “NO-REGRETS” APPROACH

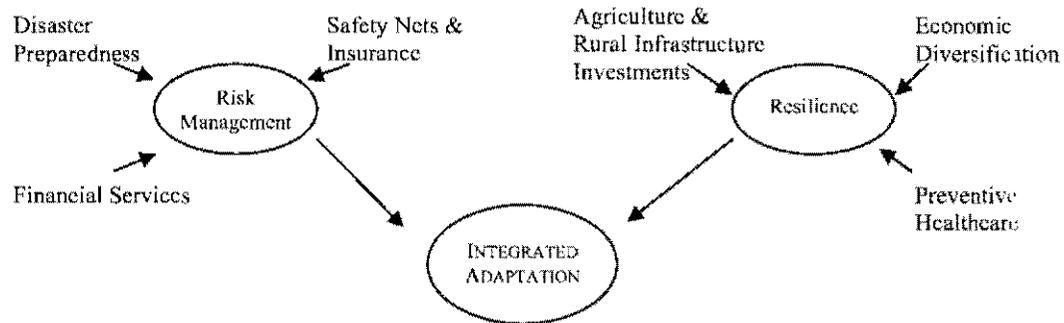
10. *How should Tajikistan adapt to climate change, given the many other pressing development challenges that it faces?* Are there trade-offs, or can long-term climate adaptation be reconciled with near term development priorities? The report argues that, far from being in conflict with each other, climate change adaptation strategies for Tajikistan are in fact in close conformance with its general poverty reduction and development objectives. In fact, development is an integral and most important tool for adaptation. Greater income diversification, improved health and education as well as better access to information, services, resources and infrastructure enhances the adaptation capacity of households, particularly for the poor. *Adaptation planning in Tajikistan should start with the so-called “no regrets” policies*—i.e. investment and policy decisions that will provide benefits under current climate conditions as well as strengthen resilience to future changes.

11. *Tajikistan is not well adapted to its current climate let alone impending changes* as evident in low agricultural productivity, water stress, and high losses incurred due to disasters. Furthermore, many current policies exacerbate rather than reduce vulnerability to climate change. This in particular relates to excessive emphasis on cotton cultivation,¹ poor water management systems that do not create incentives for efficient water use, and insecure land tenures that do not provide farmers adequate property rights and hence incentives to properly develop land. Introducing reforms in these areas will help improve people’s livelihoods and facilitate economic growth irrespective of the climate change scenarios.

12. *Along with much needed policy reforms*, devising an effective adaptation strategy requires that adequate attention be directed towards two main areas (1) building resilience to strengthen the ability of households, communities as well as local and national governments to withstand any negative climate impacts and (2) improving the risk management capacity of households, particularly the poor, to cope with increased risks associated with climate change (figure).

¹ Cotton has traditionally been favored by policy makers in Tajikistan because of its importance as a major foreign exchange earner, resulting in output being maintained at levels far above what is economically viable.

Basic Elements of an Integrated Climate Change Adaptation Strategy



Source: Adapted from L. Cord, C. Hull, C. Hennem, and G. van der Vink, (2008) cited earlier.

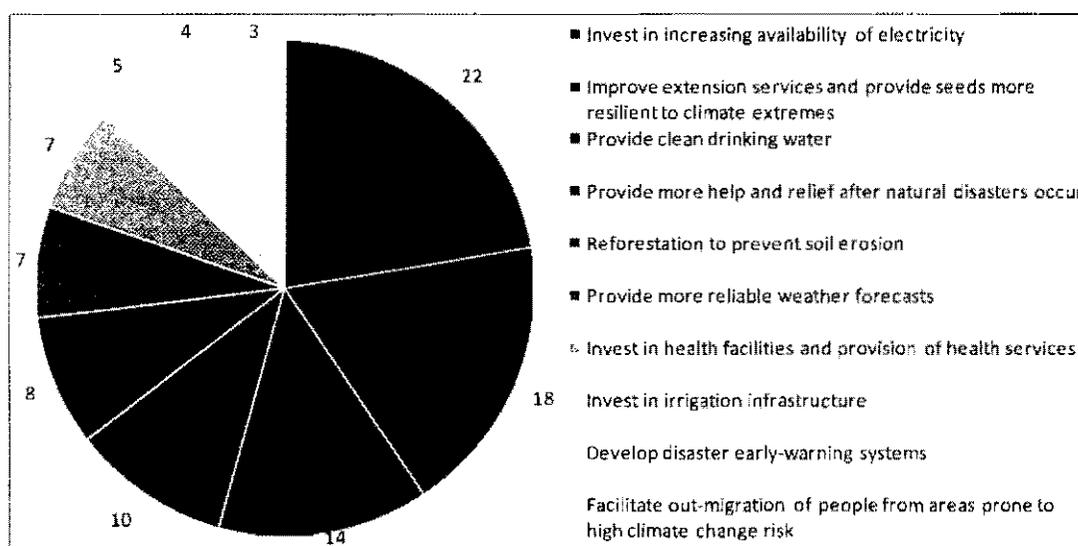
Building greater resilience will require investments in agriculture and rural infrastructure, economic diversification and preventive healthcare. In agriculture, reforms should focus on removing constraints that tie farmers to cotton cultivation, creating incentives for efficient water management, and ensuring secure land titles. Furthermore, development of extension services will be necessary to promote sustainable land management, facilitate diversification towards crops using less water and increase agricultural productivity. Building greater resilience to climate change will entail not just reducing dependence on crops vulnerable to variability in climatic conditions, but also reducing dependence on agriculture. Creating conditions for development of more off-farm livelihoods opportunities to reduce dependence on climate sensitive activities in agriculture requires actions on several fronts—e.g. improvements in the prevailing investment climate to stimulate private investment and job-creation, skill building, better public infrastructure, etc. Lastly, health reforms should continue with an emphasis on preventive measures, improvement of hygiene and strengthening disaster preparedness of the health sector. It will also be important to increase access to clean drinking water to reduce the incidence of water-borne diseases.

Strengthening risk management will require greater emphasis on measures to improve disaster management, enhance access to financial services (particularly in rural areas) and develop safety nets and insurance products. Improving early warning systems, strengthening public infrastructure (e.g. river bank dikes and levees), constructing shelters and working with communities to build their capacity to prevent and respond to disasters are good examples of disaster management activities that have already been undertaken in Tajikistan. Significant investment will be needed to scale-up such initiatives to all vulnerable locations. It is also important to improve the regulatory framework for the banking sector and provide support to development of microfinance institutions to help households and small businesses accumulate assets, diversify livelihoods/production and develop coping mechanisms that will make them less vulnerable to climate variability and extremes. Furthermore, it will be necessary to develop flexible safety net programs that address the needs of the chronic poor and can be scaled up in case of a disaster, which could help reduce poverty and increase resiliency to climate change.

13. Several development partners in Tajikistan have funded projects that contribute to climate change adaptation by promoting sustainable management of natural resources, improving community level governance, strengthening local infrastructure or improving health care, primarily at the local level using innovative community-driven approaches to improve management of natural resources and raise incomes. A supportive national regulatory framework will be imperative to allow for further development of these and other relevant initiatives and to enable faster climate change adaptation.

14. **Priority sectors:** When P-LITS respondents were asked to choose the single-most important priority for additional government spending related to climate change, (i) investing in increasing availability of electricity (22 percent), (ii) improving extension services and providing seeds more resilient to climate extremes (18 percent), and (iii) providing clean drinking water (14 percent) received the highest share of votes from respondents (figure); (iv) providing more help and relief after natural disasters occur (10 percent), (v) reforestation to prevent soil erosion (8 percent), (vi) providing more reliable weather forecasts (7 percent), and (vii) investing in health facilities and provision of health services (7 percent) got the next highest share of votes. In other words, the key priorities for adaptation areas emerging from the survey—agriculture, improvement of water management and infrastructure (mainly electricity supply and irrigation), disaster management and public health are the same four key areas that the country’s latest poverty reduction strategy identifies as being especially important from both a climate change and development perspective.

Most Important Priority for Additional Government Spending on Climate Change Adaptation



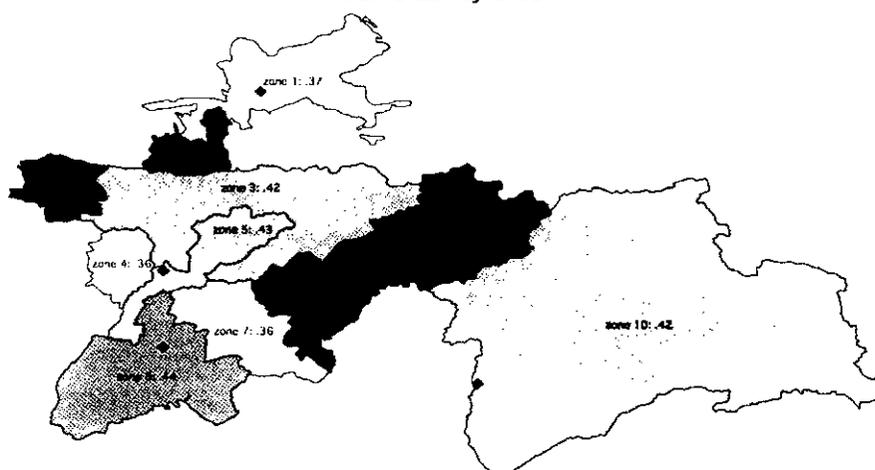
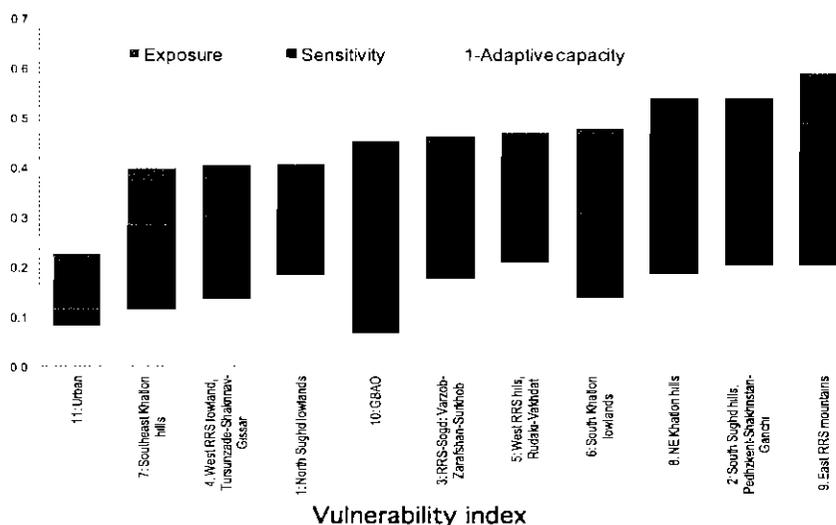
Source: World Bank staff estimates based on P-LITS data.

TARGETING PUBLIC INVESTMENTS: A REGIONAL VULNERABILITY INDEX

15. Which geographic locations in Tajikistan are most vulnerable to climate change? Household vulnerability to climate change depends on diverse factors—i.e. not just on likely physical impacts of climate change. This report analyzes vulnerability as a function of three main factors: (i) exposure to climate change and variability; (ii) sensitivity to impacts of that exposure; and (iii) ability to adapt to ongoing and future changes.

- **Exposure** to climate change and variability is highest in Gorno-Badakhshan autonomous oblast (GBO), as well as the South Khatlon lowlands because of their high frequency of extreme temperatures and broad range of intra-monthly temperature fluctuations.
- **Sensitivity** is highest in the east mountain area Region of Republican Subordination (RRS) because of the area’s reliance on agriculture, high sensitivity to disasters, and widespread food insecurity. Sensitivity is also high in South Sughd, North-East Khatlon hills, Vartob-Zarafshan and GBO.
- **Adaptive capacity** varies substantially. It is highest in GBO because of its high scores on education and income diversification; also good in the South-east Khatlon hills, the West RRS lowlands, and the South Khatlon area: areas characterized by above-average income levels and education.

Vulnerability map for Tajikistan



Source: World Bank staff estimates based on data from several sources. See main report for details

16. The report presents a regional index of vulnerability for Tajikistan which is constructed based on the simple average of the above exposure, sensitivity, and adaptive capacity sub-indices. Indicators of past climate variability and the frequency of disasters are used to assess exposure to climate change; health, livelihood, food security and demographic characteristics to determine sensitivity to climate impacts; while social, economic and institutional characteristics are used to assess adaptive capacity. The results show that vulnerability varies across different regions of Tajikistan according to socio-economic and institutional factors in ways that do not follow directly from exposure, geography, or elevation. To the extent that policy makers in the country wish to direct funding toward areas with the highest vulnerability to climate change, they should focus on rural areas, in particular eastern RRS mountains, Southern Sughd hills, and Khaiton hills and lowlands (see figure above). Although these zones are vulnerable for somewhat different reasons they share a high degree of sensitivity to climate change, particular food insecurity, disaster sensitivity, and reliance on agriculture. They also have weak adaptive capacity, in part stemming from low income and education levels. Their exposure is only moderate but their high sensitivity and fairly moderate adaptive capacity render these areas vulnerable. By contrast, urban areas as a composite group have the lowest vulnerability, far lower than any of the rural zones, mainly because they have the lowest sensitivity, the second-highest adaptive capacity, and average exposure.

Summary of Key Recommendations on Climate Change Adaptation in Tajikistan

Facilitate economic diversification. Priority measures should include diversification of agricultural production, particularly towards crops that use less water, and promotion of off-farm livelihood opportunities to reduce dependence on climate-sensitive activities. The latter will require improvement of the business climate, skill building, enhancement of public infrastructure as well as development of banking and microfinance institutions (*see paragraphs 2.4-2.16 for more information*).

Promote sustainable management of land resources and increase agricultural productivity. This will involve ensuring secure land ownership to provide incentives for sustainable resource use, removing constraints that tie farmers to cotton cultivation and educating farmers on modern crop and land management techniques (*see paragraphs 2.28-2.31 and 2.36 for more information*).

Improve water management. Scale up existing initiatives aimed at decentralizing water governance, promote efficient irrigation technologies and create incentives for efficient water use, e.g. through introduction of individual meters and improving the collection rates for water provision (*see paragraphs 2.28, 2.32, 2.33, 2.34*).

Implement health reforms with an emphasis on preventive measures, improvement of hygiene and enhancement of disaster preparedness of the health sector. Current government reforms aimed at strengthening primary health care should be continued with a particular attention to the needs of rural areas. Priority measures include raising qualifications of medical professionals in rural areas, rehabilitating the facilities and providing medical equipment, ensuring that vulnerable communities have stockpiles of essential medicine and access to transportation to take patients to urban areas in case of disasters as well as improvement of sanitation and hygiene (*see paragraphs 2.17 – 2.27*).

Improve disaster prevention and response capacities. Scale up existing initiatives on conducting natural hazard risk assessments, improvement of early warning systems, strengthening protective infrastructure, construction of shelters and working with communities to improve their disaster response and prevention capacities (*see paragraphs 2.38 – 2.44 for more information*).

Introduce flexible safety net programs that will address the needs of the chronic poor and could be expanded in case of a disaster or other shock. It will be best to limit the number of programs but ensure that they are well targeted and adequately financed (*see paragraphs 2.53 – 2.60 for more information*).

Integrate climate risk into sectoral and national policy documents as well as budget frameworks. This will involve improving knowledge on climate change issues of the government officials, conducting sectoral vulnerability assessments, development of the National Adaptation Strategy as well as integrating climate risks into national and regional development plans to ensure that achievement of short-term goals (e.g. in the areas like infrastructure investments or the use of natural resources) does not increase the country's vulnerability in the long-run (*see paragraphs 2.65 and 2.68 for more information*).

Consider geographic targeting of adaptation investments. To the extent that policy makers wish to direct funding toward areas with the highest vulnerability to climate change, they should focus on rural areas, in particular eastern RRS mountains, Southern Sughd hills, and Khatlon hills and lowlands. These areas have the highest sensitivity to climate change impacts and the lowest adaptive capacity (*see chapter 3 for more information about geographic variation in vulnerability*).

INTRODUCTION AND OUTLINE

1. Today there is a widespread consensus that global climate is changing and that this process presents an urgent development challenge. The effects of climate change are directly observed through the increase in average annual temperatures as well as through climate shocks, particularly floods and droughts. According to the Stern Review on the Economics of Climate Change (2006), if current emission trends continue, global temperatures will rise by 2-3C within the next fifty years. Such increase can cause a permanent loss of up to 3 percent of world output, compared with what could be achieved in a world without climate change.
2. Climate change (CC) impacts will be felt differentially across regions and localities: while some parts of the world may initially even benefit from modest rises in temperature, most countries will be negatively affected. The poorest countries will suffer most, and within these countries the poor will be impacted disproportionately. Disadvantaged geographic location, low incomes, poor infrastructure and low institutional capacity are among the factors that make poor countries particularly vulnerable to the effects of climate change.
3. A recent World Bank study has warned that countries in the Europe and Central Asia (ECA) region are significantly threatened by climate change, with serious risks – e.g. floods, droughts and melting of glaciers – already in evidence.¹ According to this report, Tajikistan emerges as the most vulnerable country among the 28 ECA countries studied. In large part, this is because Tajikistan has social and productive structures that make it very sensitive to the impact of a changing climate, as well as the lowest adaptive capacity.
4. While the physical impacts of climate change are well documented in Tajikistan's national communications to UNFCCC, much less attention has been paid to the analysis of economic, social and distributional aspects of climate change. Understanding which sectors, localities and population groups will be most affected is vital for development of adaptation strategies. The current report aims to fill this gap by analyzing 1) the probable impacts on livelihoods by sector and location, 2) the potential impacts on household welfare and 3) the extent to which prevailing policies facilitate or impede adaptation to help inform effective climate change response strategies. It relies on diverse data sources: weather station records, various household surveys, census data as well as interviews with stakeholders to address these issues.
5. The Pilot Program on Climate Resilience has recently been launched in Tajikistan with donor support, which will provide the Government of Tajikistan with USD50 million in grant financing to strengthen institutional capacities for climate resilience and to fund investment projects (see Annex 1 for more details). There is also interest among other donors and national counterparts in integrating a climate change perspective in their operations. It is hoped that this report will provide analytical underpinnings for the design of the government's adaptation strategies and the new initiatives of donors and NGOs.
6. The report supports the conclusions of earlier studies that climate change will act as a multiplier of existing stresses on natural and socio-economic systems. In Tajikistan, like in the rest of ECA, vulnerability in the near future will be driven by poor environmental management, crumbling infrastructure and economic policies rather than by the magnitude of climate change itself. This view is supported by the results of the regional analysis, which shows that vulnerability varies according to socio-economic and institutional development in ways that do not follow directly from exposure or elevation. Some of the sparsely populated high altitude mountain zones are less vulnerable than the prime agricultural valleys.

¹ World Bank (2009): *Adapting to Climate Change in Europe and Central Asia*

7. The report argues that faster social and economic development is the best strategy for adaptation. Higher income levels, improved health and education as well as better access to quality public services and infrastructure enhances the capacity of households, and the economy as a whole for adaptation. Lessons from the experience of donor-supported projects show that adaptation to climate change can have significant synergies with local and national development objectives. The report analyzes current policies and regulations (e.g. land tenure rights, water management, agricultural policies, etc) and identifies key reform priorities to facilitate faster climate change adaptation. Whenever possible, the experience of existing initiatives is cited to illustrate good adaptation practices.

8. The document is organized as follows: chapter 1 presents the physical impacts and transmission channels of climate change, its impacts on household welfare as well as the results of the public opinion survey on climate change in Tajikistan; chapter 2 suggests the key elements of the adaptation strategy and provides examples of the current donor-supported initiatives that are relevant for adaptation; finally, chapter 3 presents a sub-national vulnerability index and identifies the localities most vulnerable to climate change.

1. PHYSICAL IMPACTS, TRANSMISSION CHANNELS, AND PUBLIC PERCEPTIONS OF CLIMATE CHANGE

1.1 Country Background and Chapter Outline

1.1 Tajikistan is a landlocked country in Central Asia with a population of approximately seven million people and per capita GDP of US\$702 (2008). The economy depends on exports of cotton, aluminum and hydroelectricity as well as on remittances from migrants to Russia, estimated at 46 percent of GDP in 2008.³

1.2 Tajikistan consists of four administrative divisions (oblasts). These are Sughd, Khaidon, the autonomous oblast of Gorno-Badakhshan (GBO) and the Rayons of Republican Subordination (RRS). Oblasts are in turn subdivided into 48 smaller administrative units called rayons.

1.3 Most of Tajikistan's terrain (93 percent) is covered by mountains, and over half of the country is situated above 3000 meters. Only 6 percent of the land area is arable.⁴ Grains and cotton are major crops, cultivated on about 70 percent of the cropped area.⁵

1.4 Tajikistan is the poorest country in the Europe and Central Asia (ECA) region: 54 percent of population is classified as poor and 17 percent as extremely poor at the end of 2007.⁶ In Tajikistan, poverty is concentrated primarily in rural areas, which reflects the demographics of the country. Overall, rural areas account for 75.7 percent of all poor and 70.9 percent of extremely poor in Tajikistan.

1.5 The chapter provides a brief description of the physical impacts of climate change as well as presents the key findings of the nationally representative survey on public perceptions of climate change (CC). It attempts to identify how CC impacts can potentially affect agriculture, health and the incidence of disasters as well as to differentiate the effects on welfare groups whenever possible. The choice of the sectors is justified by their high sensitivity to climate change impacts (which is further aggravated by the existing challenges facing these sectors) as well as by the survey results, which show that potential climate shocks affecting agriculture, health and disaster frequency are of major public concern.

1.6 The chapter's findings reveal that any shocks to agriculture can result in significant increases in poverty, particularly in rural areas and that the poor are more vulnerable to the health risks associated with climate change. Furthermore, disasters are already causing the highest human losses in ECA and their frequency and severity is expected to increase with climate change. These findings call for actions to improve agricultural productivity, facilitate economic diversification, reduce rural poverty and invest in health infrastructure and disaster prevention programs.

Table 1.1. Tajikistan at a Glance

Population - 7 million people
Estimated population growth rate - 2 percent
Rural Population (percent of total) - 73.7
Poverty Rate at \$2.15 a day (PPP) - 41 percent
Employment
Agriculture - 44 percent
Services & Trade - 26 percent
Manufacturing - 6 percent
Other - 24 percent
Unemployment rate - 9.5 percent

Source: World Bank, Tajikistan Country Brief 2009; ILS 2007

³ *Tajikistan Country Brief*, World Bank, 2009.

⁴ *The Second National Communication of the Republic of Tajikistan under the United Nations Framework Convention on Climate Change*. The Government of Tajikistan, 2008.

⁵ *Agriculture in Tajikistan*. Statistical Yearbook, Tajikistan State Statistics Committee, 2007. Dushanbe

⁶ *Tajikistan Living Standards Measurement Survey: Indicators at a Glance*, State Statistics Committee, UNICEF, 2007

1.7 The rest of the chapter is organized as follows: section 1.2 describes the physical impact of climate change, section 1.3 analyzes the potential impact of climate change on different sectors and welfare groups, section 1.4 presents key findings of the climate change survey, and section 1.5 offers concluding remarks.

1.2 Physical impacts of climate change in Tajikistan: trends and projections⁷

1.8 The climate is changing throughout Europe and Central Asia region. In Tajikistan, the physical impact of climate change is observed through increase in average annual temperatures, melting of glaciers and the increased frequency and severity of disasters. According to the Second National Communication of Tajikistan, prepared under UNFCCC (2008), average annual temperatures rose by about 0.5-0.8C across most parts of the country during the 65 year period studied, with the biggest increases observed in Dushanbe (1.0C) and Dangara (1.2C). It is estimated that the mean annual temperature will rise by 0.2 – 0.4C in most areas of Tajikistan by 2030 in comparison with the period of 1961 – 1990. The maximum increase of temperature is expected in winter – by 2C (Model ECHAM4/OPYC3, Potsdam Institute for Climate Research).

1.9 Warmer temperatures contribute to the melting of glaciers. In fact, since 1930 the total area of glaciers in Tajikistan declined by one-third and is expected to fall a further 15-20 percent over the next 30-40 years, with many small glaciers disappearing altogether. Such changes have a major impact on hydrology and increase the risk of floods. Melting of glaciers in Tajikistan contributes 10-20 percent of the flow of large rivers annually; during hot and dry years this contribution can reach 70 percent. Climate warming will intensify the melting of glaciers, which will initially increase the summer water flow but in the long-term will reduce water availability. Many communities will likely suffer critical water shortages with agriculture and hydropower sectors being most negatively affected.

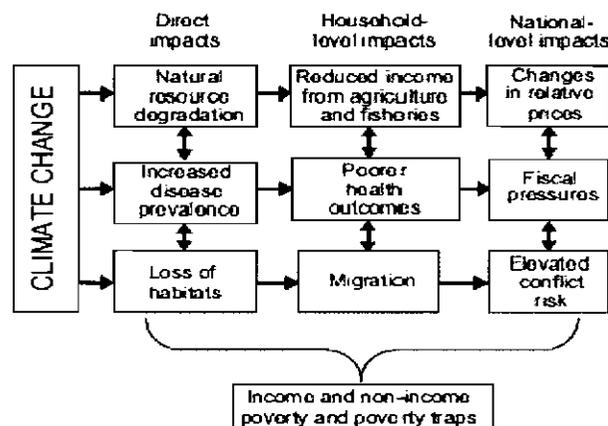
1.10 To date, changes in precipitation have been quite uneven due to topographical diversity of the country. During the reviewed period, the amount of precipitation in the Eastern Pamir (mountainous plateau with the elevation of 4,000 – 6,000 meters) reduced by 5-10 percent and in Murghab by 44 percent but increased by 5-10 percent in Central Tajikistan and by 20 percent in the southern sub-mountain areas. The complexity of mountain landscape makes it very difficult to accurately predict future precipitation scenarios and there is significant disagreement in precipitation projections obtained using different climate scenarios and models.

