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CCAP Synthesis Report 2012

Building Capacity on Climate Change Adaptation in the Coastal Areas of Pakistan (CCAP)

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Designer: Saadia Tajammal

CCAP
Synthesis Report
2012

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ACRONYMS

AGM	Annual General Meeting
BAP	Better Adaptation Practices
CBO	Community Based Organisation
CCAP	Building Capacity on Climate Change Adaptation in the Coastal Areas of Pakistan
CDMA	Climate Data Modelling Analysis
CSO	Civil Society Organization
CVA	Community Based Vulnerability Assessment
DEC	District Environmental Committees
DSS	Decision Support System
E-Flow	Environmental Flow
EC	European Commission
EPA	Environmental Protection Agency
FFS	Farmer Field School
FIF	Friends of Indus Forum
GCM	General Circulation Models
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
IDRC	International Development Research Centre
IFAP	Indus for All Programme
IPCC	Intergovernmental Panel on Climate Change
IPOE	International Panel of Experts
IUCN	International Union for Conservation of Nature
LSE	London School of Economics
LUMS	Lahore University of Management Sciences
MTDF	Medium Term Development Framework
NCCP	National Climate Change Policy
NGO	Non-Governmental Organization
NPDS	National Sustainable Development Strategy
PARC	Pakistan Agriculture Research Council
PIDE	Pakistan Institute for Development Economics
PMD	Pakistan Meteorological Department
PMU	Programme Management Unit
PSDE	Pakistani Society for Development Economics

SDPI	Sustainable Development Policy Institute
SFYP	Sixth Five Year Plan
SLR	Sea Level Rise
SoP	Survey of Pakistan
UCs	Union Councils
UNDP	United Nations Development Programme
UNESCO-IHE	United Nations Education Scientific Cultural Organisation –International Institute for Infrastructural, Hydraulic and Environmental Engineering
UN WMO	United Nations' World Meteorological Organisation
VO	Village Organisation
WWF - P	World Wide Fund for Nature – Pakistan

ACKNOWLEDGEMENT

The “Building Capacity on Climate Change Adaptation in the Coastal Areas of Pakistan”(CCAP) is a WWF-P project, jointly administered with partners LEAD-Pakistan and WWF-K, and with associates in India, Bangladesh and Iran who help cover Dasht and Sundarbans deltas besides the Indus. We are grateful to consultants and institutions whose work we commissioned and oversaw over the course of 2011-2012. The findings of their studies are synthesized in this report and we are grateful to them for participating wholeheartedly in path correction meetings and addressing reviewer comments. WWF Network colleagues and others who lent their expertise to the development of methodology – and also collaborated in fieldwork – are thanked by name in this synthesis report.

We would also like to thank stakeholders who participated in the Synthesis Report consultative provincial level consultative workshop in Karachi on 29 December 2012. Further, we appreciate organisations such as SDPI, IUCN, UNDP, among others who took out the time to fill out a survey monkey questionnaire.

We would also like to thank Ms. Zubaida Birwani from Trust for Conservation of Coastal Resources (TCCR) for contributing PRK 85,000 for the construction of a fresh water pond at village Qadir Baksh Baloch, Kharo Chan. We would like to take this opportunity to invite other stakeholders to contribute towards CCAP's interventions.

FOREWORD BY WWF - Pakistan

This report, as the title indicates, provides a synthesis of results from 11 studies carried out over 2011-2012, with some initiated, in early design stages or in need of feedback, as is the case for a data-driven decision support system. The report is circulated to CCAP stakeholders who will use it as a guiding document, in addition to individual studies, in order to help legitimize and give direction to union-council level climate change adaptation plans at Kharo Chan and Keti Bunder.

In many cases, the report describes findings that are ground breaking in various ways. One such quality of the studies is that they are based on primary data, or, as is the case with Indus Delta wide temperature and precipitation forecasts to 2100, data that is disaggregated at the district level and based on the processing of Pakistan Meteorological Department data. This is a departure from reports that borrow and collate results for Pakistan based on international studies, highly aggregated data, or sources that certainly aren't endorsed by the Government of Pakistan.

The studies are above all intended to help practitioners, i.e., those responsible for implementing action plans to conserve biodiversity at CCAP's study sites as well as to equip farmers, fishers, and others inhabiting Pakistan's coastal areas to identify adjustment requirements and meet them at a low-cost. By contributing to evidence-based policy making, the chances are that yearly monetary allocations for climate adaptation for Kharo Chan and Keti Bunder will become institutionalized. That is, when equipped by a first set of studies for the design of union-council adaptation plans, the future administrator, line department officer, and collector of periodic statistical information is more likely to shun now outdated rule of thumb decisions that can neither be justified nor help prioritize and design uses for yearly spending.

EXECUTIVE SUMMARY

The report structure lends itself to a stakeholder consultation planned for Saturday 29 December 2012. In particular, it supplies readers with: a) key findings (11 studies); b) excerpted maps, graphs, climate model results, tables, and screen freezes of databases for feedback; c) tables to elicit votes on levels of significance they attach to impacts across economic, political, sociological, and ecological themes; d) the same tables elicit a list of suggested activities for union council adaptation plans by impact area and theme; and, e) page annotated references accompanying these tables so they may consult detailed content in individual studies (these are posted on www.wwfpak.org/ccap).

The study on better adaptation practices provides a vulnerability resilience index that is a new addition by King's College to social science work in this field, as well as a critical assessment of the successes of adaptation interventions in 5 countries. Similarly, the Bangladesh review of adaptation by the London School of Economics for agrarian sectors, among other sectors, showcases practices that have served farmers and can be reapplied in Dasht, Sundarbans (Indian side) and Indus deltas.

Besides these studies designed to be reapplied and customized for the purposes of communities in Balochistan and Sindh coastal ecosystems, the synthesis report also processes findings from studies that assess vulnerability of households generally, with respect to salinity specifically, and elsewhere with respect to extreme weather events and hazards that characterize life in coastal belts of Pakistan.

The community based vulnerability assessment provides primary data-based results of perceptions on threats to and past losses of public and productive infrastructure, and changing abundances of renewable resources on which they are dependent, among others.

A description is provided of a study initiated for examination of the extent of salinity and its impact on horticultural and agricultural plots. The synthesis report suggests the study's use of soil and water samples (already collected), and upcoming satellite algorithms to detect salt reflectiveness in yet another innovative and authoritative study carried out by the Pakistan Meteorological Department.

Based on the WWF - Pakistan's own GIS laboratory in Lahore, ground truthing exercises, multi-temporal satellite imagery, and remote sensing provide insights into settlement level resilience requirements. In particular, susceptibility is mapped for floods and land erosion by encroaching seawater, among others, and secure sites are identified for future use in adaptation plans.

The socio-economic baseline for 2011 enables end-line and mid-line comparisons for CCAP and its stakeholders to review the extent of progress made to quantitatively measured indicators of well being. Village-specific disease, education, household income, already existing adaptations, ranked challenges, and poverty-environment natural

resource based dependency are among indicators calibrated in the report. It already contains 2007-2011 baseline comparisons for concerned villages for fish prices, for example, making it highly actionable.

A decision support system is completed in its prototype form, namely a digital software allowing users to select tehsils from a map of Pakistan, and display windows with precipitation and rainfall data covering several decades. The data is that of the Pakistan Meteorological Department, who especially interpolated more aggregated data to render it to the 'tehsil' grid level.

The fate of the Thatta coastal ecosystem itself and that of communities dependent on its assets is largely determined by freshwater flushing the Indus Delta in sufficient year long quantities. For this purpose, an environmental flows study has been initiated, at least up to the design phase. WWF-International network experts will investigate sediment morphology, cubic meters of water per second requirements for the migration, spawning and breeding activities of brackish/freshwater species, and possibly focus on other biodiversity assets.

The above decision support system databases, empirical and qualitative studies would not be complete without a frank examination of Pakistan's institutional mechanisms and frameworks for planning and executing climate change policy. The study that examines these frameworks and their functioning is another qualitative study, much like the community based vulnerability assessment. It too uses key informant interviews, processing of transcribed taped recordings, and uses reliable techniques to supply recommendations on such themes as where capacity building is needed and views on best institutional channels to push federal climate policy forward.

Finally, following a WWF-UK recommendation, a feasibility study was commissioned ahead of the Semester 5 (January 2013 onwards) purchase of intervention items for beneficiaries at Kahro Chan and Keti Bunder. These items include raised emergency platforms, early warning systems, cold storage tanks, drinking water pumps, sand filters, installation of solar/hybrid alternative energy units, and livelihood diversification items such as hatcheries and vocational training. The recommendations are extremely succinct and detailed, presented in a table with column headings covering: proposed intervention, unit cost of the intervention, implied number of units, recommended village, and justification for either go-aheads or terminations.

Rab Nawaz
Director Sindh – WWF Pakistan
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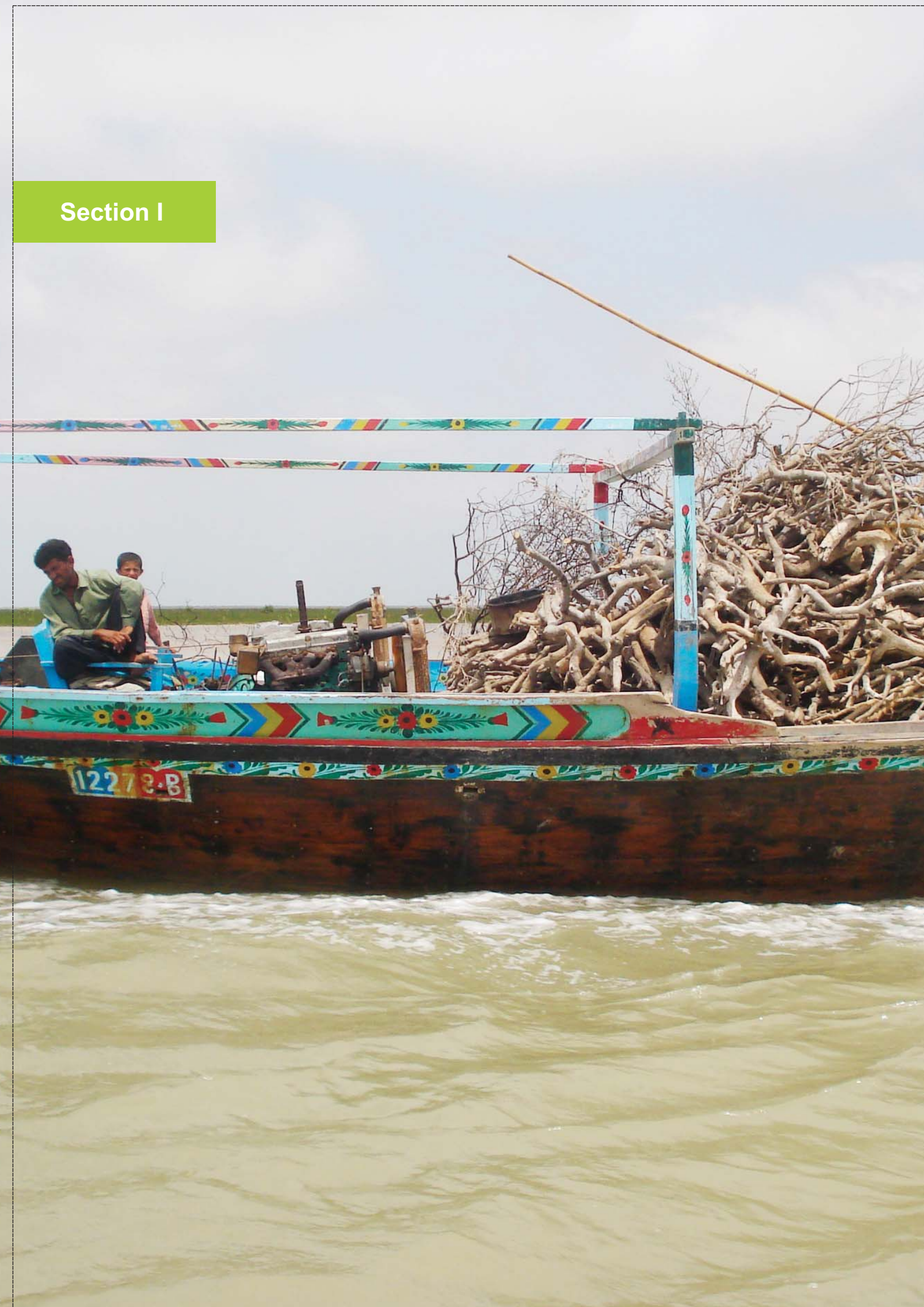
Section I



1. INTRODUCTION

STRUCTURE OF THE REPORT

This report is structured in the following way: First, a synthesis of individual studies is given. The synthesis contains key findings only, along with selected charts, tables, graphs, maps, and text boxes.

Second, stakeholders are given tables by themes (see paragraph 1 of the Executive Summary above) to enable CCAP's Secretariat to record their significance rankings for impacts emanating from changes in sea level, sea temperature, precipitation, and atmospheric temperature. Further, the table records their proposed activities for inclusion in union council level adaptation plans.

Third, annexures to the report provide survey instruments or other large maps and tables that accompany our synthesis of each study. This can help readers to reference detailed data as they use the synthesis report at CCAP's consultations of Saturday 29 December 2012, 28 February 2013 and thereafter.

Purpose of the report

The report's role is to be seen in the zcontext of its 5-year parent CCAP project (see www.wwfpak.org/ccap). It supports the CCAP objective of building climate resilience in coastal communities by supplying factual input to the design of action plans. It is important to note that the factual input includes not only science but also community perspectives and ownership.

The report's audience is primarily practitioners, i.e., those expected to counterpart fund adaptation infrastructure, trainings, and other beneficiary directed activities; and, those who will design activities, prioritize them, and deliver them to beneficiaries. Naturally, this includes planners and policy makers.

2. POLITICAL AND INSTITUTIONAL ANALYSIS

The present study, the political and institutional analysis, is broken up into four sections as follows:

1) Policy making, planning and implementing organizations
2) Policy instruments and mechanisms
3) Mainstreaming of climate change adaptation into policy making and planning
4) Recommendations of key institutions and follow up action for 2013

The expected contribution of this study is to provide a guideline for mainstreaming climate change adaptation in a post- 18th Amendment scenario at the national/ provincial/ district levels. The term mainstreaming refers to the successful incorporation of desirable actionable content into Pakistan's policy and planning documents, e.g. policy documents succeeding the federal cabinet approved national climate change policy, the Medium Term Development Framework, MTDF Public sector Development Plan, the annual development plan of each province, and sector plans. There are varying views concerning what constitutes actionable content; however, for our purposes we take actionable to include notifications and other formal approvals, earmarked PKR amounts reflected in a given year's allocation at the provincial and district levels, as well as indicators to help planners gauge progress in the building and operating of such concrete actions as putting in place emergency support platforms

From a practitioner's perspective the feasibility study, one of the eleven studies contained in this synthesis report has the hallmarks needed to focus interventions cost effectively and to prioritize them village-by-village. By contrast, this study is a first step towards accessing obstacles and opportunities confronting the mechanisms that result in yearly monetary allocations with which to finance the kinds of interventions that are the subject of the feasibility study. A proper assessment of such opportunities and constraints must first interview and solicit critical opinion from those holding public office and those reliant on institutionally sanctioned monetary allocations. The present Political and institutional Analysis does just this for Sindh province in which CCAP's coastal beneficiaries reside.

We begin by listing findings concerning section 1, namely, “policy making, planning and implementing organizations”. A major constraint according to provincial government respondents is not the remoteness of an Islamabad based consultative process for the development of policies and plans, but rather that representation at subsequent workshops and interactive sessions is usually from the Deputy Director/ Secretary/ Minister level but not by those directly involved in the decision making process. Despite the recently formed Third Party Cell at the provincial level, strategy and policy are not sufficiently coherent and are in urgent need of civil society organizations' support. Another important area with which the report recommends stakeholders to prioritize either for reform or to bear in mind is that annual development plans are a collections of

schemes of bricks and mortar: i.e. while soliciting funding for union council level adaptation plans, stakeholders should prioritize/ support the handful of officers taking the trouble to move beyond inserting a brief comment on a file to actually making the effort to obtain the complete follow through required.

Yet another policy shortcoming is the pressing need for the formulation and approval of provincial plans listing their own interventions for implementation as a follow up to the presentation to the Cabinet on fifth march 2012 of Pakistan's Climate Change Policy. The Additional Chief Secretary of each province forms part of a structure that is ready for pro-active steps once the National Plan of Action is endorsed by the advisory group. Another agency, the Ministry of Disaster Management, may have a tendency to hoard and not share with provincial environmental protection agencies its yearly shares of facilities, donor resources and capacity building.

Consequently, as in one instance, in the absence of sufficient institutional resources and institutional consultations on climate change policies, pre-flood and post-flood measures continued in 2012 to be taken independently by provincial departments. Civil society representatives consulted on this important subject argued the need for a coherent umbrella programme to prevent ad hoc initiatives that attract vested interests to move in. They recommend the commissioning of vulnerability studies particularly for those affected by floods, droughts and cyclones whose frequency has increased. They further are on standby to be invited to participate in the medium term development framework and eleventh fifth year plan evaluations; the former was last carried out by the Pakistan Institute for Development Economics.

As regards section 2 on *"policy instruments and mechanisms"*, an often repeated civil society recommendation is that as water and agriculture have become very important in the last 5- 10 years, concise studies on the impacts of climate change in these sectors must be carried out. It may be noted that a spin off project of the CCAP, an IDRC funded joint study between LUMS, WWF- Pakistan and the London School of Economics, not only sets out to examine the political economy of water and food security but also intends to complete by 2015 a micro econometrics study supplying authoritative estimates of percentage declines in yields and profit from crops such as wheat due to climate change. Government respondents underlined the need to develop a position both internally and externally on climate change to assist its prioritization in a context where there exists a competition between environmental issues on the one hand, and economic and political issues on the other hand. One way to do this, it was suggested, is to define a national *"Green Economy"* following the examples of Asian pioneers with similar GDP per capita to Pakistan, e.g., the Kingdom of Cambodia's Global Green Economy Initiative memorandum of understanding. Respondents agreed that the climate change policy has conveyed the importance of Pakistan's coasts and marine protection areas but has not prioritized them from a gender perspective. It was thought that there was a marginal focus on agriculture and much of what is needed in terms of reform will be helped by champions in parliament and the private sector who would advocate and lobby for the prioritization of climate change particularly for the coastal areas.

As regards section 3 of the study, namely *"mainstreaming of climate change adaptation into policy making"*, we note that those peer reviewing this study agreed with WWF-Pakistan and CCAP staff that often times respondents displayed a misunderstanding of the meaning of adaptation since many of their replies referenced mitigation opportunities such as reducing vehicle

emissions and overseeing corporate social responsibility in the private sector. By contrast, those who understood the term stated that significant knowledge gaps must be addressed at all levels to assist farmers in their adjustment to changed harvest seasons. Resettlement policies to protect communities from repeated floods were mentioned along with construction on poles in flood prone areas.

Government officials in Sindh were asked to comment on union council level adaptation plans. An important institutional and political development referred to was the plan to develop District Environmental Committees to assist environmental protection agencies in their mandate. A prevailing view among such respondents unfortunately is that communities and district governments' feedback on climate change plans is unnecessary since they do not have the capacity to interpret policy documents.

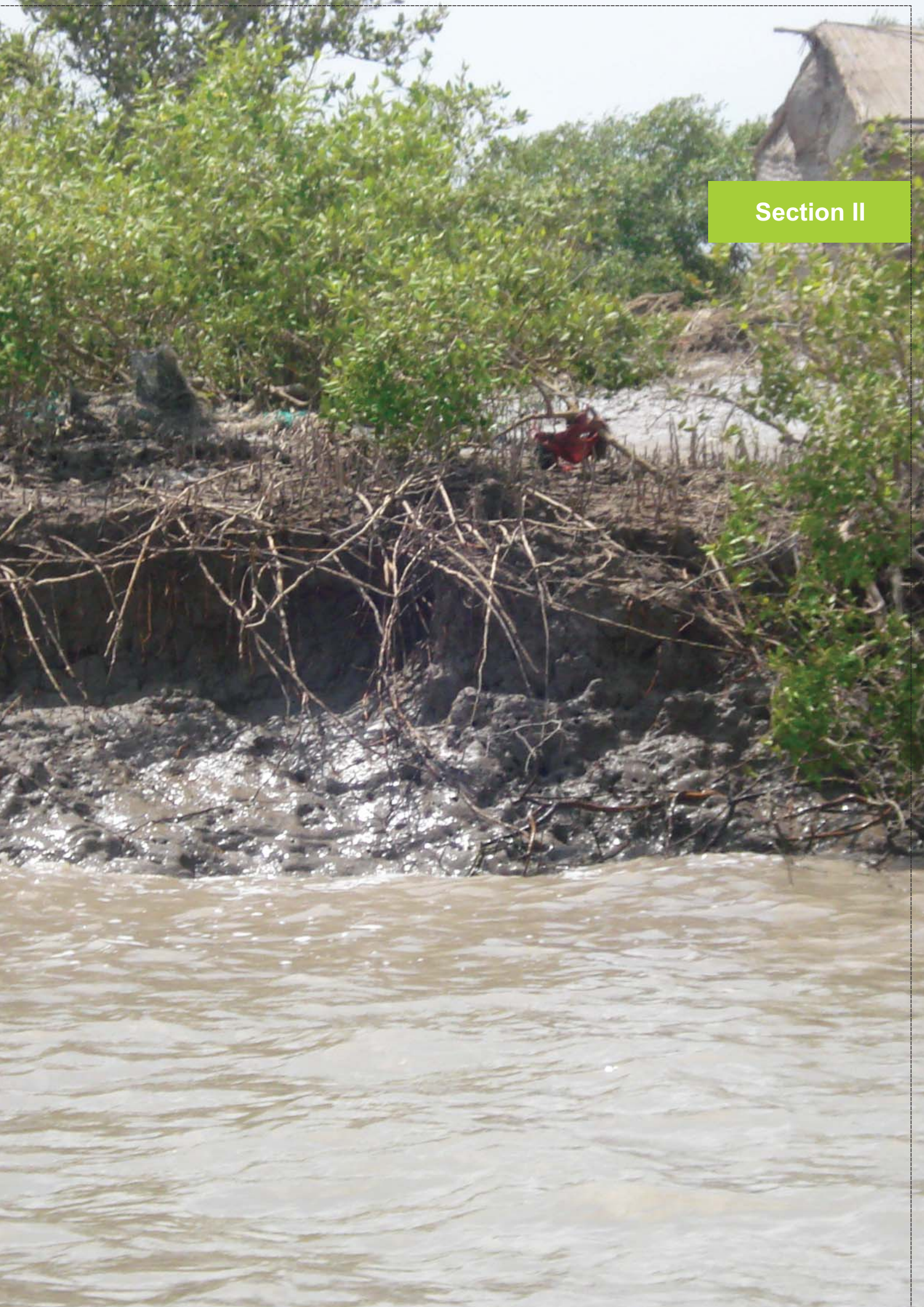
As regards section 4 of the study, namely *"recommendations of key institutions and follow up action for 2013"*, respondents in the government said such follow up is needed to build the capacity of line officials and concerned departments e.g. the forest department, where only those who have participated in trainings and workshops are aware of climate change. Respondents at the federal level were particularly concerned by this need to set aside financial resources to train and build internal capacity to provide technical advice. They too agreed on the need to develop a green economy in Pakistan. A civil society respondent felt the next step after approval of the National Climate Change Policy is to establish ownership of a result orientated strategy. The mainstreaming process would need to be led by the Climate Change Ministry with greater consultation at all levels; an interesting suggesting was made that adaptation plans need to be ecosystem based.

Key Climate Change related Policy Documents:

· National Environment Policy 2005
· National Sustainable Development Strategy
· Draft Climate Change Policy 2011
· National Conservation Strategy
· Vision 2030, Mid Term Development Framework
· Reports of Climate Change Task Force

Coastal Region in Policy Documents

The Climate Change Policy highlights the coastal eco-region however it does not emphasize the need for protection given its critical condition.



Section II

3. ENVIRONMENTAL FLOWS

BACKGROUND

An *"environmental flow"* is an amount of water that is kept flowing down a river in order to maintain the river in a desired environmental condition. Pakistan's landmark 1991 Water Accord governing water sharing between the provinces recognized the need for minimum flows downstream of the Kotri barrage. These flows are a political priority of the Sindh government, concerned in particular about saline intrusion into the Lower Indus. Minimum flow requirements are also required to maintain delta ecosystem functioning and associated livelihoods and, prevent delta erosion and mangrove destruction.

Rivers are being used for many purposes, and dams, canals etc. are built in rivers to change the flow regime. Added to this, the impacts of climate change may further exacerbate these changes. These changes affect the natural goods and services that we get from rivers, often to our detriment. The characteristics and ecosystems drivers are controlled in a very significant way by physical processes, in particular flows. An environmental flow regime describes all the different flows (wet season, dry season, floods, droughts etc.) that are needed to keep the river and all its aspects functioning in a desired condition.

The purpose of an environmental flows study for the CCAP project is to provide yet another empirical / scientific as well as policy input for consideration by stakeholders who want ecosystem resilience and resilience of communities of fishers and farmers dependent on the service flows of the deltaic and coastal ecosystem. As concerns ecosystem resilience, this study, which has only just been initiated, is expected to focus on certain biodiversity assets, be they fish or mangroves or other plant or animal species affected by climatic change and its impact on the health of the Indus River. Further, the study is expected almost certainly to discuss standard measures of river health including morphology of its sediments, cubic meters of water flow per second at different points along the river's path, as well as combined status of these parameters at the different locations in order to infer trends and possible impacts on spawning, breeding, and migrations of fish assets, for example.

Already, WWF – International's network has lent its expertise in the study design and methodology and has offered to assist by leading fieldwork in Pakistan as well as analysis. Environmental flows are not just about establishing a 'minimum' flow level for rivers. All of the elements of a natural flow regime, including floods and droughts, are important in controlling the characteristics and natural communities in a river. For example, rivers with a constant flow regime can quickly become dominated by pest species. Environmental flows are aimed at keeping at least some of the natural flow patterns along the whole length of a river, so that the people, animals and plants downstream can continue to survive and use the river's resources. So environmental flows are really about using water resources fairly.

In 2005, three studies on environmental flow requirements for the Indus were completed for the Pakistan Government to provide guidance on the required flows envisaged by the Accord. An International Panel of Experts (IPOE) reviewed the studies. More recently a review of this work was undertaken by Prof. N. Wright of UNESCO-IHE to assist WWF-Pakistan in developing a public position on the Indus flow studies. From the findings of this review, in combination with the review of the IPOE and further discussions with WWF, the following issues were highlighted as

requiring further investigation:

- Sediment movement and fluvial geomorphology
- Saline intrusion
- Role and resilience of mangrove areas

Overall objective

In terms of an intended audience for the CCAP's environmental flows study, the outputs of this study will help to inform decisions around the use and management of water in the wider Indus basin. It will also provide an important insight into the current status of sediment flows and whether these flows will be sufficient to meet the needs of biodiversity in the delta as well as current and future human populations in a changing climate – as such it will be an important component of a deltaic vulnerability assessment and guide climate adaptation options/plans.

In particular, one can well imagine activities that are inspired by this environmental flows study and are incorporated in Kharo Chan and Keti Bunder's union council level adaptation plans. For example, an activity that would demand CCAP administered CBO's and VO's time at particular locations, possibly in the estuary of the Indus Delta, could consist in monitoring the behavior of fish species that are at once dependent on brackish water and freshwater. Similarly, to the extent freshwater flows are used by certain types of farmers, one could well imagine a WWF-administered farmer field school trainers manual that contains a curriculum and specific water use recommendations that are derived directly or indirectly from the CCAP environmental flows study. Even if the environmental flows study did not explicitly address the issue of food security, both in terms of availability of commercial produce grown in the delta and household food budgets, one may well apply some of the numeric findings to food security and climate change studies in years to come.

Were we to subsume climate change adaptation plans in given coastal districts into plans made possible by the more primary conservation imperative of river health management, the CCAP would merely consider the medium to long term goal of the environmental flows study to be:

- Restoration of sediment supply to the delta
- Prevention of saline water intrusion to the lower river
- Prevention of further loss of, and potential rehabilitation of mangrove forests
- Restoration of ecosystem functions, especially with respect to fisheries

Section III

4. CLIMATE DATA MODELING ANALYSIS

INTRODUCTION

The Climate Data Modelling Analysis looks at past, present and future climatic trends in Pakistan. The study aims to scale up and increase the amount of factual, up to date literature available on climate change in Pakistan. WWF – Pakistan's Climate Data modelling Analysis study was conducted by the Chief Meteorologist of Pakistan, Dr. Ghulam Rasul.

This is the first time stakeholders will have access to as comprehensive a set of government issued and endorsed results based on climate change models drawing on primary data collected within the country. The climate data modelling analysis puts forward Pakistan's climate change scenario (details provided below). Previously it has not been uncommon to come across studies used for climate justice campaigns or other purposes that had solely quoted results of international studies about Pakistan. The present study contains data drawn from 56 of Pakistan's total number of meteorological observatories and processed by the research laboratory of the Pakistan Meteorological Department (PMD). The processing involves the use of several regional as well as general circulation models. Gradually it is expected that the capacity of PMD's research laboratory will increase so that its research output is even more frequent than is already the case.

It's Been Published

Parts of this study have already been published in the Pakistan Journal of Meteorology and are available online.
The article can be accessed at: www.pmd.gov.pk

PIDE Study Launch event 14 November 2012

Participants at the twenty eighth Annual General Meeting (AGM) the Pakistani society for development economics (PSDE) were the first to hear Dr. Ghulam Rasul, Chief meteorologist PMD, deliver the key findings of the present study at this even which was sponsored by CCAP among others. At the PSDE's 28th AGM other climate change studies including doctoral theses being supervised by the Pakistan Institute for Development Economics (PIDE) were presented. The audience included federal and provincial planners and policy makers thereby ensuring the attention of economic, natural resource, and environment related ministries. Pictures, press release and media can be found on our website.

Meanwhile, as the demand for raw meteorological data by universities and research centers is met by the PMD, both instructors and students and members of the research community generally will acquire powerful processing hardware of their own, along with fluency in scripting and modelling techniques. Publically available datasets are also likely to be posted on the PMD's website, though this is an expensive service, (available in countries like the US), where digitized sets, certified data, or 30-50 year time series sets up to the present are not available freely.

The findings of this study will not only be used to back interventions at the local scale, but in addition will promulgate Pakistan's immediately vulnerable and climate sensitive circumstances to the world. This study also provides the scientific proof that will enable

Pakistan to apply for climate related aid, climate justice funds, climate change research grants, and other climate related projects.

In this study Dr. Rasul authoritatively presents eye opening climatic trends that have been observed in Pakistan, including rising night time temperature, sea level rise, sea surface temperature rise and greater numbers of extreme weather events among others. This study provides stakeholders with certified and factual information that will incite them into action, e.g. even if the Pakistan Agriculture Research Council is already researching the implications of higher night time temperatures and shorter winter seasons Dr. Rasul's report may be read by other stakeholders who would demand even more detailed studies to be carried out examining aspects that are relevant to them including food security of farming households as opposed to national food security. We must recognize and acknowledge that these trends will have serious consequences for the whole country, both positive and negative. It is likely that these changing climatic conditions will touch every sector and individual, take for example WWF- Pakistan and LUMA and LSE's effort to examine yield and profit implications for wheat and other crops (please see: http://lums.edu.pk/ccap/content/about-the-project).

It is thus necessary to increase our overall preparedness and minimize the effects of these external shocks (this is often referred to as adaptation). The study not only draws attention to existing and future climate trends but it also provides readers with their associated consequences, and some proposed adaptation strategies. The information provided in the Climate Data Modelling Analysis will be a critical component of devising all future climate related interventions in Pakistan.For quality assurance purposes data was collected from 56 metrological stations in Pakistan all of which follow standards laid by the United Nations' World Meteorological Organization (WMO). In this study the Pakistan Meteorological Department (PMD) developed climate change scenarios for the entire Indus Basin at 50km and 25km spatial grid resolutions. Climate Projections made are based on reliable tools such as General Circulation Models (GCMs). The GCM's were further refined by internationally developed models such as PRECIS and RegCM4.

How to get a hold of this study

This study is available on our website (www.wwfpak.org/ccap), and in a hard copy format upon request. We hope to reach a wide audience including our regional partners, associates, government officials and other organizations.

Study Overview

Pakistan lies in a geographical region where temperature increases are expected to be higher than the global average, making it an extremely climate sensitive country. The impacts of climate change felt in Pakistan range from tropical cyclones in the south to glacier retreat in the north. All the impacts of climate change and their manifestations have been looked at in detail in the Climate Data Modelling Analysis conducted by PMD. High-risk areas have been identified and recommendations to problems presented by climate change have been mentioned.

This study takes us through quantitative data and qualitative data that suggests a 10-year

trend in climate change, excepting for some variation in 2005. The significance of the 10-year trend cannot be sufficiently underlined, as agreed by the IPCC countries' whose average mean temperature or average mean precipitation trends for a 10-year period or longer are classified as undergoing climate change. In the absence of agreement on such a trend countries cannot climate to have climate change but must instead refer to climate variation which does not in any way necessarily entail trends. The importance of classification for countries be they recipient countries of climate change adaptation funds, or, recipients of special and differential treatment in the World Trade Organization owing to a *"least developed country"* status, is consequential. We hope that this synthesis report helps galvanize debate on this subject.

The CCAP project is primarily focusing its efforts on the Indus Delta; however, the region cannot be looked at in complete isolation, it needs to be looked in the broader context of the entire country. It is for this reason that a considerable amount of the study focuses on Pakistan as a whole. In fact, the climatic regimes of one part of the country are bound to stress other parts or the whole. A future yearly average precipitation and temperature trend for different districts of Sindh from the present day up to 2100 is available in the report. Areas included in the analysis include: Mithi, Moenjodar, Mirpurkhas, Chhor, Nawabshah, Dadu, Padidan, Larkana, Sukkar, Rohri, Jacobabad, Hyderabad, Thatta, Badin, Pasni, Gwadar, and also Kharo Chan and Keti Bunder (both of which are WWF – Pakistan CCAP target).

Key Findings

- Time series of area weighted mean daily temperatures averaged over each year show a sharp rise in temperature during the first decade of 21st century except the year 2005. Impacts included loss of vegetation, deforestation, irregular precipitation cycles and heat waves. (Diagrams in Annexure)

- Changes in thermal regime have occurred, daily temperature variations have increased. The minimum temperature, which is the measure of lowest nighttime temperature, and the maximum temperature, commonly representing the highest daytime temperature, have increased in both summer and winter seasons throughout Pakistan.

- Warmer nights threaten crop production (due to heat stress) by increasing overall water requirements and higher rates of respiration. The author explains how this leads to lower net dry material production, which in turn can possibly be linked to hikes in food prices and food insecurity. In a joint project of the Lahore University of Management Sciences and the World Wide Fund for Nature – Pakistan funded by the International Development Research Centre (IDRC), results of a political economy and a micro-econometric study examining the links between food security and climate change in the Indus Ecoregion are expected by 2014-2015.

- Winter seasons have shown more of a warming trend compared to the summer seasons. This in turn extends the summer season and shortens the winter season, thereby shortening the kharif crop-growing period. Crops that are expected to undergo and have in many cases already shown visible physical changes include wheat and bananas. Wheat

grains do not gain proper size and weight nor do they accumulate optimum starch contents hence reducing the total grain yield. Bananas growing in the present climatic conditions are expected to bear poor fruit sets and give rise to dwarf yields.

- There is a shifting trend where the Bay of Bengal is cooling down and the North Arabian sea is warming; as a result, the number of tropical cyclones has increased.
- Temperature and precipitation variation in the Indus Delta cause heavy soils with poor drainage that ultimately destroy standing crops and prevent the timely plantation of the next season's crops.
- It is expected that a rise of 4 degrees Celsius will occur within the century in the Indus Delta region.
- Data was collected over a five year period at Gwadar; based on the data it was found that there is a rising trend in sea level rise (SLR). It was determined that if the thermal regime continues to heat up at the present rate there will be an average rise of 6mm per annum. Impacts of SLR are likely to include coastal erosion, wetland and coastal plain flooding, inundation of deltaic plains, salinization of aquifers and soils, and a loss of ecosystem biodiversity.

Climate Change poses serious threats to Pakistan. Here's why

- Food Insecurity
- Loss of livelihoods
- Loss of homes and land
- Mass Migration
- Disease outbreaks and mental health disorders
- Loss of ecosystems. Mass extinctions of animal and plant species.
- Threatens community networks and familial relations

Climate Change impacts at the Local Level

- Temperatures are rising. Expected 4-degree rise within this century.
- Increased intensity and frequency of extreme weather events
- Sea level (SL)
- Seawater surface temperatures
- Change in Precipitation

Next Steps for CCAP and its stakeholders

- Large scale dissemination of findings through media, educational materials, publications and more
- Present findings to government officials at the scenario report launch and advocate for more climate change provisions

Conclusion

The climate data modelling analysis provides hard scientific and quantitative research that is needed to back some of the claims and interventions that WWF is going to take within the upcoming years. The study will be instrumental in expanding the knowledge base and will be a launching point for empowering stakeholders to take more informed measures against the impacts of climate change. Planners and Policy makers may make use of district level forecasts up to 2100 in a general sense. That is, forecasts are only reliable for up to three months, and besides, highly disaggregated time series data at the farm level is needed to monitor lucrative crops or crops that are important for food security purposes before adaptation expenditures can usefully be applied; for example, as mentioned earlier, the national agricultural research centers would need to use PMD's report to establish baselines, legitimize climate change research expenditures and cross check their own findings. While PMD's study highlights crops and agricultural productivity concerns for the most part, the Indus Eco-region's changing weather patterns would require sophisticated policies, market based instruments, adaptation plans, and periodic monitoring through disaggregated time series data for inland and coastal fisheries.

In other words, fish stock may be affected in a number of ways owing to changes in surface water temperature and atmospheric temperature along with other factors that are discussed in the annex to the synthesis report.

5. INTERACTIVE MAP

INTRODUCTION

This component of the CCAP project is not a report; instead, a developing database is offered here, containing temperature and precipitation data for Pakistan. The database is accompanied by (personal computer compatible) desktop software that allows users to query historic and forecasted data. In particular, users view a map of Pakistan demarcated by district boundaries, can select any such district in any province, and can view temperatures and precipitation yearly-averages in a pop-up window. This decision support tool may be placed at the disposal of relevant lined officials and concerned provincial departments of Pakistan as has been successfully done for other decision support tools by WWF – Pakistan (see for example: http://dss-foreverindus.org)

Purpose

The intention behind creating user-friendly desktop software to query historic and future data is to assist climate change adaptation planning and policymaking. The government's official and vetted meteorological department data is now made accessible in a way that it was not before. The CCAP specified 40-years historic data up to present (2012), as this is an acceptable figure for short-term forecasting. The final product will benefit from feedback by CCAP stakeholders who would describe desired software/data features based on their particular intended usages.

Data

At present the software offers up a window containing an attribute table for a given district (selected from a drop down menu or via mouse click directly on the map). The attribute table lists data for smaller scale jurisdictions, namely Tehsil/Taluka. For each Tehsil, longitudinal and latitudinal points are given alongside the temperature corresponding to those spatial points, as well as precipitation. It should be stated here that at the time of the writing of this report in December 2012, the data for 2011 is provisional while the 2012 data is still being calibrated by the Pakistan Meteorological Department. This is a desirable basic starting point for decision-support software; however, uses are expected to vary depending upon users.

Besides the data base contained in this decision support tool, the desktop software offers a number of features that will be of interest to CCAP stakeholders. Among others these features include:

Features besides and accompanying the data

- Colour-coded spreads over the map denoting changes over time in levels of aridity, e.g., characterizing zones that regroup districts. This can help one to instantly pin-point locales where agricultural investment opportunities or risks exist.

- The graphic user interface (front-end) enables rapid retrieval, easy location of talukas by province, and the option to

visualize 40- year data in graphs.

- There is a feature that allows comparison of variability in precipitation/temperature across talukas, and helps users to map and select provinces in which queries are to be conducted.

- Geographical User Interface (GUI)**:** A graphical user interface is software that provides users with images versus texts to interact with. Images that are represented in our study are maps, topographical features, and different charts. The following describes details of the GUI developed by CCAP.

- A standalone graphical user interface (GUI) was developed in a recent version of Map Window which is an open source desktop based Geographic Information System (GIS). It is fast, free, and efficient. The software is extremely user friendly and simplified, allowing people who have no formal training in GIS to navigate it comfortably. The software is readily available and can be downloaded. (Please see: http://www.mapwindow.org/)

- The software functions as a back-end architecture upon which an interactive graphic user interface (front-end) can readily retrieve data.

- The GUI displays a map of Pakistan that enables users to see provinces, district boundaries and district names and to click on different districts such that a window appears listing all talukas for that district and their respective temperature and precipitation data. More specifically, if one right clicks on the map layers, a drop down menu appears. One of the choices in the menu is *view attributes*, which opens an attribute table editor: the table comprises of provinces, districts, tehsils and their respective temperature and precipitation data. If one wishes to locate one of these regions on the map one can simply click on the location name in the attribute table and the associated region will light up on the map.

Quality Assurance

- The precipitation and temperature data sets were provided by the Pakistan Meteorological Department. The datasets were collected using universally accepted standards established by United Nation's World Meteorological Organisation.

- All the data was screened and verified to ensure that it does not contain anomalies, e.g. outliers that would hinder comparison of data across talukas, or graphing of data, and analysis based on the processing of this raw time-series data.

- All Decadal average surfaces of temperature and rainfall were generated using inverse distance weighting interpolation method.

What to expect

- Calculated, interpolated or otherwise calibrated time-series data on temperature and rainfall for the next 40-years leading up to 2050 from 2012 for all talukas in all provinces of Pakistan at a 25 km x 25 km grid resolution.

- The DSS compares different climate related scenarios on a single map: users enter names of talukas in Window Map, and retrieve 40-years of data on 2 indexes

of climate change, namely:

(1) Precipitation, and
(2) Temperature

- A search engine is included in which taluka names can be entered.
- In response to each search, 40-year temperature and rainfall data is displayed. Users are then presented with different options for viewing data. Data can be viewed in graph form or as a series of data in a downloadable excel format, i.e, in'.xls' or '.xlsx' format.
- Instructions, drop-down menus, navigation keys, disclaimers and acknowledgement text are present that facilitate use of the DSS across a range of users including senior policy makers and planners as well as university and school students.

Key uses for stakeholders

The DSS aims to act as a problem solving tool and a data repository for stakeholders. The DSS gives users access to up to date, factual and nonpartisan data in a visually appealing, and simplified way. This removes, to some extent, the uncertainty in analysis, adds to the knowledge base and gives users the capacity to make more informed decisions

Target Audience

Among users targeted by CCAP are the Ministry of Climate Change, the Ministry of Food Security, and the Pakistan Agricultural Research Council. Specific data uses can be extraordinarily varied, even within such planning agencies, including development of productivity models that incorporate rainfall and temperature variables to determine yield or farmer profit for a baseline year and future years. Feedback will be solicited by CCAP, including at its 29 December 2012 synthesis report launch. Clearly, Pakistan's future planners and policy makers, as well as entrepreneurs or environmentalists, and students at the various local universities are also the intended users of this developing database/decision-support aid.

Uses for CCAP and Stakeholders

The developed mapping software will help support decisions such as identification of *"adaptation hot-spots"*, i.e., identification of locations at the sub-district scale that will and have experienced highest variation in rainfall and temperature over the next 40-years and the past 40-years. These localities will most likely have larger numbers of human adapters.

The DSS will enable us to track these adaptation practices and to continually monitor their progress and reach at the tehsil/taluka, district and provincial level. We can map jurisdictions where the relative crop productivity is being affected by climate change trends and forecasts.

Findings from this study will feed directly into action plans formulated by the CCAP team. Researchers, or, those commissioning and overseeing research, will ultimately be able to determine where best to spend research budgets based on primary data collected about adaptation behavior.

Other work that can be facilitated by the interactive map includes new university studies on climate change adaptation in inland and coastal areas. Further, planners and policy makers may use the DSS to commission adaptation research to determine budgetary outlays and financial return on such outlays.

NEXT STEPS

A Pilot launch will be held and stakeholder feedback will be incorporated to further customize this tool and enhance user friendliness. We are looking at ways to convert this into a web based DSS that can be accessed at any point in time by a wider audience in web browsers such as Mozilla, Google Chrome and Internet Explorer.

The software developed by National University of Science and Technology (NUST) will be continuously worked on and updated through the project lifespan. The CCAP team including a team of DSS experts are also looking into expanding the scope of the interactive map beyond temperature and precipitation data to include: infrastructure, ecologically significant sites, flora and fauna data, socioeconomic data, epidemiological data, topographical features, disaster prone and disaster affected areas, food and water scarce areas, future climate projections, populations of climate change adapters, impacts of adaptation, and populations immediately vulnerable to climate change.

6. HAZARD MAPS

CONTEXT

One way of categorizing and/or regrouping CCAP's studies is their geographic coverage and scope. In this way, we may think of one set of studies covering the delta, its estuary, its creeks, and the sea. The other set of studies cover areas elsewhere besides the delta, namely the Indus River, Sindh's districts, and even decision-making and planning hubs in Sindh and in the federal capital in Punjab. This latter set of studies includes the political and institutional analysis, the environmental flows study, the best adaptation practices study, the study of Bangladesh's agricultural sector, the decision-supporting database of temperature and precipitation at the 25x25km grid resolution, the environmental flows study and the climate modelling study.