1.3 Transmission Channels and Distributional Impacts

1.11 According to the 2nd National Communication of Tajikistan under UNFCCC, the primary impact of climate change on the livelihoods of people and the economy as a whole will be observed through 1) the reduced water quantity and quality, which will affect agriculture, health (through the rise of water-borne diseases) and the hydropower sector and 2) the increased frequency and severity of disasters (mudflows, floods and droughts). These physical impacts will have effects at the household and national level and can potentially deepen poverty and increase the possibility of permanent poverty traps (Fig. 1.1). The rest of this chapter will provide a more detailed assessment of the impact of climate change on agriculture, health and the incidence of disasters as well as on different welfare groups.

⁷ Unless otherwise mentioned, all climate-related information in this section is based on the Second National Communication of Tajikistan under UNFCCC, cited above

Figure 1.1: Transmission Channels through which CC Impacts the Poor



Source: L. Cord, C. Hennek, and G. van der Vink, (2008): *Climate Change and Poverty: Towards an Integrated Policy Framework for Adaptation*. PREM Economics of Climate Change Discussion Papers, World Bank, Washington DC.

Agriculture

1.12 The agricultural sector of Tajikistan is highly vulnerable to climate change. This vulnerability stems from both primarily negative physical impacts as well as from resource and institutional constraints, cropping patterns that favor cultivation of water-intensive cotton and the significant environmental challenges faced by the sector today (e.g. deforestation and land degradation). The major physical impacts of climate change are expected to be manifested through increased water scarcity, worsening of soil conditions and desertification, change in timing and lengths of plant/crop growing seasons as well as the outbreaks of pests.

1.13 According to forecasts, the flow of rivers will decrease in summer in the long-term due to diminished inputs from snow, rain and glaciers. Groundwater reserves will likely decrease as well due to reduction of recharge from surface water and precipitations. Higher temperatures will result in higher potential evapotranspiration increasing plant water consumption by 1-10 percent by 2030. These factors will put pressures on the poorly maintained irrigation system, whose efficiency is currently estimated at 55 percent.⁸

1.14 It is also expected that climate change will increase the intensity and spread of land degradation. Long dry periods, in combination with high temperatures in spring and summer seasons, will lead to the intensification of desertification processes in Southern and Central Tajikistan.⁹ In addition, pest infestations can become more common. As temperatures rise, some pest species can become active earlier in the season, increase the intensiveness of their reproduction as well as expand the area of their spread. In Tajikistan, potential outbreaks of cotton worms and locust are of particular concern. In recent years, increased populations of these pests have caused significant economic damage. For example, during 2003-2005, cotton worms' outbreak has led to a reduction of cotton harvest for up to 50 percent within the area exceeding 36,000 hectares in southern Tajikistan. Similarly, locust outbreaks are becoming more common and from 2000 to 2007 the areas infected by locust increased over five times – from 16 thousand to 85 thousand hectares in the southern districts of Tajikistan.¹⁰

⁸ The Government of the Republic of Tajikistan. 2008. *The Second National Communication of the Republic of Tajikistan under the United Nations Framework Convention on Climate Change*, Dushanbe

⁹ Ministry for Nature Protection of the Republic of Tajikistan. 2002. *The First National Communication of the Republic of Tajikistan to the United Nations Framework Convention on Climate Change*, Dushanbe

¹⁰ The Government of the Republic of Tajikistan. 2008. *The Second National Communication of the Republic of Tajikistan under the United Nations Framework Convention on Climate Change*, Dushanbe

The agricultural sector will also suffer from the increased frequency and severity of the extreme weather events: droughts, mudflows and floods that can destroy crops and livestock and threaten people's livelihoods.

1.15 *Agricultural Income and Welfare*. With about three-fourths of Tajikistan's population living in the countryside and heavily dependent on farming, agriculture is one of the most important livelihoods. About 40 percent of households countrywide derive more than half of their income from agriculture while 20 percent obtain more than seventy percent of their income from agriculture. People employed in agriculture face the highest risk of poverty as median incomes are just 70 Somoni per month, which is below the poverty line. Geographically, reliance on agriculture is highest in the rayons of GBAO, Eastern RRS and Southern Khatlon.

1.16 Households in Tajikistan depend on agriculture in three major ways: 1) through production of agricultural goods for self-consumption and for sale, 2) through agricultural wages and 3) through the purchase of agricultural products for consumption. All welfare groups have a high share of agricultural production in total income, although households in the 2nd, 3rd and 4th quintiles are more dependent on agriculture (Table 1.2). This can be explained by the fact that the poorest households have limited access to land (e.g. no land ownership, smaller land plots or marginal lands) as well as cannot afford modern agroinputs while the wealthiest households tend to have more diversified incomes. Agricultural wages are very low, so they constitute a very small share of total income. In fact, only 3 percent of households derive more than 50 percent of total income from agricultural wages.

Table 1.2: Dependence on Agriculture

Quintiles of hh consumption	Share of ag. production (home produced food & farm income) in total income	Share of agricultural wages in total income	Share of purchased food in hh consumption
Poorest	39	6	43
2	44	8	42
3	45	7	42
4	45	5	41
Richest	38	4	39
Overall	42	6	41

Source: TLSS 2007 estimates

1.17 Food produced for households' consumption dominates agricultural production. Even in urban areas, the share of home-produced food accounts for a quarter of total income. The share of income from the sold produce (i.e. net agricultural income) is relatively low – 8 percent for rural households (Table 1.3). Even families with comparatively large land plots – over 21 sotkas (0.2 ha) derive only 14 percent of cash income from agriculture. This can be explained by the dominance of subsistence agriculture as well as by lack of access to markets in rural areas (many rayons are cut off major roads in winter and spring).

Table 1.3: Sources of Income by Consumption Quintiles

Quintile	Urban					Rural				
	Wages	Home Produced Food	Remittances	Net Agric. Income	Social Protection	Wages	Home Produced Food	Remittances	Net Agric. Income	Social Protection
1	54	23	9	2	6	38	35	11	10	4
2	47	29	10	3	4	36	39	10	8	4
3	50	29	8	1	4	34	41	11	8	3
4	50	26	11	1	5	32	44	11	7	3
5	55	22	8	1	5	35	39	11	8	3
Total	51	26	9	2	5	35	40	11	8	3

Source: TLSS 2007 estimates

1.18 Remittances constitute an important source of income for all welfare groups and are higher in rural areas. Rural households are more likely to send their members abroad due to lack of employment opportunities and low incomes from agriculture. The share of agricultural income in total income is 30

percent for migrants' households and 53 percent for non-migrants' households. However, despite having an extra source of income, migrants' households continue to engage in agricultural activities and are not less dependent on self-produced food. The share of home-produced food in total food consumption is 46 percent in migrant households versus 45 percent in non-migrant households in rural areas and 23 percent versus 24 percent in urban areas respectively. In other words, migrant households continue to depend on agriculture and are not less sensitive to potential climate shocks.

1.19 Most households have small land plots (Table 1.4), hardly suitable for commercial farming. Access to land (own or rented) is correlated with higher consumption. Having up to 10 sotkas of land for farming on average increases consumption by 12 percent, while having more than 20 sotkas increases consumption by 20 percent in comparison to the situation of no land ownership.¹¹

Table 1.4: Land ownership

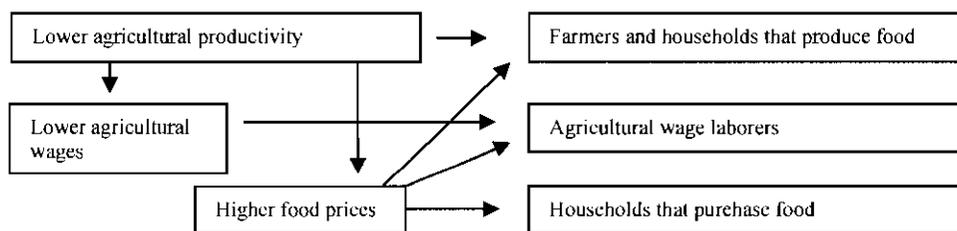
Land size (1 sotka = 0.01 ha)	percent of households
no land	13
<10 sotkas	36
10-20 sotkas	24
20-100 sotkas	21
> 100 sotkas	6
Total	100

Source: TLSS 2007 estimates

Short-term Effects of Decline in Agricultural Productivity on Welfare

1.20 The analysis below attempts to estimate the impact of a hypothetical decline of agricultural productivity on welfare. Only short-term impacts are modeled. Long-term effects are expected to be smaller as households will gradually adapt. The simulations are based on TLSS 2007 survey that does not include cotton producers, thus they are not covered in the analysis. There are three channels through which adverse climate conditions can affect people's livelihoods from agriculture (Figure 1.2), namely through decline in yields (direct effect) as well as reduction of agricultural wages and increase in food prices (indirect effects). These impacts will likely occur at different times, so the simulations below analyze the effects of each of these channels separately.

Figure 1.2: Impact of Decline in Agricultural Productivity on Welfare



Source: World Bank staff

1.21 The estimates of the decline in agricultural yields are based on the assumption that farmers will use the same inputs and grow the same kind of crops. The modeled decline in productivity is uniform across all farmers regardless of their access to irrigation, geographic location and the crop mix they grow. Thus the modeled impacts are upper bound of what should be expected in reality.

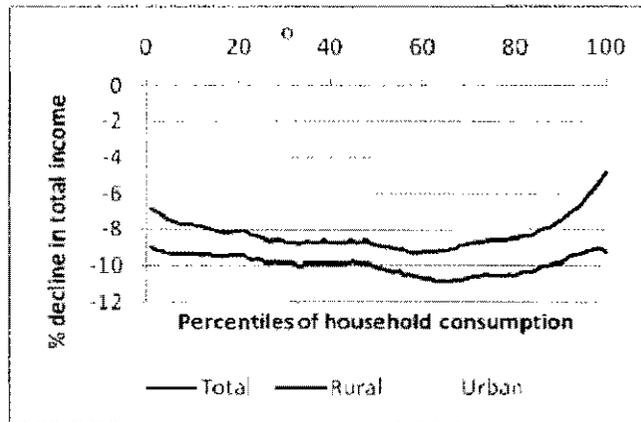
1.22 A decline in yields will affect agricultural wages. The assumption is that labor productivity will fall uniformly with yields. Farmers will not pay workers above their marginal labor productivity, so either the wages will fall or demand for labor will go down. The modeling of this effect takes into account adjustment of employers but not of the agricultural laborers. Most likely agricultural wage earners will switch to non-agricultural jobs, migrate or use other adaptation strategies, so as in the previous example, the actual impact on total income will be smaller.

¹¹ World Bank 2009. *Republic of Tajikistan Poverty Assessment*, Washington DC

1.23 The analysis below assumes that decline in agricultural productivity in Tajikistan will lead to a rise in food prices in the country. This can occur under certain conditions, e.g. the rise in the global food prices and/or import restrictions. The simulations estimate how consumption and poverty levels are going to be affected if households continue to buy the same food basket. Again, as in the previous two examples this is an upper bound as households will likely switch to cheaper goods.

1.24 Figure 1.3 illustrates the impact on household's income of a hypothetical decline in agricultural production by 20 percent. This effect will result in an overall decline in income of 8.5 percent. Rural areas will suffer almost twice as much as urban. Decline in total income will constitute 9.6 percent in rural areas and 5.4 percent in urban. The middle quintiles will be more affected as they are more dependent on agriculture.

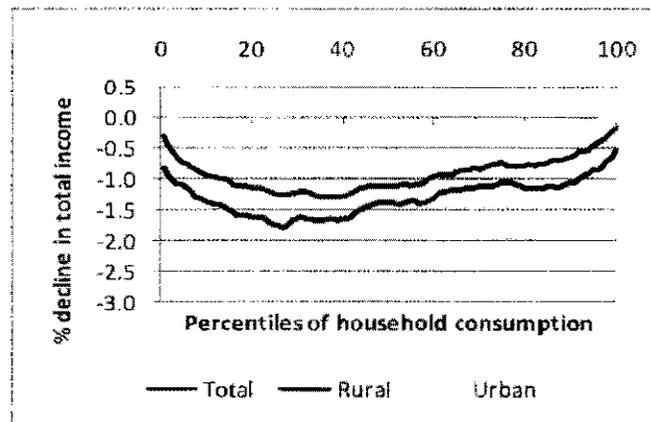
Figure 1.3: Impact of a hypothetical decline of agricultural production by 20 percent on households' income



Source: TLSS 2007 estimates

1.25 Decline in income from agricultural wages will not have a significant impact on welfare, as agricultural wages are low and their share in total household's income is insignificant (Figure 1.4). A hypothetical decline in agricultural wages by 20 percent will result in a decline of households' income by about 1.2 percent. This will affect primarily rural households whose income will decline by 1.6 percent vs. 0.3 percent in urban areas.

Figure 1.4: Impact of a hypothetical decline of agricultural wages by 20 percent on households' income

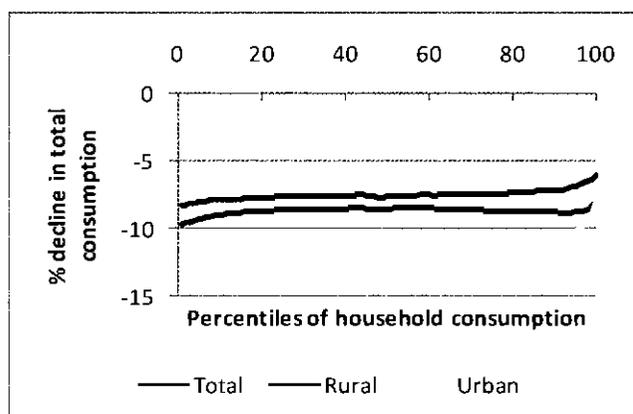


Source: TLSS 2007 estimates

1.26 In contrast, an increase in relative food prices will have a more serious impact as food expenditures constitute a sizable share of households' budgets (Fig. 1.5). A 20 percent increase in food prices will reduce households' consumption by 8.2 percent on average. The poor will be affected slightly more than the non-poor. Consumption of the poorest quintile will be reduced by 8.5 percent and consumption of the wealthiest

quintile by 7.8 percent. The effect will be stronger in urban areas. Consumption of the urban poor will decline by 10.3 percent.

Figure 1.5: Impact of a hypothetical increase in food prices of 20 percent on household consumption



Source: TLSS 2007 estimates

The estimates of effects on welfare under other potential scenarios, in particular decline in income by 10 percent and 50 percent are provided in Annex 3.

1.27 *Impact on poverty.* Agricultural production is an important source of income for most Tajik households. So, even a 10 percent decline in agricultural income increases poverty rate by 7 percent and poverty gap by 12 percent, while decline in agricultural income by 20 percent increases poverty rate by 13 percent and poverty gap by 24 percent respectively (Table 1.5). A reduction of income from agricultural wages does not have a significant impact on poverty as their share in the total income of most households is very small. An increase in relative food prices has the highest impact on poverty rate of all the three channels discussed in this chapter. A 20 percent increase in relative food prices results in an increase of poverty rate by 16 percent and poverty gap by 25 percent.

1.28 All of these effects will have a stronger impact in rural than in urban areas. This is because rural areas have a much greater concentration of population around the poverty line, so that even a modest decline in income/purchasing power will have a significant impact on poverty. For instance, a 20 percent decline in agricultural production will increase poverty by 15.5 percent in rural areas and by 4.7 percent in urban areas, while a decline in agricultural wages will result in increase in rural poverty by 2.9 percent and an increase in urban poverty by 0.7 percent. Similarly a rise in food prices will increase poverty by 16.7 percent in rural areas and by 14.5 percent in urban areas.

Table 1.5: Hypothetical effect on hh poverty rate and poverty gap, percent

	10 percent decline in income from agricultural production (food production and farm income)	10 percent decline in income from agricultural wages	10 percent increase in relative food prices	20 percent decline in income from agricultural production (food production and farm income)	20 percent decline in income from agricultural wages	20 percent increase in relative food prices
Poverty	+7 percent	+1 percent	+9 percent	+13 percent	+2 percent	+16 percent
Poverty Gap	+12 percent	+3 percent	+12 percent	+24 percent	+7 percent	+25 percent

Source: TLSS 2007 estimates

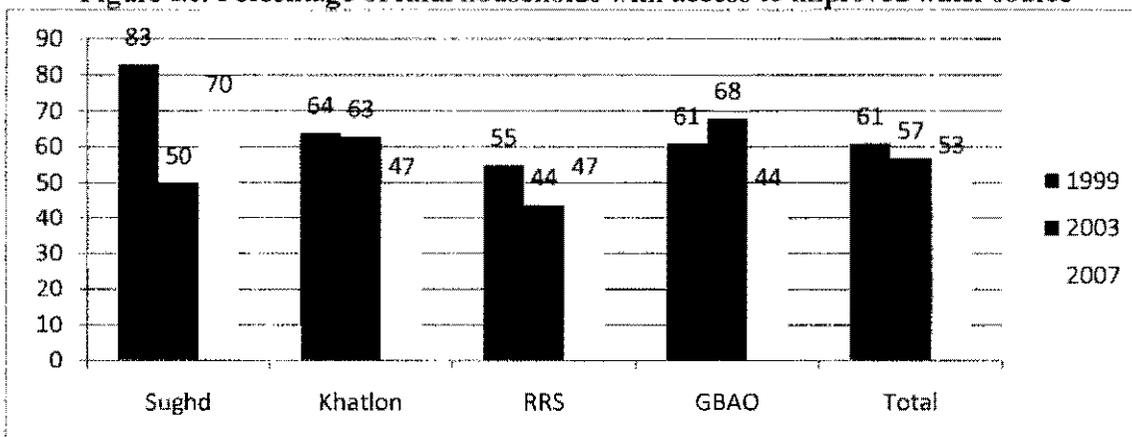
Health

1.29 The major health impacts of climate change in Tajikistan will be observed through the increased thermal stress, water-borne diseases and disaster effects. The incidence of heatwaves is expected to increase, which will raise a number of health risks for the population. For instance, high temperatures and drought experienced in 2001-2002 contributed to increased mortality rates, with hot and arid parts of the country (e.g. Khatlon region) disproportionately affected.¹² Furthermore, the drought has resulted in malnutrition as households reduced food consumption. Rising temperatures can also increase the country's sensitivity to malaria as the number of days favorable to reproduction of malaria mosquitoes will increase.

1.30 Warming climate is likely to increase the incidence of water-borne diseases. Pathogenic organisms can multiply faster in higher temperatures. Furthermore, the dry season flow in rivers and streams is likely to decrease (particularly during times of drought), which will increase the concentration of pollutants, including disease organisms. A reduction in water availability will likely lessen the volumes of water used for hygiene and sanitation, further increasing the risk of the spread of infectious diseases. In addition, climate change is expected to increase the frequency and magnitude of floods, which can cause contamination of public water supplies with bacteria and parasites as surface discharge flows into rivers and reservoirs.¹³ The situation can be further aggravated by the low efficiency of water treatment facilities, which currently does not exceed 40 percent.¹⁴

1.31 Water-borne diseases are already a major cause of morbidity in Tajikistan. According to TLSS 2007, 23.4 percent of people that reported having some illness during the four weeks before the survey, had diseases that could be caused by the poor quality of water. The survey results also show that access to improved drinking water sources has declined in all regions of Tajikistan (Fig.1.6). In fact, nearly half of the rural population relies on unprotected sources like lakes, rivers or unprotected wells. The exposure to various pathogens is aggravated by the fact that almost 40 percent of households that uses water from unprotected sources does not boil or treat their water.

Figure 1.6: Percentage of rural households with access to improved water source



Source: TLSS 2007 estimates

¹² The Government of the Republic of Tajikistan. 2008. *The Second National Communication of the Republic of Tajikistan under the United Nations Framework Convention on Climate Change*, Dushanbe

¹³ McMichael A.J, D.H. Campbell-Lendrum, C.F. Corvalán, K.L. Ebi, A. Githeko, J.D. Scheraga and A. Woodward . 2003. *Climate change and human health - risks and responses*. WHO, Geneva.

¹⁴ The Government of the Republic of Tajikistan. 2008. *The Second National Communication of the Republic of Tajikistan under the United Nations Framework Convention on Climate Change*, Dushanbe

1.32 Lastly, the health sector will be strongly affected by the extreme weather events. Disasters (particularly mudflows and floods) result in physical injury and death, decrease nutrition and raise the risk of water-borne and infectious diseases due to disruption of public water supply and sewage systems as well as overcrowding of population in temporary camps. In the past, floods have often been associated with the outbreaks of water-borne diseases, particularly typhoid. For instance, following the heavy rain and floods almost 9,000 people contracted the typhoid fever (95 died) in 1997. The floods of 2002 and 2003 have also resulted in typhoid outbreaks with over 500 of documented cases in each year.¹⁵

1.33 Disasters also damage health infrastructure reducing the availability of health services, at the time when they are most needed. This is of particular concern, given the dire state of medical facilities, particularly in rural areas: only 29 percent of rural health facilities has access to piped water on premises, 5 percent to communications (phone or radio) and 12 percent to transportation vehicles including ambulance cars. In winter period, electricity and heating availability in rural areas does not exceed six and four hours respectively.¹⁶

1.34 *Distributional Impacts.* The poor are more likely to suffer from the increased health risks associated with climate change than the non-poor due to (1) inability to cover out-of-pocket expenditures for medical services, (2) higher prevalence of water-borne diseases among the poor than the non-poor and (3) weaker immune systems of the poor stemming from malnutrition and adverse living conditions. The analysis of TLSS (2007) shows that almost 46 percent of the poorest households found it impossible or very difficult to pay for health care, compared to 27 percent of the richest households. Almost one-third of households in the poorest quintile did not seek medical care when falling ill, primarily due to inability to cover healthcare costs (TLSS 2007).

1.35 Poor people are more likely to be affected by water-borne diseases and malnutrition than the non-poor. The incidence of diarrhea is 1.4 times higher among households in the poorest quintile than in the wealthiest quintile (TLSS 2007). Furthermore, there are pronounced differences in caloric intake by welfare status. The poorest consumption decile consumes only 1,550 calories per person per day while the richest decile consumes almost 4,000 calories per day. Children from the poorest quintile are almost twice as likely to be severely underweight as those from the wealthiest quintile¹⁷. Overall, up to one third of the rural population faces food insecurity and 27 percent of children are chronically malnourished. It is well-known that long-term food deprivation weakens immune systems and makes people more vulnerable to infectious diseases.

Natural Disasters

1.36 Tajikistan is highly prone to disasters. According to the UN Office for Coordination of Humanitarian Affairs, 85 percent of Tajikistan's area is threatened by mudflows. Landslides are also common and some 50,000 landslides have been reported by Tajik Glavgeology during the 1990s.¹⁸ Furthermore, the occurrence of droughts has increased. In the past 60 years, the country has suffered eight major droughts and with the expected rise in climate aridity the frequency and severity of droughts is forecasted to increase. The frequency and magnitude of floods will also go up as warming temperatures will increase the rate of snow melting and lead to overflowing of river banks. Furthermore, climate change can potentially affect the incidence of

¹⁵ Eurasianet. <http://www.eurasianet.org/departments/environment/articles/cav102403.shtml> and ABC News <http://www.abc.net.au/news/stories/2003/11/02/980244.htm> accessed on May 6, 2010

¹⁶ World Bank. 2009. *Republic of Tajikistan Poverty Assessment*, Washington DC

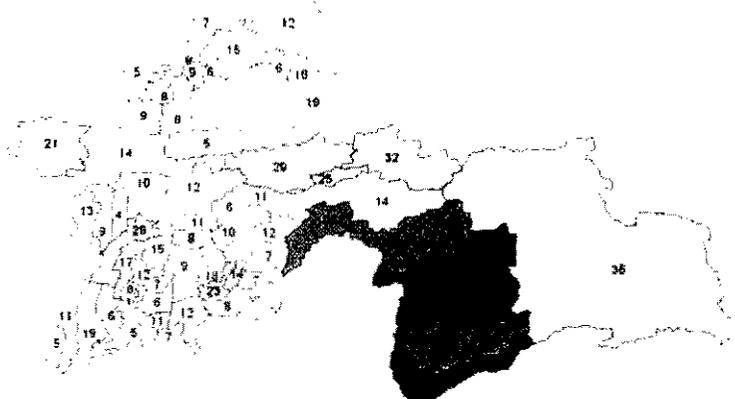
¹⁷ State Statistics Committee, UNICEF. 2007. *Tajikistan Living Standards Measurement Survey 2007: Indicators at a Glance*

¹⁸ United Nations Office for the Coordination of Humanitarian Affairs. 2006. UNDAC Mission Disaster Response Preparedness in Tajikistan, March 12-27, 2006 http://www.unep.or.jp/ietc/DM/Final_Report_UNDAC_Tajikistan.pdf

avalanches whose occurrence is dependent on temperature and the amount of solid precipitation in the zone starting at 1500 meters above sea level and higher.¹⁹

1.37 The frequency and cost of natural disasters is already a major challenge. The largest number of disasters occurs in the mountainous GBAO region (Figure 1.7; please see Annex 4 for codes, names, and spatial location of different rayons in Tajikistan). This is due primarily to the high incidence of avalanches. However, as this region is sparsely populated and ranks relatively well in institutional development, the costs and casualties associated with disasters in GBAO are less significant than in other parts of the country.

Figure 1.7: Disaster Frequency by Rayon (1997 - 2008)



Source: Prepared by World Bank staff based on data from the Committee of Emergency Situations and Civil Defense, Tajikistan. Map show the number of disasters that occurred in each rayon during 1997-2008

1.38 The biggest damage is caused by floods and mudflows in the more populated Padjakent, Qubodiyon, Rudaki, Varzoh, and Hamadoni rayons, which suffered about TJS 25-28 million of total damage during 1997-2008 (Figure 1.8). Overall, the annual cost of disasters is estimated at 115 million TJS or 1.6 percent of GDP.²⁰ Disasters affect almost all sectors of the economy, primarily through the damage of infrastructure (Annex 5 presents a snapshot of damages to public infrastructure and residential buildings during 2001-2006).