The present hazard mapping study belongs to the former set of studies that have in common their referencing of villages, their primary data obtained from households (be it qualitative or quantitative data), the in situ sampling of physical soil and water samples, or ground truthing to corroborate satellite images. This set of studies thus includes the socioeconomic baseline, the feasibility of pilot interventions, the community based vulnerability assessment, the salinity study, and the presently discussed hazard mapping study. While the former set of studies lend themselves to political economy considerations, enabling decadal forecasts, or studying river health and its impact on biodiversity, the set which the hazard mapping belongs to, is concerned with ascertaining village-specific parameters that combine to give a nuanced picture of resilience requirements.

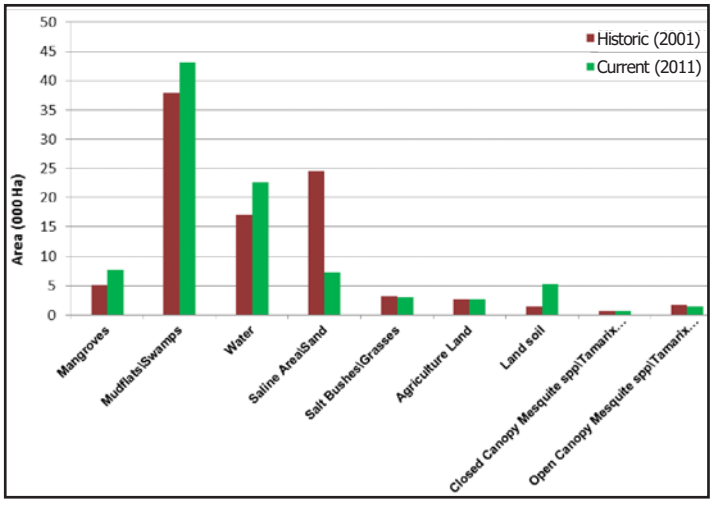
Purpose

The purpose of hazard maps is to supply planners and policy makers with a decision support tool. In particular, the maps supply a visual guide of the placement of road networks, important public infrastructure, villages themselves, and, importantly, locales at Kharo Chan and Keti Bunder that are prone to such extreme weather events as cyclones, floods, sea encroachment and tsunamis.

Objectives

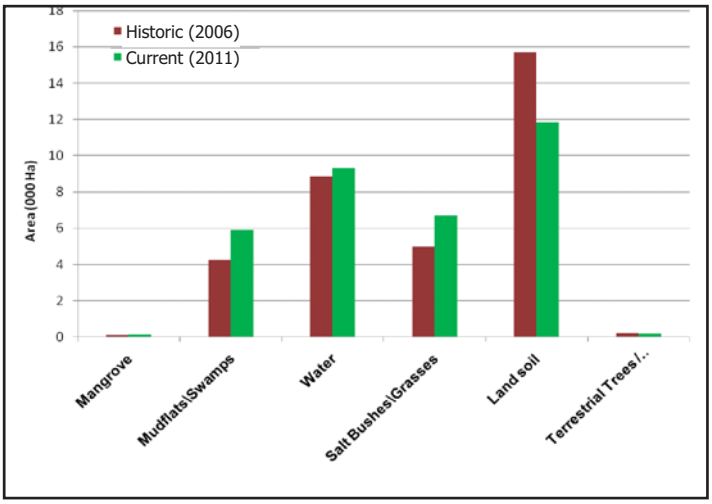
The study's objectives are to prepare analysis based on multi-temporal satellite images, including an estimation of land erosion along the Indus Delta and Jiwani coast, extent of flood impact assessment and identification of flood prone areas. Further, the study aims to provide climate change planners with maps of mangroves, ones that detail road networks, important public infrastructure, administrative boundaries, hydrological toponyms, and villages themselves; but, also ones that show changes over time in land cover and land use.

Figure: 1



Key Findings and Resilience Planning

Figure: 2



One key finding is the physical spread as measured in hectares of overall mangroves cover, closed canopy cover/ closed to open canopy cover and open mangroves cover. The report over a 10-year period of time slot from (2001-2011) comes with an interesting note that total mangroves cover has been increased by approximately 200 hectares in Keti Bunder. While looking specifically at open canopy mangrove cover in Keti Bunder we note that it has increased by 1,000 hectares approximately. These findings are rigorous as the satellite image reflectance values have been correlated with the ground truth data with the help of GPS coordinates. Total mangrove cover in Kharo Chan has grown by about 2,000 hectares in the past decade to almost exactly the same overall spatial extent of roughly 7,700 hectares.

The above figures and analysis are of practical value not least because they highlight relative rates of growth in mangrove cover, but help to identify the areas where there has been tremendous increase in the mangroves extent which are a source of natural sea barrier against the storms of recent years. The impact of these storms on the products of fisheries and farmer community as well can be helped by this growth of mangroves cover that has proven at Kharo Chan and Keti Bunder sites to have shielded fisher boats that were tethered to these trees.

In the study, other land cover / land use classes classified for Jiwani, Kharo Chan and Keti Bunder also include: mudflat/ soil/ shrubs /bushes/ grasses/ bare rock/ soil, terrestrial trees, and water. The study provides graphical and statistical analysis of the change in the Land-Cover and Land-Use (LCLU) classes of the project sites. About 15 LCLU classes have been mapped for all the project sites for temporal analysis. There has been significant percentage decline over the last decade in algal mat, saline area and open canopy mangroves classes at Keti Bunder. At Kharo Chann, there has been a decline in saline area and in open canopy species such as Mesquite spp. and Tamarix spp. At Jiwani, land soil reduced by over 20% of the total area. CCAP must now follow up on these findings and take up the challenge of increasing the resilience of these natural assets jointly with other stakeholders.

A number of climatic and biophysical parameters like temperature and precipitation, along with the coastal vegetation were introduced to the study to analyze the patterns of different hazards. Previous records of natural disasters were also important to assess the frequency and intensity of the disasters. The hazard mapping study is downscaled to the village and taluka level. After flood 2010 it was observed that mangrove cover is on the increase with a high growth rate near Sohnri and Adhiari creeks in Kharo Chan. This key finding is a piece of information that is worth consideration in conjunction with salinity

study, socioeconomic baseline, vulnerability assessment and other studies before. A combination of these studies may strengthen the conservation of natural resources to ensure the increasing growth trend maintains, or, to examine for replication purposes, what conditions are necessary for sustained growth, or, understand which portions of this cover are likely to act as sea barriers and help villagers to organize accordingly.

Figure: 3

Cyclone	Date	Area	Casualties	Remarks
Cyclone Phet	June 2010	Karachi		Third deadliest Cyclone (2 million affected)
Cyclone Yemyin	21-26 June 2007	Karachi, Ormara and Pasni	700	Third deadliest Cyclon (2 million affected)
Cyclon TC 01A	21-29 May 2001			
Cyclone TC 02A 1999 (Category 3)	20 May 1999	Shah Bunder & Karachi	6200	Strongest and most powerful cyclone on record
1993 Indo-Pak cyclone (Category 1)	1993	Karachi, Thatta and Badin	609	Caused flooding in Karachi and displaced some 200,000 in Thatta and Badin
1965 Karachi Cyclone	15 December 1965	Karachi Coast	10,000	Deadliest TropicalStorm in Pakistan's History

The study incorporates major tropical cyclones that have struck Pakistan's coastal areas. The frequencies of cyclones show that these have been at least 10 times in number since 1895. The findings on cyclones' statistics are careful to list casualties, concerned areas, dates, and the damage potential. The deadliest tropical storm in Pakistan's history hit Karachi coast in December 1965 and brought about the death of ten thousand people along Karachi's coast. The factual information, (considered highly reliable by the Government of Pakistan), on these extreme events includes commissioning studies to assess the costs of damages to households in terms of lost lives and lost income in order to justify government spending. This will help to protect and to increase the resilience of the concerned communities to this climatic phenomenon whose frequency is on a continuous increase. Organizations like the 'Friends of Indus Forum' can help lobby parliamentarians and others in high position of responsibility who would be able to popularize this inclusive information. Furthermore, studies to observe possible yearly trend of disruption to commercial fisheries and their exportable surplus may be suggested, as these kinds of studies tend to resonate more strongly with federal ministries than district or settlement level statistical findings.

Elsewhere in the study a table lists scores for *"physical damages"*, *"economic and financial losses", and "overall impacts"* for tsunamis and cyclones. The geospatial distribution of both the ranking/ scoring as well as the frequency of these extreme events along with comparative figures on number of deaths turns out to be a decision support tool for planners and policy makers. Ultimately the planners and policy makers will have hard facts to underline the sheer cost of postponing investments in early warning systems and in resilient infrastructure as a means to protect the livelihoods of natural resource dependent communities.

The hazard mapping report shows the extent inundation of flooding in 2010 along the Indus River. At Kharo Chan the study provides names of villages where land cutting from water pressure has been the highest. The flood study is downscaled to district level and the extent of the flooded areas is analyzed in comparison with water discharge levels below Kotri for the months July and August 2010. The flood hazard map has been furnished with the roads and health facilities to make decisions in quick emergency response.

The land erosion discusses the physical impact of sea water intrusion and increasing wave action. It was observed that the erosion rate in Kharo Chann is high with a maximum of 60.7 m/year and mean of 35.2 m/year in area along Sonhri Creek. Apparently this is not a direct threat but the rate at which we are losing land is alarmingly high. This may result in loss of land.

7. SALINITY STUDY

STUDY OVERVIEW

This study has been initiated and is partly complete, over the course of 2012, already water and soil samples, field surveys, and laboratory analysis of soil samples have been successfully undertaken.

The purpose of this study is to equip planners concerned with improving the resilience of coastal farmers confronted by possible declines in crop yield and household incomes as a result of the salinization of their farming plots. In particular the final study will combine analysis based on remote sensing and GIS tools, historic tide data, and water and soil samples in order to help determine the extent of salinity impacts on agricultural and horticultural lands on the coastline of Pakistan. A Comparison of this analysis will be made with prior studies conducted in the target areas, the comparisons made will be used to calculate and record differences between past and present soil profiles.

The scope of this study is confined to Keti Bunder and Kharo Chan union councils. Efforts will be made, if possible, to achieve an understanding of the extent of seawater intrusion based on tide data and satellite imaging. Where tide data and satellite imaging is not available, proxy indicators will be identified and used to achieve an understanding of the extent of sea water intrusion and information to corroborate farmers' perceived crop loss and crop yield reduction at present and in the context of future climate change projections. This will in all likelihood include temperature and precipitation data and historical water balance records.

To date the Pakistan Meteorological Department has conducted a field survey and soil sample analysis. They are jointly preparing the study with especial responsibility for technical content. For example, they will help WWF – Pakistan's GIS team determine the salinity spread with the help of an algorithm only recently applied by meteorologists who use satellite imaging in addition to soil and water sampling. The CCAP team recognizes an importance to encouraging the design and use of unprecedented techniques and methodologies since this at once contributes to indigenous capacity building and greater precision in planning.

A setback to ground truthing field visits as well as the commissioning of satellite images during the last half of 2012 has been the advent of standing water from rains and floods.

The Agrometerological Centre in Tando Jam was monitoring the CCAP sites to ensure that as soon as the land dried, work could immediately begin. A questionnaire was administered to Kharo Chan and Keti Bunder farmers to obtain responses on their perception of damage from seawater intrusion, inundation by 2010 floods, salt and other sediment deposition.

The completed study will result in both reusable datasets as well as analysis of this data set covering the following:

1. Cross section data on perceived crop loss/yield reduction due to salinity 20+ year and forecasted trend of sea level rise in mm/yr.

2. Average sediment accumulation (Historical Rainfall Data derived from satellites at 20km resolution.

3. Area of land (in hectares) inundated (with scenario analysis of future sea level rise)

4. Futuristic map of agricultural and horticultural fields relating damage from inundation and floods

Survey Instrument

In terms of the survey instrument designed we note here the modules that were included, yielded units of data that will constitute our reusable database.

Users of this synthesis report are invited to consider the types of data being collated and our programme management unit in Karachi would be delighted to note recommendations, in the future, to improve such things as data strings needed to enable certain types of analysis, appropriate units of measurement with which to prompt respondents, or, identification of data streams that could possibly be used to construct proxy variables.

The questionnaire contained different modules, including modules on acres of land fertility, ground water quality,

tidal behavior, change in the extent of creeks, types of crops grown, and percentage of acres inundated by fresh water and brackish water. Specific questions focused on perceived causes for crop loss and decline in yields, new crops introduced, number of acres for different plots owned, saline land abandoned due to soil infertility, and sources of fresh water in the area.

A second survey is being initiated and will focus on ground truthing of satellite images as well as corroboration of taluka level 40-50 years of historic rainfall and temperature time series data. This exercise will be executed by the WWF – Pakistan GIS laboratory, with assistance of CCAP staff.

What to Expect in the Study

Apart from the above cross-section data, in a second instance the study's authors will commission and oversee high quality images of agricultural and horticultural fields. The product or results will be digitised maps probably using ARC GIS software. The images will point out areas of land affected by salinity, whether agricultural or non-agricultural, and also, extent of sea water intrusion and sediment accumulation. Alongside the maps, if possible, GIS staff will be requested to measure in hectares/km the extent of encroachment over a historic period and expected future changes as a forecast of years to come.

The study is expected in its final version to be a single report comprising sections covering the following content:

1. Tabulation of numeric results of water and soil samples

2. Tabulation of numeric information corresponding to satellite images and the future trends (e.g. salinity, sea level, and sedimentation as measured in millimetres and kilometres)

3. Inferences and other commentary accompanying the above tables and covering topics such as seawater inundated area, average sediment accumulation, changes in land use and crop loss/yield reduction.

4. Adaptation response recommendations

for agricultural and horticultural lands for policy makers, planners and development practitioners.

Soil Analysis

Chemical properties of soil, and textural characteristics, such as sand, sandy loam, loam, clay loam, clay, silty clay loam, and silty clay, were determined for Keti Bunder and Kharo Chan regions.

While comparing 2012 survey results, administered by PMD, to previous studies such as Chaniho et al's 2010 study on "Evaluating Soil and Groundwater Salinity in Taluka Tando Bago, Sindh" it was found that in the upper layers of the soil, at a 10cm depth, the clay contents have increased from 5%-10%, silt has increased from 5%- 7% and loam from 1%- 3%. We acknowledge that the two studies being compared were not administered in the same talukas but according to PMD soil experts, the soil in Tando Bago is similar enough in chemical composition and texture to soil in the target areas where comparisons could be made and results drawn can be applied to Keti Bunder and Kharo Chan areas.

In addition it was found that the organic matter in the soil has gone up from 0.01%-0.03% in Keti Bunder and Kharo Chan. Pakistan's Chief Meteorologist states that this slight improvement in organic matter and fertility can be attributed to the 2010 Floods. The vertical profile of the soil sampled shows how organic matter is only present in the top layers of soil, whereas in lower soil layers organic matter is either absent or very scant. Farmers have responded positively and are grateful for the additional organic matter present in their soils; however they recognize that this increased fertility will not rehabilitate land that was previously water logged, and where salinity and sodicity levels are high.

Crop Loss due to Salinity

Mentioned here are a few of the survey initial findings. More data processing and analysis is still underway.

According to the Pakistan Meteorological Department, the process of trying to isolate impacts of salinity on crop loss when so many other variables are at play was extremely difficult. Variables that were mentioned in their report included, crop growing conditions, weather extremes, availability and affordability of necessary inputs, environmental behavior and timely availability of rental machinery. PMD managed to account for some of these by corroborating findings from the soil analysis data and in-person interviews with farmers.

Even though there are a number of variables at play when determining crop health, it was noted by survey administrators that farmers have reported soil salinity to be the single most detrimental impact to crop productivity. According to farmers the saline and waterlogged soils negatively impact crops during germination, growth and development stages.

Enumerators also recorded that crop roots were more likely to be destroyed in high concentrations of aqueous salt solutions than.

It has also been observed that heavy monsoon rains, in the past three, years over the Indus Delta have exacerbated and further deteriorated soil fertility. Due to poor drainage and percolation, water remains stagnant over already saturated soils. This makes it difficult

for those living in low lying area to sow their crop seeds, more specifically wheat seeds.

Next Steps:

The salinity study is expected to be completed by March 2013. The study will be uploaded to our website upon completion.


Section IV

8. SOCIO-ECONOMIC BASELINE

PURPOSE AND INTENDED USES OF THE BASELINE:

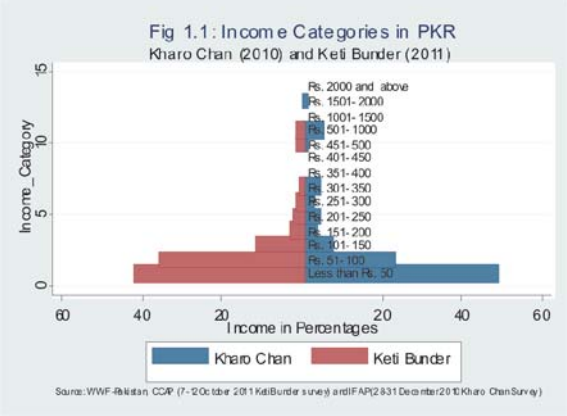
The purpose of the Socio-economic Baseline and Needs Assessment Study is twofold: (a) to design action and policy interventions for the project based on the physical, social, institutional information obtained; (b) to produce benchmark information for monitoring certain testable performance indicators. These indicators are being used concurrently with implementation measures during the 2012 – 2015 period as well as mid-project and post-project assessment and evaluation cycles.

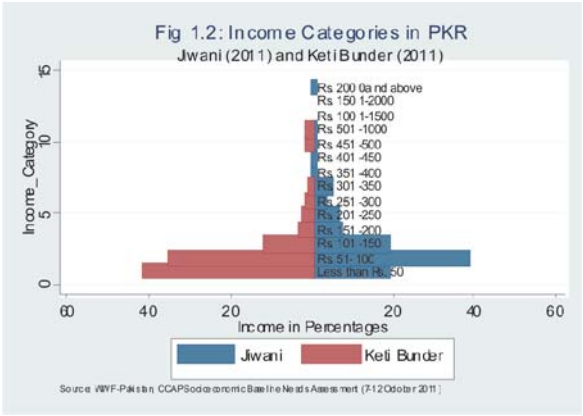
The database created from these surveys will be periodically updated as an ongoing monitoring tool and will be made available on the website from 2013 for research purposes. The database will be posted as a .dta file in STATA-12 command based econometrics software. When queried with the help of the questionnaire, which will also be posted, simple commands in the software can generate high-level statistical analyses on subsistence and economic activity and its relationship to environment and climate related household decisions.

The final Socio-economic Baseline is posted at www.wwfpak.org/ccap and has been nationally and internationally peer reviewed from subject area specialists within the broader WWF Network; and it has already begun to be used for research uses running in parallel to, and expected beyond, the life of the CCAP project.

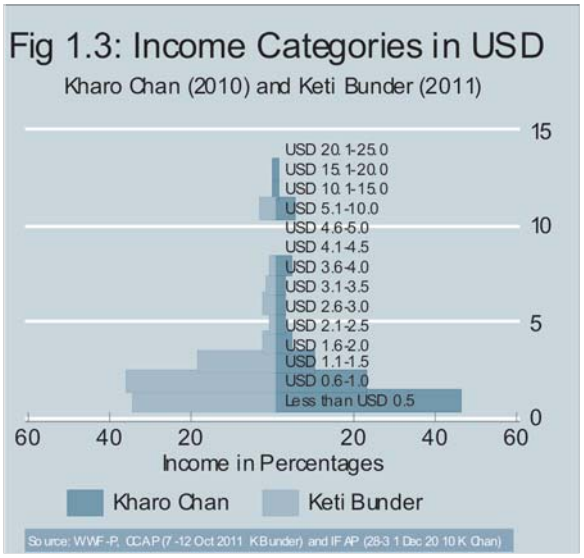
SOCIOECONOMIC BASELINE REPORT FINDINGS

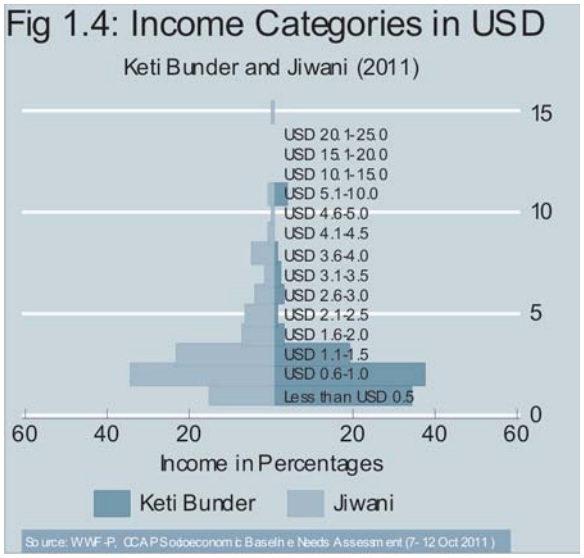
Income categories across sites





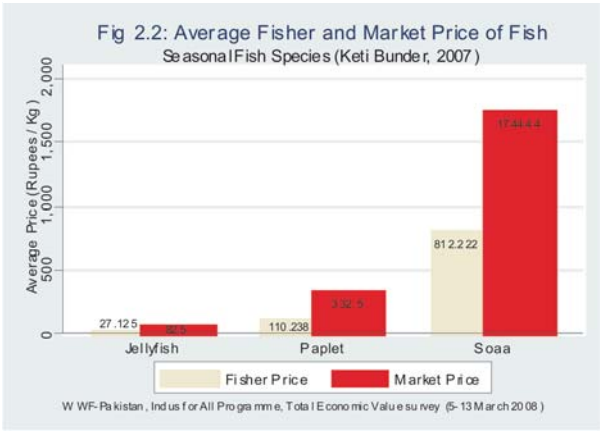
In figure 1.1, the x-axis measures the sample percentage of households for two given sites that are first divided into daily per capita figures and then grouped in ascending order (from bottom to top) into horizontal bars representing PKR intervals or *"categories"* as per the y-axis legend. Adjusting for inflation after 2007-08, the report's authors take the Government of Pakistan's official poverty line, translated into a daily per capita basis, to be about PKR 50. This corresponds to the first, bottom most income category in figure 1.1. Comparing figures 1.1 and 1.2, we see sample shares lying below the national poverty line to be 50%, just over 40% and just under 20%for Kharo Chan, Keti Bunder and

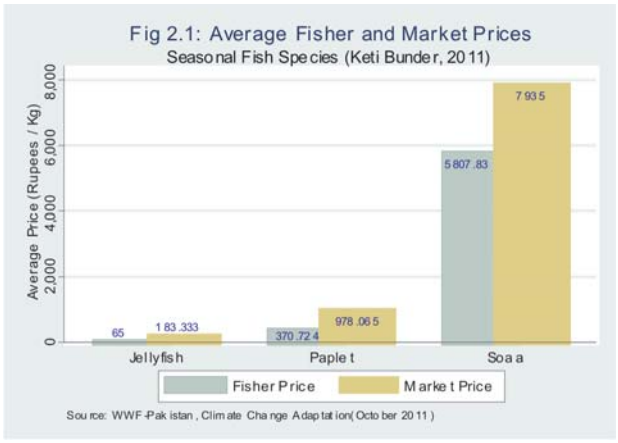




Jiwani, respectively. Using the international poverty line of USD 1-1.25, at least 60% of sampled households at Kharo Chan and Keti Bunder fall below the poverty line; the corresponding figure is just over 50% for Jiwani (figures 1.3 and 1.4).

Natural resource dependency

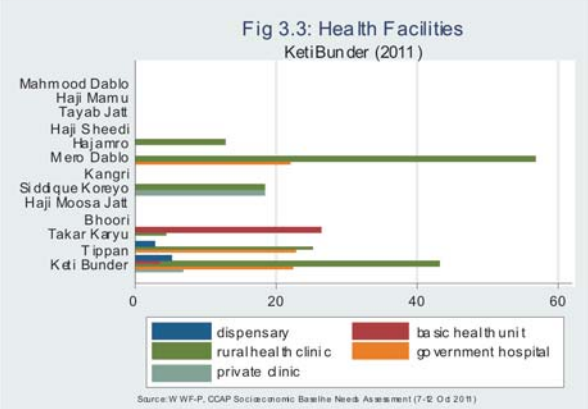


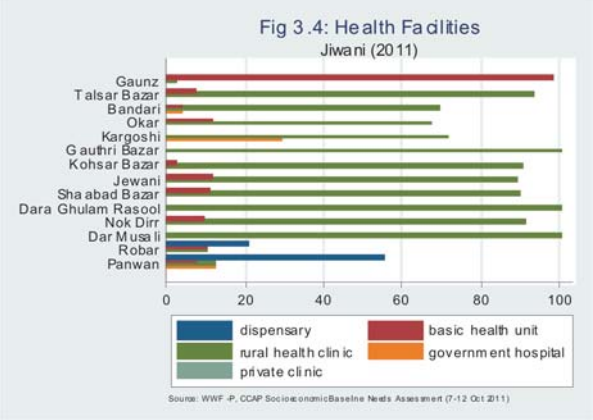


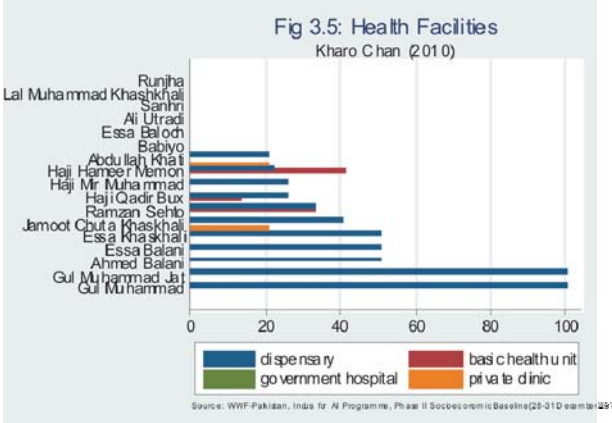
The socioeconomic report summarizes varieties of fish that are caught, sold and consumed in order to illustrate natural resource dependency. In figures 2.1 and 2.2 reported price data are displayed (both prices received by fishermen themselves, as well as the actual market prices received by the intermediaries known as middlemen). The disparity between fisher and market prices exceeds 100% across all fish types both now and four years ago. As regards the comparison between market average unit prices of 2007 and 2011, the 4-year average inflation figure of 15.5% is vastly exceeded in all cases (by factors of 16 for Jellyfish and even 32 for Soaa).

Non-income livelihood indicators – health facilities

In terms of availability of health facilities (figures 3.3 to 3.5) there is greater access to government hospitals and rural health clinics for a larger number of villages at Keti Bunder then there is at Kharo Chan. Access and use of private clinics is only reported at two villages at Keti Bunder and two villages at Kharo Chan and none at Jiwani. Villages without exception at Jiwani have access to either rural health clinics or basic health units. With the exception of two villages, namely Robar and Panwan, 60% or more of households at all villages reported such access. This is unusual in terms of not only availability of health facilities but also ability to access such facilities. In contrast, half of all villages sampled at Keti Bunder reported no access to any kind of health care facility; while a quarter of all villages sampled at Kharo Chan similarly reported no access to health care facilities.







Availability of health facilities at Keti Bunder, Kharo Chan and Jiwani

Figures 3.3 to 3.5 suggest an interesting relationship between health and vulnerability to climate variability and change, particularly when assessing the loss of productivity and income attributed to health related impacts of climate change. One effect may be depletion of savings, as vulnerable communities may need more expensive health care, which in turn diminishes resilience to impacts of climate change and may lead to an increase in environmentally *'irresponsible'* decision-making. Environmental changes as a result of climate variability and change may also trigger or intensify existing disease vectors, which in turn undermine resilience i.e. heat stroke, malaria, dengue fever, skin diseases and gastro-intestinal problems to list a few. As the study identifies which villages are vulnerable and the level of vulnerability within villages is highly useful in identifying relevant public sector investment opportunities in CCAP's semester 5, beginning January 2013; and engaging the necessary stakeholders for policy relevant decision-making.

Non-income livelihood indicators – disease prevalence

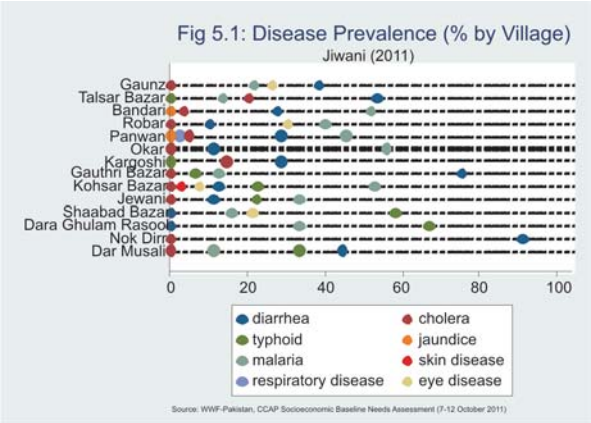
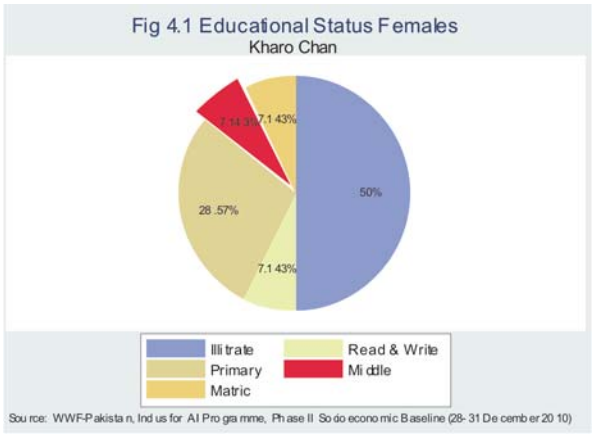


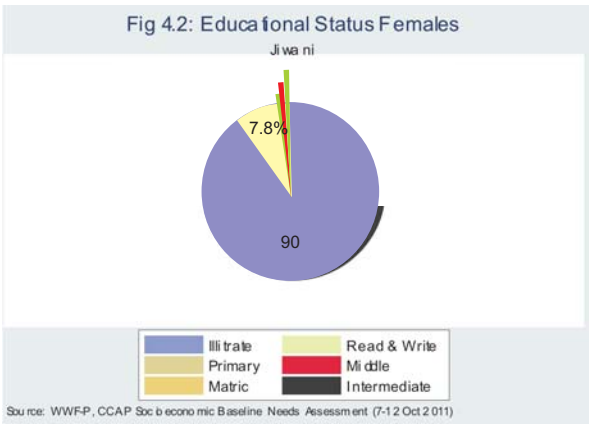
Figure 5.1 (above) shows disease prevalence by village at Jiwani (diseases not reported are regrouped along the vertical axis, the percentage of responses to disease types are shown on the horizontal axis). There is an evident high prevalence of typhoid and malaria. Diarrhea and cholera are the next most prevalent diseases. Keti Bunder has similar eye disease prevalence to Jiwani, but unlike Jiwani, has several reports of skin disease.

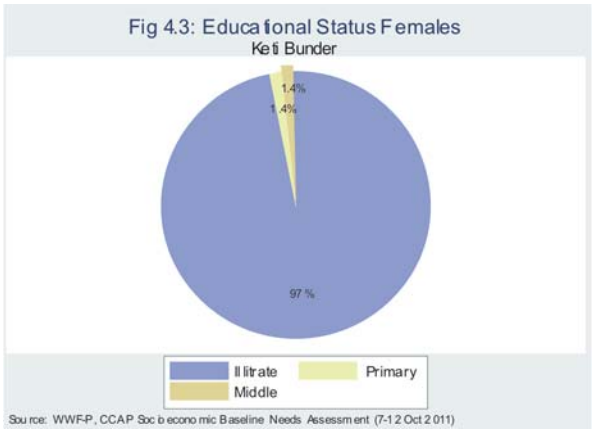
Female livelihood indicators

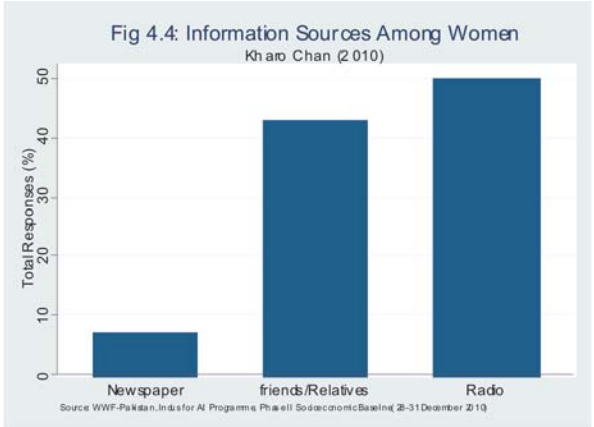
At Kharo Chan, half of the sample was illiterate, while 30% had primary schooling. The corresponding figures for illiteracy at Keti Bunder and Jiwani are 97% and 90%, respectively. Female respondents at all sites were asked about information sources (see for example figure 4.4). This can be useful information in the context of disseminating early warning information about climate change or other dangers such as cyclones. The three sources shown in figure 4.4 add up to a 100%, revealing that radio is only marginally more widespread as an information source than word of mouth.

Women, children and elderly persons are the







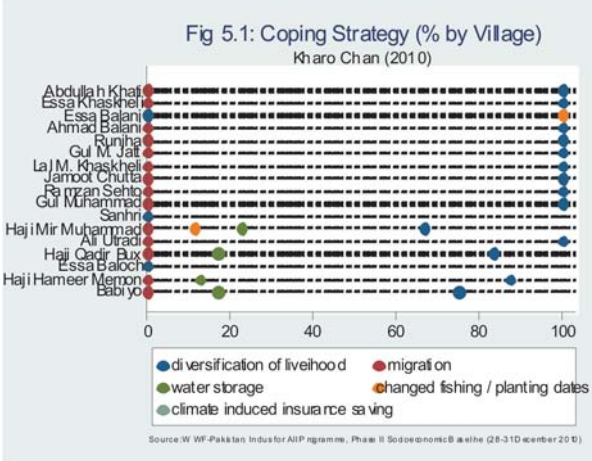


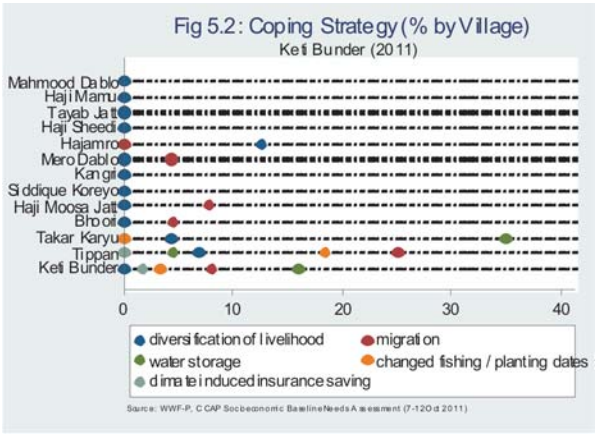
Figures 4.1-4.3 (to the left) show female educational status at the project sites

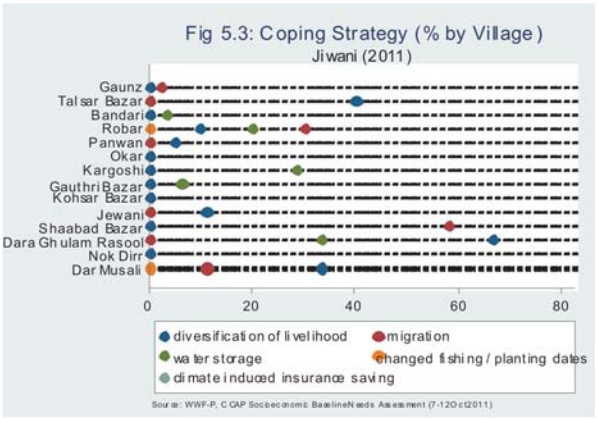
worst affected in disaster situations and the least able to recover from disaster induced economic, physical and social shocks. The 2010 floods, for instance, resulted in a high female and child mortality count. The CCAP baseline results support introducing climate neutralizing female education with maximum coverage for early warning broadcasts. Furthermore, women will be re-conceptualized as agents of adaptation by introducing trainings on adaptation, early response and recovery beginning 2013.

Climate change adaptation and coping strategies

The survey instrument was designed to help provide insights into effective fishers and farmers' adaptation activities (figures 5.1 – 5.3). These are expected to be of interest to a range of stakeholders such as the district government, and district level agriculture and fisheries departments and extension services staff. Each graph lists the five coping or adaptation strategies that respondents were asked to identify as actionable options (in the immediate and long – term scenario). The level of significance of the coping strategies for any given village can be gauged on the 'X' axis where the percentage of sampled households is reflected. On the horizontal axis if the dot is at 60 then 60% of sampled households in that village







responded positively to that option – identified that as an ongoing adaptation action.

In figure 5.2 five villages report migration, with as much as 25% of the 20 households sampled at Tippun village, in response to climactic change.

Water storage is adopted as a strategy in 3 villages including Tippun village and was also reported as a strategy by 4 villages at Kharo Chan (figures 5.1 and 5.2). As many as 6 villages at Keti Bunder do not report any change in behavior in response to climactic variability or change. This may suggest an absence of NGO presence and limited social mobilization in the area; limited impacts of climactic stress in as much as households are not affected sufficiently to prompt changes in behavior and decision-making; or lack of pre-emptive planning and decision making among others.

There is significant migration at Shahbad Bazar at Jiwani (figure 5.3) and to a lesser

extent at Dar Musali, Gunz, and Robar villages. Water storage and livelihoods diversification also appear to be common adaptation strategies at Jiwani where only 2 villages do not report any coping /adaptation strategy at all.

Village level information such as that in figures 5.1 – 5.3 is unusual because of the emphasis it places on shaping micro level interventions. CCAP will actively rely on these results to design and orient adaptation actions; and will minimse risk by avoiding sites where such interventions may not bear fruitful results since these are not problems as identified by household respondents.

Approach

- The survey uses a 2-stage stratified cluster sampling strategy. All income estimates made in the study are based on thorough checks of USD and PKR poverty lines extrapolated to 2011. The results are contextualized to provide insight into village level recommendations. The study is enriched by analysis of directly comparable data from previous socio-economic and environmental baselines carried out by WWF in 2010 and 2007.

- Separate questionnaires were designed for male and female respondents. The survey instrument itself will be made available to the academic community by posting it to the project's website. Innovative design features include rigidly designated measurement units, a numerical only format that also covers qualitative information and direct transferability to STATA-12 software. Instances of valuable data collected through the instrument include: comparable data sets [2008 – 2011 in the case of Keti Bunder] andanalysis of income and market prices using extrapolation of 2008 – 2012 average inflation.] It is expected that other studies will benefit from the design and will contribute to improve survey and questionnaire design.

Section V

9. COMMUNITY BASED VULNERABILITY ASSESSMENT

The Community Based Vulnerability Assessment (CVA) study is designed to provide one input among many towards identifying communities, villages and even households where interventions to increase resilience to climate change can be implemented. Other studies that are relevant in this sense, i.e., helping to pinpoint and in some cases to prioritize places where an intervention can be implemented, include ones like the CVA study which have collected primary data at union councils (UCs) where CCAP beneficiaries are located. Examples of these studies include the Socioeconomic Baseline, Hazard Mapping, Environmental Flows and salinity studies. Of these perhaps the Socioeconomic Baseline is the most rigorous in isolating classes of beneficiaries and their activities and status by village location.

As noted above, those who are designing adaptation and resilience interventions cannot interpret the CVA in isolation. The study itself references the Socioeconomic Baseline at length to its credit. This allows a qualitative study like the CVA to be supplemented by a quantitative information that in some cases has the effect of corroborating vulnerability, and in other cases, dimensions of vulnerability that go well beyond quantitative measures such as ownership / access to quantities of amenities, and instead introduces such notions as peoples' apprehensions about the future or constraints experienced over the duration of a single fishing boat trip. What is therefore obtained is a far more comprehensive overall picture for use by development practitioners, as well as those in public office who would commission further such studies or use their results to justify a new adaptation spending allocation from a yearly public sector spending development pool. The CVA undertook a number of methodological approaches in order to strengthen credibility of its input into the union council level adaptation plans destined for Jiwani, Keti Bunder and Kharo Chan. In particular the study is rigorous in the following ways: application of surveys at intervals over a 12-month period in order to be sure to capture vulnerabilities that are fresh in the minds of respondents experiencing them in the course of their fishing activities (October 2011-January 2012), or, alternatively fresh in their minds as their experience carrying out other gainful activities in the non-fishing season (July 2012). Similarly, there is rigor in the choice of subjects covered in the survey

What is a Community Based Vulnerability Assessment? Why is it useful?

- A participatory tool used to understand and gauge the ground realties of climate change and its impacts at the community level.
- Identifies a community's strengths and vulnerabilities by looking at: (1) livelihood opportunities and resource base, (2) health, (3) ability to safe guard itself, (4) social protection net, and (5) governance
- The tool is developed to strengthen socio-ecological resilience, and scale up existing adaptation practices.

instrument which in their different ways cover vulnerability with respect to added constraints, many of which translate readily into out of pocket expenses imposed on day to day chores as well as livelihood activities, e.g., the questionnaire successfully elicits focus groups respondents' firsthand textured accounts of newly introduced constraints in existing endeavors such as fishing, water collection, pastoralism, farming, parenting, and use of ecosystem service flows from mangroves. The study also samples from among female members of the household and across generations besides villages that have known pre-existing vulnerabilities (e.g., repeated infrastructural loss and loss of life in the face of cyclones such as Yemyin in 2007 and Phet in 2010). Interestingly, the study delivers a data base of reusable qualitative data that has been stored in Atlas.ti software as regards concrete study findings; the following list are key findings extracted from the CVA:

Methodological Steps

- Literature Review
- Gap Analysis
- Reconnaissance field visits and consultations.
- Site selection criteria determined
- Sampling methodology developed
- Questionnaire design
- Training enumerators
- Pilot testing and finalization of questionnaire
- Data collection and translation
- Analysis of primary and secondary data using Atlas.ti software
- Report writing

KEY FINDINGS

Fishing

- The number of months spent at sea has decreased, thus shortening the time window within which to match the previous season's size of catch - i.e. a measureable increase in the fishing effort has been undertaken. A respondent in Jiwani mentioned how the fishing season has shortened from 9 months to 8 months.

- Decline in the stock of specific species within specific seasons- i.e. measurable loss of all catch, and consequent loss of earnings for a given recruitment effort level. Species decline was observed in the following seasonal fish: Heera, Mushka, Dangri, Palla, Mangra, Chowdi, and Mori. Considering that price increases can signal overfishing, it is worthwhile to investigate focus group responses mentioning a 20- fold increase for the price of certain species over a 10-year period (e.g. Dangri was reported by inhabitants of Keti Bander at PKR 50/ kg 10 years ago while it now sells for PKR 1,000/kg.)

- The perceived causes behind population decline of overall catch- i.e. attributing what are in some cases climatic causal factors of such declines, e.g. a rise in temperature appear to correlate to observed changes in fish stock and migratory patterns of fish. Respondents remarked that *"[We think that fish stock has declined due to increased warming of the sea]"* also noting *"fish swim away to greater depths where it's cooler"*. Other climatic and non-climatic factors that impact fish stock include: wind speed, increased levels of

salinity in sea water, less rainfall, greater numbers of boats and trawlers, use of fine mesh nets, deforestation of mangroves and decreased fresh water flows in estuarine ecosystems.

- Loss in assets; boats and fishing nets on the shore often get destroyed or swept away by severe weather events such as cyclones, rising sea levels, and heavy winds. It was noted in Jiwani in 2012 that 60 boats were lost to intense climatic conditions. The losses incurred are financially burdensome, prevent fishing trips and trigger food insecurity.

- Limited access to market; coastal communities in Keti Bunder and Kharo Chan often do not have access to fish markets. This is largely due to poor infrastructural development (road quality worsens as exposure to extreme and erratic weather patterns increases), which in turn makes it difficult for the fisher folk community to sell their catch, and compels them to go through a middleman, thus reducing their overall profits.

- Fish catch often spoils because people do not have access to ice boxes, refrigerators and other cooling facilities.

Agriculture

- The perceived losses and gains in the agricultural sector are largely attributed to climatic and non- climatic stimuli, such as salt water intrusion, erratic precipitation patterns, increased temperatures, shifts in seasonality, reduced water flows downstream from Kotri barrage, lower rainfall, inflation, and market fluctuations, credit and insurance access. A male community member in Kharo Chan was recorded saying, "*For us the changing weather had brought one positive change; the cotton is coming which will make us economically strong. but those who grow paan they are suffering from the changing weather*"

- Growing seasons have altered in both Thatta and Gwadar districts: 99% of all the focus group participants and in depth interviewees mentioned that the seasons have been changing. The summers are getting longer and the winter seasons are getting shorter and colder. Crops that were once successfully grown in certain areas are no longer productive in those localities. The average crop yield (measured in kg) is declining and individuals who rely on crop sales for income generation are finding themselves in a bind. A woman in Kharo Chan was reported saying *"due to rise in temperature, crops shrink".* Scientific support for the information mentioned above can be found in CCAP's Climate Data Modelling Analysis (CDMA). The CDMA provides detailed insight into the crop maturation process, and how it has been affected by rising night time temperatures and shorter growing seasons. The author gives examples of 2 crops that are being adversely impacted, namely bananas and wheat, both of which are grown at the CCAP target sites.