Figure 1.8: Costs of Disasters by Rayon, Million TJS (1997-2008)



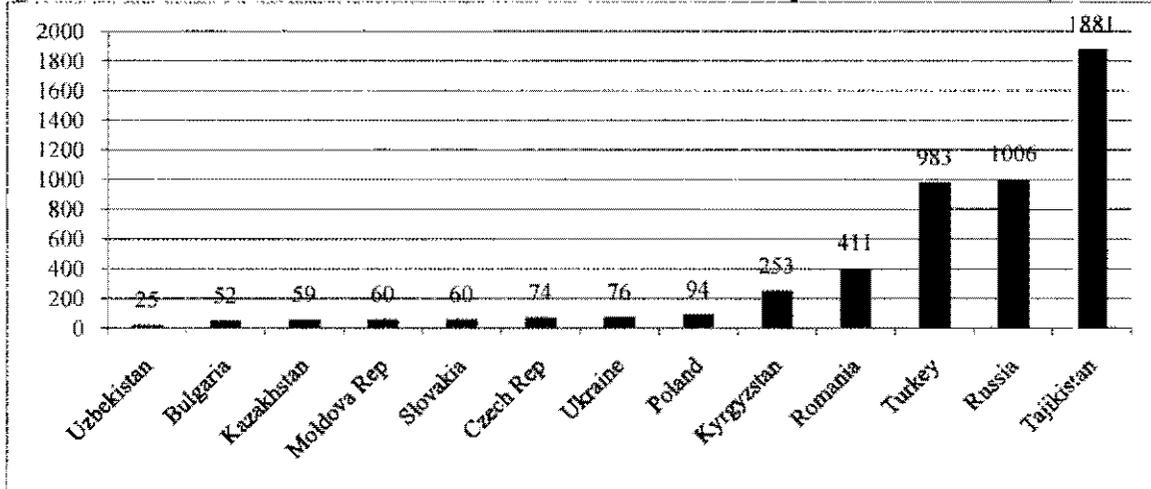
Source: Prepared by World Bank staff based on data from the Committee of Emergency Situations and Civil Defense, Tajikistan. Map shows the cost of disasters in Million TJS in each rayon during 1997-2008

¹⁹ The Government of the Republic of Tajikistan. 2008. *The Second National Communication of the Republic of Tajikistan under the United Nations Framework Convention on Climate Change*, Dushanbe

²⁰ World Bank. 2008. *Tajikistan Country Environmental Analysis*. Washington DC

1.39 Apart from the high monetary costs, disasters are also causing significant human losses. In fact, over the past 20 years, Tajikistan had the highest number of deaths associated with disasters in ECA (Figure 1.9). This is both due to a high exposure to natural hazards as well as low institutional capacity to prevent and respond to disasters when they occur. During 1997-2008, the largest number of casualties occurred from mudflows in Asht, Rasht and Jirgatal rayons, which also have the highest number of casualties per disaster (Figure 1.10).

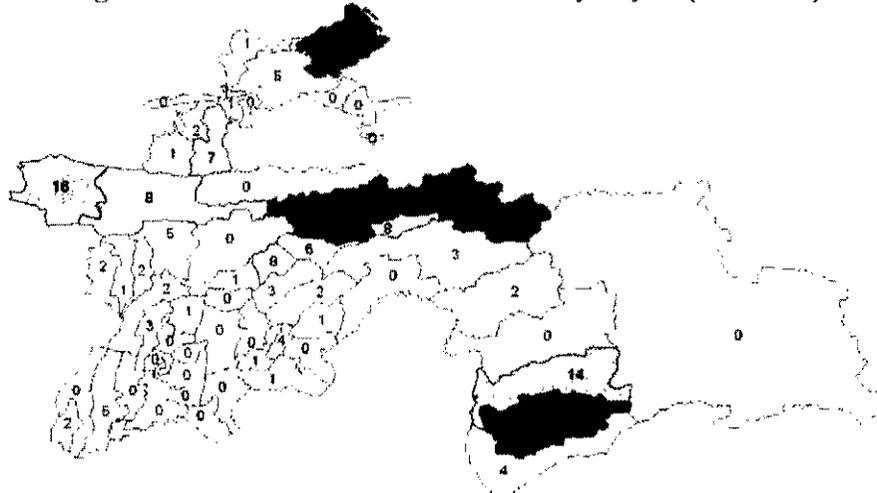
Figure 1.9: Number of Deaths Attributable to Disasters* in Europe and Central Asia (1990-2009)



*Disasters in this graph include floods and mass movements (mudflows, landslides, avalanches and rockfalls)

Source: EM-DAT: The OFDA/CRED International Disaster Database www.emdat.be, accessed on May 25, 2010

Figure 1.10: Disaster-related Casualties by Rayon (1997-2008)



Source: Prepared by World Bank staff based on data from the Committee of Emergency Situations and Civil Defense, Tajikistan. Map shows the number of disaster-related casualties that occurred in each rayon during 1997-2008.

1.40 It was not possible to differentiate the impact of disasters by welfare status because only a minor share of households in TLSS was directly affected by disasters. However, evidence from global studies shows that the poor tend to suffer disproportionately as their housing is of inferior quality and often constructed in hazardous locations. They also cannot afford the costs of migration to less hazard-prone locations. Lastly, after disasters occur, it takes them longer to restore their livelihoods as the poor tend to have non-diversified incomes and little savings.

1.4 Public Perceptions of Climate Change: Evidence from the P-LITS Survey

1.41 The findings of the nationally representative household survey commissioned for the report, *Pilot Life in Transition Survey (P-LITS)*, show that public awareness of the different consequences of climate change is quite high (similar to prevailing levels in EU27 countries and Kazakhstan) and that a large majority of the respondents are already affected by climate-related hazards.

1.42 The climate change questionnaire was one of the modules of a larger Pilot Life in Transition Survey (P-LITS), which was organized in Tajikistan and Kazakhstan in February 2010. LITS is a joint project of the World Bank and EBRD, which was first carried out between August and October 2006 to assess the impact of transition on people in 29 ECA countries and understand how the attitudes towards market and political reforms are related to individual and households characteristics. The second LITS round is to be implemented in the fall of 2010, when the updated LITS questionnaire will be administered in all ECA countries where the LITS 1 was canvassed in 2006. In preparation for the launch of LITS 2, a pilot test was carried out in the two Central Asian countries, where the draft LITS questionnaire was administered to nationally representative samples of 500 respondents per country (i.e. 1,000 respondents in total). Table 1.6 presents the distribution of the samples across different regions in Tajikistan.

Table 1.6: Distribution of the P-LITS sample in Tajikistan

Region	# households interviewed
Dushanbe	50
GBAO	20
Soghd	150
Khatlon	170
RSS	110
Total	500

Source: World Bank Pilot Life in Transition Survey (P-LITS)

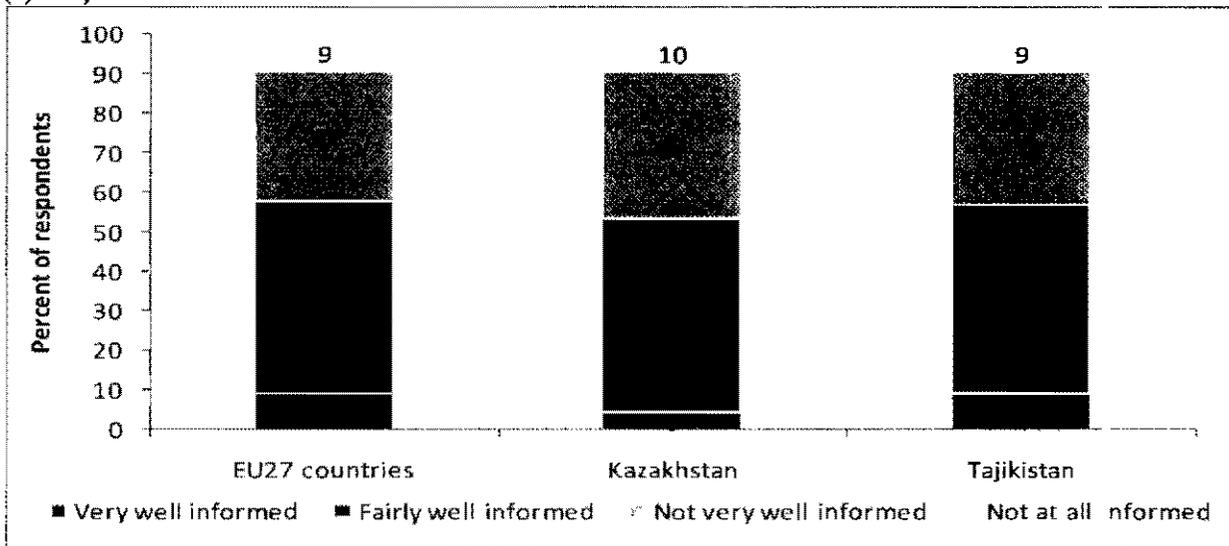
1.43 The climate change module included many questions from a special Eurobarometer survey on attitudes towards climate change that was canvassed in all EU27 countries in 2008,²¹ along with a few additional questions of special interest and relevance to Tajikistan. As a result, the data collected for Tajikistan can be compared not just with Kazakhstan but also with EU27 countries in selected subject areas. The climate change module is presented in Annex 2.

1.44 *Climate Change: Awareness of the Main Causes and Consequences:* Respondents in P-LITS were asked if they thought they were well informed about the different consequences of climate change, with answers recorded on a 4-point scale: (i) very well-informed, (ii) fairly well-informed, (iii) not very well-informed, and (iv) not at all informed. Public awareness of the different consequences of climate change in Tajikistan is quite high, and in fact comparable to prevailing levels in Kazakhstan and EU27 countries (Figure 1.11a): a majority of respondents (57 percent) in Tajikistan (felt they were either very well-informed (9 percent), or fairly well-informed (48 percent) about the different consequences of climate change. Within the country, the level of public awareness varied considerably across different regions (Figure 1.11b): overall awareness levels were highest in Dushanbe (81 percent very/fairly well informed), followed by Soghd (60 percent) and Khatlon (54 percent), and lowest (41 percent) in Regions of Republican Subordination (RSS). Awareness levels among women in Tajikistan tended to be somewhat lower than among men.

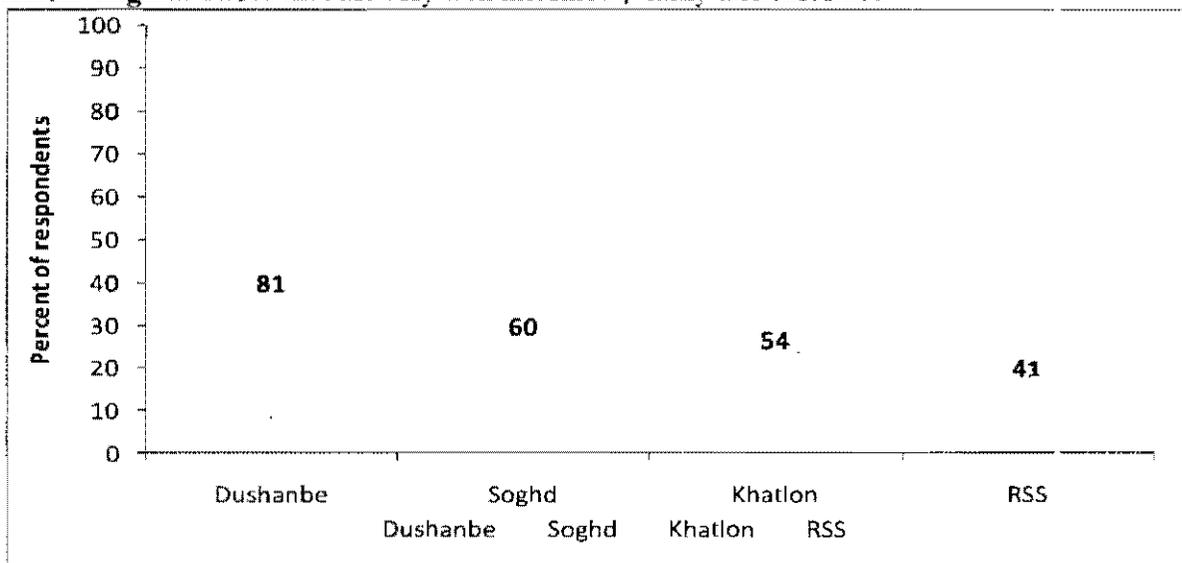
²¹ *Europeans' attitude towards climate change* Special Eurobarometer 300, Wave 69.2 September 2008. The survey was requested by the European Commission and the European Parliament, and coordinated by the Directorate General for Communication of the European Commission.

Figure 1.11: Awareness of the Different Consequences of Climate Change

(a) Tajikistan vs. other countries:



(b) Across Region: Those that are very well informed / fairly well informed

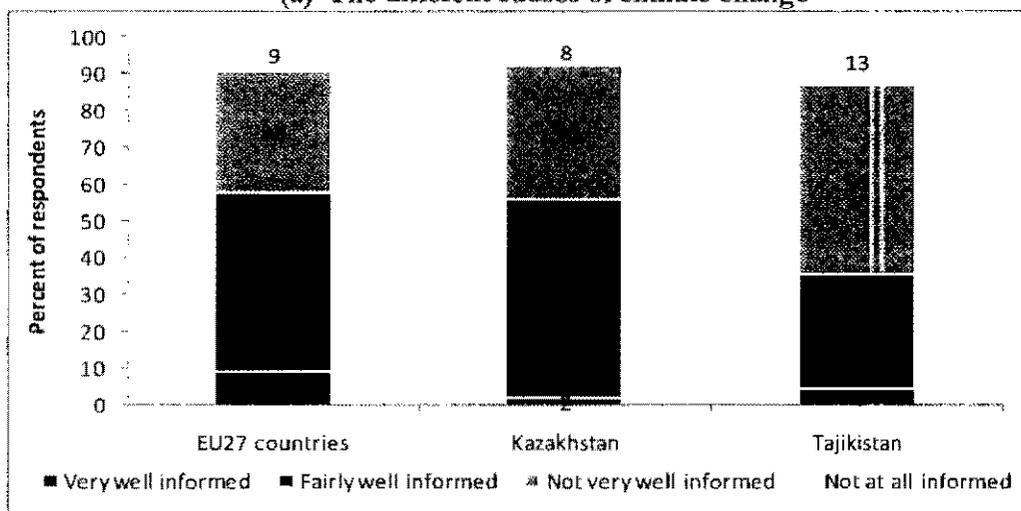


1.45 Survey respondents were also asked if they felt they were well-informed about (a) the different causes of climate change, and (b) ways in which we can slow down climate change. Awareness of the different causes of climate change is somewhat lower in Tajikistan compared to Kazakhstan as well as EU27 countries: about 35 percent of respondents in Tajikistan felt they were very well-informed/fairly well-informed about the main causes of climate change, as compared to around 56-57 percent in Kazakhstan and EU27 countries (Figure 1.12). Similarly, public awareness of ways in which climate change could be slowed down was also considerably lower in both Tajikistan and Kazakhstan (24-27 percent of respondents very well/fairly well-informed about ways in which climate change can be slowed down) as compared to EU27 countries (53 percent).

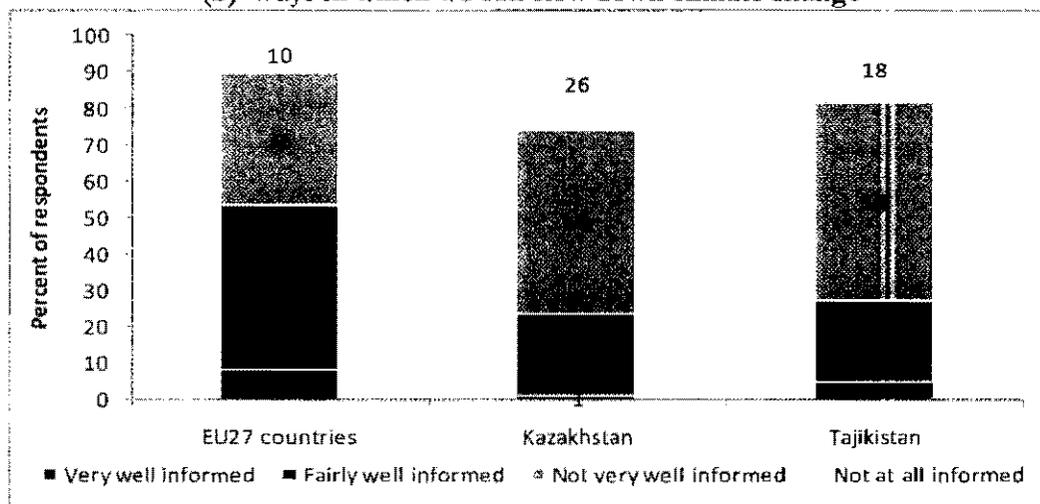
Figure 1.12: Awareness of Climate Change Causes and Mitigation Measures

Personally, do you think you are well informed or not about...

(a) The different causes of climate change



(b) Ways in which we can slow down climate change



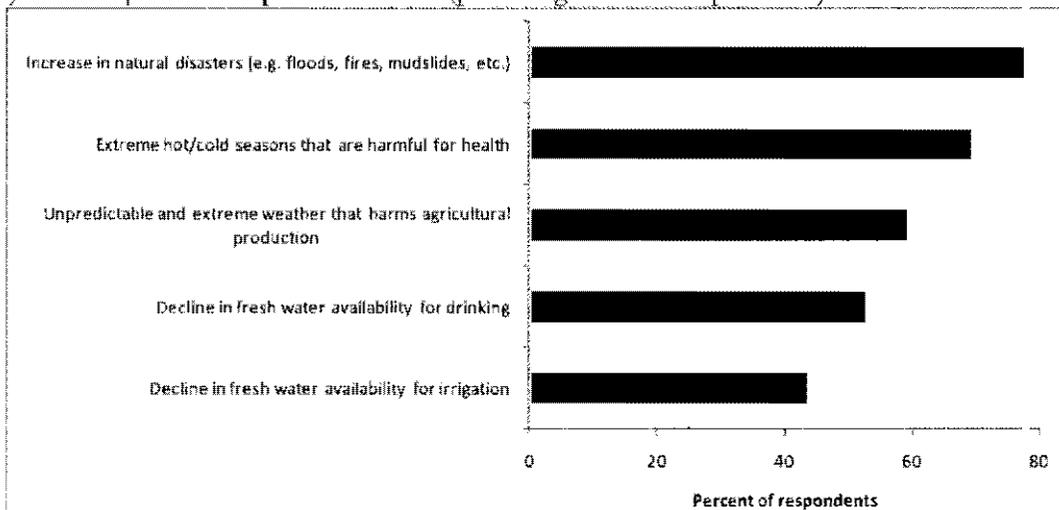
Source: World Bank staff estimates based on P-LITS 2 data; Special EU Barometer 300/wave 69.2

1.46 *Climate Change Impacts of Greatest Public Concern*: Respondents were presented several possible adverse impacts of climate change, and were asked to choose (a) which of these were of concern to them, as well as (b) which of these was of greatest concern. “Increase in natural disasters” was cited as a concern by the highest share of respondents (78 percent), and as the most important concern by the second-highest share of respondents (25 percent), while “dangers posed by extreme hot/cold seasons that are harmful for health” were cited as a concern by the second-highest share of respondents (69 percent), and as the single-most important concern by the highest share of the respondents (30 percent, Figure 1.13). “Unpredictable and extreme weather that harms agricultural production” was third on both lists.²²

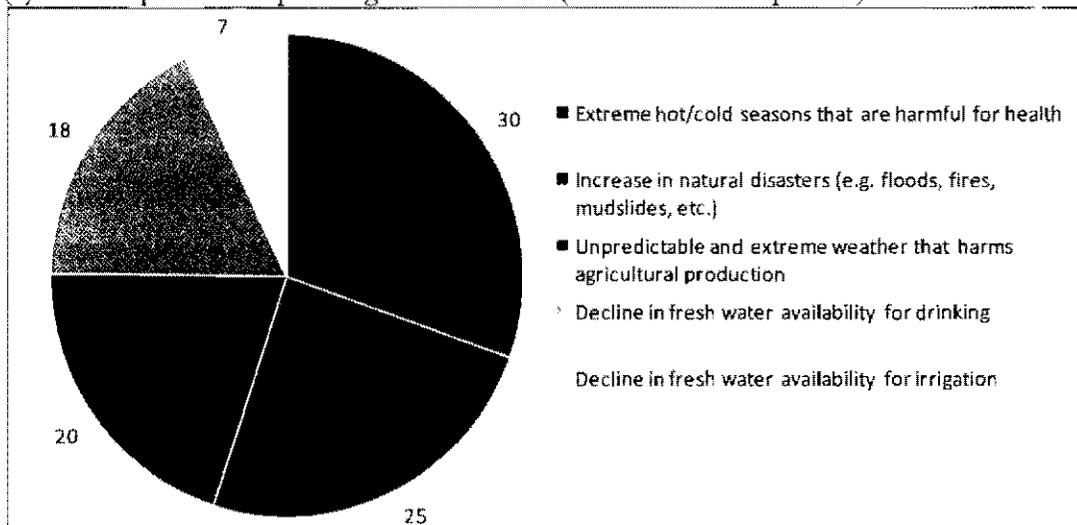
²² Respondents reporting themselves as being fairly/very well informed about the main consequences of climate change were more likely to select natural disasters and increased damage to agriculture (and less likely to select less water for

Figure 1.13: Tajikistan: Potential Climate Change Impacts of Greatest Concern

(a) Cited as potential impact of concern (percentage of total respondents)



(b) Cited as potential impact of greatest concern (totals sum to 100 percent)



Source: World Bank staff estimates based on P-LITS 2 data.

1.47 *Public Perceptions of Seriousness of Climate Change Problem*: How serious a problem do citizens of Tajikistan perceive climate change to be? The answer to this question depends upon how the issue is posed to them. Respondents in the P-LITS 2 were asked a series of questions regarding the extent to which they think climate change is a very serious problem confronting the world. First, they were presented a list of various issues, and were asked which of these they considered to be “very serious problems” facing the world. Three main findings are noteworthy (Table 1.7): (i) “poverty, lack of food and drinking water” and “international terrorism” emerged among the top 3 serious problems (ranked by votes received) in all three countries; (ii) however, a majority of respondents in Kazakhstan and Tajikistan noted “spread of infectious diseases” to be a serious problem (70 and 84 percent respectively); (iii) climate change was selected by a sizeable share of respondents in Kazakhstan (36 percent) and Tajikistan (41 percent), though not as high as in EU27 countries (64 percent).

drinking and irrigation) compared to those reporting themselves as not at all/not very well informed about the main consequences of climate change.

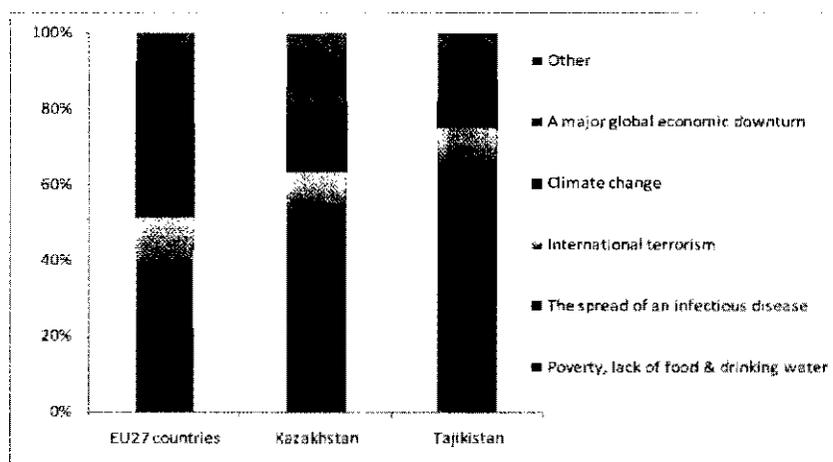
Table 1.7: Respondent Opinions about Major Problems Currently Facing the World

Issue:	percentage of respondents in the country that consider the issue to be a very serious problem		
	EU27 countries	Kazakhstan	Tajikistan
Poverty, lack of food and drinking water	70	66	76
The spread of an infectious disease	24	70	84
International terrorism	55	50	47
Climate change	64	36	41
A major global economic downturn	25	47	38
Proliferation of nuclear weapons	24	33	29
Armed conflicts	39	53	28
The increasing world population	20	12	17

Source: World Bank staff estimates based on P-LITS 2 data; Special EU Barometer 300/wave 69.2

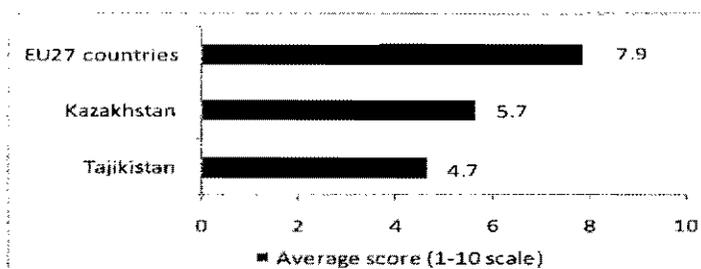
1.48 However, when asked to select the single-most serious problem confronting the world, only 5-7 percent of respondents in Tajikistan and Kazakhstan chose climate change (ref. 31 percent in EU27 countries); instead, respondents in these two countries ranked “spread of infectious diseases” and “poverty, lack of food and drinking water” as the two most important problems (Figure 1.14). Using a 10-point scale where 1 represents “not a serious problem at all” and 10 represents “an extremely serious problem”, respondents were asked how serious a problem they considered climate change to be: as Figure 1.15 shows, average scores by respondents in Kazakhstan (5.7) and Tajikistan (4.7) were considerably lower than in EU27 countries (7.9).²³

Figure 1.14: Tajikistan: Most Serious Problem Currently Facing the World



Source: World Bank staff estimates based on P-LITS 2 data; Special EU Barometer 300/wave 69.2

Figure 1.15: Seriousness of climate change problem (1-10 point scale)



Source: World Bank staff estimates based on P-LITS data; Special EU Barometer 300/wave 69.2

²³ Among EU27 countries, the lowest reported scores were in the Netherlands (6.8) and the highest in Cyprus (9.4).