- Food insecurity compounded with increasing market prices has made it even more difficult for communities to afford input costs for agricultural activities, e.g. the price of seeds, fertilizers, water, etc. have all sharply risen. On the other hand, the total agricultural output keeps on decreasing; this scenario sets up a risky situation for farmers as it has become

increasingly difficult to predict the overall net gain or losses that a farmer will incur no guarantee of returns on investment. If this pattern continues to persist, it is certain that agriculture will no longer be a stable source of food production and income generation in Keti Bunder, Kharo Chan and Jiwani. This is particularly true in the case of Jiwani where currently very little agriculture is underway. It was noted in WWF – Pakistan's Socioeconomic Baseline study that only 3 households in Jiwani owned agricultural land.

- Variability and erratic precipitation trends have made it difficult for people to continue with Barani agriculture as a viable income source in Jiwani.

Migration

- The CVA study notes a number of obstacles preventing households from readily migrating when confronted by poverty and significant or lasting disruption to their livelihoods. In a related study carried out a few years before the CVA, Dr. Anil Salman visited Keti Bunder with the help of WWF – Pakistan and interviewed households who reported disruption to their livelihood from climate change. One such focus group discussion respondent remarked, *"Migration is very limited, even though extreme events have occurred, because we are poor, and have no financial assets and no options. If we were financially strong we could migrate temporarily."*

- Overall migration levels are not significant at Jiwani or Kharo Chan. However, in Tippun village in Keti Bunder a significant trend in migration can be seen.

Infrastructure

- Infrastructural destruction is on the rise as the numbers of natural hazards climb: roads get damaged, homes are lost, places of worship have been destroyed, and embankments are ruined.

- Natural hazards in the coastal area include cyclones, coastal erosion, flooding and sea level rise. A female respondent in Jiwani mentions how 30 houses and a mosque were lost to coastal erosion in 2012.

- In this instance we note that the loss of infrastructure is felt at the household, community and village level. The losses incurred disrupt the whole social fabric of coastal communities and can lead to further indebtedness.

Pastoralism

- Droughts may be disrupting rangeland ecosystems but they may equally be lowering pressure on rangeland use. In particular, droughts may be responsible for a further reduction in freshwater and grazing land that are required for goats, and sheep. As many as 163 households at Jiwani, as compared to 27 households, own goats from the total number of sampled households in CCAP's socioeconomic baseline. A focus group respondent noted: *"We are selling animals because drought is increasing"*.

- Rangelands have been markedly impacted at Jiwani according to focus group respondents who attribute the impacts to the non-occurrence of rains,

"Due to non-occurrence of rains, we are selling animals because drought is increasing"

- The sales of goat and sheep represents a forced end to an important form of savings for households; this would precipitate possibly the detrimental decline in household resilience to shocks such as inflation and job loss. It therefore may not be surprising for respondents at Jiwani to attribute human debts to droughts which may occur in this indirect fashion: *" non-occurrence of rainfall is causing drought, people and cattle are dying"*

Indigenous knowledge an forecasting weather

- There may be a genuine need for supplying meteorological information to supplement indigenous knowledge used by farmers or fishers so that their livelihoods are not disrupted to the point that a long lineage of knowledge disappears entirely: According to a respondent interviewed by Dr. Anil Salman and his team it was recorded ***"****Our traditional knowledge does not help us, as earlier we could predict from the visible signs, from the color of clouds, wind direction, behavior of birds, but now we cannot"*

- Respondents reported practices that would be the present day equivalent of an early warning system to alert fishers and farmers to the onset of extreme weather events. Such received traditional knowledge that is transmitted from generation to generation as this can be heard at Jiwani: *"Before the storm hit, the roosters started crowing during the day"* and, *"By looking at clouds we assume that cold has started and by looking at stars we say that clouds will appear tomorrow", or still yet:* "we forecast through winds."

Type	Threat	Impact	Action
Boat	Storm	Livelihood (rozgaar)	Nothing
Mangrove Plantation	Logging	Sea intrusion	Nothing
House	Storm	Homeless	Nothing
Sea	Loss of life	Coastal errosion	Bund
Social interaction/ community	Declining	increasing expense	----

- The following table excerpted from the CVA report suggests, as can be seen in the "action" column, that there is a clear absence of resilience to threats impacting such valued manmade and natural assets as mangrove plantations, boats, and houses:

Adaptation trainings: an opportunity for much needed self-reliance

Awareness and sensitization expenditures of CCAP and others are warranted in view of communities' hopelessness in the face of natural calamities caused by changing weather patterns: *"If Allah wants to keep us safe we will survive here."* If anything, CCAP's awareness work may take away from this kind of feedback that it needs to emphasize self-reliance and means of increasing self-reliance through information and guidance. For example, WWF-India has disaster preparedness training workshops for community members of Sundarbans that include swimming lessons. The hopelessness is evident in another statement

from a head of household at Keti Bunder: *"we can't do anything in this natural cycle but we are worried that if this continues then our village will suffer from a lot of damage. We have not done anything. What can we do? It is the will of God."*

Disaster warnings are not enough – Disaster preparedness should be upscaled

Community members' capacity needs to be built in order to face a natural disaster. They are not properly trained to cope or adapt to the possibility of disasters. These disasters are now increasing in frequency according to a number of studies examining Arabian Sea (Mustafa and Wrathall, 2011). People's lack of awareness is exemplified in the following focus group response taken at CCAP's sites: *"when we become aware or are informed or of a natural disaster then we get very worried and we don't know what we should do and where we should go."*

Local coping strategies

The term *"coping"* refers to immediate actions taken in response at the time of a disaster itself; whereas the term *"adaptation"* refers to actions taken by communities in anticipation of extreme weather events to offset their impacts. The following are examples of local coping strategies used in the CCAP's target villages in Kharo Chan and Keti Bunder·

- *"During the rains to make sure that the water is drained, the children and the men dig ditches so that the water drains into the sea quickly."*
- Also, at Jiwani the study notes that people keep food reserves before a disaster is going to hit. Sometimes the stores are bought hurriedly with not many hours or days' notice presumably and therefore we consider this type of action to be a coping strategy as well as possibly an adaptation (if it is undertaken long in advance as a contingency measure).

The table below lists local adaptation practices that should be upscaled, reconsidered, or discontinued (columns 1-2). It also lists better adaptation practices being undertaken at present in Indian Ocean Basin countries, including Thailand, India, Bangladesh, Sri Lanka and Mozambique (column 3). The replicability potential of these strategies is also pointed out in the table, though not as results of commissioned feasibility studies, consultation, or existing work within CCAP or others' work examining strategies at the project sites (column 4).

The CCAP Programme Management Unit has completed a feasibility study in December 2012 of livelihood interventions that are planned for implementation in semester 5 of the CCAP project (Jan-Jun 2013). The results of this study are appended in the annex to the present Synthesis Report. The table below uses the findings of this feasibility to gauge and suggest adaptation practices that have a higher chance of being successful (column 4).

The data used in compiling the table below was sourced from the CVA study's survey database, CCAP site staff communications, pictures of adaptations underway, and a feasibility report commissioned by CCAP for determining whether to proceed with the purchase of physical intervention materials.

CCAP's stakeholders were asked to fill

column 5 of the table at the synthesis report consultative workshop on 29 December 2012. Participants were requested to suggest names of relevant donor agencies, government departments, implementing bodies and nongovernmental organizations. The stakeholders were additionally asked to commit and support existing and proposed adaptation practices, either through designing activities jointly, participating in fundraising, or, following up donors listed in order to perform a liaison service for CCAP, or even commit their own time and financial resources to supporting the adaptation practices proposed. Key achievements from the workshop are mentioned in the last section of this document.

Adaptation Practices in Keti Bunder, Kharo Chan, and Jiwani (lower case letter)*	Activities should be up-scaled*	Adaptation practices in the Indian Ocean Basin (Thailand, India, Bangladesh, Sri Lanka, and Mozambique) (upper case letter)*	Should be further investigated and then replicated in Pakistan*	Concerned donors, government agencies and implementing bodies for recommended adaptation practices
Mangrove plantations (a)	☺	Storm shelters (A)	☺	
Embankments to prevent sea water intrusion (b)	☺	Breeding saline shock resistant and ornamental fish in seaweed cages (B)	☺	
Rainwater harvesting (c)	☺	Committee of Volunteers that gives early warning messages, and trains locals in disaster preparedness (C)	☺	
Migration (d)	☺×	Post disaster micro credit (D)	☺×	
Introduction of different crops (e)	☺	Creating a green belt (E)	☺	
Crab fattening (f)	☺×	Lobster fattening (F)	☺×	
Elevated homes (g)	☺	Elevated plinths for homes and livestock enclosed by tree plantations (G)	☺	
Climate Induced Insurance saving (h)	☺	Rope making from cotton waste and coconut husk (H)	☺×	
Use of fine mesh nets to increase overall fish catch (i)	×	Cultivating shrimp (I)	☺×	
Diversification of livelihoods (j)	☺	Bioremediation of contaminated water (J)	☺	
Water ponds(k)	☺	Migration (K)	☺	
Alternate energy, such as solar energy (l)	☺×	Organic farming practices/ permaculture(L)	☺	

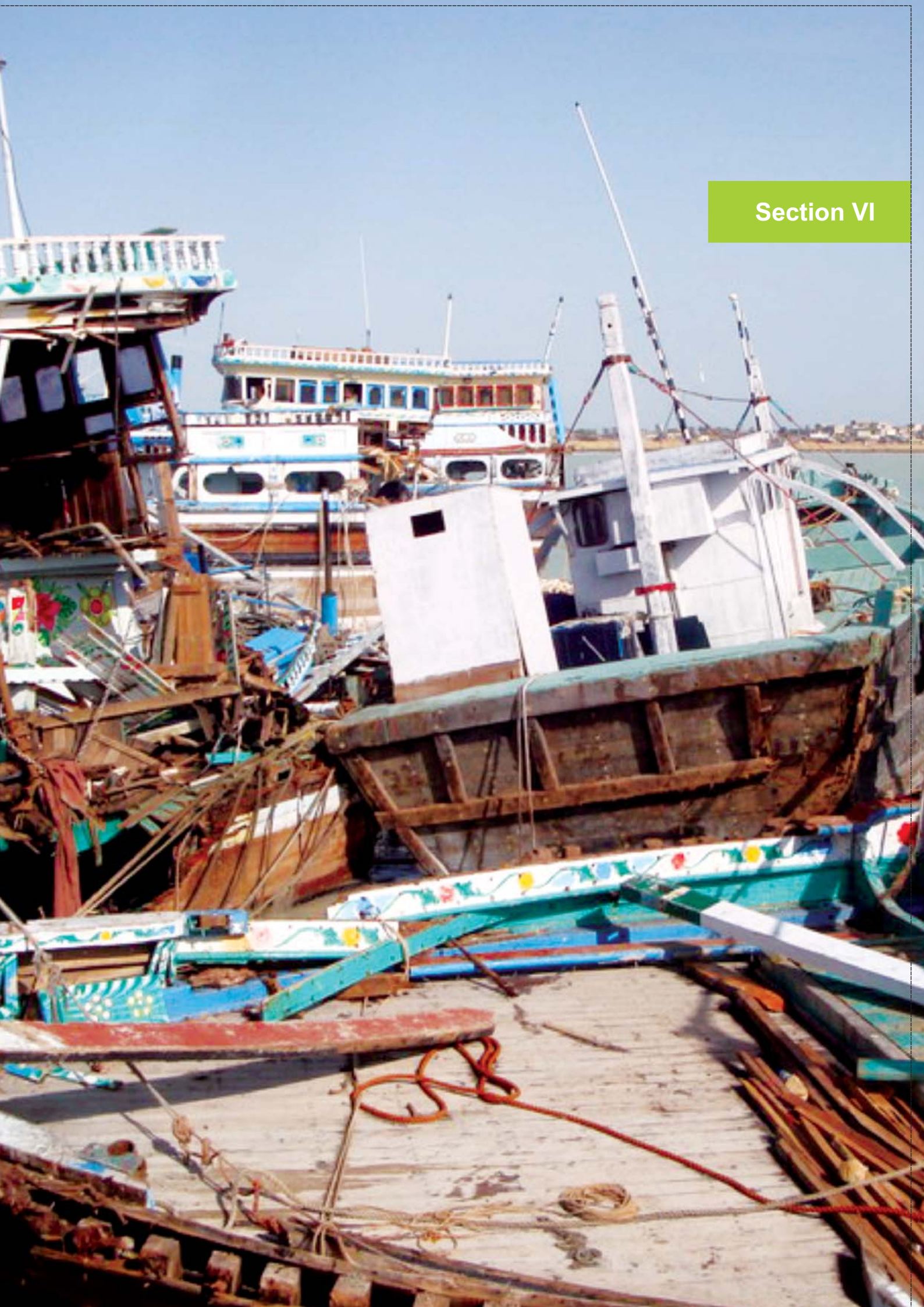
*☺ Activities that should be replicated or scaled up

*× Activities that should not be adopted until given further reconsideration

☺× Activities that are neither detrimental nor beneficial to any significant degree

*(x) Adaptation practices noted in the first column are represented by (x). This will be a useful key to understand which adaptation practice is being referred to when suggesting relevant donors and implementing bodies in column 3.

*(X) Adaptation practices noted in the second column are represented by (X). This will be a useful key to understand which adaptation practice is being referred to when suggesting relevant donors and implementing bodies in column 3.



Section VI

10. CLIMATE CHANGE ADAPTATION "THE BANGLADESH EXPERIENCE"

INTRODUCTION:

This section of the CCAP project is a desk-based report. The report introduces readers to the climate change adaptation experience in Bangladesh. It focuses on: adaptation strategies practiced; institutional mechanisms of climate change in place; observed climate change migration in the region; and agriculture and climate change case studies from Bangladesh, South America and Africa.

Besides CCAP's focus on coastal communities in Pakistan, the project has a strong regional focus as well. In particular, it hopes to enhance knowledge and best practice exchanges between Pakistani, Indian, Iranian and Bangladeshi stakeholders in the Indus, Dasht and Sunderbans deltas. In alignment with CCAP's 2015 goal of regional transboundary cooperation, the project has followed through with a number of initiatives. For example, it is associated with WWF-India and the Centre for Coastal Environmental Conservation in Bangladesh. It has hosted a regional conference entitled, *"Climate Change Adaptation in Coastal Areas: Perspectives from the Dasht, Indus and Sundarbans Deltas"* in Savar, Bangladesh. Further, CCAP commissioned Dr. Ben Groom, at the London School of Economics, to carry out the present literature review on "*Climate Change Adaptation: The Bangladesh Experience"*.

The prevailing view with respect to climate change is that the frequency and severity of extreme weather events in South Asia are only going to increase in the future. It is therefore widely accepted that adaptation is a crucial component of the climate change response, particularly in vulnerable countries such as Bangladesh, located at the confluence of three major rivers as well as being extremely low lying, Bangladesh is vulnerable to extreme weather events such as typhoons and flooding. The prospect and occurrence of such disasters is an important barrier to development and well-being, thus the government and citizens of Bangladesh have a longer history of preparing for, adapting to and recovering from natural disasters compared to a country like Pakistan, which has only recently started to encounter large-scale climate related damages.

Each of the studies conducted as part of the delta wide assessment vulnerability by the CCAP team, including the *"Climate Change Adaptation: The Bangladesh Experience"* are interconnected, some in more obvious ways than others. This study is perhaps most usefully read and understood in conjunction with, *"Climate Data Modeling Analysis", "Socioeconomic Baseline", "Community Vulnerability Assessment", " Better Known Adaptation Practices",* and the *" Political and institutional Analysis". These have been listed in the suggested chronology that they should be read in.*

Purpose

The CCAP team hopes to identify appropriate solutions and replicate interventions, institutional mechanisms, and success stories proposed in the literature review that are most applicable and best suited to the Pakistani coastal communities in Keti Bunder, Kharo Chan and Jiwani, and can be integrated into future action plans at the union

council level. There are many lessons to be learnt, and later applied, from Bangladesh to Pakistan and the surrounding regions. Both Pakistan and Bangladesh are considered to be climate sensitive countries, thus they are both vulnerable to conditions brought about by climate change; this is not their only commonality, they are also similar in terms of culture, topographical features and climate trends; these factors make Bangladesh a good case study for Pakistan to follow. Bangladesh is the most advanced and experienced in the field of adaptation in the region; this will and has enabled practitioners in the past to recognize and isolate suitable next steps with greater ease for the coastal communities living in the deltaic regions of India, Pakistan, Iran and Bangladesh. The transboundary initiatives carried out by CCAP provide us with a situational analysis, where one can easily compare on the ground activities being implemented in different regions in the Indian Ocean Basin.

WWF-Pakistan's approach to synthesising and making use of the Bangladesh literature review

- Key adaptation practices were narrowed down and then reviewed and discussed at the synthesis report launch with climate change experts, agronomists, government officials, meteorologists, economists, environmental lawyers and activists at the scenario report launch. Input from participants will then be integrated into action plans.

- The table at the end of the CVA analysis in the present synthesis report displays proposed best practices, suggested government departments and organizations that need to take appropriate actions. A more exhaustive table will be prepared later on that will include recommended villages, and justifications, and costs for selected interventions.

- This study along with the *"better adaptation practices"* study are efforts to trace, track and catalogue collective responses to the climate change challenge. CCAP will provide readers with a list of key organizations that are working on adaptation in the region.

What to expect in "*climate change adaptation: the Bangladesh experience*"

- A summary is given of Bangladesh's chief concerns surrounding climate change and the role of adaptation in responding to climatic change.

- The section on *"planned adaptation"* provides a summary of the national plans, government institutions, climate change funds and specific adaptation projects that currently exist in Bangladesh.

- A detailed list of government ministries and the national policies with regard to climate change is provided and discussed, including the role of non-governmental organizations and climate adaptation funds.

- Autonomous adaptation, essentially adaptation at the micro (e.g. Household) level, is then discussed in the Bangladesh context.

- A range of possible adaptation practices are considered which then lead to a more detailed focus on agriculture and food security.

- A *"policy suggestions"* section discusses

recommendations based on the literature review itself.

Overview/ key findings

WWF international and the author of this study rely on the IPCC's (2007) guideline for adaptation, which defines this phenomenon as one which moderates harm or exploits *"beneficial opportunities"*. The goal of an adaptation measure is to increase the capacity of a system to survive external shocks or change. *"An adjustment in natural or human systems in response to actual or expected climate stimuli or their effects".*

In the Bangladesh study the authors describe climate change as an environmental issue having significant implications on poverty and inequality. The pattern and behavior of climate, including variability and extreme events, plays a significant role in freshwater availability, agricultural productivity, function of natural eco-systems and biodiversity, human health and livelihoods.

Exposure to these manifestations of climate change can increase communities' sensitivity and reduce their overall adaptive capacity thereby adding to their level of vulnerability. Therefore, economic growth and the performance of a society are extremely susceptible to conditions brought about by climate change. The poor are generally the most vulnerable to climate change as they live in the disaster prone remote areas and have little capacity to adapt to the shocks. They are also more dependent on ecosystem services. Indeed, it is widely agreed that developing countries are more vulnerable to climate change than developed countries mostly because of their proportionately larger agricultural sectors, with food security affected adversely.

The authors note findings of William Cline's recent studies carried out in 2007 and 2008 of the estimated impact of climate change on agriculture in a large number of sampled countries as follows:

- Warming will decrease production by accelerating growth speed of crops and reducing their water consumption;
- Evaporation from topsoil will increase, as does transpiration, again inducing moisture loss or evapotranspiration;
- This is partially countered by the increase in rainfall anticipated due to climate change;
- On the positive side, CO2 can help agriculture via carbon fertilization which aids agriculture for so- called C3 crops (wheat, rice and soy) but not C4 crops (sugarcane and maize).

Developing countries face 10-15% reductions in crop yields overall, compared to around 5% gains in developed countries; Africa, Latin America and South Asia suffer the worst reductions: in the range of 20%. In South Asia, India appears to be most vulnerable, with 30-40% losses predicted.

There are a number of strategies proposed as a means to adaptation to climate change in agriculture. Bradshaw et al.(2004) has mentioned the following: crop diversification, mixed crop livestock farming systems, using different crop varieties, changing planting and harvesting dates, drought-resistant varieties and high-yield water sensitive crops.

Di Falco et al (2011) have examined the driving forces behind farm households' decisions to adapt to climate change, and the impact of adaptation on farm households' food productivity in the Nile basin of Ethiopia. The major findings of this research are-

a. There are significant and non-negligible differences in food productivity between the farm households that adapted and those that did not adapt to climate change

b. Adaptation to climate change increases food productivity.

They also analyzed the drivers behind adaptation. Econometric results show that information on both farming practices (irrespective of its source) and climate change is crucial in affecting the probability of adaptation. Di Falco and his colleagues find that farm households with access to credit are more likely to undertake strategies to tackle climate change. The provision of information through radio, farmer-to-farmer extension, and extension officers is a key driver of adaptation. The analysis also shows that the quasi-option value, that is the value of waiting to gather more information, plays a significant role in farm households' decision on whether to adapt to climate change. Farmers that are better informed may value less the option to wait to adapt, and so are more likely to adapt than others.

Climate change in Bangladesh is expected to exacerbate and aggravate many existing vulnerabilities, with increasingly frequent and severe floods, cyclones, storm surges and droughts forecast. Sustained and sustainable growth and development will be crucial in Bangladesh's long-term efforts to adapt to climate change. The government has developed *Vision 2021*: a set of strategies/initiatives to mitigate the adverse effects of climate change. *Vision 2021* has declared the following visions and measures:

- All measures regarding environment will be taken to protect Bangladesh, including planned migration abroad from the adverse effects of climate change and global warming.
- Facing natural calamities and planned reduction of air pollution
- Prevention of industry and transport related air pollution
- Disposal of waste in a scientific manner will be ensured.
- Steps will be taken to make Bangladesh an ecologically attractive place through retention of forests and water bodies and prevention of river erosion.

To achieve the goals of *Vision 2021*, a medium term plan has been developed: Sixth Five Year Plan (SFYP) The SFYP document is divided into two parts. The first part will focus on the underlying strategies, policies and institutions for achieving the major targets of economic growth, employment, human development, poverty reduction, social protection and environmental management. Resource requirements and financing strategies are also discussed in this part. Part II of the SFYP will discuss detailed sectoral strategies, plans and programmes. One unique feature of the SFYP is that it will be a living document, therefore there will be scope for reviewing the resource requirements and allocations over the five year period.

Interestingly, the literature review describes environmental management strategies of the SFYP. These for the most part consist in amendments to existing laws and regulation or drafting of new sectoral guidelines and legislation: However there is also a call to establish a 'National Environment Fund' for natural disaster victims. The literature review further lists subject areas where donors and the Bangladeshi government itself have invested in adaptation, including crop productivity, drainage schemes, polder schemes, cyclone shelters, disaster management products, irrigation schemes, agriculture research programmes and coastal green belt projects (mangrove plantations). Some forward looking future adaptation plan strategies that are mentioned in the national adaptation programme of action are provision of drinking water to

coastal communities, land water zoning and conflict management, inclusion of climate change in secondary and tertiary curricula, and promotion of drought, flood and saline tolerant varieties of crops.

The report has a highly useful table listing names of institutions and corresponding activities for each such institution. This by itself should stir CCAP stakeholders to see whether corresponding institutions in Pakistan are capacitated to carry out similar activities and whether they have the resources and capacity to do so effectively.

The study concludes by examining such autonomous adaptation strategies as crop switching, e.g. the growing unpopularity of 'Aman' rice, which is rainfall dependent that is being replaced by 'Boro' rice which is dependent on irrigation and not rainfall. Other techniques discussed are integrated farming, floating gardens and caged aquaculture.

The government of Bangladesh has emphasized crop diversification in favor of cash crops and crops suitable in the coastal and hilly areas.

Conclusion

This literature review is extensive, where it provides CCAP with both bottom up and top down recommendations for climate change adaptation that can be applied in Pakistan. This report leaves CCAP and its stakeholders with very practicable suggestions for next steps towards implementing climate change adaptation in Pakistan. Stakeholders also had the opportunity to directly engage with some of the material presented in this study by participating in the synthesis report table exercise. The exercise provided participants an opportunity to vote on some of the adaptation practices mentioned in the study.

11. BETTER ADAPTATION PRACTICES

STUDY OVERVIEW

This study is one of the 11 studies commissioned by CCAP in 2011- 2012 that are desk and field based reports intended to assist the notification and implementation of union council level adaptation plans for Pakistan's coastal areas. In particular, stakeholders such as government, civil society, private sector and academia are expected to use the findings of such studies, among others, to: a) justify the need for adaptation plans; b) list priority beneficiaries and priority actions; c) identify activities appropriate to Pakistan's coastal context and design and direct those activities to best leverage them.

The 'Better Climate Adaptation Practices' study relates to the third of the above objectives. That is, it describes the state of the art in adaptation interventions or activities, drawing on lessons from contexts similar to those of Pakistan's coastline from India, Bangladesh, Sri Lanka, Thailand and Mozambique. The interventions are for the most part best practices that emerged from the implementation of Non-Governmental Organization administered projects.

In this study, examples of best adaptation practices are drawn from a variety of coastal income generation activities, many of which are characterized by a dependence on the sale of natural resources. For example, a stakeholder alignment best practice for afforestation and livelihood diversification work in Bangladesh involves not only community led interventions, but also strengthening of government capacity at different tiers, revising coastal management policies, and development of a functional system for collection, internalization and dissemination of climate related knowledge. There are specific management practices relating communities' most valued possession, namely livestock, but also detailed advice on housing elements such as elevated plinths and tree planting around elevated mounds to supplement the plinths.

It may be noted that the CCAP has commissioned and completed an entire standalone study entitled *"Climate Change Adaptation: The Bangladesh Experience"* therefore, while the better climate adaptation practices study provides a cursory list of lessons drawn from published literature, largely the work of non-governmental operations working in Bangladesh, the CCAP has already posted on its website and reviews for the reader of this synthesis report another, in- depth assessment of adaptation practices in Bangladesh's agriculture sector; this second study covers adaptation from at least five separate perspectives, namely planned adaptation, autonomous adaptation, specific adaptation programmes- some of which are governmental decrees, climate change related funds, as well as institutional mechanism. However, as noted in the above paragraph, Daanish Mustafa and Lauren Reid emphasize the successes of community lead interventions along with capacity building and reform of governmental systems designed to deliver awareness and the reform of coastal management policies. In our discussion in the present synthesis report we would therefore invite stakeholders to view CCAP's year one and two formation of community organizations and volunteer organizations in Keti Bunder and Kharo Chan as an opportunity to be used. That is, community leaders selected and trained by CCAP site office staff, whose remit extends to several villages at once are on standby to roll out funded activities that appear in union council level adaptation plans. Further, we would invite line officials selected by CCAP

for climate change capacity building trainings conducted by LEAD Pakistan to solicit input from village leaders at the two concerned union council levels; the exact mechanisms by which this exchange of information can occur are LEAD Pakistan's trainings and WWF-Pakistan district coordination committees that meet bi annually. Moreover, CCAP encourages its stakeholders to consider carefully means by which knowledge is collected, internalized and disseminated. For example the recording of agrometeorological best practices can take place through their incorporation into curriculum and training manuals to be disseminated at farmer field schools under WWF – Pakistan's oversight. One examples of this type of knowledge that merits recording is a tried and tested land preparation process designed to lower evaporation rates for water standing on agricultural plots. Other examples relate to profitable crop switching in the face of a shortened winter season and higher nighttime temperatures, should this be required.

In India, there are lessons relating to the importance of recognizing, then measuring, differential vulnerability across gender, class, and caste lines. While the latter does not characterize Pakistani society, the applicability is high considering the intricate and sophisticated societal structures present in Balochistan and Sindh. The idea of such analysis is to hasten delivery of meaningful interventions such as livelihood diversification, adaptive infrastructure, and participatory governance structures that cannot be arbitrarily tailored. In Sri Lanka, we find a highly efficient use of greenbelt plantations and bioremediation plots that double up as kitchen gardens in which women are the main managers and beneficiaries, thereby increasing resilience by building household income.

CCAP's associate in India, WWF – India, is well placed to share firsthand experiences of hastening the delivery of interventions such as adaptive infrastructure in view of societal realities. At the two day regional conference (October 16-17, 2012) convened by CCAP for its Bangladeshi and Indian associates, among others, WWF – India already gave an example of this. In particular our WWF colleague in the Sundarbans post village vulnerability listings in public locations and within their site office, enabling all villagers to consult where their own households resilience levels have been prioritized for intervention delivery as compared with households across all villages participating in WWF's conservation planning. While it is not clear from any objective social study whether this best addresses differential vulnerability of the type described by Mustafa and Reid among practitioners, this certainly inspires confidence in what is a practical and expedient tool accompanying the public prioritization of beneficiaries. As the event of October 16-17 also ended with a concrete commitment by a Sri Lankan participant to channel best adaptation practices to Dasht, Sundarbans and Indus deltas, CCAP is expected to follow up on Mustafa and Reid's mention of adaptation practices used in Sri Lanka.

In Thailand, above and beyond use of mangroves as natural barriers, communities invested heavily in the biodiversity of their local mangrove ecosystems. Harvesting regulations prohibiting grapsoid crab fishing and sale during the October period, but also resource mapping, patrols, and establishment of a crab bank further contributing to strengthening economic resilience in the face of climate variability. In Africa, we learn that relocation as a means of adapting is not uncommon, even if it is regarded as an action of last resort. Nevertheless, it is underlined here that migration should be voluntary and that institutions responsible for a diverse set of initiatives supporting this form of adaptation

must be above all willing, flexible, understanding and engaged. Thus, in Mozambique, resettlement away from floodplains was accompanied by state interventions focused on incentives. The state incentives involved particular focus and leverage of social networks and local livelihoods, strengthened by NGO agricultural initiatives. The latter helped to increase income-generating agricultural practices while reducing the risk of losing existing agricultural assets such as farm animals.

Unfortunately, while it is worthwhile informing CCAP stakeholders of successes in applying crab fattening in other countries, what practitioners like WWF – Pakistan urgently need is an increase in the transfer of highly applied knowledge. Not only is crab fattening not applicable in certain location of Kharo Chan and Keti Bunder, it has also been associated with negative environmental consequences. As with weeklong trainings carried out by Sri Lankan experts in Thatta under the Indus for all Programme (2006-2012), the CCAP would do well to transfer knowledge concerning low cost materials to use, the assembly procedures of the materials, the durations and types of feed to administer at required intervals, among other highly practical solutions. This is not a criticism of Mustafa and Reid's desk based literature review.

This study by Daanish Mustafa and Lauren Reid is valuable for another reason. It is responsible for adding to the international literature a tool that WWF – Pakistan expects to apply in its CCAP project up to 2015. The tool that the authors elaborate in their study is a set of operationalizable metrics for measuring adaptation as needed for guiding adaptation programming. In particular, the vulnerability resilience indicators put forward relate to *"diversity"* (e.g., livelihoods, access to eco-services), *"ecosystem services"* (e.g., access by poor, policy knowledge), *"equity"* (e.g., governance that enhances participation across scales, access and opportunity across genders), *"social capital"* (e.g., mobilization of local organization, preparedness and knowledge exchange), and *"infrastructure"* (e.g., communication infrastructure including for early warning purposes). The authors bemoan the absence of equity reporting in the literature they review, since this resilience indicator could not be applied to the findings they report in the present CCAP study. Finally, the authors review impartially WWF's experience across the world in the area of climate change adaptation, conservation and livelihoods diversification. This will not only be of interest to WWF - Pakistan but to all its CCAP partners and associates, and other stakeholders involved in adaptation work. WWF - Pakistan may take up the challenge of using Mustafa and Reid's operationalizable metrics and resilience indicators, perhaps in the course of monitoring the CCAP project's overall impact on its roughly twenty thousand beneficiaries, be they fishers or farmers inhabiting the creek and inland areas of the Indus Delta. These tools could subsequently or simultaneously be tested by CCA's associates in Bangladesh and India. As is common in on- the- ground conservation interventions, theoretical frameworks such as Mustafa and Reid's indicators are rarely applied in their original design but the field testing should acknowledge the authors for their contribution and should serve as a basis for assessing the utility and replicability potential of the concerned indicators.

Section VII

12. SYNTHESIS REPORT CONSULTATIVE WORKSHOP

WWF- Pakistan's *"Building Capacity on Climate Change Adaptation in the Coastal Areas of Pakistan"* (CCAP) project held a daylong consultative workshop, where comments and input were solicited from participants, for the Draft CCAP Synthesis Report.

The consultative workshop successfully brought together a wide range of stakeholders, including representatives from the Ministry of Climate Change, (UNDP) United Nations Development Programme, (NIO) National Institute of Oceanography, (SDPI) Sustainable Development and Policy Institute, CCAP field staff, among others. The workshop started with presentations, Q&A sessions, and interactive group exercises and ended with a musical evening.

Some of the presentations made looked at GIS hazard mapping, Political and Institutional Analysis, Community Based Vulnerability Assessment, and the Ministry of Climate Change's role in adaptation in the coastal areas of Pakistan, among others.

At the consultative workshop, Mr. Jawed Ali Khan Director General Environment, Ministry of Climate Change stated that the Ministry of Climate Change would support all efforts to assess the risks, and assist the vulnerable communities identified by CCAP. Participants from SUPARCO and SDPI agreed to work with WWF – Pakistan to upscale coordination efforts and collaborative research among stakeholders. UNDP informed WWF – Pakistan of different funding opportunities that exist to multiply ground interventions at CCAP target sites.

Two group exercises were conducted at the event, the first (Annex 1) required participants to fill out a matrix where significance of impacts of climate change were ranked and then corresponding adaptation practices were suggested to counteract impacts mentioned. The second exercise (pg # 40), also in tabular format, asked participants to rank a list of current adaptation practices underway in CCAP target sites, and the Indian Ocean Basin that they believe should be scaled-up. The group exercises were aimed at increasing the overall interactive nature of the workshop, and provided focused points of discussion that drew on the experiences and expertise of participants. Active efforts were made to encourage participation of all stakeholders, in particular the facilitator pre-prepared a series of key questions to be asked and conducted a voting exercise in which participants were called upon to rank the significance of a particular impact of climate change in the first group exercise. It was noted that 90% of all participants agreed that shorter winter seasons and higher night time temperatures would have a negative greater significant impact on crop yields and farm household incomes. The remaining responses recorded for this question were scattered among other ranking categories (effects are uncertain, positive and negative impacts likely to be experienced, and effects are uncertain).

The dialogue surrounding the voting exercise was dynamic, participants were enthusiastic to discuss responses and justify their answers; this provided the CCAP team with additional insight and a more nuanced understanding of climate realities felt at the community level. Sectors such as agriculture, fisheries, and forestry specifically, mangrove conservation generated substantial contributions.

However due to time constraints we were unable to complete the whole exercise at the event. Fortunately, participants were very receptive to follow – up mechanisms and agreed to fill out the table on a later date on

their own time. For the purpose of the participant's convenience and reaching a wider audience, including those individuals who were unable to make it to the event, the CCAP team converted the Impact-Significance- Activity Table into a Survey Monkey questionnaire. The survey was administered online and could be taken at any time or place. Some key respondents included Mr. Kashif Salik, SDPI; MS. Miriam Kugele, IUCN; and Mr. Gulnajam Jamy, UNDP; among others.

We received a 7% response rate, 50% of the respondents agreed that changing precipitation was likely to have both positive and negative impacts on vegetation and mangrove plantations. 66% of the participants agreed that changes in precipitation would have a greater negative impact on reduced frequency and volumes of freshwater released downstream Kotri Barrage. 50% of the respondents agreed that sea level changes will have a greater negative impact on mangroves.

Section VIII

Annexure 1
Impact- Significance- Activity Table

ECONOMIC

Study	Impact Type	Pg #
SEB	2	39,57
	3	25, 42, 60
	4	29, 47
CDM	1	15
CVA	4	20
	6	16
HM	7	37

I. Climate stimuli (causal push factor)	II. Expected impacts from "climate stimuli"	III. Factors affecting significance of "impacts"	IV. Significance scoring by stakeholders	V. Union council adaptation measures (proposed by stakeholders as adaptation plan activities)
ECONOMICS				
A) Change in temperature	• 1)Decrease in yields, especially for cereal crops, due to a shorter winter season and higher nighttime temperatures. Farm household incomes decline with decreased yield. • 2) Farming household's input cost of water rises owing to increased standing water evaporation due to rising temperatures • 3) Decline in fish catch per trip, from fish population drop induced by higher temperatures that disrupt metabolism reproduction, etc. Fisher household incomes fall along with catch per trip.	• a) Availability of info on agricultural extension- or WWF-P farmer field school-(FFS-) based crop-specific techniques to overcome seasons/ nighttime temp challenges. • b) Access to FFS curriculum and/or extension service broadcasts, etc, on water conservation techniques. • c) Access to CCAP-brokered specialized agency trainings, findings of reports by CCAP-commissioned agencies, and WWF marine programme better fishing practice guidelines.		
B) Changes in precipitation	• 4) Decrease in rain-fed farmer's yields as drought shocks disrupt crop growth, e.g., tillering / booting stages of wheat. household incomes fall while meeting costs of added irrigations, etc.	**d) Access to own tube well and power supply source**, thereby lowering costs and containing overall costs below govt. support prices (Note: tube well use can deplete groundwater).		
C) Rise in sea surface emperatures	• 5) Savings fall& debts rise to meet livelihood and residential infrastructural repair costs(of both fishers and farmers) from cyclones caused by rising sea water temperatures	**e) Absence of early warning systems**, DRR programmes that fail to target most vulnerable communities, no government funds for climate proofing livelihood and living infrastructure, etc.		
D) Sea-level rise	• 6) Crop yield of farmers falls as plot salinity rises • 7) Increased expenditures to renovate the destruction caused by wetland and coastal plain flooding	**f) Availability of salinization scenario analysis** and subsequent incentive (and command and control) policies to supply alternative livelihoods, to assist with resettlement, etc.		

SOCIAL

Study	Impact Type	Pg #
SEB	4	24 41 59
CDM	3	22
	4	23
CVA	2	20

I. Climate stimuli (causal push factor)	II. Expected impacts from "climate stimuli"	III. Factors affecting significance of "impacts"	IV. Significance scoring by stakeholders	V. Union council adaptation measures (proposed by stakeholders as adaptation plan activities)
SOCIAL				
A) Change in temperature	**1) Divorces, reduced calorific intake of older household members left behind, neglected parenting, etc. are associated with migrations** caused by inability to overcome yield and income shortfalls from climate change.	• a) Exogenous shocks such as inflation can further erode savings of households and accelerate migration. • b) Absence of government policies providing social safety nets, alternate livelihoods, and assistance with resettlement.		
B) Changes in precipitation	**2) Tribal conflicts can** increase with droughts and floods, with land disputed by returning families, or, in the case of droughts, water theft commonly results in lodging of police reports.	c) **Pre-existing, historic tensions among communities and tribes** can exacerbate drought or flood induced conflict.		
C) Rise in sea surface temperature	3) Cyclones are associated with sea surface temperature rise, and can cause mass displacement, or deaths (there's a statistically recorded higher incidence in deaths of women in coastal cyclones, whose absence is more devastating than that of a male head of household in terms of family wellbeing).	• **d) Family size itself will aggravate the impact** of the loss of one or the other or both parents. • e**) Absence of climate neutralizing female education, early warning, storm shelters and other disaster risk reduction activities** can aggravate impacts.		
D) Sea-level rise	4) Sea level rise can exacerbate flood impacts and contribute to the **spread of water borne diseases** e.g. Malaria, Cholera, Jaundice and Typhoid.	• **f) Absence of sufficient health facilities in conveniently nearby localities** will prolong and spread exposure to the concerned diseases. • **g) Impacts can be magnified if multiple villages are dependent** on single village's breeding pond, fresh water well, landing/drying areas which has submerged		

POLITICAL

Study	Impact Type	Pg #
SEB	1	8
	2	8
	3	23
	4	12
	4	35

I. Climate stimuli (causal push factor)	II. Expected impacts from "climate stimuli"	III. Factors affecting significance of "impacts"	IV. Significance scoring by stakeholders	V. Union council adaptation measures (proposed by stakeholders as adaptation plan
POLITICAL				
A) Change in temperature	• 1) New institutions are sometimes needed to supply justifications for: **I)Changed water regimes II)Reallocation of water between domestic and commercial uses III)Increased spending on fisher, farmer, or others' training to manage changed temperatures.** • 2) The personnel in existing and new institutions require capacity building to oversee and **commission scientific and policy studies and interpret them for critical decisions on climate change impacts.**	• a)**Year-on-year increases in PSDP/ADP allocations tend to rise with increase in GDP,** without which new institutions cannot be funded or receive personnel training. • b) **Rapid reassignment of personnel due to high turnover of politicians** at the provincial and federal levels can result in the loss of institutional capacity and follow-up of existing interventions.		
B) Changes in precipitation	• 3) Just as droughts from temperature changes impact water regimes, requiring institutions and elected leaders to reform governance, **sudden high precipitation, related runoff, flooding of low lying areas, and ground water and surface storage of water all require political action.**	• **c) The responsiveness of leadership to lobbying and sensitization efforts of organizations** like the Friends of the Indus Forum (FIF) will determine the commitment to bringing about long term reforms and spending which is already split across competing sectors.		
C) Changes in sea surface temperature	• 4) Here, highly specialized capacities and departments in old and new **institutions are needed to address complex topics ranging from food web imbalances; spawning, breeding and feeding requirements of species; to commercial and economic and social impacts on coastal farmers and fishers.**	• **d) Climate change adaptation itself – e.g., introduction of new species at fisheries and in aquaculture – either by coastal communities or government** can further disrupt biotic systems.		
D) Sea-level rise	• **5) Decision making is needed on a long term basis**, informed by scenario analysis, to plan coastal land use (e.g. farm land placement).	• **e)Quite apart from studies and the periodic collection of data, decisions will be helped by the presence of union council level adaptation plans.**		

ECOLOGICAL

Study	Impact Type	Pg #
SEB	6	28, 45
CDM	7	23
CVA	1& 8	16
	3	19
	4	20
HM	2, 7	13

I. Climate stimuli (causal push factor)	II. Expected impacts from "climate stimuli"	III. Factors affecting significance of "impacts"	IV. Significance scoring by stakeholders	V. Union council adaptation measures (proposed by stakeholders as adaptation plan
ECOLOGICAL				
A) Change in temperature	• 1) Changes in temperature affect the **survival rate of plant and animal species in terrestrial and aquatic ecosystems.** • 2) Sediment quality and quantity required for mangroves and other **coastal ecosystems service providers is directly affected by water regimes.**	• **a) Fish recruitment can already be in a downward trend** if maximum sustainable yield (MSY) is not monitored and poor fishing practices are adopted, thereby exacerbating the effect on fish stocks of reduced dissolved oxygen. • **b) Sediment loads affect the geographic composition of estuaries** that may already be suffering declines in estuary plankton.		
B) Changes in precipitation	• 3) **Loss of vegetation** due to droughts. • 4) **Changes in precipitation can retard** growth, productivity and seedling survival rate of mangroves.	• c) **High diversion of reduced frequency and volume** of releases downstream from Kotri (Hyderabad) at the level of Sajanwali village (Kharo Chan)		
C) Rise in sea surface temperature	• 5) Increased temperature changes estuary and sea phytoplankton composition • 6) Can influence quantity of commercially important export species e.g. Jelly fish	• d) Disruption in predator and prey relations among phytoplankton can be **exacerbated by the spread of diseases and parasites which also increase with sea surface temperature**		
D) Sea-level rise	• 7) Sea intrusion and salinity affect **mangroves** on the coastal belt • 8) Already threatened animal and plant species may become **extinct** because of submerged creeks	• e) **Camels graze on dense and sparse mangroves in coastal areas** and are an existing pressure that can be aggravated by salinity		

Legend

Study	
SEB	Socioeconomic Baseline
CDM	Climate Data Modelling& Analysis of the Indus Ecoregion
CVA	Community Based Vulnerability Assessment
HM	GIS Based Hazard Mapping
BLR	Bangladesh Literature Review
BAP	Best Adaptation Practices
IM	Interactive Maps
Salinity	Salinity Study of Keti Bunder & Kharo Chan
PIA	Political & Institutional Analysis

Symbols

Symbol	Interpretation
△	positive lesser significant impact
▽	negative lesser significant impact
▲	positive greater significant impact
▼	negative greater significant impact
△ ▽	positive and negative impacts likely to be experienced according to context (may be lesser or greater as above)
?	effects are uncertain

Note: symbols in this table are borrowed from "University of Manchestert. 2003. "Sustainability Impact Assessment of Proposed WTO Negotiations"

The tables above describe climate change push factors in rows (e.g., sea level rise and changes in temperature and precipitation). For each of these rows, column headers invite descriptions of corresponding impacts, factors affecting the significance of these impacts, as well as stakeholders' perceptions of the relative magnitude of significance, and their recommended activities addressing the impacts. (These activities will be incorporated in union council level adaptation plans, and filling of empty rows by stakeholders will signal ownership or, at the least, familiarity and commitment to interact with CCAP). Each table has a smaller table attached to it. This table lists studies and their subject specific content is referenced by page numbers corresponding to numbered impacts. It is intended to help stakeholders to download the studies from CCAP's website and easily consult content. Finally, the tables repeat with changes for "economic", "ecological", "social", and "political" themes.