1.49 Within Tajikistan, average ratings of the seriousness of the climate change problem vary quite a bit across different groups. Amongst those reporting themselves as being “very well informed” about the consequences of climate change, average scores were considerably higher than amongst those that were “not at all informed” (5.7 vs. 3.3 respectively). Similarly, average scores among respondents in Dushanbe (6.0), those reporting sale/barter of farm products as their main source of income (5.3), and the poorest one-third (5.0) were also higher than the rest of the population. An ordered probit model was used to analyze respondents’ rating of how serious they consider the issue of climate change to be. The results of the ordered probit regressions confirm differences across various population sub-groups discussed above are indeed statistically significant (Table 1.8).

Table 1.8: Ordered Probit Results

Respondent Characteristics	Coefficient	Std. Err.	z	P>z
1. Income group:				
Poorest one-third of population	0.3512	0.1299	2.70	0.01
Middle one-third of population	0.1175	0.1237	0.95	0.54
Richest one-third of population			<i>Reference Category</i>	
2. Region of Residence				
Dushanbe	0.8281	0.1832	4.52	0.00
GBAO	-0.3183	0.2526	-1.26	0.21
Soghd	-0.2578	0.1262	-2.04	0.04
Khatlon			<i>Reference Category</i>	
RRS	-0.3038	0.1337	-2.27	0.02
3. Sale/barter of farm products is household's main source of livelihood				
	0.5226	0.1548	3.38	0.00
4. Awareness of main consequences of CC				
Not at all informed			<i>Reference Category</i>	
Not very well informed	0.5018	0.1832	2.74	0.01
Fairly well informed	1.1215	0.1829	6.13	0.00
Very well informed	1.5978	0.2341	6.83	0.00

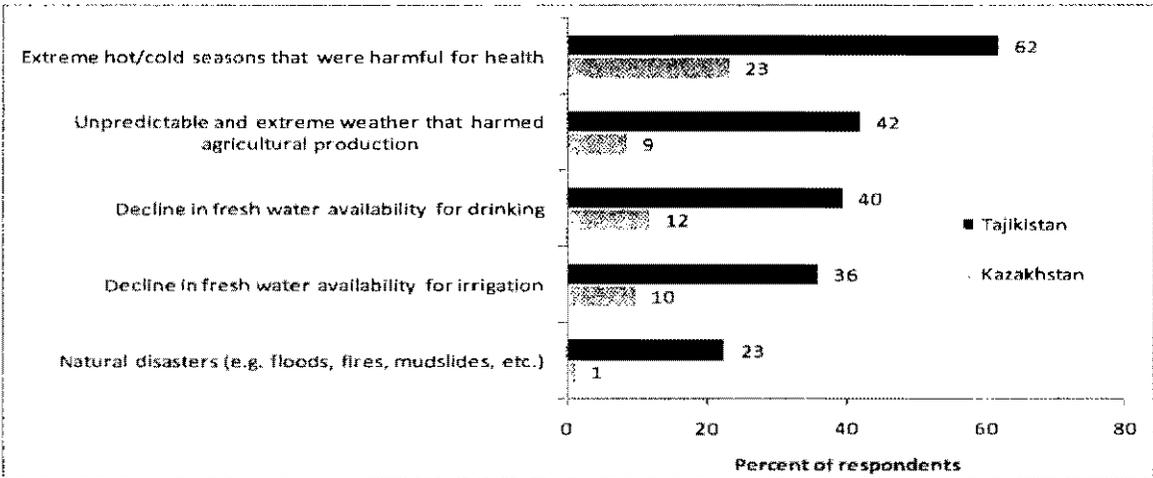
Source: World Bank staff estimates based on P-LITS data. n=465, Log likelihood = -846.52, Pseudo R2 = 0.0747

	Frequency	Percent
Income level		
Poorest one-third	167	33.40
Middle	167	33.40
Richest one-third	166	33.20
Region:		
Dushanbe	50	10.00
GBAO	20	4.00
Soghd	150	30.00
Khatlon	170	34.00
RRS	110	22.00
Sale/barter of farm products is the main source of livelihood of the household		
No	436	87.20
Yes	64	12.80
Awareness of main consequences of climate change		
Not at all informed	44	9.22
Not very well informed	162	33.96
Fairly well informed	227	47.59
Very well informed	44	9.22

1.50 *Climate-related Hazards During the Past 10 Years:* Sixty-two percent of respondents in Tajikistan reported having encountered extreme hot/cold seasons that were harmful for health during the past 10 years; 42

percent experienced unpredictable and extreme weather that harmed agricultural production, while 40 percent reported having suffered a decline in fresh water availability for drinking (Figure 1.16).

Figure 1.16: Respondents affected by climate-related hazards during past 10 years



Source: World Bank staff estimates based on P-LITS data.

1.51 As Figure 1.16 shows, the reported incidence of floods, mudslides, fires, and other such natural disasters is much higher in Tajikistan than Kazakhstan (22.8 vs. 1.4 percent). However, recent meteorological records indicate that changes in average temperatures have been of fairly similar magnitude in the two countries.²⁴ Furthermore, a much larger share of the population of Kazakhstan lives in areas with harsh winters, so the pattern of reported incidence of adverse impacts of climate related hazards across the two countries is in fact the opposite to what one has expected *a priori*. A much higher share of respondents in Tajikistan report having suffered extreme hot/cold seasons that were harmful for health than in Kazakhstan (62 vs. 23 percent) or unpredictable and extreme weather that harmed agricultural production (42 vs. 9 percent). The differences in exposure to adverse climate effects alone cannot explain large disparities in respondents’ answers suggesting that there are pronounced differences in sensitivity and adaptive capacity of the two countries. As is widely highlighted in the literature on likely climate-change impacts, countries with higher incomes, stronger institutions, developed infrastructure and public services are more resilient to the negative physical impacts of climate. In 2007, the per capita gross national income (GNI) of Tajikistan (\$460) was less than one-tenth the GNI of Kazakhstan (\$5,060)].

1.5 Concluding Remarks

1.52 Public awareness of the consequences of climate change is fairly high in Tajikistan (similar to prevailing levels in EU countries) even if awareness of its causes and ways to slow down climate change is lower. A large number of respondents have been directly affected by climate-related hazards over the past ten years (for instance, 62 percent of interviewees in Tajikistan vs. 23 percent in Kazakhstan have suffered from the extreme hot/cold seasons that were harmful for health and 42 percent vs. 9 percent respectively from extreme weather that harmed agricultural production). These findings suggest that Tajikistan is not well adapted to its current climate conditions.

²⁴ For instance, as documented in the two countries’ respective National Communications prepared recently under the United Nation’s Framework Convention for Climate Change (UNFCCC).

1.53 The physical effects of climate change in Tajikistan will have primarily negative impacts on the economy and the livelihoods of the people. Agriculture and health emerge as the two sectors that will be particularly affected. This is due to both adverse climate impacts as well as the existing challenges faced by these sectors.

1.54 Tajikistan is highly vulnerable to any shocks in agriculture. This is because of a large number of people employed in this sector (almost half of the labor force) as well as a high share of agricultural production in the total income of all welfare groups. Food production (for self-consumption & sale) and agricultural wages constitute 48 percent of total income on average. Furthermore, the sector already suffers from a number of environmental problems and low productivity, which further increases its sensitivity to climate change.

1.55 There are three channels through which adverse climate conditions can affect people's livelihoods from agriculture: decline in agricultural productivity (yields), reduction in agricultural wages and increase in relative food prices. The first two channels will have a stronger impact on the middle quintiles while the third – on the poor, particularly those residing in urban areas. The simulations of a hypothetical decline in agricultural productivity show that even a 10 percent decline has a noticeable impact on poverty. Poverty impacts are much stronger in rural areas, which is due both to a stronger dependence on agriculture as well as a higher concentration of people around the poverty line in rural areas.

1.56 The policy implications of these findings are that there is an urgent need to increase productivity of the agricultural sector as well as to create conditions for economic diversification. Furthermore, it will be important to develop flexible social assistance programs, which could be scaled up in case of a food crisis. It is also necessary to improve living standards and reduce poverty in rural areas where the majority of Tajik population currently lives.

1.57 Similar to the effects on agriculture, climate change will act as a multiplier of existing problems in the health sector. These include high prevalence of water-borne diseases, the dire state of health facilities, particularly in rural areas and high levels of food insecurity. The poor will be affected more than the non-poor due to large out-of-pocket expenditures for medical services, as well as a higher prevalence of water-borne diseases and malnutrition among the poor. Addressing these problems is important to improve the health status of the population irrespective of the climate change scenarios.

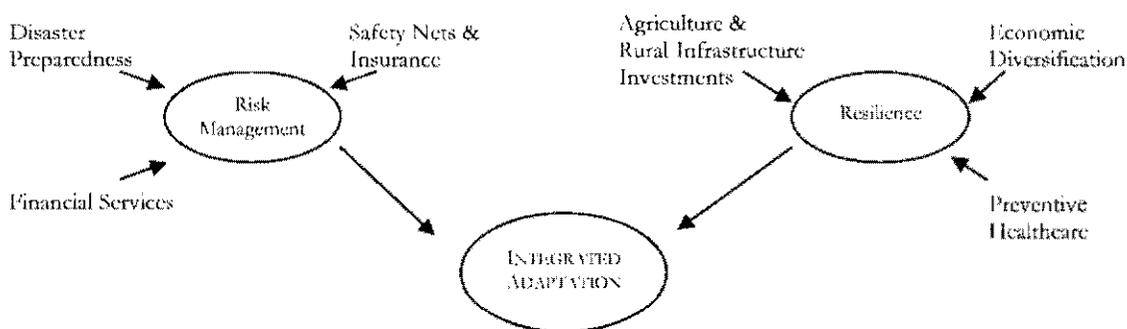
1.58 Lastly, climate change can increase the risks of natural hazards. Disasters are already resulting in significant human and financial losses and Tajikistan has the largest number of casualties associated with disasters in Eastern Europe and Central Asia. So, even in the absence of climate change there is an urgent need to invest in disaster prevention programs as well as to insure a more effective response when disasters occur. The next chapter provides a more detailed description of the potential policy and investment decisions that can strengthen resilience to climate change while addressing the immediate needs and improving the livelihoods of the people.

2. ADAPTING TO CURRENT AND FUTURE CLIMATE CHANGE

2.1 The impacts of climate change are already being felt in Tajikistan and will likely intensify in the future. This necessitates concerted adaptation efforts, i.e. responses to reduce vulnerability to current climate conditions and adjust to potential climate changes. Adaptation interventions should be multi-sectoral and integrated in the country's development plans (e.g. PRSP) as well as budget frameworks. This chapter suggests key elements of the adaptation strategy and provides examples of the current donor-supported initiatives that are relevant for adaptation. It also reviews the role of prevailing government policies in facilitating or impeding adaptation.

2.2 How should Tajikistan adapt to climate change, given the many other pressing development challenges that it faces? The chapter argues that adaptation planning should start with the so-called "no regrets" policies - investment and policy decisions that will provide benefits under current climate conditions and strengthen resilience to any future changes. There are a number of such options in Tajikistan, particularly in areas like sustainable land management, improvement of access to water, development of preventive healthcare, disaster risk management and introduction of effective social assistance programs. Thus, the core elements of an integrated adaptation strategy (Figure 2.1) are in full conformance with the country's national goals of economic and social development. They also largely reflect the priorities for additional government spending on climate change adaptation as identified by the P-LITS respondents. The narrative below will provide a more detailed description of each of the components of the adaptation strategy as well as examples of pilot initiatives in Tajikistan or emerging best-practices that address climate change-related challenges in other countries.

Figure 2.1: Basic Elements of an Integrated Climate Change Adaptation Strategy



Source: Adapted from L. Cord, C. Hull, C. Hennem, and G. van der Vink, (2008) cited earlier.

2.1 Strengthening Resilience to Climate Change

2.3 The resilience component of the adaptation strategy aims to strengthen the capacity of households, communities as well as local and national governments to withstand any negative climate impacts. Efforts should focus on 1) economic diversification, 2) preventive healthcare and 3) agriculture and rural infrastructure investments.

2.4 **Economic Diversification:** As a legacy of Soviet planning, Tajikistan has a narrow production base with specialization in a few basic commodities: aluminum, cotton and electricity (Fig 2.2.). Agricultural output is dominated by cotton and low-value food and cereal crops.²⁵ Diversification of agricultural production

²⁵ World Bank. 2006. *Priorities for Sustainable Growth: A Strategy for Agriculture Sector Development in Tajikistan*

(particularly, towards crops that use less water), development of an agro-processing industry and promotion of non-farm economic activities can help to better adjust to climate variability, cushion against demand fluctuations for cotton in international markets and increase the incomes of population. Furthermore, migration can be an important tool for economic diversification and is already widely used as a coping strategy in Tajikistan.

2.5 *Diversification of Agricultural Production & Development of Agro-processing:* In agriculture, priority measures should include elimination of government control over the cotton sector, improvement of farm productivity and attraction of investment in agroprocessing. Current cotton policies distort the efficient allocation of land, labor and farm inputs and have a negative impact not only on the cotton subsector but also on total agricultural output. Production targets, pricing controls and other types of state intervention in the cotton sector should be removed and farmers should be granted freedom in making land use decisions and in marketing their produce.

2.6 Cotton will likely remain an important crop for Tajikistan and its cultivation may be viable and profitable in some parts of the country, however it has to be done in an environmentally sustainable manner and based on market principles (i.e. without coercion of farmers). The government's role should focus on establishment of a competitive environment for the private sector, improvement of access to finance, resolution of cotton debts as well as improvement of access to information on prices and demand for agricultural products in local and foreign markets.

2.7 Development of horticulture and livestock holds much promise for potential growth and is supported by a number of donors and NGOs. There are substantial opportunities for import substitution in the domestic food market as well as some possibilities to expand exports of fresh and processed fruits and vegetables.

2.8 Crop production accounts for 80 percent of the value of agricultural sector output and was the main engine of sector growth, which was driven by increased yields and higher prices for non-cotton crops while the value of cotton production was static. Lower value food and cereal crops account for most of this growth (Figure 2.3).²⁶

Figure 2.2: Tajikistan's Exports

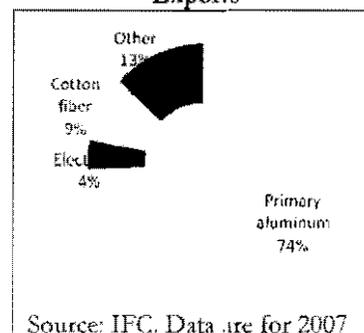
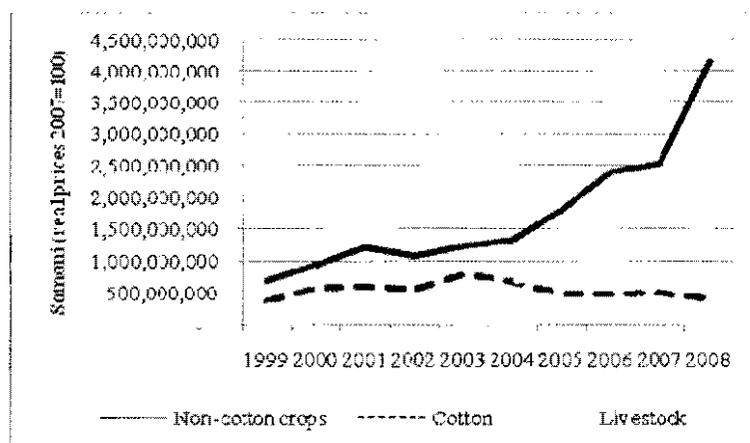


Figure 2.3: Trends in Gross Agricultural Output - Tajikistan



Source: World Bank. 2010 Country Economic Memorandum

²⁶ World Bank. 2006. *Priorities for Sustainable Growth: A Strategy for Agriculture Sector Development in Tajikistan*

2.9 The major constraints to development of horticulture are reliance on obsolete seed varieties, technologies and production practices and large post harvest losses. Following independence, extension services have largely disappeared. Yields for tree crops have declined due to older trees (most varieties are decades old) and inadequate fertilizer use and maintenance.²⁷ Adaptation to climate change will require identification of local drought-resistant crop varieties as well as development or import of new seeds with proven resilience to negative climate impacts. Cooperation with international research organizations, e.g. the International Center for Agricultural Research in the Dry Areas (ICARDA) can be helpful in this respect.

2.10 Livestock numbers have increased over the past decade but productivity remains low. Policies and programs should aim at increasing fodder production, improving the management of pastures, disease prevention and improving animal husbandry.

2.11 Promotion of low-cost, scale neutral improvements in farm management that could be affordable for smallholders will be important to increase yields and productivity. A number of donors have helped establish Farmer Field Schools or other consultative services to improve the farmers' knowledge on modern agricultural practices. These initiatives have generally been very successful in promoting sustainable land management and helping improve yields. For instance, farmers that attended Farmer Field Schools supported by UNDP Communities Program have managed to collect two-three crops per season. However, the sustainability of such projects is often an issue of concern as most farmers are currently unable to pay for consultative services unless they are linked to provision of inputs or loans. USAID, in the framework of its Productive Agriculture Project, is establishing partnerships with the agro-shops (that sell seeds, fertilizers, insecticides and other inputs), so that the staff of these stores (usually agronomists by training) provides qualified consultative services to their clients.

2.12 Transition from subsistence farming towards a commercially oriented production will require better knowledge of modern farming practices, introduction/improvement of business planning and marketing as well as strengthening the linkages between farmers and potential buyers/processors. Formal or informal farmers' organizations can play an important role in sharing innovations in crop and livestock production. By working together, farmers can increase their bargaining power vis-à-vis local governments and input suppliers, add value to their products, as well as reduce transaction costs (e.g. for transportation). Different donors have been providing support to establishment and functioning of farmer associations. For instance, UNDP has been supporting associations of dekhkan farmers by helping them establish and manage Agro Tool Banks (a collection of agricultural inputs and machinery that could be rented to members for a fee). USAID has been working with WUAs to help them find buyers for the fresh produce in Dushanbe as well as in Russia and Afghanistan. Overall, however, most farmers associations remain weak and will not be viable without external support. Governments and donors can help strengthen farmers' organizations by channeling technical assistance (e.g. extension services, marketing assistance, etc) through such entities as well as by helping them with institutional development.

2.13 It is important to create conditions for the growth of domestic agro-processing industry, which is currently dominated by small enterprises that produce a limited range of products. The operating period of most plants does not exceed six months and even during the most active periods, the majority does not work at full capacity.²⁸ The key constraints include inadequate access to finance, obsolete equipment, lack of modern packaging, product sorting and grading as well as inadequate knowledge of standards, along with high

²⁷ World Bank. 2006. *Priorities for Sustainable Growth: A Strategy for Agriculture Sector Development in Tajikistan*

²⁸ Center for Training and Consulting 2008. *Report on the Survey of Vegetables & Fruit Processing Industry of Tajikistan (Russian)*

transport costs make most of Tajikistan's agro-processors uncompetitive in international markets. Addressing these issues and attracting FDI will be instrumental for modernization of the industry.

2.14 *Diversification outside Agriculture.* Tajikistan should also pursue diversification away from climate-sensitive economic activities and try to attract investment in sectors with significant employment potential. For instance, development of eco-tourism holds a lot of promise. Pamir mountains are among the tallest in the world yet they and the country as a whole remain one of the least known tourist destinations. Underdeveloped hospitality infrastructure, poor hygiene and sanitary standards, lack of western airline operators and connections from major international airports as well as inadequate domestic transportation and communication infrastructure are among key constraints to be addressed to develop the sector. Another industry with a good potential for growth is mining. Tajikistan has deposits of silver, gold, zinc, and lead. Attraction of FDI will be vital for development of this sector.

2.15 The growth of existing enterprises and diversification of economic activity will only be possible if major improvements of the current regulatory regime as well as infrastructure are achieved. Tajikistan ranks 158th out of 183 countries on the Doing Business 2010 Report. The country's private sector is dominated by individual entrepreneurs that account for 73 percent of all firms. The growth of the micro-businesses is precluded by a difficult regulatory environment, which encourages informality and creates disincentives for private investment. Furthermore, complex trade procedures compound high transportation costs and reduce competitiveness of Tajik producers. Only 3 percent of small and medium enterprises are engaged in exports.²⁹ Improvement of the business climate will be instrumental for invigorating enterprise activity and attracting FDI.

2.16 *Migration as a Diversification Strategy.* Migration will likely emerge as a coping strategy in response to worsening climate conditions (recurrent disasters or loss of land productivity). The government should not create policies that impede migration or make people stay in areas that become unproductive. Migrants that find work in the new places will likely send remittances, which can be invested in adaptation. In fact, the volume of remittances was 3.5 times larger than the volume of exports in 2009 and over five times larger than the volume of exports in 2008 (i.e. before the crisis).³⁰ It was also significantly larger than the volume of FDI.

Table 2.1
Macro data for Tajikistan

In millions of USD	2009
Exports	458
Imports	2387
FDI	35
Remittances	1622

Source: Canagarajah, S., 2010

2.17 **Preventive Healthcare:** Climate change has a potential to exacerbate the challenges faced by the health sector today, namely control over food and water-borne diseases, parasitic diseases and malaria. Water-borne diseases are already a major cause of children's morbidity and account for 27 percent of all post-neonatal deaths.³¹ The incidence of intestinal parasite infections is also very high. A joint survey carried out in 2004 by the Ministry of Health, UNICEF and WFP showed that 63 percent of children had one or more types of enteric parasites. While warm climate increases vulnerability to different infections, the primary cause of disease in Tajikistan is inadequate access to clean water as well as poor sanitation and hygiene. Deteriorating health infrastructure, particularly in rural areas further compounds these problems. Strengthening the health

²⁹ IFC. 2009. *Business Environment in Tajikistan as Seen by Small and Medium Enterprises*

³⁰ Canagarajah, Sudharshan. 2010. *Have remittances been neglected in comparison to exports in the economic policy dialogue of low income countries. (LICs)?* People Move Blog, World Bank <http://blogs.worldbank.org/peoplemove/have-remittances-been-neglected-in-comparison-to-exports-in-the-economic-policy-dialogue-of-low-income>

³¹ UNDP. 2005. *Investing in Sustainable Development: Millennium Development Goals Needs Assessment*, Dushanbe

sector's resilience to climate change will involve both improving primary health care services as well as measures outside the immediate control of the health sector, like improvement of water quality.

2.18 Strengthening primary health care. Current government health reforms aimed at development of family medicine should be continued with a particular attention to the needs of rural areas. Apart from raising qualifications of medical professionals working in rural areas, rehabilitating the facilities and providing medical equipment, it is also important to integrate community outreach and education activities (particularly on hygiene issues) into primary health care. With donor support, community-based health initiatives have been introduced in pilot locations and could be replicated in other areas (Box 2.1).

Box 2.1: Initiatives to Support Family Medicine and Community-Based Health Care

USAID: USAID's Healthy Family Project (2002-2007) has supported the establishment of Village Development Committees (VDCs) to address community health issues in 197 villages of Khatlon Region. VDCs consist of 7-15 elected members that meet on a monthly basis to address community health issues. The initiatives included: raising money for a community health clinic, sanitation projects (e.g. moving latrines so they did not contaminate water supplies), promotion of hygiene and measures to eliminate malaria. According to the project's final evaluation, the VDCs indicated that they would continue to function after the end of donor assistance.

A current USAID's Project - *ZdravPlus* provides support to four Centers of Excellence, i.e. health centers that combine family medicine training and practice, in Dushanbe, Konihodom, Istraftshan, and Penjekent. In addition to patient treatment, the centers have conducted over 150 community education meetings and provided information on hepatitis, typhoid, anemia and immunization to more than 5,500 people during January-June 2009. USAID's work with medical staff and communities in GBAO has improved prevention and treatment of children's diseases; nearly 70 percent of mothers provided oral dehydration salts and increased fluid intake for children with diarrhea and most children have received vaccinations against six diseases before their first birthday.

Aga Khan Development Network (AKDN): AKDN has been supporting development of family health care and community outreach, primarily in GBAO region. AKDN trained about 500 community health promoters (not necessarily medical professionals) to educate communities on prevention and treatment of common infectious diseases and on the importance of immunizations. AKDN has also introduced a Revolving Drug Fund to ensure access to affordable quality medicine in GBAO region. Patients are required to pay a small percentage towards the costs of drugs, which helps ensure regular replenishment of drug supplies and subsidize those unable to pay. To date, the Fund rose over US 530, 000 and operates with minimal external support.

Source: USAID. 2007. *Final Evaluation of the Healthy Family Program*; USAID. 2009. *ZdravPlus II. Six month Report, January-June 2009*; Almaty. USAID. 2009. *In partnership with Tajikistan 1992-2009*; Aga Khan Development Network. 2008. *Aga Khan Health Services Brief*

2.19 Given the high incidence of intestinal parasite infectious in Tajikistan, annual de-worming programs for school age children are recommended. Several donors and NGOs have incorporated such initiatives in their existing programs. For instance, UNICEF is supporting the Ministry of Health in distributing de-worming tablets in the framework of its *National Vitamin A Supplementation Campaign* that covers about one million children.³² The Ministry of Health needs to be supported in institutionalization of such programs.

2.20 Increasing Disaster Preparedness of the Health System. The health sector should be prepared to respond to a potential increase in climate shocks, like heat waves, mudflows and floods. Citizens should be informed about the possible negative impact of high temperatures (e.g. dehydration and heat exhaustion, heat stroke or aggravation of cardiovascular diseases), particularly on children, the elderly and those who work outdoors. Both health centers and mass media can play a role in disseminating information on self-care steps to prevent heat-related illnesses. It is also important to ensure that primary health care facilities particularly in remote rural areas have stockpiles of essential medicines as well as access to transportation to take patients to urban centers in case of emergencies.

³² UNICEF. 2009. *UNICEF and Ministry of Health launch national vitamin A supplementation and de-worming campaign in Tajikistan*, Dushanbe http://www.unicef.org/media/media_49989.html, accessed on December 14, 2009

2.21 To address the transportation problem, USAID has supported creation of Emergency Transport Funds in rural areas of Khatlon. The funds were collected from the community and made available to pregnant women and others in need of transport to hospitals. The money was borrowed in an emergency and paid back within 2-3 weeks. Drivers were identified and their contact information posted at the primary health centers, so that all residents knew who to contact in an emergency. The funds were administered by the Village Development Committees that took care of a range of other community health issues (Box 2.1).³³

2.22 Disasters tend to increase the incidence of infectious diseases both due to contamination of water supplies as well as population displacement and overcrowding in temporary camps. Increasing vaccination levels in vulnerable communities can help prevent the outbreaks of epidemics. For instance, to reduce the spread of hepatitis A, following the major floods in Poland in 1997, annual vaccination against the disease has increased more than eight times. By 2002, the incidence of disease decreased substantially, despite another major flood in 2001.³⁴

2.23 *Improvement of Access to Clean Water and Promotion of Hygiene.* Health outcomes are strongly influenced by factors that are beyond the immediate control of the health sector, like access to clean drinking water and proper sanitation. Some of the health adaptation actions should thus be directed towards supporting interventions in other sectors, in particular improvement of rural water infrastructure.

2.24 In Tajikistan, 46 percent of rural population uses water directly from rivers, irrigation canals and other unprotected sources (TLSS 2007), however even piped water is not always safe as water treatment facilities have not been well-maintained. The level of water-borne diseases is already very high and may increase with climate change as various pathogens multiply faster in warmer waters.

2.25 A number of donors have provided grants to support community-led initiatives aimed at construction of improved wells or rehabilitation of existing water infrastructure. Such projects often have an immediate impact on the incidence of water-borne diseases. For instance, the incidence of dysentery, diarrhea and viral hepatitis in five villages of the Sughd region, where the Red Crescent Society helped construct spring water supply systems, has declined by 41 percent on average over 2007-2008.³⁵ Such efforts should be scaled up to reach out to the rural population that still does not have access to improved drinking water sources. Some immediate results could also be achieved by educating the communities about different methods of water disinfection, like chlorination at the point of use, boiling, or use of filters. This is an area that has received much less donor and government attention so far.

2.26 According to WHO estimates, hygiene education and promotion of hand washing can lead to a reduction of diarrheal cases by up to 45 percent.³⁶ It can also reduce the spread of other infectious diseases. Therefore, it is important to involve the media, schools, NGOs and health centers in promotion of proper hygiene practices. Schoolchildren can become active agents of change in their communities. For instance, UNICEF promotes better health and hygiene in 360 schools across Tajikistan. Schoolchildren are involved in testing the quality of local water, community service and peer education activities.³⁷ Scaling the project countrywide holds much promise for reducing the incidence of infectious diseases.

³³ USAID. 2007. *Final Evaluation of the Healthy Family Program*

³⁴ Rabie, Tamer, Safinaz el Tahir, Tereen Alireza, Gerardo Sanchez Martínez, Katharina Ferl, and Nicola Cenacchi. 2008. *The Health Dimension of Climate Change*. Background paper prepared for World Bank report. Washington, DC

³⁵ International Federation of Red Cross and Red Crescent Societies. 2009. *Annual Report. Central Asia (Focus on Tajikistan)*

³⁶ WHO. 2004. *Water, Sanitation and Hygiene Links to Health. Facts and Figures*

³⁷ UNICEF. Tajikistan. 2008. *Life-saving hygiene programme for students in rural Tajikistan*

http://www.unicef.org/infobycountry/Tajikistan_43161.html , accessed on December 14, 2009

2.27 *Reinforcing Malaria Surveillance Mechanisms.* Warmer climate will increase the number of days favorable for reproduction of malaria mosquitoes, thus affecting the country's sensitivity to malaria outbreaks. Therefore, continued public interventions will be necessary to sustain the success of recent years when concerted actions of the government and the donor community have resulted in reduction of malaria cases from almost 30,000 in 1997 to 635 in 2007.³⁸ Vector control programs, training of medical staff in malaria prevention and treatment, and community education campaigns should continue to prevent any future outbreaks.

2.28 **Agriculture and Rural Infrastructure Investments:** A vast majority of the population in Tajikistan lives in rural areas and depends on the natural environment for their livelihoods. The decades of soviet rule left a legacy of overspecialization in irrigated cotton production without consideration of costs and environmental impacts of such policies. Following independence, the needs of the rural economy were largely neglected with little or no investment in equipment, new seed varieties, extension services and maintenance of the irrigation and drainage systems. Soil salinity and water-logging, a consequence of poor irrigation practices, as well as widespread deterioration of pastures due to overgrazing, have emerged as major environmental challenges. In addition, soil erosion and deforestation not only reduce agricultural productivity but also increase the risk of disasters. Population growth presents an additional pressure on the already overstressed natural resources, particularly on arable land, which totals 0.7 million ha or 0.11 ha per capita.³⁹ Climate change will further exacerbate these pressures and weaken the already vulnerable rural economy. To reduce the negative impact of climate change in rural areas, efforts should focus on restoring land productivity, investing in rural infrastructure and ensuring secure property rights to provide incentives to farmers to manage natural resources in a sustainable way.

2.29 *Restoring Land Productivity.* Averting land degradation, which has become common due to unsustainable land management practices, is essential for raising agricultural productivity and should be an immediate priority. Mechanisms to reduce land degradation include planting cover crops and mulching (to conserve organic matter and moisture), contour cultivation and strip farming on sloping lands, introduction of crop rotations and application of fertilizers to increase the nutrients level. These measures help improve soil fertility and yields and can also be an effective adaptation strategy as enhanced soil organic matter facilitates better infiltration and retention of water, thus strengthening resilience to both more intensive rainfall and extended drought periods expected with climate change.

2.30 Lack of incentives and resources available to farmers are among key constraints to adoption of sustainable agricultural practices. For instance, the inducement by local governments to plant cotton on up to 70 percent of cropped area reduces the ability of farmers to practice restorative crop rotations and diversify their incomes, while lack of access to credit prevents them from adequate fertilizer use.⁴⁰ Similarly, lack of an effective mechanism for pasture use control (no national legislation; little planning of resource use; granting of annual as opposed to long-term pasture tenures, which provides few incentives for sustainable pasture use) as well as for forest management has resulted in severe overgrazing of pastures adjacent to villages and in deforestation. Lastly, a number of people with no prior experience in agriculture have engaged in farming after independence due to lack of other employment opportunities. These people are particularly in need of information on modern crop and land management techniques.

³⁸ WHO. 2008. *World Malaria Report 2008*

³⁹ World Bank. *World Development Indicators*. <http://data.worldbank.org/indicator/AG.LND.ARBL.HA.PC>, accessed on March 1, 2010

⁴⁰ World Bank. 2006. *Priorities for Sustainable Growth: A Strategy for Agriculture Sector Development in Tajikistan*

2.31 The experience of several donor-supported projects has shown that some of these problems could be effectively addressed at the local level, e.g. by involving the communities in management of natural resources as well as by demonstrating practical approaches that not only reduce land degradation but also create productive assets for rural population (Box 2.2). Reform of national regulations governing natural resource use will nevertheless be instrumental to allow for scaling up of such activities.

Box 2.2: Donor Initiatives on Sustainable Land Management

The World Bank's Community Watershed Management Project is implemented in four mountain watersheds with the objective to build productive assets of rural communities while curtailing degradation of fragile lands and ecosystems. To date, the project has supported approximately 42,000 households in 388 villages to increase their incomes and improve land and pasture management by providing small grants to households and community groups. Funds are allocated according to a predetermined formula for three types of activities: farm productivity enhancements, land resource management and rural infrastructure improvements. Average community contribution has been 30 percent of total project costs. The project has already contributed to improved environmental management on over 50,000 ha.

Land management projects are implemented primarily on degraded lands that have been previously considered unsuitable for agriculture. The examples include terracing (planting of fruit trees perpendicular to slopes to enhance soil conservation), construction of gabions (stone-filled baskets to stabilize soil and prevent erosion), optimization of land use by planting orchards and perennial forages or orchards and legumes (which also helps to control erosion), as well as establishment of woodlots. After the lands have been in good use for three years the farmers are given land use certificates. Many of these approaches have been replicated by other farmers and institutions, benefitting an additional 14,000 households.

Pasture improvement activities have also been very popular. In particular, the project has provided grants and technical assistance to rehabilitate pastures through planting of perennial plants (like lucerne or alfalfa), renovate or construct pasture irrigation systems, build cattle pens and drinking troughs in distant pastures to reduce grazing pressure as well as construct roads and bridges, which has provided access to an additional 10,000 ha of pasture land. The project has also organized a number of workshops to raise awareness on sustainable pasture management and livestock breeding systems as well as to facilitate the creation of livestock holders association as a mechanism to regulate pasture access and use at the local level. *Source: Interviews with World Bank staff*

UNDP Project "Demonstrating Local Responses to Combating Land Degradation and Improving Sustainable Land Management in South West Tajikistan" has been operating in four jamoats of Khatlon region since 2007. The assessment conducted at the beginning of the project showed that land productivity in target jamoats decreases by 10 percent annually due to improper agricultural practices and dilapidating irrigation infrastructure. The project has focused on increasing awareness of local governments and communities on rational land and water use; demonstrating practical measures to reduce soil erosion and desertification; and on creation of mechanisms for sustainable forest management. For instance, Land Degradation Units were established in cooperation with local authorities to educate the public about ways to reduce land degradation and to facilitate joint planning of water, forest and land resources.

The project helped rehabilitate land that had been abandoned due to high water table levels and soil salinity. Drought resistant varieties of Russian olive, elm and white poplar were planted to improve soil quality. To enhance sustainability, the project provided technical assistance to help dehkhan farmers establish nurseries in target jamoats, each of which has already produced 5,000-15,000 seedlings. These measures were supplemented by support to the local water user associations to improve drainage and irrigation infrastructure. Furthermore, an agreement with farmers to introduce crop rotations was reached. The project also worked with communities to replant forest shelter belts, which had been destroyed after independence due to the energy crisis. It is estimated that soil fertility in adjacent areas has improved by 10-20 percent. These practices have been widely replicated by dehkhan farmers in target communities.

Significant improvements were also achieved in tugai forest management. The tugai forests, which are officially considered part of the state reserves, were subject to unauthorized tree cutting due to unclear division of responsibilities among multiple government bodies overseeing their use and inability of state agencies to protect the forests. The project mobilized the residents living close to tugai forests into the Committee on Joint Forest Management. The Committee signed a five year lease agreement of 126 hectares of forests with the Jilikul district hukumat. The lease agreement allows the Committee members to use the tugai as pasture for cattle (except for goats) and obliges them to pay taxes for resource use. This approach has rapidly reduced tree cutting, creating the conditions for natural forest regeneration.

Source: UNDP Project Annual Reports 2007-2008; Interviews with UNDP staff

2.32 *Investing in Rural Infrastructure.* Adequate infrastructure is vital for development of the rural economy. Roads and bridges connect remote communities to local and regional markets, facilitate trade and enable farmers to access distant pastures thus preventing overgrazing. Similarly, access to reliable energy supplies can help address deforestation problems and preserve local biodiversity. The experience of several donors working in Tajikistan has demonstrated that community mobilization approaches are rather effective in implementing small-scale infrastructure improvement and rehabilitation programs. Community contribution usually equals or exceeds 20 percent of total costs in such projects. One of the ways to raise funding for small rural infrastructure projects is through mobilization of remittances. UNDP's Communities Program managed to substantially increase migrant's contributions in the Zeravshan Valley via the Migrant Household Initiative Groups. The average share of migrants' contributions grew from 40 percent in the first year up to 70 percent in the third year of program implementation, while the costs of the projects increased from an average of \$1,000 to \$5,000.⁴¹

2.33 Adaptation to climate change will inevitably involve using water more efficiently. Current water tariffs for drinking and irrigation purposes are very low and do not cover operation and maintenance costs. Furthermore, collection rates are also very low: 25 percent of people connected to plumbing in rural areas do not pay for water (most claim the service is free); of those who pay, only 10 percent have a water meter (both in urban and rural areas).⁴² Lack of funding has resulted in deterioration of drinking water supply system and inability of the government to provide access to safe drinking water to half of the country's rural population. Similarly, low tariffs, lack of individual meters and inadequate knowledge of farmers of the water requirements of different crops result in overconsumption of water for irrigation; deterioration of the irrigation infrastructure (current efficiency is estimated at 55 percent) as well as in planting of crops that will not be viable under economically efficient water prices. Such policies increase Tajikistan's vulnerability to climate change as they leave the country unprepared for the increased scarcity of water.

2.34 The government should support diversification of crops towards the ones that require less water, promote water saving irrigation technologies and create incentives for efficient water use (e.g. through introduction of individual meters and improving collection rates for water provision). It will also be important to implement institutional reforms to ensure that the irrigation system, built to serve large, state-owned collective farms, is capable of meeting the needs of individual small-holders. Decentralized water management arrangements have been promoted by several donors through support to establishment and development of water user associations (WUAs). To date, these institutions have been quite effective at improving access to water and strengthening community-level governance. (Box 2.3). This approach to water governance holds much promise and should be considered for scaling nation-wide.

2.35 Community mobilization approaches combined with seed grants can be very effective in making small scale infrastructure improvements, however many of the infrastructure needs have to be addressed at the national level (e.g. significant investment is needed in construction and rehabilitation of roads and highways connecting different regions, in improvement of access to modern communication networks and in increasing energy availability).

2.36 *Ensuring Secure Land Ownership.* Farmers will not have incentives to make investments in soil conservation and water use efficiency if they do not have secure property rights. Even though substantial progress has been achieved in restructuring the former collective farms ("kolkhozes" and "sovkhozes"), the privatization reforms remain incomplete. Farmers are often unaware of their rights to create individual *dehqon*

⁴¹ UNDP.2009. *UNDP Tajikistan Communities Programme Lessons Learned:2004-2009*

⁴² The World Bank, UNICEF & Tajikistan State Statistics Committee. 2007. *Tajikistan Living Standards Survey (TLSS)*.

(peasants) farms, privatization process remains non-transparent and corrupt, and local governments continue to interfere in cropping decisions even though such practices are not supported by the recently enacted legislation. To address the above mentioned problems some donors have piloted legal support centers in rural areas that educate farmers about their rights as well as provide legal advice and represent farmers in court. For instance, the USAID-sponsored legal aid centers helped resolve 10, 830 land-related problems, facilitated the creation of 770 dehkan farms and initiated 47 court cases during 2005-2008.⁴³ The next steps in land policy development should focus on simplifying the procedures for land privatization, strengthening the capacity of local governments to implement new regulations and informing farmers of their entitlements.

2.37 Ensuring Secure Land Ownership. Farmers will not have incentives to make investments in soil conservation and water use efficiency if they do not have secure property rights. Even though substantial progress has been achieved in restructuring the former collective farms (“kolkhozes” and “sovkhozes”), the privatization reforms remain incomplete. Farmers are often unaware of their rights to create individual *dehqon* (peasants) farms, privatization process remains non-transparent and corrupt, and local governments continue to interfere in cropping decisions even though such practices are not supported by the recently enacted legislation. To address the above mentioned problems some donors have piloted legal support centers in rural areas that educate farmers about their rights as well as provide legal advice and represent farmers in court. For instance, the USAID-sponsored legal aid centers helped resolve 10, 830 land-related problems, facilitated the creation of 770 dehkan farms and initiated 47 court cases during 2005-2008.⁴⁴ The next steps in land policy development should focus on simplifying the procedures for land privatization, strengthening the capacity of local governments to implement new regulations and informing farmers of their entitlements.

Box 2.3: Water User Associations as a Way to Improve Access to Water

The Water User Association Support Project funded by USAID and implemented by Winrock International has been operating in Tajikistan since 2004. To date, it has supported more than 30 WUAs, consisting of over 1,300 members and benefitting more than 260, 000 people in Tajikistan. The project has started with training the association organizers who then worked with the farmers to explain the potential benefits of self-organizing to manage water resources as well as to help form a WUA if farmers showed interest. All WUAs were established based on hydrologic catchment or watershed boundaries (not according to the boundaries of jamoat or former kolkhoz). While each WUA developed its specific by-laws, certain principles were universal. These included that all farmers were eligible to join a WUA, participate in all WUA activities as well as have access to information on its finances and that elections of the head of the association would be done through secret ballot to avoid elite capture.

WUA members were trained in business and financial management, irrigation system maintenance and conflict resolution as well as provided with the grants to support irrigation system rehabilitation projects. On average, WUAs contributed 30 percent of the total project costs, mostly in the form of labor. WUAs charge a membership fee based on the land area under irrigation as well as water use fees based on the amount of water that is consumed. The fees cover operational expenses and salaries of essential staff like engineer or accountant.

WUAs have been effective in providing reliable irrigation water supply to farmers as well as in collecting user fees. At least 90 percent of WUA members pay the fees on time. The project also helps reduce transaction costs as the associations reach a collective agreement on water use issues with local governments whilst in the absence of a WUA the government would need to enter into individual water user agreements and collect fees from each farmer.

Access to irrigation services enabled farmers to expand production. According to assessment of the project's impact from 2005 to 2006, cotton production increased from 1.8 to 2.8 tons per hectare, wheat and orchard harvests nearly tripled and vegetable and strawberry yields doubled. Following production increases, WUAs were provided with training on food preservation techniques as well as assisted in selling their produce in local and export markets.

Source: USAID, 2006. *Water User Associations: Experience with Organization and Grant Implementation Phases, October 2004 – May 2006*

⁴³ USAID, 2008. *USAID Land Reform and Market Development Project. Final Report*, September 2008

⁴⁴ Ibid

2.2 Enhancing Capacities for Risk Management

2.38 The risk management component of the adaptation strategy aims to strengthen the capacity of households, particularly the poor, to cope with increased risks associated with climate change. This includes development of disaster preparedness programs, safety nets, and improving access to financial services.

2.39 **Disaster Preparedness:** Climate change is expected to increase the frequency and severity of natural disasters, particularly mudflows, floods and droughts, posing additional risks to livelihoods, and infrastructure. Therefore disaster risk management should be an integral part of adaptation. Vulnerability to natural hazards depends not only on the severity of weather events but also on availability of protective infrastructure and institutional capacity to prevent and respond to disasters. Disaster prevention rather than a mere response to their occurrence should become a priority for government and donor support and funding.

2.40 Given the country's mountainous topography and the remoteness of many rural communities, the success of disaster risk management operations depends on improved disaster risk awareness and preparedness at the community level. Indeed, the risk of disasters is in many ways shaped at the local level (e.g. through inappropriate land use patterns) and when disasters do occur, the immediate response is provided by communities. The greatest number of lives is saved during the first few hours after a disaster and before the arrival of outsiders.⁴⁵ Therefore, local institutions and communities should be engaged in disaster risk management activities.

2.41 The national government also has a role to play by investing in disaster preparedness infrastructure, improving early warning systems and ensuring the availability of trained and well equipped staff at the rayon/local level. It is also important to improve information sharing and cooperation among different state agencies involved in disaster planning and response as well as to carry out a nationwide disaster risk assessment to identify the most vulnerable localities in the country. Such an assessment could inform the government's and the donors' disaster prevention work as well as future infrastructure projects. The Government of Tajikistan recognizes the importance of improved disaster management and has partnered with the donor and NGO community to reduce the risk of disasters. It has recently created the Information and Analytical Center under the Committee of Emergency Situations and Civil Defense to collect and systematize the information on disasters and to monitor disaster-related risks. The Government also adopted a National Disaster Risk Management Strategy for 2010-2015, which outlines the major directions of planned activities in the area of disaster management. Proper coordination among various stakeholders as well as adequate financing will be instrumental for the successful implementation of the strategy. Overall, national and local efforts should focus on disaster prevention as well as on capacity building for emergency response.

2.42 *Disaster Prevention.* Disaster risk is influenced not only by climatic events but also by the way communities, farmers, firms and other local actors use land and natural resources. For instance, increased crop cultivation on steep slopes, deforestation, and construction of housing in environmentally hazardous areas after independence has increased vulnerability to disasters in many rural areas of Tajikistan. Raising community awareness about potentially hazardous land management practices as well as providing them with the knowledge and funding to manage natural resources in a more sustainable manner can reduce the risk of disasters as well as provide additional income-generating opportunities.

2.43 Many of the natural hazards (e.g. landslides) are recurrent. Developing landslide hazard maps at the village and district level can help identify houses and infrastructure most vulnerable to disasters as well as

⁴⁵ Cristoph Pusch. 2004. *Preventable losses: saving lives and property through hazard risk management*. Working Paper Series No.9. Hazard Management Unit, The World Bank, Washington DC

inform future construction projects. Community mobilization approaches whereby communities are engaged in identification of local disaster risks and provided with grant funding to undertake infrastructure improvement projects have proven to be effective in strengthening resilience to disasters at the local level both in Tajikistan (Box 2.4) and in other countries where such projects have been introduced.

2.44 *Emergency response.* Increasing the ability of local actors to respond to disasters effectively and with minimal losses to community assets should be an integral part of disaster preparedness activities. Efforts should concentrate on development of emergency response strategies, evacuation plans, construction of shelters, identification and training of volunteers for the search and rescue brigades, development of early warning systems and organization of public awareness campaigns. Women should be involved in disaster-preparedness work as in many disadvantaged locations most young men have migrated abroad while women are not prepared to protect themselves and their children. Development of emergency response strategies should be followed by drills with participation of local leaders, schools, medical personnel and community organizations. Public awareness campaigns conducted through the media as well as local institutions like schools or mosques should aim to educate people about natural disaster risks and available protection measures as well as encourage community involvement in disaster mitigation.

Box 2.4: Community-Based Initiatives on Disaster Risk Reduction

Care International has been implementing a community-based project on disaster preparedness since 2003. The project has contributed to the creation of 64 village committees in Varzob, Vahdar and Yovon districts of Khatlon region. All community-based organizations have been provided with training on community risk assessment, disaster management, first aid and natural resources management, assisted in the development of risk and evacuation maps and in organization of community drills. In addition, each community was provided with grants to implement small-scale disaster-mitigation projects (e.g. construction of flood protection walls) in their villages.

FOCUS, an affiliate of the Aga Khan Development Network, has been working in the GBAO region since 1997. It undertakes projects to strengthen the abilities of local communities and the Government's Committee of Emergency Situations and Civil Defense (CoES) to cope with disasters through initiatives in information management, capacity building and community-based risk reduction. FOCUS has partnered with 270 communities in all districts of GBAO to build their preparedness and response capacity to natural disasters. The NGO has implemented over 250 community-based hazard, vulnerability and risk assessments, coordinated the development of village disaster management plans and identified and established over 300 safe heavens and evacuation paths. To enable efficient emergency response, over 95 wireless communication devices were installed linking communities with FOCUS and CoES. FOCUS has also conducted disaster awareness and preparedness workshops in villages, schools and hospitals throughout GBAO reaching over 100,000 people. Communities have been provided with assistance to undertake small-scale projects (e.g. river-bank protection, construction of diversionary channels to mitigate the impact of mudflows, road rehabilitation).

Source: UNISDR. 2007. *Building Disaster Resilient Communities*, AKDN. 2008. *Focus Humanitarian Assistance Brief*

2.45 A number of donors and NGOs (e.g. Care International, EC, Focus, Oxfam, Oxfam, UNDP, WB) have applied community mobilization approaches in selected disaster-prone locations of Tajikistan. The experience of two of these projects is summarized in Box 2.4. While significant investments are necessary to scale these initiatives to all vulnerable areas, the international experience shows that disaster risk reduction measures are cost-effective in mitigating the negative impacts of weather extremes. The benefits are calculated not only in money saved but also in more secure livelihoods and saved lives. Some examples include: China's investment of US \$3.15 billion on flood control between 1960 and 2000, which is estimated to have averted losses of about US\$ 12 billion; the Rio de Janeiro flood reconstruction and prevention project in Brazil yielded an internal rate of return exceeding 50 percent; and the disaster mitigation and preparedness programs in Andhra Pradesh, India yielded a benefit/cost ratio of 13.38.⁴⁶

⁴⁶ UNISDR. 2008. *Climate Change and Disaster Risk Reduction*. Briefing Note 01. Geneva

2.46 **Financial Services:** Reliable access to financial services can help households and small businesses of Tajikistan accumulate assets, diversify livelihoods/production and develop coping mechanisms that will make them less vulnerable to climate variability and extremes. Access to financial services has long been seen as one of the tools to help reduce poverty. Indeed, a saving account can help the rural poor deposit money after a good harvest and withdraw it in times of need, thus smoothing consumption and reducing vulnerability; while access to credit can enable farmers purchase drought-resistant seeds and other inputs or even start a business outside of agriculture.

2.47 Despite the recent growth of the financial sector, access to credit and other financial services in Tajikistan is limited, especially in rural areas. Only 0.4 percent of households have a bank account (0.2 percent in rural areas) and 2.5 percent have used any formal institution for borrowing (ILSS 2007). Access to finance is cited as the top constraint facing a business in the IFC Survey on business environment (2009).

2.48 The reasons behind low utilization of financial services include 1) low public confidence in banks, as evidenced by the fact that less than 5 percent of the worker remittances remain in the banking sector as deposits (IFC 2009), 2) limited range of products provided by banks; 3) lack of bank branches in the rural areas (the National Bank maintains tight control on bank branching, which requires prior NBT's approval of the branch as well as the branch manager and chief accountant; the process can take months or years, so banks minimize such requests); 4) limited lending to agriculture (except for government directed lending for cotton, which has resulted in accumulation of debts and contributed to higher perceived risks of the agriculture sector) and; 5) weaknesses in skills and tools of bank employees to assess credit risk.⁴⁷

2.49 Microfinance institutions (MFIs) have grown rapidly in the past few years, yet their outreach is still limited, with approximately 150,000 borrowers in 2008 who received about \$135 million in microcredit from these organizations.⁴⁸ More than half of MFIs' lending is focused on non-farm activities.⁴⁹

2.50 A supportive regulatory environment can turn financial institutions into catalysts of business growth and poverty reduction; while access to financial services can increase resilience of population to various shocks (including climate extremes). The reforms should include 1) removing restrictions on opening new branches for banks and MFIs; 2) attraction of FDI into the banking sector and strengthening competition among banks (at present, banks have segmented the market geographically and by sector, so sometimes operate with significant monopoly); 3) simplification of a regulatory framework for MFIs (e.g. easing the procedure for getting a foreign currency loan, simplifying licensing and reporting requirements and a tax regime); 4) abolishment of government-directed lending to cotton as it undermines the stability of the whole banking system; 5) capacity building of banks employees to introduce modern credit scoring tools (currently most lending decisions are based primarily on collateral rather than on the profitability and projected cash flow of the enterprise)⁵⁰ and 6) assistance to MFIs and banks in development of climate-proof products.