Annexure 2
Feasibility and Replicability Findings Table

Proposed Intervention	Unit Cost (as provided by CCAP PMU)	Implied Number of Units	Recommended Village	Why/Justification/ Remarks
Raised Emergency Support Platforms	1,600,000	As per available resource	1. Kharo Chan 2. KetiBunder 3. Abdullah Mallah or Abdullah Khatti or Ismail Khaskheli (KB) 4. Beer Jat or Gurb (KC)	Due to central locations
Early Warning Systems	300,000	-do-	1. Berrim (KB) 2. M YousifDablo (KB) 3. MisriRajero (KB) 4. Abdullah Mallah or Abdullah Khatti or Ismail Khaskheli(KB) 5. Haji Ibrahim Jat (KC) 6. Haji Ahmad Jat (KC) 7. Beer Jat or Gurb (KC)	Remotest & isolated villages where there may be no mobile phones network. Central location Remotest & isolated villages where there may be no mobile phones network. Central location
Cold Storage Tanks	145,000	-do-	As per indicated criteria	
Drinking Water Ponds& Sand Filter	255,000	-do-	As per indicated criteria	Creek Villages
Installation of Solar Energy Units	1,250,000	-do-	As per indicated criteria	
Installation of Hybrid Energy Units	950,000	-do-	As per indicated criteria	
Mangroves Plantation	1,374,250	-do-	As per indicated criteria	
Aquaculture/ Hatcheries	1,220,840	-do-	As per indicated criteria	
Small Enterprises	465,000	-do-	KetiBunder KharoChann	
Saline Agriculture	315,000	-do-	inland villages	Agriculture land is available with inland villages

Annexure 3

GIS Hazard Maps

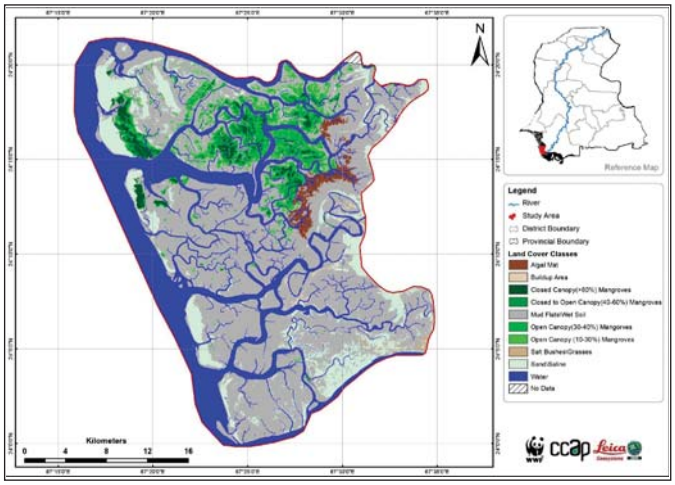


Figure 1: Land cover map of Keti Bunder developed for 2001

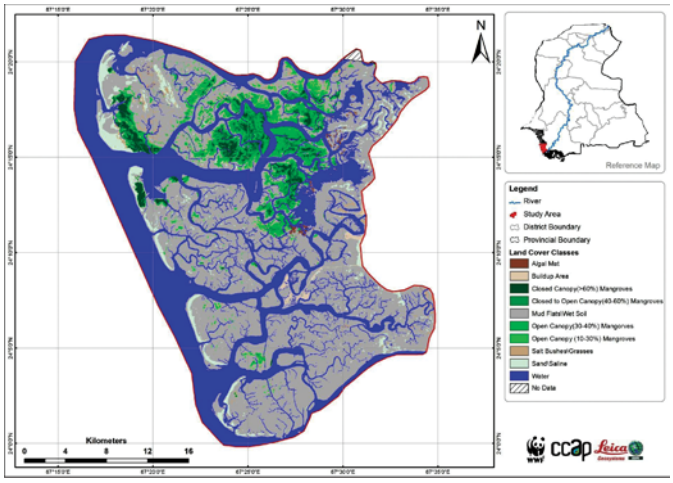


Figure 2: Land cover map of Keti developed in 2011

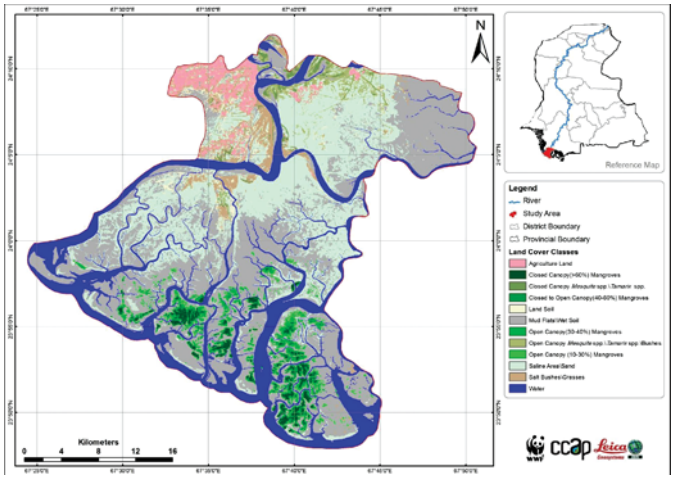


Figure 3: Land cover map of Kharo Chan developed for 2001

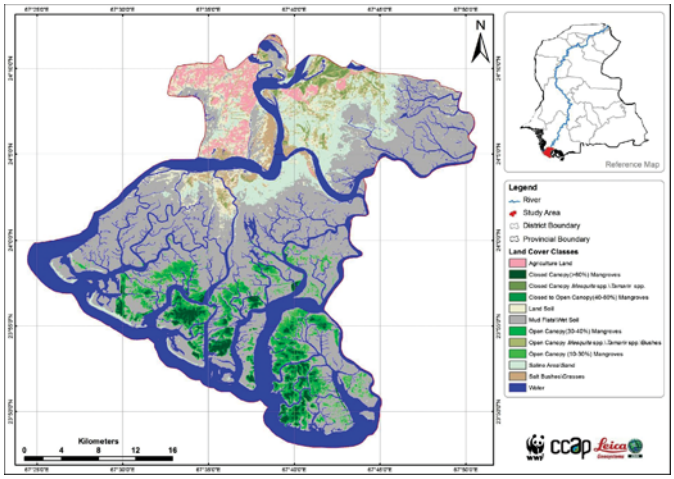


Figure 4: Land cover map of Kharo Chan developed for 2011

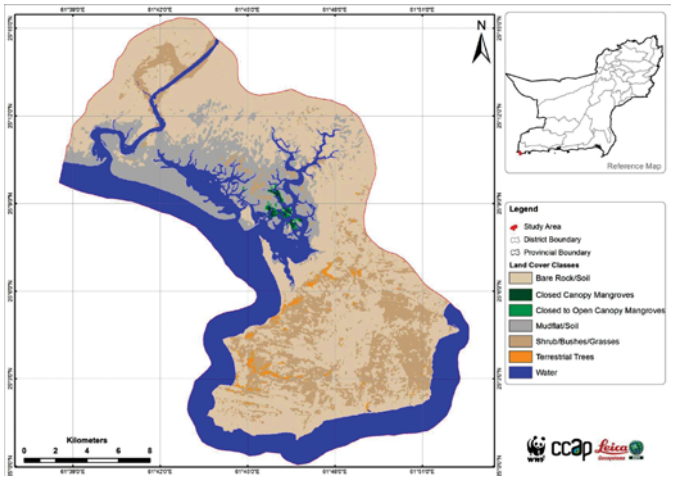


Figure 5: LCLU map of Jiwani developed for year 2000

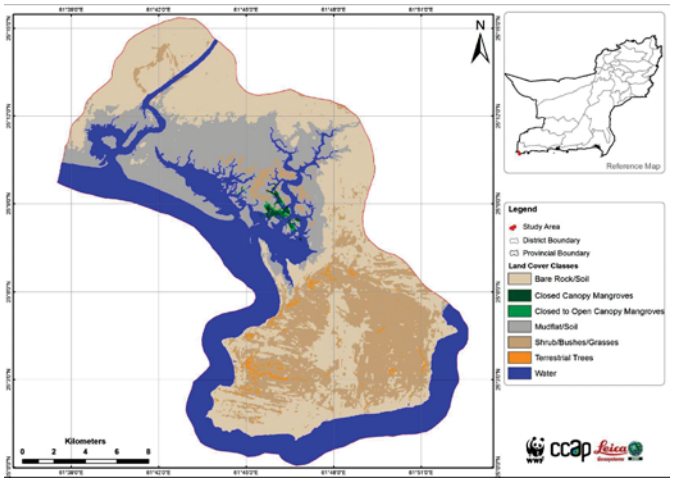


Figure 6: LCLU map of Jiwani developed for year 2011

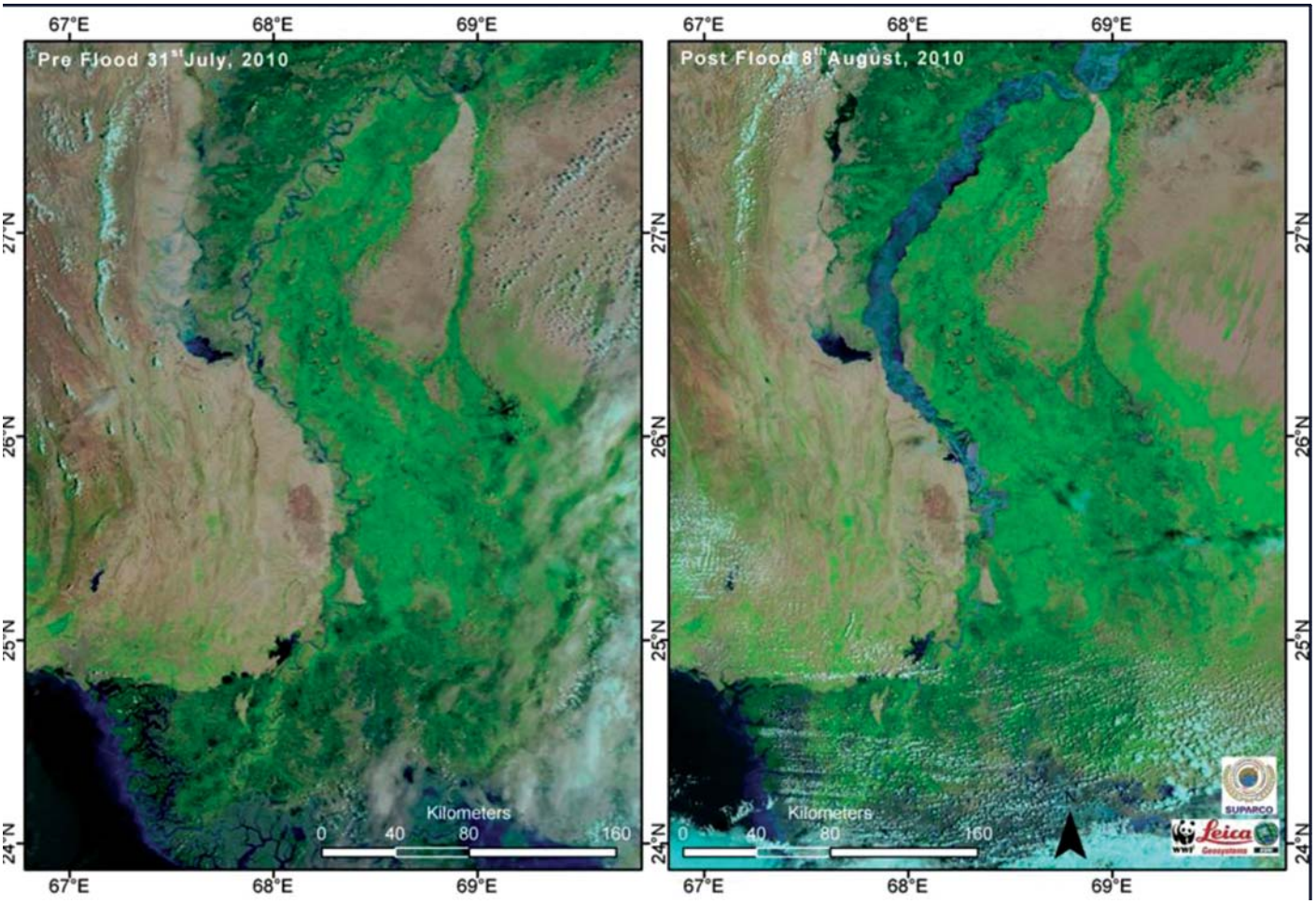


Figure 7: MODIS images- flood Extent along the Indus River, Sindh

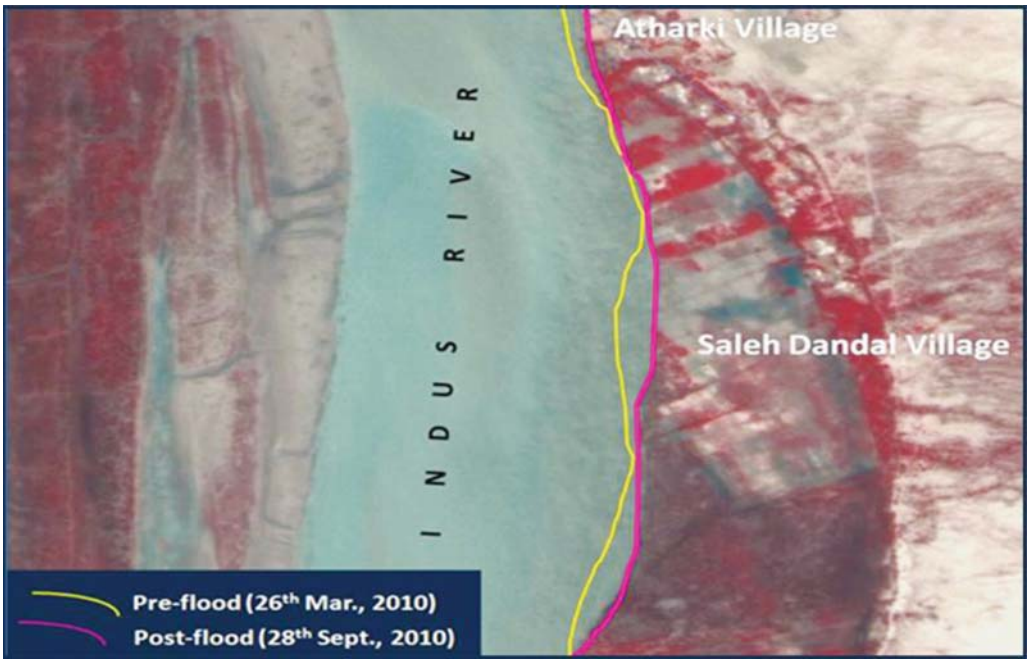


Figure 8: Erosion due to flood 2010 along Indus River, In Atharki Village.

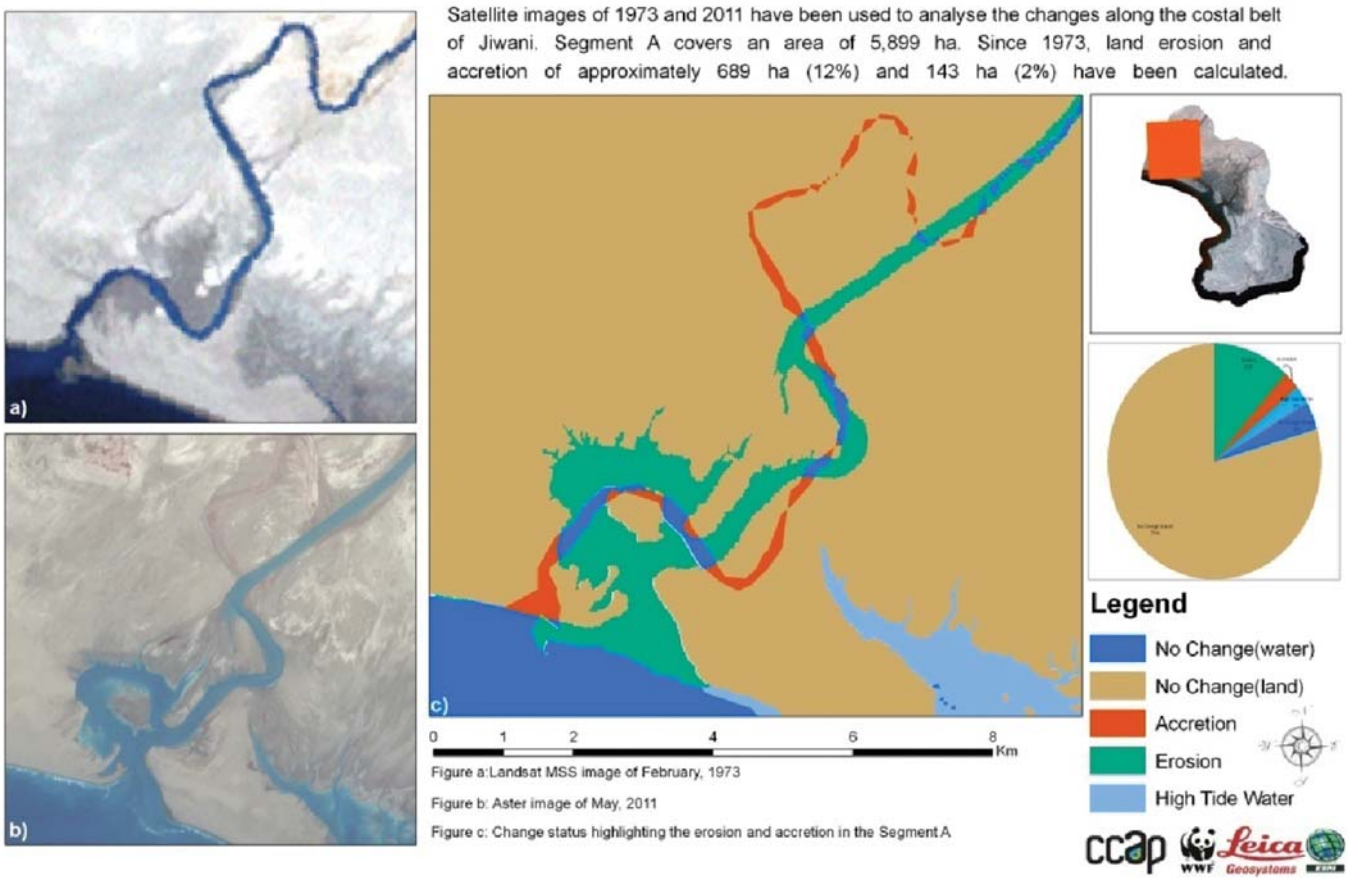


Figure 9: A remarkable erosion and accretion, observed along the coastline of Jiwani – Balochistan which basically appears due to the change in overall drainage pattern

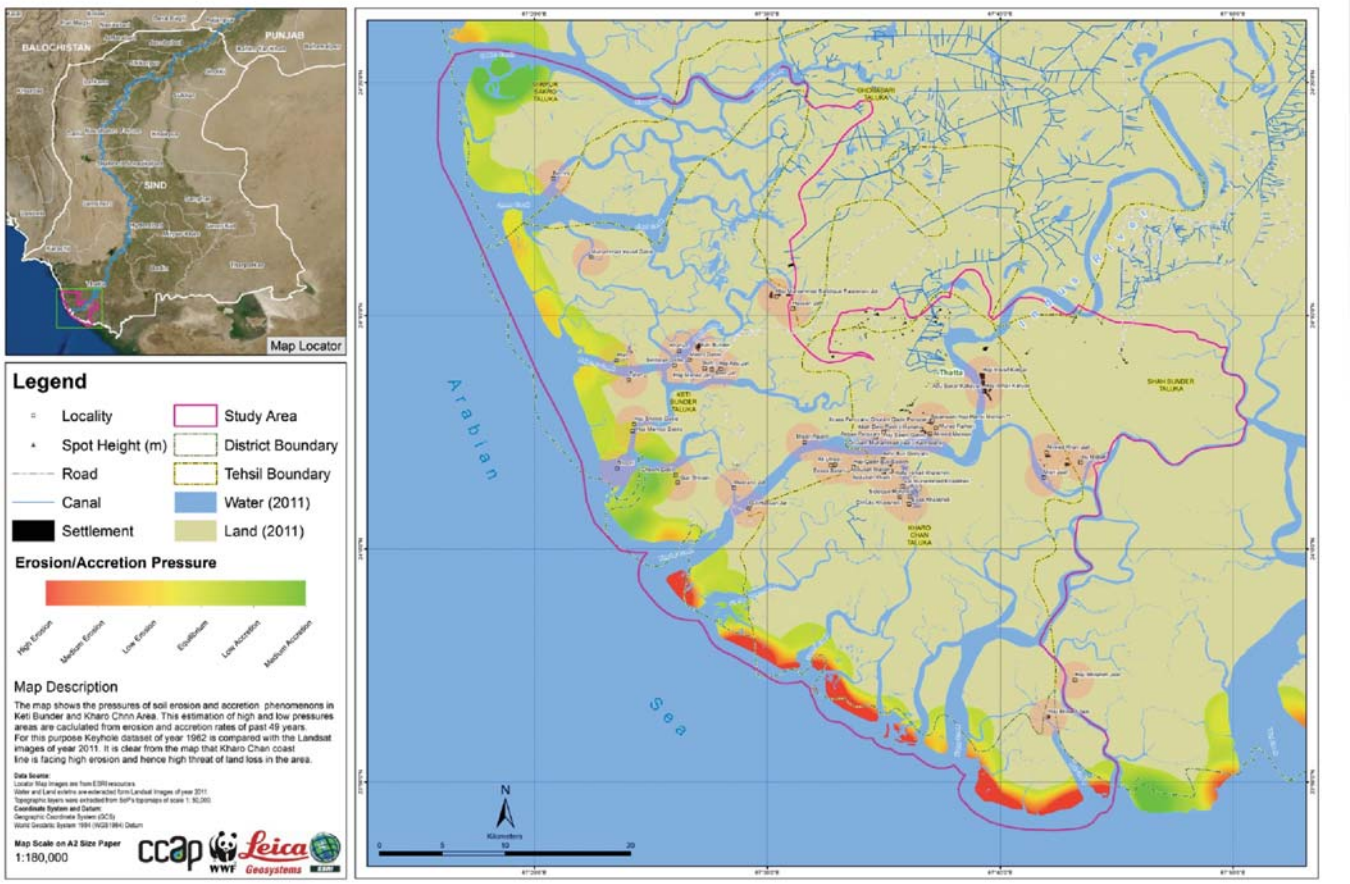


Figure 10: Density map- erosion & accretion pressure

Figure 11. Ground picture taken through Fixed Point Photography of mangroves plantation site in Keti Bunder – left (May 2010) and right (May 2012)