2.51 In many countries, financial institutions, particularly microfinance organizations, have taken the lead in development of products and services that are specifically aimed at reducing vulnerability of their clients to climate shocks. For example, the Self-Employed Women's Association (SEWA) in India offers housing loans

⁴⁷ Government of Tajikistan. 2009. *Draft Tajikistan Financial Sector Development Strategy 2009-2013*

⁴⁸ IFC. 2009. *Business Environment in Tajikistan as Seen by Small and Medium Enterprises*

⁴⁹ As of 2007, the composition of disbursed loans by sector was: trade 49.2 percent manufacturing 4.5 percent, services 6.2 percent, livestock 29.9 percent, agricultural production 10.1 percent (Source: Tajikistan Financial Sector Development Strategy 2009-2013)

⁵⁰ Government of Tajikistan. 2009. *Draft Tajikistan Financial Sector Development Strategy 2009-2013*

to replace roofs, reinforce walls or rebuild in less hazard-prone locations.⁵¹ As a condition of the housing loan, an MFI can suggest that clients use a design that lends itself to easy reconstruction (e.g. the Vietnamese Red Cross helped install houses designed to be easily restored after floods). Many MFIs provide loans for installation of wells or building catchments to collect rainwater. Financial institutions can also play a role in adapting to increased scarcity of water by providing credit for switching to less water-intensive crops.⁵² Lastly, with donor assistance, many developing countries have introduced insurance products aimed to reduce vulnerability to climate shocks.

2.52 With the exception of the few small initiatives that provide loans to insulate houses and thus reduce deforestation, no environmentally-sensitive financial products are currently available in Tajikistan. The development of the insurance market is constrained by the outdated legislation, low public confidence in the sector and poor understanding of insurance products by the general public. MFIs are currently not legally permitted to offer insurance although negotiations with the National Bank are on-going to allow MFIs to do so in partnership with the insurance companies.

2.53 Climate change can have a potentially negative impact on the operations of financial institutions (particularly MFIs as they typically deal with more vulnerable clientele). For instance, increases in disasters and disease outbreaks can have a highly negative impact on the loan repayment rates and may result in a run on deposits, so apart from facilitating adaptation of their clients, the financial institutions should adapt themselves. Most MFIs in Bangladesh allow their members to reschedule loan installments during times of flood. The recent publication by Grameen Foundation recommends that MFIs develop flexible disaster plans, introduce/scale voluntary savings schemes, expand their insurance portfolio and partner with the multilateral institutions to develop concessional funding facilities to reduce the impact of disasters. Most of these recommendations will be relevant for Tajikistan as well, yet at this stage of the sector development, financial institutions are concerned with more immediate needs and risks.

2.54 Safety Net Programs and Insurance: Effective safety net programs can help reduce household vulnerability to changing climate and to a number of other shocks (like the recent food and fuel crisis or the international financial crisis). Currently social assistance programs are virtually non-existent in Tajikistan. The social protection system is dominated by the old age and disability pensions, which account for 89 percent and 10 percent respectively of all social benefit receipts. Social assistance programs comprise the remaining 1 percent of receipts and include a small program of allowances to primary school students from low-income households, gas and electricity subsidy programs and several other poorly-targeted and severely underfunded programs.⁵³ This leaves the chronically poor of Tajikistan with almost no support from the state and makes the population particularly vulnerable to potential economic and/or climate shocks.

2.55 In this context, it will be beneficial to design flexible safety net programs that will address the needs of the chronic poor and could be scaled up in case of a disaster or other shock. It will be best to limit the number of programs but ensure that they are well-targeted and adequately financed. Once introduced, such programs can become an instrument through which donors will channel additional assistance in case of a crisis. The types of social assistance programs that could be introduced/scaled in Tajikistan include public work programs, cash transfers, and, potentially insurance-related transfers to the poor.

⁵¹ Hammill, Anne, Richard Matthew and Elissa McCarter. 2008. *Microfinance and climate change adaptation*. IDS Bulletin. Volume 39, Number 4, September 2008; Institute of Development Studies

⁵² Dowla, Asif. 2009. *Climate Change and Microfinance*. Grameen Foundation Publication Series

⁵³ World Bank. 2009. *Republic of Tajikistan Poverty Assessment*, Washington DC

2.56 Public Works Programs Employment programs can be effective in providing income generating opportunities to the poor in times when agricultural income is reduced (e.g. due to unfavorable weather conditions or disasters). Such programs can also help improve public infrastructure and restore biodiversity, thus increasing community resilience to negative impacts of climate change. Examples of public work programs include road construction and maintenance, building embankments to prevent the overflow of rivers, rehabilitation of irrigation systems, reforestation and soil conservation. In countries, where such programs have been introduced, they have also reportedly strengthened the capacity of local institutions to manage development projects and helped many small-scale contractors to grow.⁵⁴

2.57 Successful implementation requires effective targeting; administrative capacity at the local level; and investment in projects that will have lasting value for the community. Overall, the lower the wage rate, the better the self-targeting but also the lower the net benefit per worker. Usually, the wage should be set just below the market wage for unskilled manual labor in the area in which the scheme is introduced (WB, 2003).

2.58 One of the best-known public works programs is the *National Rural Employment Guarantee Act* in India. The Act aims at enhancing the livelihood security in rural parts of India by guaranteeing at least 100 days of wage employment a year to every household whose adult members are ready to do unskilled manual work. The program has been successful in enhancing agricultural productivity (through water harvesting, erosion control and micro-irrigation), increasing access to markets and services through rural connectivity works, inclusion of the marginalized groups and women in the workforce and stabilizing household incomes.⁵⁵

2.59 While Tajikistan may not be able to introduce a similar program on a countrywide scale, it may be possible to do so in the most vulnerable and/or disaster prone locations. Donors can also consider incorporation of the public work programs into their infrastructure development initiatives. For instance, the World Bank is planning to introduce cash-for-work programs for renovation of the irrigation and drainage infrastructure in the “Public Employment for Sustainable Agriculture and Water Management” project, which aims to increase household food security in selected districts of Khatlon region. The World Food Program provides food assistance to food insecure households in all regions of Tajikistan through its *Food for Work Program*. The program targets the most vulnerable households based on a set of criteria (e.g. monthly income per household member cannot exceed 95 somoni, land plots cannot exceed 0.2 ha, etc) and provides them with food assistance to build or rehabilitate public assets. Infrastructure projects are selected in partnership with *hukumats*, *jamoats* and local NGOs who usually also provide construction materials. In 2009, there were 1650 recipients, who helped construct 13 km of drainage canals, rebuild five bridges, rehabilitate seven schools, rebuild 185 homes and build or restore ten latrines. Similar activities could potentially be organized on a cash-for-work basis.

2.60 Cash Transfers Regular cash transfers can play an important role in reducing the vulnerability of chronic poor who will suffer most from increased climate variability and stresses. Depending on the objectives of the social assistance program, unconditional or conditional transfers should be introduced. If the goal is to alleviate general poverty, unconditional cash transfers targeted to the poorest will be a good choice, and if child poverty and building human capital is of the main concern, transfers conditional on parents keeping their children at school and/or attending health centers are an effective tool.⁵⁶ Conditional cash transfers (CCTs) were introduced in many countries and turned to be largely successful at improving child nutrition,

⁵⁴ World Bank. 2003. *Systemic Shocks and Social Protection: The Role and Effectiveness of Public Works Programs*, Social Safety Nets Primer Notes, 2003, No 1

⁵⁵ The National Portal of India http://india.gov.in/sectors/rural/national_rural.php, accessed on February 25, 2010

⁵⁶ World Bank. 2009. *Republic of Tajikistan Poverty Assessment*, Washington DC

health and school attendance rates. For instance, in Mexico, CCTs have been found to reduce by 23 percent the probability that children aged 12-14 will leave school and enter the labor market in the event of drought, unemployment or other shocks. In Brazil, the incidence of malnutrition among children aged 6-11 months was 60 percent lower in poor households covered by the nutrition program (UNHDR 2007/2008). Having a functional cash transfer program in place will also be important for delivery of timely post-disaster assistance.

2.61 *Insurance Programs.* The government should create favorable conditions for the development of the commercial insurance market. Globally, there are some innovations that combine insurance and safety net approaches. For instance, weather-indexed insurances are gaining popularity in different countries of the world (Box 2.5). Unlike the traditional insurance, which provides coverage against poor crop yields, weather-indexed insurance covers directly against “bad weather”. Damage payments are set based on the objectively defined “trigger events” (e.g. rainfall, soil moisture) according to an index and farmers collect payouts if the index reaches a certain measure, regardless of actual losses, so farmers still have incentives to make productive management decisions. This approach removes moral hazard problems inherent in traditional insurance schemes as well as lowers transaction costs for the insurance agency as no household-specific data collection is necessary. When well-designed, such insurance programs can enhance farmers’ adaptive capacity by encouraging greater experimentation and investment in higher risk higher return activities.

Box 2.5: Weather-Indexed Insurance in Mexico and Ethiopia

Mexico has a program for natural disaster management that includes weather indices as “triggers” for payouts to farmers and to mobilize safety net programs such as public works and feeding programs. Specific ranges of rainfall, temperature and wind speeds for specific regions serve as proxies for high expected household and smallholder losses. Ethiopia is adopting a similar approach in its “productive safety nets” project which relies on weather indicators as triggers for safety net transfers. What is interesting about these safety net programs is that the triggers are transparent and known by poor and vulnerable households, and they do not need to be directly insured. The poor therefore do not pay premiums. Instead, governments either purchase insurance from national or international insurers and re-insurers, or maintain disaster funds in savings accounts. As such, there is scope to combine safety net programs with insurance markets, and to allow households to manage their assets and livelihoods knowing that they will have ex-post assistance for coping activities, whereas state and national governments pay ex-ante to set up the risk response strategy.

Source: Heltberg, R. et al 2008

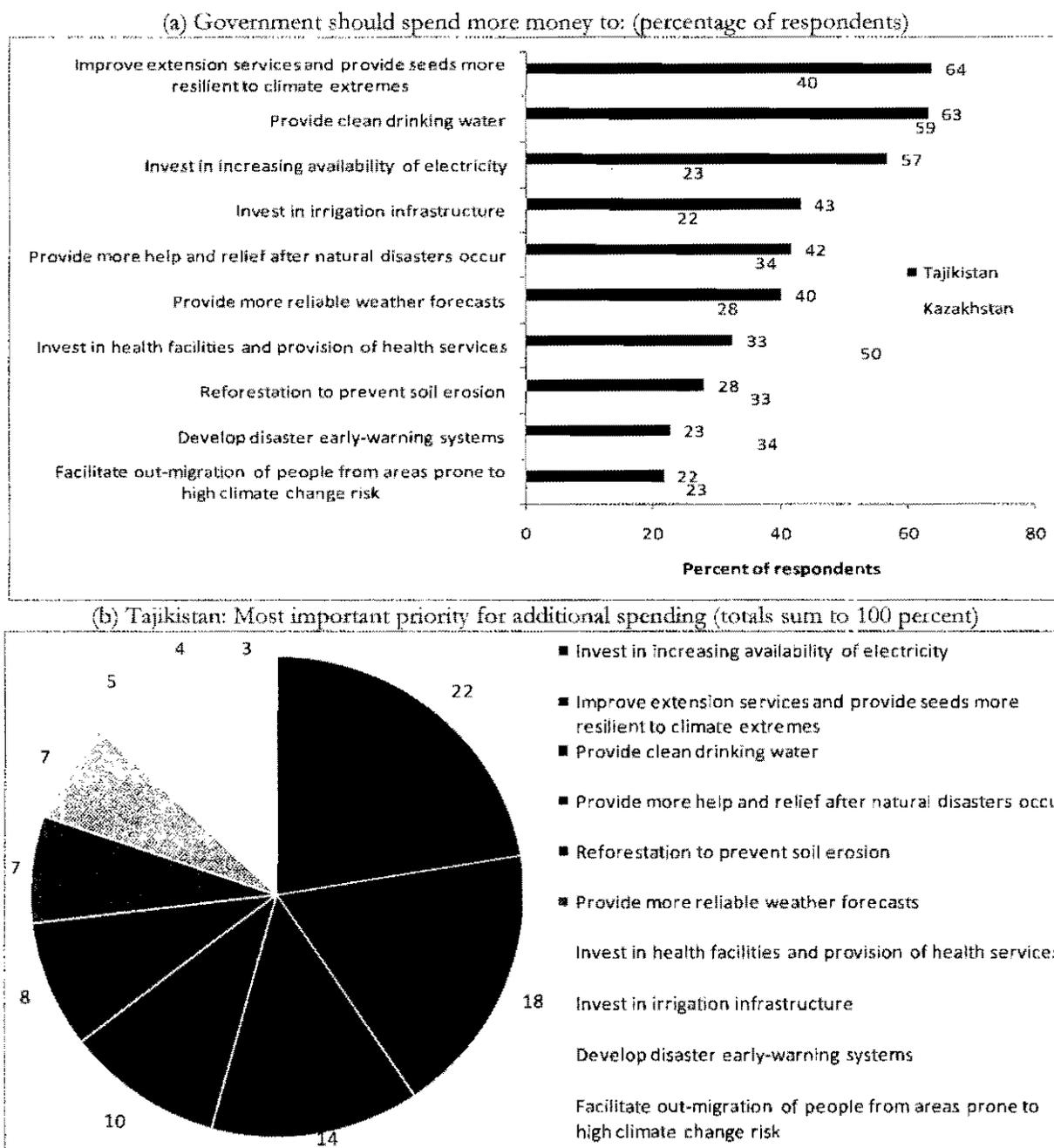
2.3 Priorities for Additional Spending on Adaptation: Evidence from the P-LITS Survey

2.62 Most of the interventions described above closely reflect the priorities for government spending on adaptation as seen by the respondents of the P-LITS Survey. Respondents were asked the question: suppose the government had a sizeable sum of money to soften climate change impact on people in your community, or communities like yours: on which of the following do you think the government should spend more money? More than half the P-LITS 2 sample in Tajikistan identified “improving extension services and providing seeds more resilient to climate extremes” (64 percent of respondents), “providing clean drinking water” (63 percent of respondents), and “investing in increasing availability of electricity” (57 percent) as important priorities for government spending (Figure 2.4a).

2.63 As one would expect, peoples’ past experiences with adverse climate change-related impacts play an important role in influencing their views regarding what future course of action should be taken to adapt to climate change: the P-LITS data show that respondents that reported having experienced unpredictable and extreme weather that harmed agricultural production, or a decline in fresh water for drinking or irrigation, are much more likely to favor increased government spending on improving extension services and providing seeds more resilient to climate change, providing clean drinking water, and investing in irrigation infrastructure respectively, compared to respondents that did not experience such climate-related hazards.

2.64 When asked to choose the single-most important priority for additional government spending related to climate change, (i) investing in increasing availability of electricity (22 percent), (ii) improving extension services and providing seeds more resilient to climate extremes (18 percent), and (iii) providing clean drinking water (14 percent) received the highest share of votes from respondents (Figure 2.4b); (iv) providing more help and relief after natural disasters occur (10 percent), (v) reforestation to prevent soil erosion (8 percent), (vi) providing more reliable weather forecasts (7 percent), and (vii) investing in health facilities and provision of health services (7 percent) received the next highest share of votes

Figure 2.4: Priorities for Government Spending on Climate Change Adaptation



Source: World Bank staff estimates based on P-LITS data.

2.4 Concluding Remarks

2.65 Tajikistan is ill-adapted to its current climate conditions let alone impending changes as manifested in low agricultural productivity, water stress and high losses incurred due to disasters. Furthermore, many of the existing policies exacerbate rather than reduce vulnerability to a changing climate. This in particular relates to cotton policies, environmental and water management policies. In addition, absence of effective safety net programs increases vulnerability of the poor to adverse climate events as well as other possible shocks as evident during the recent financial crisis. Irrespective of the climate change scenarios, reforming these policies is important for improving the livelihoods of the people and facilitating economic growth.

2.66 Climate change adaptation strategies should not be regarded as stand-alone initiatives. As demonstrated in this chapter, they are in close conformance with Tajikistan's general poverty reduction and development objectives. In fact, development is an integral and most important tool for adaptation. Greater income diversification, improved health and education as well as better access to information, services, resources and infrastructure enhances the capacity of households, particularly the poor, for autonomous adaptation. Furthermore, there is evidence that development dramatically reduces the number of people affected by floods and droughts regardless of the climate change scenarios and that the higher the level of a country's development the smaller the costs of adaptation as a percentage of GDP.⁵⁷ The findings of the P-LITS survey also reflect the close connection between adaptation and development spending, with over fifty percent of respondents identifying improved extension services and provision of seeds more resilient to climate extremes, provision of clean drinking water and investment in increased availability of electricity as key priorities for government spending on adaptation.

2.67 Several donors have funded projects that, while not designed with climate change considerations in mind explicitly, have contributed to adaptation by promoting sustainable management of natural resources, improving community-level governance, strengthening local infrastructure, preventing disasters, or improving health care.

2.68 A supportive national regulatory framework will be necessary to allow for further development of these and many other relevant initiatives and to enable faster climate change adaptation. Reform priorities include ensuring secure land ownership, removal of constraints that tie farmers to cotton cultivation, improvement of water governance and strengthening access to financial services. It will also be important to develop more off-farm livelihood opportunities (through better infrastructure, business-friendly investment climate, improvement of education and skills in the rural areas) to reduce dependence on climate-sensitive activities, like agriculture.

2.69 Adaptation planning will require that climate-related risks are integrated in the sectoral (e.g. agriculture, water management, health) and national policy making as well as budget frameworks. Currently, there is very little awareness among line ministries of the potential implications of climate change for their respective sectors. Increasing knowledge on climate change issues among government officials, conducting sectoral vulnerability assessments as well as development of a national adaptation strategy are some of the measures that can be recommended in this regard. Furthermore, given the close link between poverty and vulnerability to climate change, it is important to integrate climate risks in the Poverty Reduction Strategies and other National Development Plans and ensure that achievement of short-term goals (in particular in areas like infrastructure investments, territorial development and the use of natural resources) does not increase the country's vulnerability in the long run.

⁵⁷ World Bank. 2010. Consultation Draft. *The Cost to Developing Countries of Adapting to Climate Change: New Methods and Estimates*. Washington DC

3. REGIONAL VARIATION IN VULNERABILITY

3.1 The question addressed by this chapter is whether it is possible to discern where the most vulnerable are located? The answer to this question has important implications for adaptation strategy. Much of the population and the economy of Tajikistan are in the two major valleys which are the loci of irrigated agriculture and where water availability is a major climate change-related concern. The remainder inhabits the mountainous areas of varying elevation where mudslides and other natural disasters are major risks. Adaptation strategies need to determine where to invest in planned adaptation. Such strategies face an apparent dilemma between protecting the core agricultural economy by investing in the most productive areas or funding disaster risk management activities in the more mountainous areas.

3.2 A geographically disaggregated picture of vulnerability to climate change is helpful for planning adaptation strategies in the same manner that a poverty map is helpful for designing anti-poverty policies and programs (Hentschel, Lanjouw, Lanjouw, and Poggi; 2000). The vulnerability index estimated in this chapter addresses the question: if policy makers wish to direct funding toward the areas with the highest vulnerability to climate change, where should that funding go? And what are the factors that render some areas more vulnerable than others? The chapter does not aim to estimate the cost and benefits of investing in different geographic areas or to offer any policy prescriptions. Instead, the estimates presented here should be seen as a useful starting point for a dialogue about where the most vulnerable are located and what factors render them more vulnerable than others.

3.3 Vulnerability is a function of exposure to climate change and variability; sensitivity to the impacts of that exposure; and ability to adapt to ongoing and future changes (Hahn, Riederer, and Foster, 2009). Indicators and indices are useful for describing a complex reality in simple terms and permitting comparisons across space and time provided that they can be comprehended intuitively, are impartial, and are geographically comparable (Vincent, 2004). Many authors have argued that the ‘adaptation deficit’—excessive vulnerability to current climate variability—is a good proxy of future vulnerability to climate change (e.g., World Bank 2009b). Thus the chapter focuses on vulnerability to current climate variability, not projected future changes.

3.4 Geographic variation in vulnerability is assessed based on a wide array of available proxies and diverse data sources including household surveys and weather station records. The assessment of vulnerability considers a range of factors beyond the geo-physical impacts of climate change. These factors include the extent to which assets and livelihoods are sensitive to impacts of climate change as well as the social, economic, and institutional factors that are likely to shape adaptive capacity. In Tajikistan, migration and elevation are two critical factors to consider. A common household livelihood strategy is overseas migration for work, mostly to Russia. Tajikistan received remittances equivalent to 40 percent of its GDP in 2008, almost all from male migration to Russia. Households in the rural highlands have on average almost 50 percent more migrant workers than households in the rural lowlands, and correspondingly receive higher amounts of remittances.

3.5 The results suggest that vulnerability to climate change and variability varies substantially across regions and agro-ecological zones in ways that are not a priori obvious. The vulnerability index varies according to socio-economic and institutional development while exposure and elevation exert smaller influences: geography is not destiny. The results indicate that urban areas are by far the least vulnerable while the eastern RRS mountain zone is the most vulnerable. The estimates suggest that some of Tajikistan’s sparsely populated high altitude mountain zones are the least vulnerable while prime agricultural valleys are among the more vulnerable areas. This implies that relatively vulnerable geographic areas can overlap centers of population and economic activity. Adaptation planners therefore do not necessarily face a trade-off between

defending the most vulnerable areas and defending the economically most important areas from the impacts of climate change.

3.6 The rest of the chapter is organized as follows: section 3.1 discusses vulnerability and adaptive capacity, section 3.2 introduces the data and methodology used for constructing the index, section 3.3 presents the results and section 3.4 offers concluding remarks.

3.1 Vulnerability and Adaptive Capacity

3.7 Vulnerability is the risk of experiencing poverty or some other deprivation during some time interval. Estimates of vulnerability to poverty normally focus on the risk of the household falling below the poverty line as a result of changes in income resulting from risky events. An individual or household is vulnerable to risk(s) associated with climate change if these risk(s) will result in a loss of well-being that pushes the individual or household below a threshold level of well-being. Vulnerability is a function of the risks, exposure and sensitivity to risks, and adaptive capacity. In this paper *exposure* is defined as the chance that assets and livelihoods will be impacted by climate change risk and *sensitivity* as the susceptibility of assets and livelihoods exposed to risk.

3.8 Adaptive actions are adjustments in assets, livelihoods, behaviors, technologies, or policies that address ongoing and future climate changes (IPCC, 2007; Stern, 2006; UNDP, 2007; Smit and Wandel, 2006). Adaptation confers private benefits - it is in people's self-interest to adapt in order to safeguard lives and livelihoods. Adaptive actions comprise both private, club, and public goods. Heltberg, Siegel, and Jorgensen (2009) define *adaptive capacity* as the ability to deploy social risk management strategies for reduction of risk and human vulnerability associated with climate change.

3.9 Adaptation matters: when category 3 cyclone Bhola hit was then East Pakistan in 1970, upwards of 500,000 people died. When in 1991 a category 4 cyclone hit now independent Bangladesh, mortality was 138,000. In November 2007, cyclone Sidr, also of category 4, resulted in only 5-10,000 deaths. Bangladesh achieved this remarkable reduction in disaster mortality through a combination of early warning systems and cyclone shelters. Early warning systems spanned both high tech information systems and low tech outreach such as volunteers on bikes that spread warning messages. What this example shows is that the effectiveness of societies' adaptive capacity is paramount for how climate events translate into human and economic consequences (Heltberg, Siegel, Jorgensen, 2009). Another stark example is the impact of earthquakes in Haiti and Chile. While more than 200,000 people died in Haiti's 7.0 earthquake in January, 2010 from collapsed buildings, an 8.0 earthquake in Chile in February 2010 resulted in 486 deaths, many from tsunami waves. There is a saying among engineers that buildings, not earthquakes, kill people. Likewise, adaptation and maladaptation determine vulnerability to climate change.

3.10 Even though adaptive capacity has been the subject of increasing research in recent years (Adger, 2006; Smit and Wandel, 2006) little is known with precision about how it varies across countries, regions of countries, and sectors and how it can best be strengthened. The drivers of adaptive capacity include physical, financial, human, and social capital assets. Adaptive capacity is unequally distributed: it varies systematically along existing fault lines for inequality and social exclusion such as gender, ethnicity, and socio-economic status (e.g., Ribot, 2010). Therefore, the poor are not only the most exposed to the impacts of climate change, they are also the least equipped to adapt to it. The constraints to adaptation can be financial but often are rooted in belief systems and social structures (Adger et al, 2009). For example, all cultures have different traditions for how, and what sources of climate knowledge, they use--traditions that are vitally important for how weather forecasts are used or whether early disaster warnings are needed. The roots of maladaptation can thus be cognitive just as much as they can be rooted in financial constraints or flawed

engineering. However, much remains to be learned about how these insights might translate into better adaptation interventions on the ground in different contexts.

3.2 Data and methodology

3.11 This section describes how the concepts of exposure, sensitivity, adaptive capacity, and vulnerability were translated into numerical indices; what variables were used; how variables were aggregated into sub-indices and sub-indices into a composite vulnerability index; and how sub-national geographical areas were determined.

3.12 **Conceptual approach:** The measure of vulnerability to climate change relies on the IPCC working definition of vulnerability as a function of exposure, sensitivity, and adaptive capacity (IPCC, 2001) and incorporates social, economic, and natural science indicators. A number of other contributions have done the same (e.g., Polsky et al., 2007; World Bank, 2008). The index of vulnerability is constructed as the simple average of three sub-indices: exposure, sensitivity, and adaptive capacity. In line with previous literature, a range of climatic, economic, social, and institutional variables are included as the drivers of vulnerability and the focus is on vulnerability to current climate variability. One advantage of this approach is the reduction in dependence on climate models and projections which despite recent advances are still presented at too coarse a scale with too high degrees of uncertainty to be useful for regional analysis (Hahn, Riederer and Foster 2009).

3.13 This report improves upon the approaches used by previous studies by covering all areas of the country, both rural and urban, and by carefully exploiting a host of available survey, census, and meteorological data. The indicators of past climate variability are used to assess exposure to natural disasters and climate variability; social, economic, and institutional characteristics of households and regions that affect their adaptive capacity; and health, livelihood, food security, and demographic characteristics that determine sensitivity to climate change impacts.

3.14 **From concept to choice of variables:** A number of judgments have to be made when translating the concepts into estimates of vulnerability at the sub-national level; this is particularly so for adaptive capacity. For example, does migration and urbanization reduce or increase vulnerability? Vincent (2004) interprets growing urbanization as a sign of weak rural resilience and therefore high vulnerability. However, in the Tajik context, migration is accompanied by remittances vital to the livelihoods of the household members left behind. At least to the migrant households, remittances help reduce vulnerability. The report therefore treats remittances income as one of the independent sources of income which increases diversification of income sources and thereby improves adaptive capacity. A variable measuring the extent of diversification of non-agricultural income sources at the household level is constructed, which is a good indicator of how well communities have already adapted: well-diversified communities (including those with remittance incomes from migrants) are displaying adaptive behaviors and might be expected to continue to do so in the future.

3.15 A well-educated population with reasonable and diversified income sources and developed institutional structures is better able to manage risks and prevent biophysical impacts from translating into human impacts. Therefore the adaptive capacity sub-index also includes average per capita household consumption and the share of population with education above secondary.⁵⁸ Institutional strength and stability are also

⁵⁸ Access to information and communications infrastructure is also arguably important in influencing vulnerability (Blake et al, 1994). In the past, authors have used telephone access measures as proxies for information sharing, early warning, and general connectivity. However, now that most households have cell phones, the value of telephone access as a proxy variable has arguably diminished. This leaves us with no usable data source on access to information.

important for determining the coping range of a population. Governance and political stability are important criteria here but unfortunately, no direct indicator is available at the sub-national level. However, three good proxies for institutional strength are available in the data and all contribute to adaptive capacity:

- Social capital and trust is measured in the form of generalized trust. The question "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?" has been used in many settings to assess general interpersonal trust as a dimension of social capital. It is available for Tajikistan from the Life in Transition (LiTS) survey. The proportion of households that state they have some or complete trust in other people is used for the analysis.
- Quality of public services such as police, courts, education, health, and social assistance contribute toward adaptive capacity. Areas with good services will find it easier to respond to climate risks and to craft the public-private collaboration required to prepare for climate change. This variable is measured using LiTS data on the average number of public services (out of 8 max) for which households declare that they are either satisfied or very satisfied. If all households in a region were satisfied with the quality of all 8 public service areas, the value becomes 8. If no household is satisfied with any of the services, the value becomes zero.
- Corruption in daily interactions measures a key hindrance for adaptive capacity and, vice versa, absence of corruption makes adaptation easier and proxies institutional strength. We measure corruption using LiTS data on the average number of public services (out of 8 max) for which households declare that they never or seldom find it necessary to pay bribes in order to obtain the service in question (the services are the same as above, namely police, courts, education, health, and social assistance services).

3.16 Constructing indices of exposure and sensitivity to the impacts of climate change proved relatively more straightforward. The exposure index is constructed from variables measuring temperature and precipitation variability and natural disaster frequency and the the sensitivity index from variables measuring agricultural, demographic, health, poverty, and disaster-related sensitivity to climate variability. This is described in greater detail below.

3.17 **Variables in the index:** The *exposure sub-index* is comprised of the following six variables measuring exposure to variability and extreme values of temperature and precipitation as well as to natural disasters:

- Standard deviation of the average monthly temperature 1950-90 (see formula below for how it was formed)
- The range between maximum and minimum average monthly temperature
- The frequency of extremely hot or cold months, defined as the frequency of months in which the average temperature exceeded 30 C or fell below - 10 C.
- The frequency of extremely dry months in the spring (less than 5 ml total precipitation per month) and summer (0 ml total precipitation per month)
- The standard deviation of monthly total precipitation
- The frequency of weather related disasters between 1998-2009.

3.18 *The sensitivity sub-index* is comprised of five variables measuring agricultural, demographic, health, poverty, and disaster-related sensitivity to climate change and variability:

- Sensitivity of agriculture to impacts of climate change and variability is measured as the average of three variables: area of irrigated land per capita, the degree of diversification of crop land-use measured by the Herfindahl index, and the share of households whose main income source is agriculture.
- Demographic sensitivity is measured by the share of the population below 5 and above 65 years of age.

- Sensitivity to adverse impacts on health is measured by the average of two variables, the under-five mortality rate and the share of households relying on an unprotected water source.
- Sensitivity to poverty and hunger is measured by the share of households that report food insecurity (the consumption-based measure of poverty is avoided because it correlates closely with income which is used in the adaptive capacity sub-index).
- Finally, sensitivity to the impacts of natural climatic disasters (as opposed to exposure to them) is measured by the mortality rate from natural climatic disasters and the estimated per capita economic costs of these disasters.

3.19 *The adaptive capacity sub-index* is comprised of four variables measuring consumption, education, income diversification, and institutional development:

- Household consumption per capita
- Share of population with higher education (above secondary)
- The Herfindahl index of income diversification (higher value, more diversification)
- Institutional development and social capital is measured by the average of three variables: trust (share of households with general trust in other people); absence of corruption (share of households that never or only rarely have to pay bribes); and political involvement (share of households that participated in presidential elections).

3.20 **Index methodology:** Various methods exist for aggregating variables into sub-indices and sub-indices into composite indices. Simple averages assume all variables carry equal weight. Weighted averages can be used to depart from the assumption of equal weights but introduce the need for 'expert judgment' to determine the weights, thereby introducing another element of arbitrary choice. Regression-based weights are only feasible when an objective measure of the outcome (in this case vulnerability) exists; this is obviously not the case here since then there wouldn't be the need to compute the index. Eakin and Bojorquez-Tapia (2008) note that equal weighting makes an implicit judgment about the degree of influence of each indicator and propose a complex fuzzy logic-based weighting method as a more objective approach.

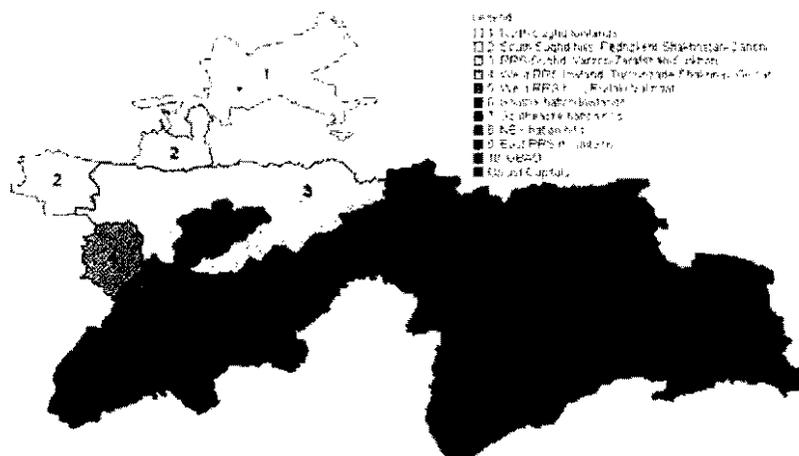
3.21 In the report, simple unweighted averages are used as the simplest and least arbitrary method available. Simple unweighted averages of normalized variables are used to form sub-indices and simple averages of sub-indices to form the overall vulnerability index. Only variables that each represent distinct aspects of vulnerability are included, which avoids having the implicitly unequal weights that would result if two or more similar variables were included. Variables are defined in the most intuitive manner so that for the exposure and sensitivity sub-indices, the highest value always corresponds to the greatest vulnerability while for adaptive capacity, the highest value corresponds to the lowest vulnerability. All variables are normalized by a linear transformation into the 0-1 interval. In particular, variable x is transformed to x' , where $x' = (x - \min x) / (\max x - \min x)$ where minimum and maximum is taken over the value of x across the regions.

Therefore vulnerability is calculated as: $Vulnerability = 1/3(Exposure + Sensitivity + (1-Adaptive Capacity))$. Annex 6 provides more details on formulas and variables used in this chapter.

3.22 **Agro-ecological zones used in the analysis:** Tajikistan is characterized by highly variable geography, terrain, ethnic composition, and socio-economic status. Parts of the country are remote and sparsely populated highlands; other parts are fertile valleys of good agricultural potential. Some parts still feel the effect of the civil war in the 1990s. When exploring regional variability of Tajikistan in respect to climate change, selection of the level of analysis is dictated by a trade-off between overlooking important local difference and data availability constraints. The results are presented at two levels of geographic aggregation, namely (a) for 10 agro-ecological zones and one composite urban area; and (b) for the rural areas of the oblasts, the four major administrative divisions of the country.

3.23 For the agro-ecological zone analysis, Tajikistan can be divided into 10 geographical zones. The basis for this is a map of 14 agro-ecological zones defined by the WFP in a study on food security (WFP, 2007). The WFP's 14 zones were identified on the basis of homogeneous land cover and land use and based on consultation with local experts. In this report, the WFP map is modified by merging some of the agro-ecological zones so that they are continuous and homogeneous in altitude and terrain and so that sufficient data points are available for each zone. The analysis is limited to rural areas within these zones. Figure 3.1 shows the resulting zones which are further described in Annex 7.

Figure 3.1: The 10 agro-ecological zones with oblast capitals



Source: World Bank staff estimates based on WFP, 2007

3.24 The chapter also attempts to estimate urban vulnerability. The processes that drive vulnerability are often different in urban and rural areas, and adaptive responses are organized in distinct ways. Still, comparing urban and rural vulnerability is interesting and most of the data sources used in the analysis presented above are in fact available for the country's major urban areas, namely Dushanbe (the capital), Khujand, Istaravshan, Kurganteppa, Kulyab, and Horog. Because of few observations in the household surveys for individual urban areas we group all urban areas into one. Urban vulnerability is estimated using the same methods and data as for rural areas with the exception that for urban areas the agricultural variables are not included in the calculation of the sensitivity index.⁵⁹

3.3 Results

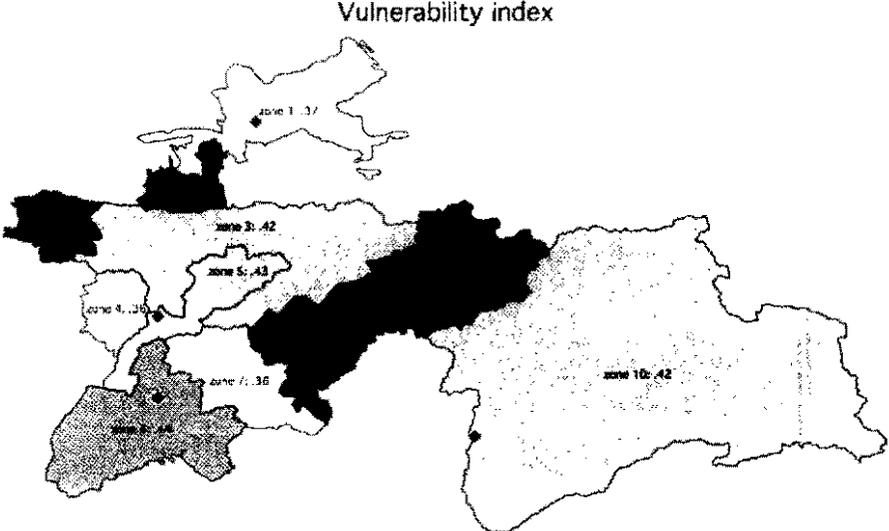
3.25 The results show that vulnerability varies according to socio-economic and institutional development in ways that do not follow directly from exposure, geography, or elevation. Urban areas are by far the least vulnerable while the eastern RRS mountain zone is the most vulnerable and the remote GBAO mountains rank in the middle. The narrative below first presents results for rural agro-ecological zones, then for the urban areas, and finally for oblasts.

⁵⁹Measures of crop diversification and irrigation per capita are only meaningful in the rural context. In the report, these variables are used to compare the rural areas within themselves, but they are not defined in the absence of agricultural land. Not using these values in calculating the index value for urban areas is algebraically equivalent to using the country average values of these variables.

3.26 **Results for agro-ecological zones:** The results show substantial and sometimes surprising variation in vulnerability and its components. Overall vulnerability varies much less than the exposure, sensitivity, and adaptive capacity sub-indices. The sub-indices tend to cancel each other out. For example, while the remote GBAO highlands experience the highest exposure, it also benefits from the highest adaptive capacity of any area combined with medium sensitivity. Overall, GBAO therefore has medium vulnerability according to these estimates. This shows that a full understanding of the determinants of vulnerability alters the results from what analysis of exposure to the impacts of climate change alone would have led to; such analysis would have placed GBAO in the top as the most exposed region.

3.27 The most vulnerable areas are the eastern RRS (Region of Republican Subordination) mountains, Southern Sughd hills, and Khatlon hills and lowlands (Figure 3.2 and Figure 3.3). These are areas of varying elevation and population density. The combined population of the three most vulnerable zones exceeds 500,000 (9 percent of the total) while that of the four most vulnerable zones—that is, including Khatlon lowlands’ population of more than 1 million—exceeds 1.6 million (27 percent of the country’s total). Although the zones are vulnerable for somewhat different reasons, they share a high degree of sensitivity to climate change, particular food insecurity, disaster sensitivity, and reliance on agriculture. They also have weak adaptive capacity, in part stemming from low income and education levels. Their exposure is only moderate but their high sensitivity and fairly moderate adaptive capacity render these areas vulnerable to climate change. Again, a full understanding of vulnerability leads to results that differ from what a focus on exposure would have indicated.

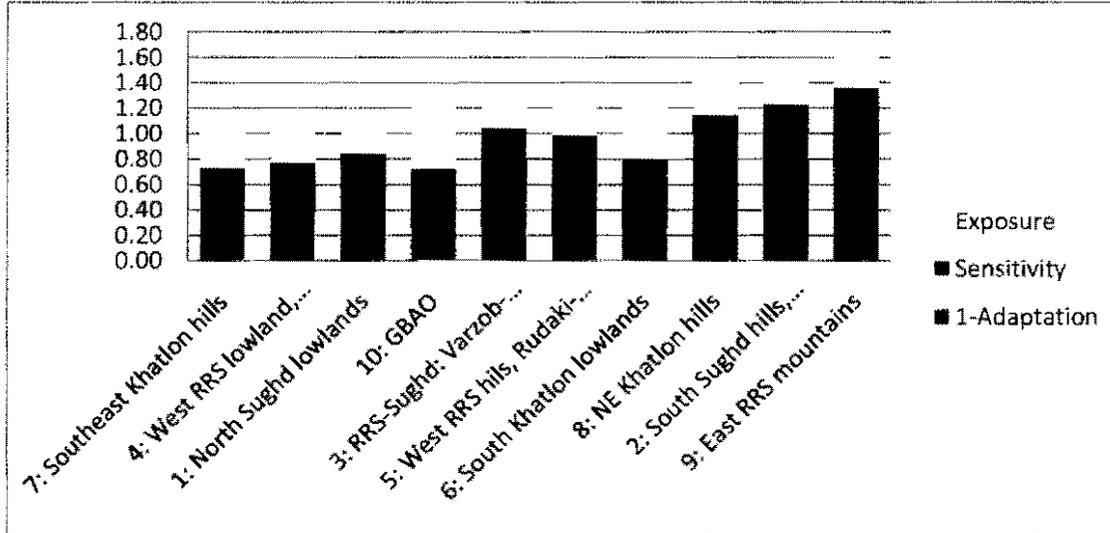
Figure 3.2: Vulnerability map for Tajikistan (10 agro-ecological zones)



Source: World Bank staff estimates based on various data sources

3.28 Urban areas as a composite group have the lowest vulnerability, far lower than any of the rural zones. This is because urban areas have the lowest sensitivity, the second-highest adaptive capacity, and average exposure. In other words, the comparatively better socio-economic and institutional development renders urban areas less vulnerable. Compared to urban areas, all the rural zones, covering around 73 percent of the population, appear vulnerable.

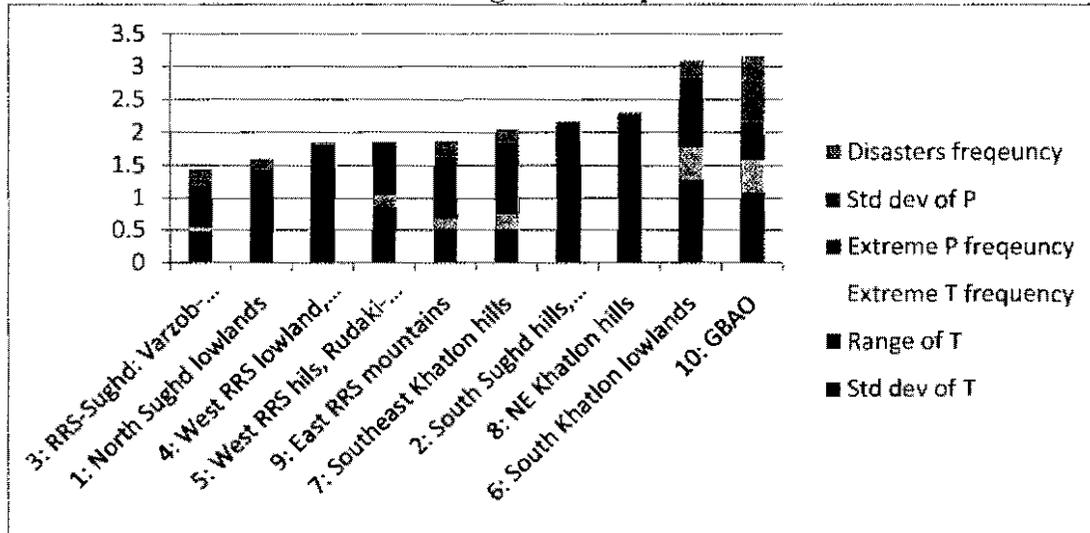
Figure 3.3: Components of the vulnerability index



Source: World Bank staff estimates based on various data sources

3.29 Exposure to climate change and variability is highest in GBAO, as mentioned, as well as the South Khatlon lowlands because of their high frequency of extreme temperatures and broad range of intra-monthly temperature fluctuations. GBAO is also characterized by frequent natural disasters. Overall exposure levels are fairly uniform in the rest of the country according to these estimates (Figure 3.4).

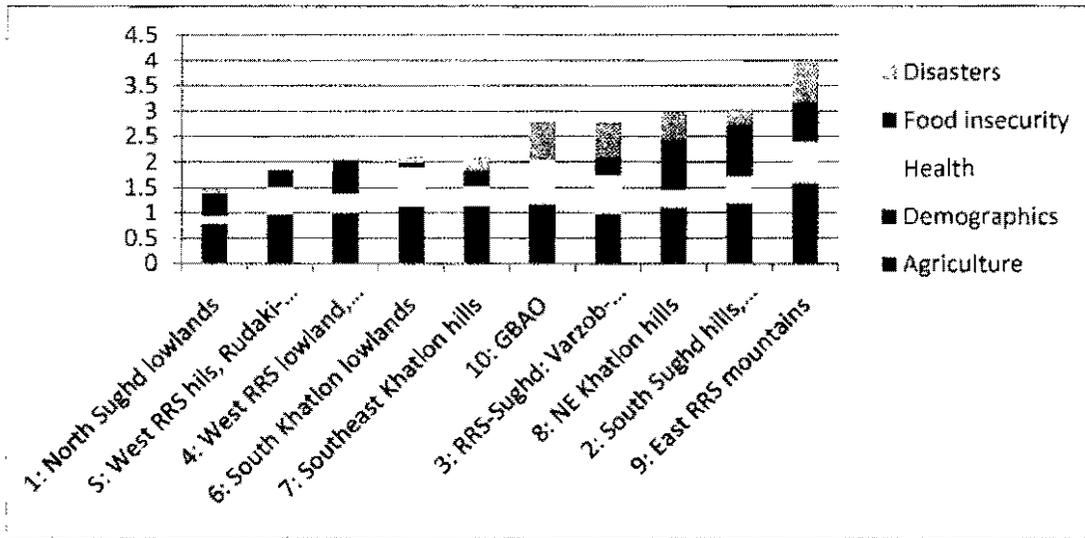
Figure 3.4: Exposure Index



Source: World Bank staff estimates based on various data sources

3.30 Sensitivity is highest in the east RRS mountain area because of the area's reliance on agriculture, high sensitivity to disasters, and widespread food insecurity (Figure 3.5). Sensitivity is also high in South Sughd, North-East Khatlon hills, Varzob-Zarafshan and GBAO because of disaster sensitivity and various other reasons. Rural sensitivity is lowest in North Sughd where health and disaster indicators are better and there is less exclusive reliance on agriculture.

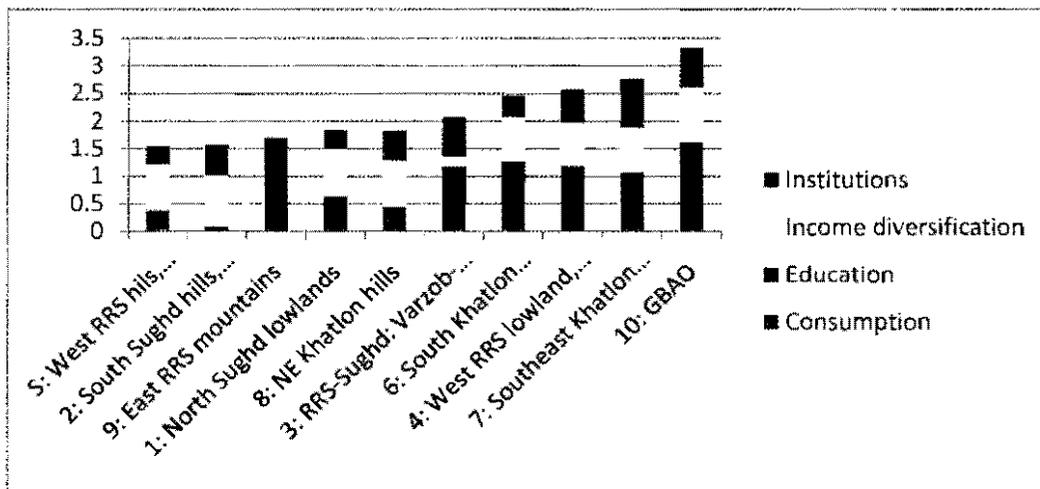
Figure 3.5: Sensitivity Index



Source: World Bank staff estimates based on various data sources

3.31 Adaptive capacity varies substantially (Figure 3.6). It is highest in GBAO because of its high scores on education and income diversification. Adaptive capacity is also good in the South-east Khatlon hills, the West RRS lowlands, and the South Khatlon area; these areas are characterized by above-average levels of income and education.

Figure 3.6: Adaptive capacity

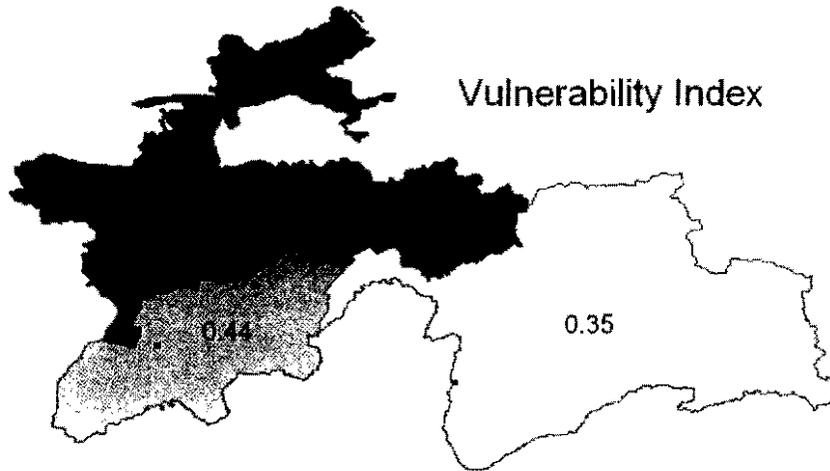


Source: World Bank staff estimates based on various data sources

3.32 **Results at the oblast level:** The chapter also estimates the vulnerability index at a higher level of aggregation, that of the four administrative oblasts that make up Tajikistan (Sughd, Khatlon, RRS, GBAO). This is done for rural areas only. GBAO oblast comes out as the least vulnerable among the four oblasts, and RRS oblast as the most vulnerable (Figure 3.7). Again, GBAO's estimated low vulnerability to climate change is despite high sensitivity levels for almost all the measured variables (agriculture, disasters, health) which is compensated for by moderate exposure and high adaptive capacity due to income diversification from

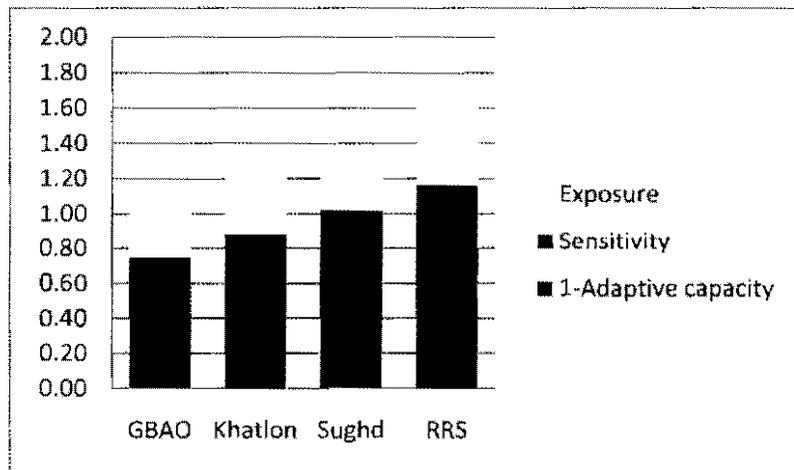
migrant remittances and high level of education among the population. In contrast, the most vulnerable RRS oblast shows high values of exposure (e.g. extremely low precipitation and temperature variation); medium sensitivity; and the lowest adaptive capacity, partly stemming from low income diversification (Figure 3.8).