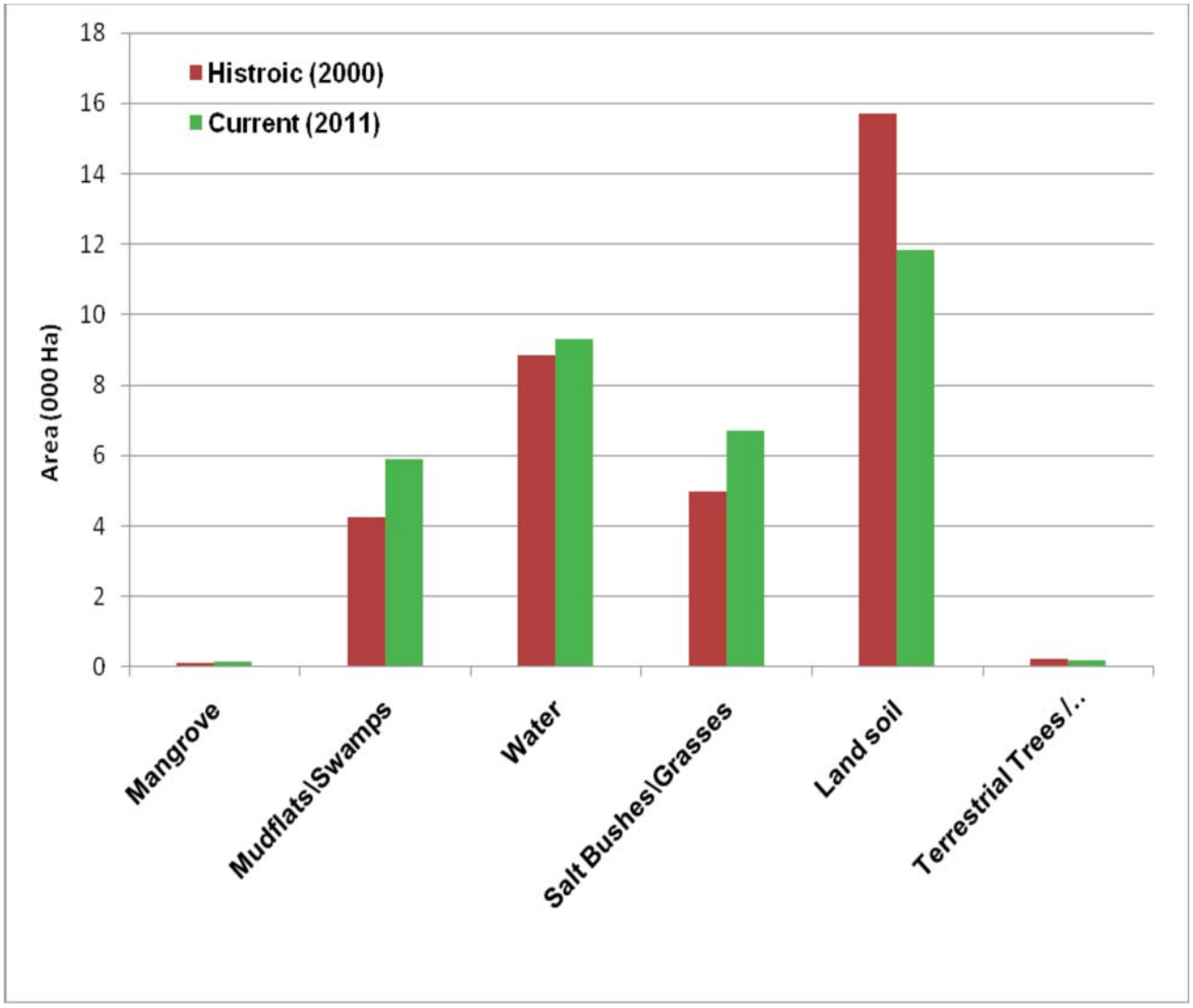


Figure 12: Graphical representation of historic and current statistics – Jiwani

Annexure 4

Climate Data Models

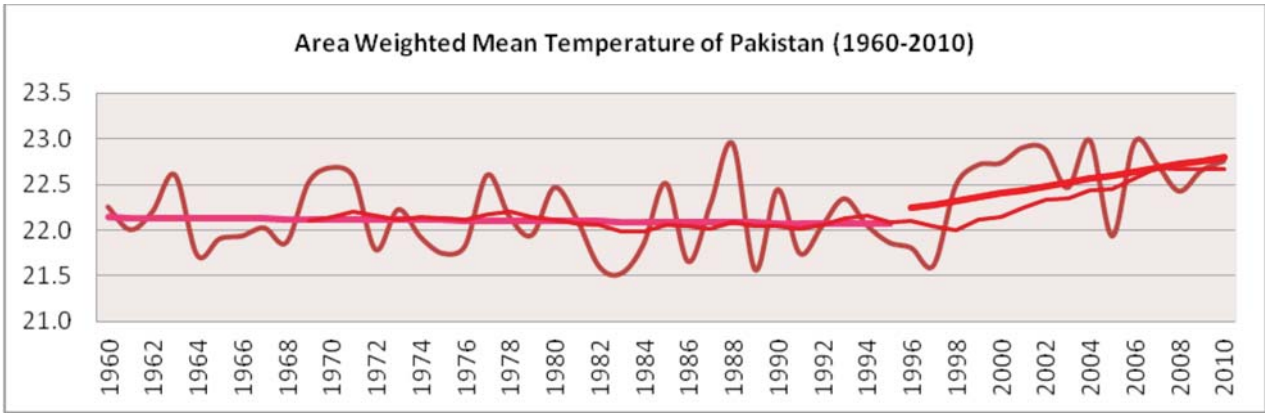


Figure 13: Time series of area weighted mean daily temperatures averaged over each year shows a sharp rise in temperature during the first decade of 21st century except the year 2005.

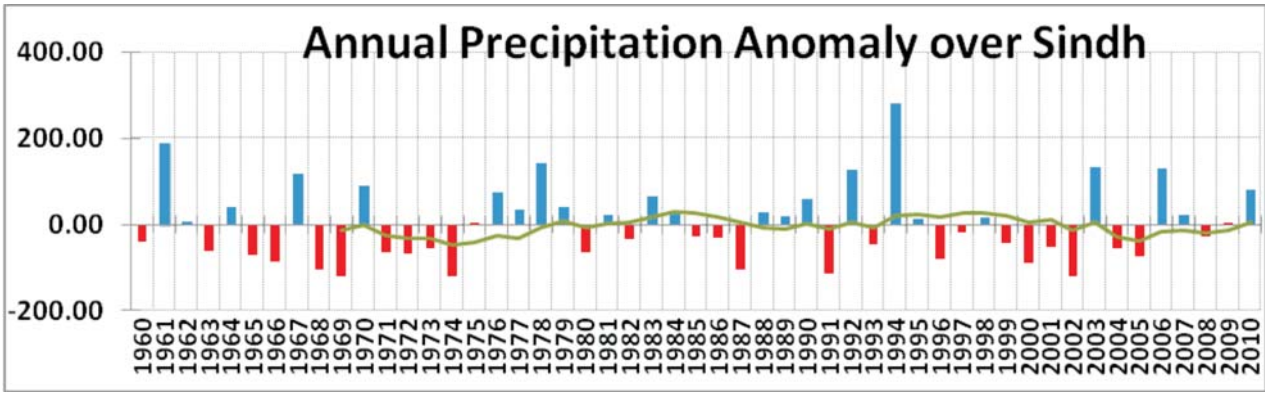


Figure 14: Inter-annual variability of precipitation (mm) over Sindh about the long term average showing predominant drought as well as some flood years.

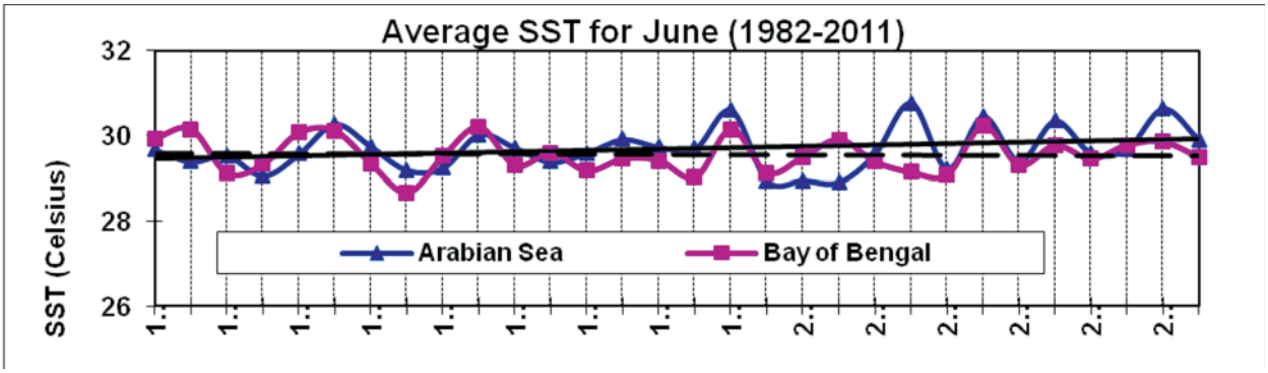


Figure 15: Inter-annual variation of sea surface temperature over the North Arabian Sea and the Bay of Bengal in June from 1982 to 2011.

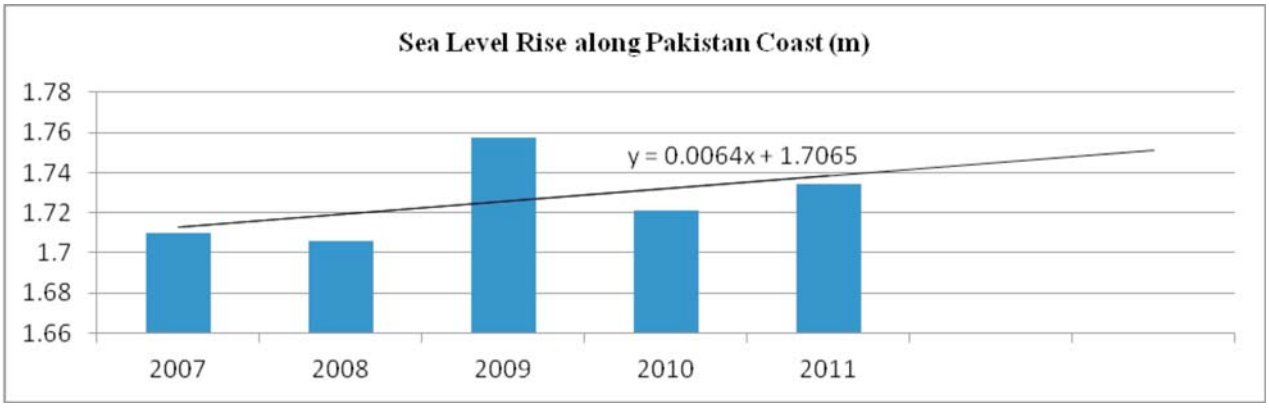
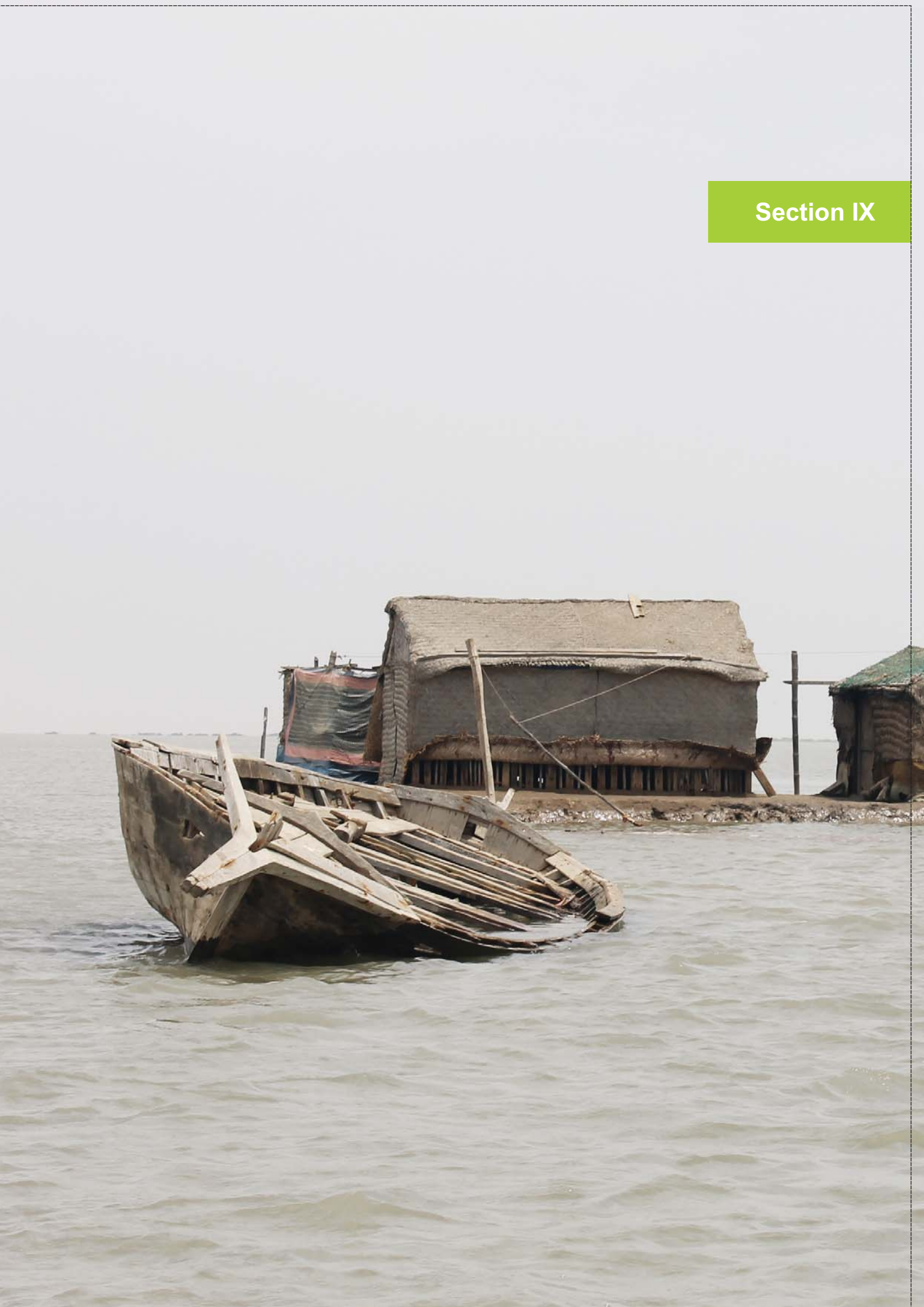


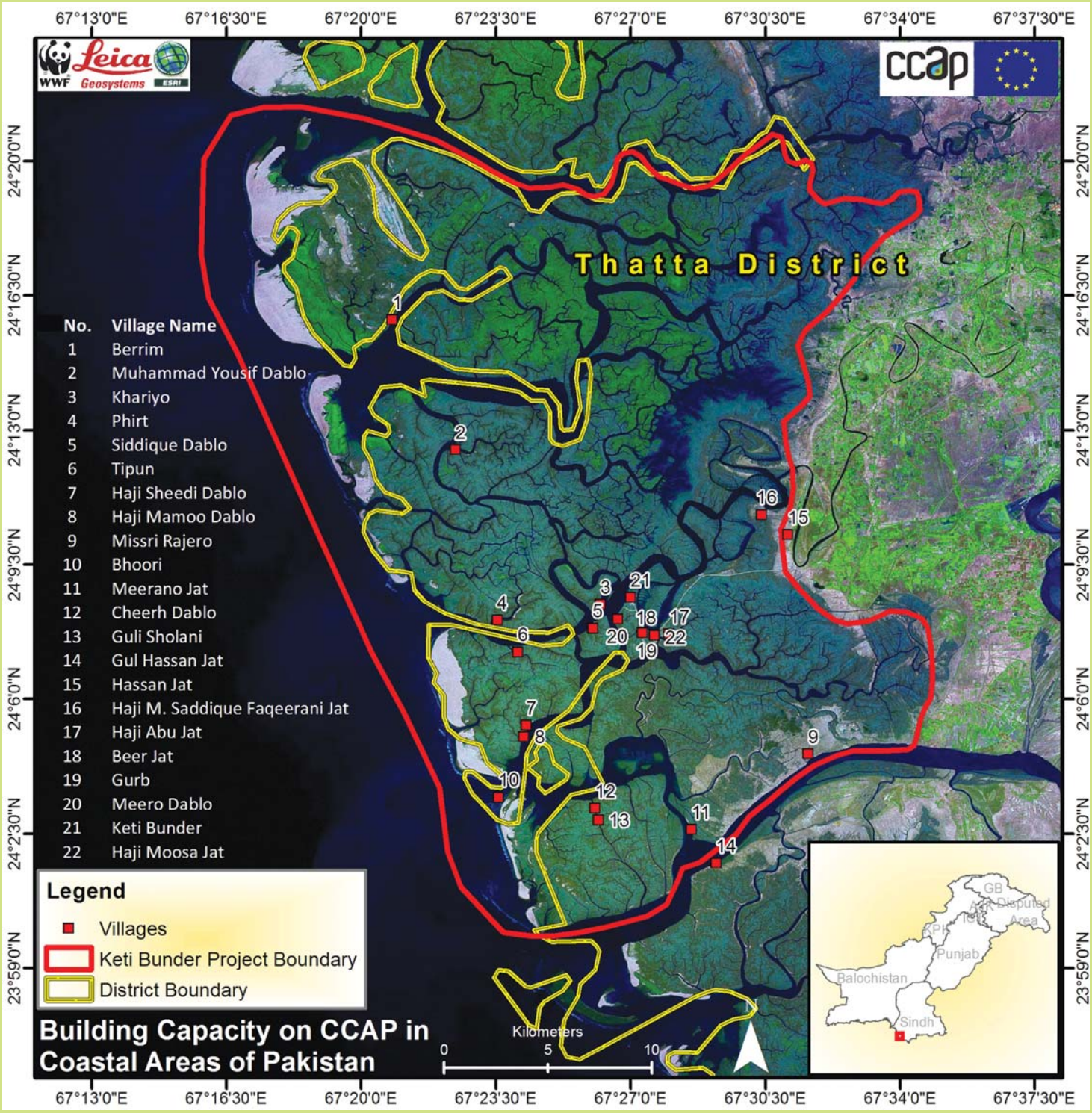
Figure 16: Tide gauge data showing annual average sea level at Gawader along Pakistan coast from 2007 to 2011. (Data Source: National Institute of Oceanography, Karachi).

Section IX



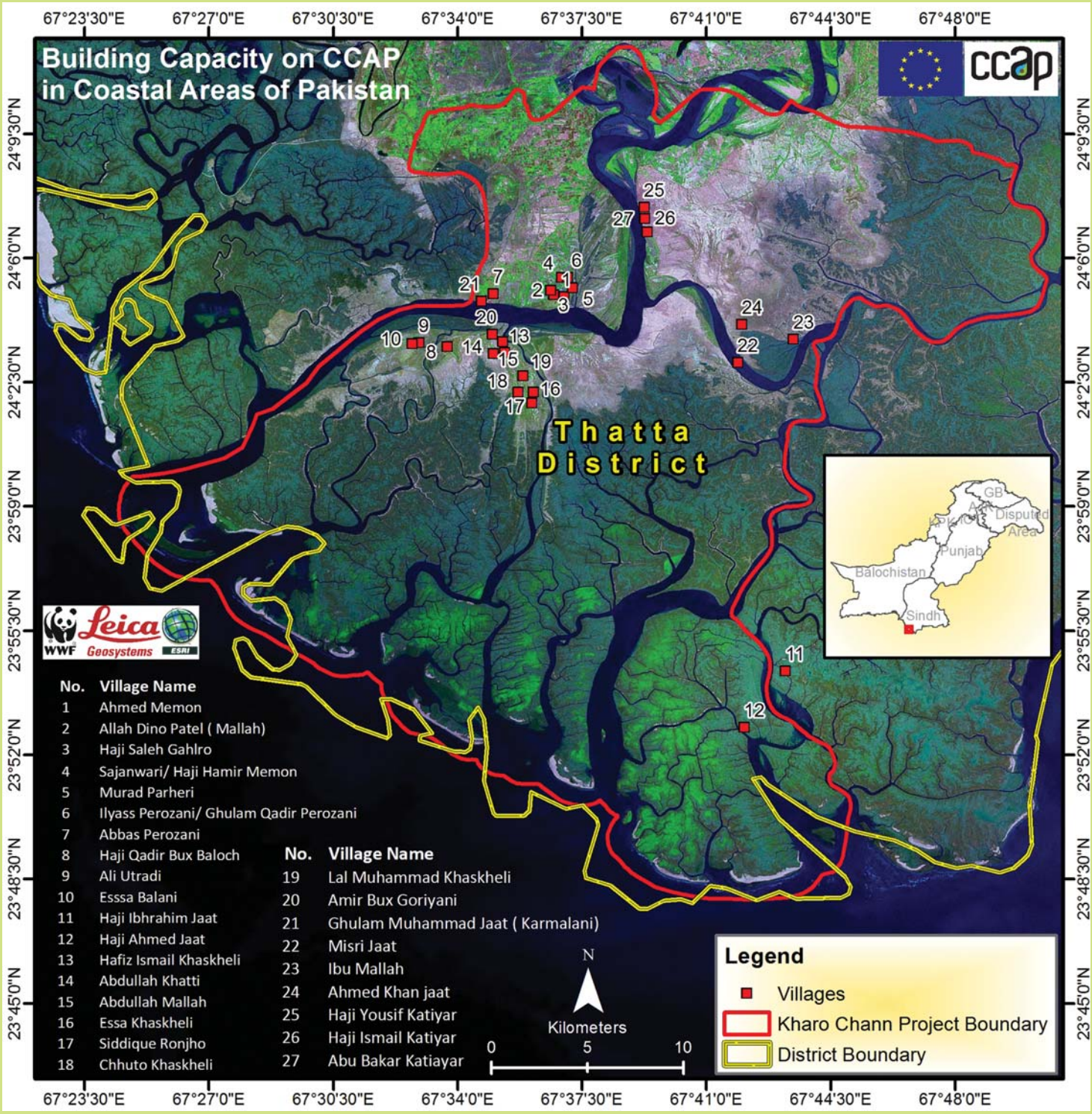
Project site

Keti Bunder



Project site

Kharo Chan



WWF - Pakistan came into being in 1970, and has been working to conserve Pakistan natural resources ever since.

Pakistan is a semi arid country with rapidly decreasing natural resources we are active in the country with projects designed to conserve them.

Our Next challenge
Climate change.

WWF

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

www.wwfpak.org info@wwf.org.ok

lead