Figure 3.7: Vulnerability map for Tajikistan (oblast level)



Source: World Bank staff estimates based on various data sources

Figure 3.8: Components of the vulnerability index (oblast level)



Source: World Bank staff estimates based on various data sources

3.4 Concluding remarks

3.33 In this chapter, an index of vulnerability to climate change and variability in Tajikistan was constructed and presented. The results show that vulnerability varies according to socio-economic and institutional development in ways that do not follow directly from exposure or elevation: in climate change, geography is not destiny. The results indicate that urban areas are by far the least vulnerable while RRS oblast, in particular its eastern mountainous areas, is the most vulnerable and the remote GBAO mountains rank in the middle.

3.34 Some of Tajikistan's sparsely populated high altitude mountain zones are the least vulnerable while the populated South Khatlon valley is among the four most vulnerable areas. This implies that relatively vulnerable geographic areas can overlap centers of population and economic activity. Adaptation planners therefore do not necessarily face a trade-off between defending the most vulnerable areas and defending the economically most important areas from the impacts of climate change.

3.35 The results indicate that to the extent that policy makers wish to direct funding toward areas with the highest vulnerability to climate change, they should avoid urban areas in favor of rural areas, in particular eastern RRS mountains, Southern Sughd hills, and Khatlon hills and lowlands. These are areas of varying elevation which share a high degree of sensitivity to climate change and weak adaptive capacity. These results do not tell policy makers *how* to design adaptation. The results do suggest, though, that migration to urban areas and abroad for work might usefully form part of overall adaptation strategies.

Annex 1: Pilot Program of Climate Resilience in Tajikistan

Through financial support from a number of donors, the World Bank, Asian Development Bank, and European Bank for Reconstruction and Development have launched a Pilot Program on Climate Resilience (PPCR) to help the world's most vulnerable countries (Tajikistan being one of them) in integrating climate risk into development planning and to support pilot adaptation initiatives. The Program will provide Tajikistan with USD 50 million in grant financing to strengthen institutional capacities for climate resilience and to fund investment projects. The PPCR in Tajikistan comprises two phases. In Phase 1, six technical assistance activities are currently being funded to strengthen Tajikistan's capacity and analytical evidence base and help define an investment plan. Phase 2 is concerned with implementing the investment plan. PPCR's six areas of intervention in Tajikistan are:

- **Building Capacity for Climate Resilience** aimed at building stronger institutional capacity and awareness of climate change amongst a variety of stakeholders groups, including civil society, the media and highly vulnerable groups such as women and children. This component also includes the establishment of a PPCR Secretariat and coordination mechanisms to ensure effective implementation of PPCR activities and maximize their development impact;
- **Improvement of Weather, Climate and Hydrological Service Delivery** aimed at improving the national hydro-meteorological monitoring system to provide timely warnings on dangerous events, support water management, and build the evidentiary basis for climate variability and change. It includes a major technical re-equipment of the observation networks and strengthening of the information base of the service. Service delivery will be improved through expanded provision of hydromet service products to consumers, and bolstering the national forecasting, warning, and response system. Institutional strengthening of the hydromet services, to improve its personnel and financial sustainability is another major component.
- **Climate Science and Modelling Program** aimed at enhancing Tajikistan's capacity to conduct climate science and glaciology research, develop climate change models and interpret the outputs from those models to provide policymakers and sector specialists with the data they need to plan for climate change. This component includes also -training of local experts to ensure the sustainability of this work beyond the PPCR; and coordination and dissemination of information;
- **Enhancing the Climate Resilience of the Energy Sector** aimed at piloting the integration of climate change analysis and climate resilience measures into the planning and implementation of hydropower investments using the rehabilitation of Kairakkum hydropower plant (HPP) as a pilot. This activity will also help to build the capacity of the Tajik authorities to conduct climate change analysis as part of investment planning in the hydropower sector;
- **Agriculture and Sustainable Land Management** aimed at replicating and scaling up effective, existing land management practices to ensure that climate resilience becomes an integral part of land management and agricultural production. The exact detail of initiatives will be determined through a country-wide analysis and consultation process, funded through PPCR Phase 1;
- **Building Climate Resilience in the Pyanj River Basin** aimed at increasing climate resilience in critical ecosystems, communities and infrastructure that are based in major glacier-dependent river basins and containing a large proportion of agricultural land, such as the Pyanj River basin. Measures aimed at integrating sector-based climate-proofing measures in vulnerable eco-systems and critical infrastructure will be piloted in the Khatlon target area and Pyanj tributaries.

Annex 2: P-LITS Climate Change Module

Section 5 Climate Change	RESPONDENT: THE PERSON SELECTED AT THE BOTTOM OF SECTION 1. NO SUBSTITUTIONS ARE POSSIBLE.	RESPONDENT'S ID CODE																																																
<p>(5.01) In your opinion, which of the following do you consider to be a very serious problem currently facing the world as a whole?</p> <p style="text-align: center;">READ OUT CROSS ALL THAT APPLIES ▼</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">a</td> <td style="width: 75%;">Poverty, lack of food and drinking water</td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> </tr> <tr> <td>b</td> <td>The spread of an infectious disease</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>c</td> <td>International terrorism</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>d</td> <td>Climate change</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>e</td> <td>A major global economic downturn</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>f</td> <td>The proliferation of nuclear weapons</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>g</td> <td>Armed conflicts</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>h</td> <td>The increasing world population</td> <td></td> <td></td> <td></td> <td></td> </tr> </table> <p style="text-align: center; font-size: small;">MARK WITH A CROSS THE MOST IMPORTANT ▲</p>			a	Poverty, lack of food and drinking water					b	The spread of an infectious disease					c	International terrorism					d	Climate change					e	A major global economic downturn					f	The proliferation of nuclear weapons					g	Armed conflicts					h	The increasing world population				
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<p>(5.02) And how serious a problem do you think climate change is at the moment?</p> <p style="text-align: center; font-size: x-small;">Please use a scale from 1 to 10 "1" would mean that it is not a serious problem at all, and "10" would mean that it is extremely serious.</p> <p style="text-align: center; font-size: x-small;">Not a serious problem at all SHOW CARD WITH SCALE - CIRCLE ONLY ONE NUMBER An extremely serious problem DK</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 10%;">1</td> <td style="width: 10%;">2</td> <td style="width: 10%;">3</td> <td style="width: 10%;">4</td> <td style="width: 10%;">5</td> <td style="width: 10%;">6</td> <td style="width: 10%;">7</td> <td style="width: 10%;">8</td> <td style="width: 10%;">9</td> <td style="width: 10%;">10</td> <td style="width: 10%;"></td> <td style="width: 10%;">11</td> </tr> </table>			1	2	3	4	5	6	7	8	9	10		11																																				
1	2	3	4	5	6	7	8	9	10		11																																							
<p>(5.03) Personally, do you think that you are well informed or not about ...?</p> <p style="text-align: center; font-size: x-small;">SHOW CARD WITH SCALE - CIRCLE ONE ANSWER PER LINE READ OUT - ROTATE</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 20%;"></th> <th style="width: 10%; font-size: x-small;">Not at all informed</th> <th style="width: 10%; font-size: x-small;">Not very well informed</th> <th style="width: 10%; font-size: x-small;">Fairly well informed</th> <th style="width: 10%; font-size: x-small;">Very well informed</th> <th style="width: 10%; font-size: x-small;">DK</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>The different causes of climate change</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>b</td> <td>The different consequences of climate change</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>c</td> <td>Ways in which we can slow down climate change</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> </tbody> </table>					Not at all informed	Not very well informed	Fairly well informed	Very well informed	DK	a	The different causes of climate change	1	2	3	4	5	b	The different consequences of climate change	1	2	3	4	5	c	Ways in which we can slow down climate change	1	2	3	4	5																				
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c	Ways in which we can slow down climate change	1	2	3	4	5																																												
<p>(5.04) As a result of climate change, do you think people in your country will be ...</p> <p style="text-align: center; font-size: x-small;">READ OUT - ONE ANSWER POSSIBLE</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 80%;">On balance, better-off</td> <td style="width: 20%;">1</td> </tr> <tr> <td>Not affected much</td> <td>2</td> </tr> <tr> <td>On balance, worse-off</td> <td>3</td> </tr> </table>			On balance, better-off	1	Not affected much	2	On balance, worse-off	3																																										
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<p>(5.05) Have you perceived any noticeable changes in the climate during the past ten years?</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 80%;">YES</td> <td style="width: 20%;">1</td> </tr> <tr> <td>NO</td> <td>2</td> </tr> </table> <p style="text-align: right; font-size: x-small;">>> (5.08)</p>			YES	1	NO	2																																												
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<p>(5.06) Have you or other household members taken any steps to adapt to these changes?</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 80%;">YES</td> <td style="width: 20%;">1</td> </tr> <tr> <td>NO</td> <td>2</td> </tr> </table> <p style="text-align: right; font-size: x-small;">>> (5.08)</p>			YES	1	NO	2																																												
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<p>(5.07) What steps have you taken to adapt to these changes in the climate?</p> <p>1 _____</p> <p>2 _____</p> <p>3 _____</p>																																																		
<p>(5.08) There is consensus among the scientific community that climate change can have serious potentially negative impacts on the lives of people. Which of the following potential impacts of climate change would be of most concern to you?</p> <p style="text-align: center;">READ OUT CROSS ALL THAT APPLIES ▼</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">a</td> <td style="width: 75%;">Increase in natural disasters (e.g. floods, fires, mudslides, etc)</td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> </tr> <tr> <td>b</td> <td>Unpredictable and extreme weather that can harm agricultural production</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>c</td> <td>Decline in fresh water availability for drinking</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>d</td> <td>Decline in fresh water availability for irrigation</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>e</td> <td>Extreme cold and hot seasons that can be harmful for health</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>f</td> <td>Other (specify)</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>g</td> <td>No potential impacts are of any concern</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>h</td> <td>DK</td> <td></td> <td></td> <td></td> <td></td> </tr> </table> <p style="text-align: center; font-size: small;">MARK WITH A CROSS THE MOST IMPORTANT ▲</p>			a	Increase in natural disasters (e.g. floods, fires, mudslides, etc)					b	Unpredictable and extreme weather that can harm agricultural production					c	Decline in fresh water availability for drinking					d	Decline in fresh water availability for irrigation					e	Extreme cold and hot seasons that can be harmful for health					f	Other (specify)					g	No potential impacts are of any concern					h	DK				
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g	No potential impacts are of any concern																																																	
h	DK																																																	

(5.09) Has your household been personally affected by climate-related hazards in the last 10 years?

READ OUT		CROSS ALL THAT APPLIES ▼	
a	Natural disasters (e.g. floods, fires, mudslides, etc)		
b	Unpredictable and extreme weather that harmed agricultural production		
c	Decline in fresh water availability for drinking		
d	Decline in fresh water availability for irrigation		
e	Extreme cold and hot seasons that were harmful for health		
f	Other (specify) _____		
g	No climate-related hazards were of any concern		
h	DK		

MARK WITH A CROSS THE MOST IMPORTANT ▲

ASK (5.10) ONLY IF ANSWER TO (a) OR (b) ABOVE IS MARKED WITH A CROSS

(5.10) Did you have any prior warning of these natural disasters / unpredictable or extreme weather events?

YES	1
NO	2

(5.11) Suppose the government had a sizeable sum of money to soften climate change impact on people in your community or in communities like yours. On which of the following do you think the government should spend more money?

READ OUT		CROSS ALL THAT APPLIES ▼	
a	No climate change related spending necessary		
b	Providing clean drinking water		
c	Investing in irrigation infrastructure		
d	Improving extension services and providing seeds more resilient to climate extremes		
e	Providing more reliable weather forecasts		
f	Reforestation to prevent soil erosion		
g	Investing in increasing availability of electricity		
h	Providing more help and relief after natural disasters occur		
i	Developing disaster early-warning systems		
j	Invest in health facilities and provision of health services		
k	Facilitating out-migration of people from areas prone to high climate change risk		
l	Other (specify) _____		
m	DK		

MARK WITH A CROSS THE MOST IMPORTANT ▲

(5.12) For each of the following statements please tell me whether you totally agree, tend to agree, tend to disagree or totally disagree?

Interviewer: if necessary explain that CO2 (carbon dioxide) is a gas generated notably in the combustion of fossil fuels for example by all types of transport that use hydrocarbons and by industrial plants and power generators using fossil fuels.

READ OUT - ROTATE ITEMS 1 TO 3

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree	DK
a	1	2	3	4	5
b	1	2	3	4	5
c	1	2	3	4	5

SOME PEOPLE FEEL THAT CLIMATE CHANGE IS A GLOBAL PROBLEM REQUIRING ACTION ON ALL OUR PARTS, WHILE OTHERS FEEL THIS IS A PROBLEM CAUSED MAINLY BY RICHER COUNTRIES, HENCE THEY SHOULD BE THE ONES TO TAKE STEPS TO COMBAT IT

(5.13) Do you believe the Government of [COUNTRY] should take measures to fight climate change?

SHOW CARD - ONE ANSWER

No, climate change is not an important problem in our country	1
No, fighting climate change will divert the resources from other more important sectors	2
No, governments of rich countries should take measures to fight climate change	3
No, not unless other countries also take such measures	4
Yes, the government should take actions to fight climate change	5

(5.14) Do you get weather forecasts about upcoming extreme weather events?

YES	1
NO	2

(5.15) Did you take any action after hearing the last such forecast?

IF YES, SPECIFY WHAT ACTION(S) WAS / WERE TAKEN

IF NOT, SPECIFY WHY NO ACTION WAS TAKEN

**Annex 3: Impact on Welfare of a Hypothetical Decline in Agricultural Productivity
(by 10 percent, 20 percent and 50 percent)**

OVERALL:

Hypothetical effect on total hh income/consumption, percent

Quintiles of hh consumption	10 percent decline in income from agricultural production (food consumption and farm income)	10 percent decline in income from agricultural wages	10 percent increase in relative food prices
Poorest	-4.0	-0.6	-4.3
2	-4.4	-0.8	-4.2
3	-4.5	-0.7	-4.2
4	-4.5	-0.5	-4.1
5	-3.8	-0.4	-3.9
Total	-4.3	-0.6	-4.1

RURAL

Table : Hypothetical effect on total hh income/consumption, percent

Quintiles of hh consumption	10 percent decline in income from agricultural production (food consumption and farm income)	10 percent decline in income from agricultural wages	10 percent increase in relative food prices
Poorest	-4.6	-0.8	-3.9
2	-4.7	-1.0	-3.9
3	-4.9	-0.8	-3.9
4	-5.1	-0.7	-3.8
5	-4.6	-0.6	-3.4
Total	-4.8	-0.8	-4

URBAN

Quintiles of hh consumption	10 percent decline in income from agricultural production (food consumption and farm income)	10 percent decline in income from agricultural wages	10 percent increase in relative food prices
Poorest	-2.5	-0.1	-5.1
2	-3.2	-0.2	-5.0
3	-3.0	-0.4	-5.1
4	-2.7	-0.1	-5.2
5	-2.2	-0.1	-4.8
Total	-2.7	-0.2	-5

OVERALL:

Hypothetical effect on total hh income/consumption, percent				
Quintiles of hh consumption	20 percent decline in income from agricultural production (food consumption and farm income)	20 percent decline in income from agricultural wages	20 percent increase in relative food prices	
Poorest	-8.1	-1.2	-8.5	
2	-8.8	-1.6	-8.4	
3	-9.1	-1.5	-8.3	
4	-9.0	-1.1	-8.2	
5	-7.6	-0.8	-7.8	
Total	-8.5	-1.2	-8.2	

RURAL

Hypothetical effect on total hh income/consumption, percent				
Quintiles of hh consumption	20 percent decline in income from agricultural production (food consumption and farm income)	20 percent decline in income from agricultural wages	20 percent increase in relative food prices	
Poorest	-9.3	-1.6	-7.8	
2	-9.5	-2.0	-7.8	
3	-9.7	-1.7	-7.8	
4	-10.2	-1.4	-7.6	
5	-9.3	-1.2	-6.7	
Total	-9.6	-1.6	-8	

URBAN

Quintiles of hh consumption	20 percent decline in income from agricultural production (food consumption and farm income)	20 percent decline in income from agricultural wages	20 percent increase in relative food prices	
Poorest	-5.0	-0.3	-10.3	
2	-6.5	-0.4	-10.1	
3	-6.0	-0.7	-10.2	
4	-5.3	-0.1	-10.4	
5	-4.5	-0.1	-9.7	
Total	-5.4	-0.3	-10	

OVERALL:

Hypothetical effect on total hh income/consumption, percent			
Quintiles of hh consumption	50 percent decline in income from agricultural production (food consumption and farm income)	50 percent decline in income from agricultural wages	50 percent increase in relative food prices
Poorest	-20.1	-3.0	-21.3
2	-21.9	-4.0	-20.9
3	-22.7	-3.7	-20.8
4	-22.6	-2.7	-20.4
Richest	-19.0	-2.0	-19.5
Total	-21.3	-3.1	-20.6

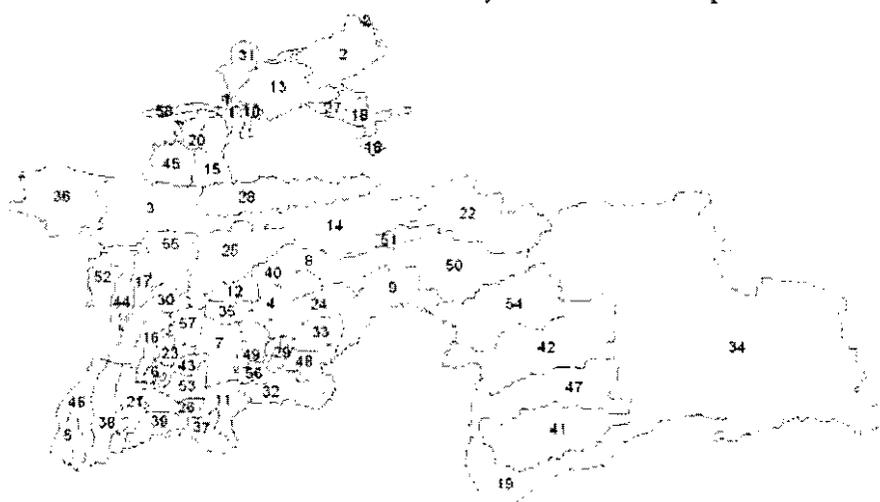
RURAL

Table : Hypothetical effect on total hh income/consumption, percent			
Quintiles of hh consumption	50 percent decline in income from agricultural production (food consumption and farm income)	50 percent decline in income from agricultural wages	50 percent increase in relative food prices
Poorest	-23.2	-3.9	-19.6
2	-23.7	-4.9	-19.5
3	-24.3	-4.2	-19.6
4	-25.5	-3.4	-19.0
Richest	-23.2	-3.0	-16.8
Total	-24.0	-3.9	-19

URBAN

Quintiles of hh consumption	50 percent decline in income from agricultural production (food consumption and farm income)	50 percent decline in income from agricultural wages	50 percent increase in relative food prices
Poorest	-12.4	-0.7	-25.7
2	-16.1	-0.9	-25.2
3	-15.0	-1.8	-25.5
4	-13.3	-0.3	-26.0
Richest	-11.2	-0.3	-24.2
Total	-13.6	-0.8	-25

Annex 4: Rayon Index for Chapter 1



District Name

- 1 Spitamen (Nov)
- 2 Asht
- 3 Ayni
- 4 Baljuvon
- 5 Khusrav Nosiri
- 6 Bokhtar
- 7 Danghara
- 8 Nurobod (Darband)
- 9 Darvoz
- 10 Rasulov
- 11 Farkhor
- 12 Fayzobod
- 13 Ghafutov
- 14 Rasht
- 15 Ghonchi
- 16 Khuroson (Ghozimalik)
- 17 Hissor
- 18 Isfara
- 19 Ishkoshim
- 20 Istaravshan
- 21 Jilikul
- 22 Jirgatol
- 23 Jomi (Kuybyshevsky)
- 24 Khovaling
- 25 Vahdat
- 26 Rumi j
- 27 Kombodom
- 28 Kuhistoni Mastchoh
- 29 Kulob

District Name

- 30 Rudaki
- 31 Mastchoh
- 32 Hamadoni (Moskovskiy)
- 33 Muminobod
- 34 Murghob
- 35 Norak
- 36 Pandjakent
- 37 Panj
- 38 Qabodiyon
- 39 Qumsangir
- 40 Roghun
- 41 Roshtqala
- 42 Rushon
- 43 Sarband
- 44 Shahrinav
- 45 Shahrستان
- 46 Shahrıtuz
- 47 Shughnon
- 48 Shurobod
- 49 Temurmaliik
- 50 Tavildara
- 51 Tojikobod
- 52 Tursunzoda
- 53 Vakhsh
- 54 Vandj
- 55 Varzob
- 56 Vose
- 57 Yovon
- 58 Zafarobod

Annex 5: Impact of Natural Disasters on Infrastructure in Tajikistan, 2001-2006

Description	2001	2002	2003	2004	2005	2006	Total
Number of Deaths	124	483	475	475	547	482	2586
Number of injured people	247	1643	1620	1601	2036	1737	8884
Residential houses affected	1889	18,542	8896	3961	4789	6296	44373
Schools and kindergartens affected	66	505	288	169	175	136	1339
Health centers affected	6	154	44	63	43	47	357
Community centers and other state buildings affected	34	162	37	92	64	121	510
Damaged roads, km	224	1588	658	1247	6358	681	10756
Bridges affected	39	152	92	81	115	15	494
Damaged irrigation canals, km	169	877	550	419	254	57	2326
Hydrostations and facilities affected	21	72	65	47	69	9	283
Water supply and sewage systems affected, km	19	50	48	30	24	11	182
Total natural disasters	2037	2170	2165	2438	2289	2207	13306

Source: World Bank.2008. *Tajikistan Country Environmental Analysis*. Washington DC

Annex 6: Formulas and Variables

Adaptive Capacity.

$$A = (a_1 + a_2 + a_3 + (a_4 + a_5 + a_6) / 3) / 4$$

where,

a_1 - household consumption per capita, LSMS

a_2 - share of population with higher education, CENSUS

a_3 - negative Herfindahl index of income diversification (higher value, more diversification), LSMS

a_4 - measure of trust (share of households having trust in people), LITS

a_5 - measure of corruption (share of households never or only rarely having to give bribes), LITS

a_6 - measure of political involvement (percent of households that participated in presidential elections), LITS.

All variables a_1 , a_6 are normalized by linear transformation.

Sensitivity:

$$S = ((s_1 + s_2 + s_3) / 3 + (s_4 + s_5) / 2 + (s_6 + s_7) / 2 + s_8 + (s_9 + s_{10}) / 2) / 5, \text{ where}$$

s_1 - negative of the amount of irrigated land per capita, LSMS

s_2 - Herfindahl index of agricultural land use diversification, LSMS

s_3 - share of household depending on agriculture (>50% of income is from agriculture), LSMS

s_4 - share of population under 5, CENSUS

s_5 - share of population above 65, CENSUS

s_6 - under 5 mortality rate, Tajikistan Statistical Agency.

s_7 - share of population with unprotected water source, LSMS

s_8 - share of population that is food insecure, LSMS

s_9 - per capita casualties from disasters, 1998-2009 MOE data

s_{10} - per capita damage from disasters, 1998-2009 MOE data

all variables s_1 , .. s_{10} are normalized by linear transformation.

Exposure:

$$E = ((sdT_1 + \dots + sdT_{12}) / 12 + (sdP_1 + \dots + sdP_{12}) / 12 + (rT_1 + \dots + rT_{12}) / 12 + (N_{hot} + N_{cold}) / 2 + N_{dry} + N_{disaster}) / 6,$$

where,

sdT_i - standard deviation of average temperature in month i .

sdP_i - standard deviation of total precipitation in month i .

rT_i - range between maximum and minimum average temperature in month i .

N_{hot} - frequency of extremely hot months, when average temperature was higher than 30 C.

N_{cold} - frequency of extremely cold months, when average temperature was lower than - 10 C

N_{dry} - frequency of extremely dry months in the spring (less than 5 ml total precipitation) and summer (0 ml total precipitation)

$N_{disaster}$ - frequency of weather related disasters between 2000-2009

$$\text{Vulnerability: } V = (A + S + E) / 3$$

Annex 7: Composition of the Geographical Zones



Zone	Districts
1: North Sughd lowlands	1,2,10,13,18,20,27,31,58
2: South Sughd hills, Pedhzent-Shakhristan-Ganchi	15, 36, 45
3: RRS-Sughd: Varzob-Zarafshan-Surkhob	3, 12, 14, 28, 40, 55
4: West RRS lowland, Tursunzade-Shakrinav-Gissar	17, 44, 52
5: West RRS hills, Rudaki-Vakhdat	25, 30
6: South Khatlon lowlands	5, 6, 11, 16, 21, 23, 26, 37, 38, 39, 43, 46, 53
7: Southeast Khatlon hills	7, 29, 32, 35, 49, 56, 57
8: NE Khatlon hills	4, 24, 33, 48
9: East RRS mountains	9, 22, 50, 51
10: GBAO	19, 34, 41, 42, 47, 54

Population by zone

Zone	Population, Census 2000
1: North Sughd lowlands	994,648
2: South Sughd hills, Pedhzent-Shakhristan-Ganchi	297,270
3: RRS-Sogd: Varzob-Zarafshan-Surkhob	332,803
4: West RRS lowland, Tursunzade-Shakrinav-Gissar	392,001
5: West RRS hills, Rudaki-Vakhdat	426,660
6: South Khatlon lowlands	1,080,409
7: Southeast Khatlon hills	536,901
8: NE Khatlon hills	148,201
9: East RRS mountains	116,528
10: GBAO	152,041
All rural	4,477,462
Urban Population	1,620,981
Total population	6,098,443

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