Building Capacity on Climate Change Adaptation
in Coastal Areas of Pakistan

Negotiating Known Unknowns:

'Better' Climate Adaptation Practices from the Indian Ocean Basin

WWF for a living planet®

ccap

Authors
Daanish Mustafa and Lauren E. Reid.

Published in May 2012 under project 'Building Capacity on Climate Change adaptation in Coastal Areas of Pakistan,' WWF - Pakistan.

This publication has been produced with the assistance of the European Union. The contents of this publication are the sole responsibility of the World Wide Fund for Nature – Pakistan and can in no way be taken to reflect the views of the European Union.

Cover Picture
Jetty at Keti Bunder, Thatta District, Sindh Province © WWF - Pakistan/ Ghulam Rasool

606 - 607, Fortune Centre, Block 6, P.E.C.H.S., Shahra-e-Faisal, Karachi
Tel: 021 34544791-92, Fax: 021 34544790, www.wwfpak.org/ccap

Recommended citation
Mustafa, D. and L. E. Reid. 2012. *Negotiating Known Unknowns: "Better" Climate Adaptation Practices from the Indian Ocean Basin.* World Wide Fund for Nature – Pakistan

The designation of geographical entities in this publication, and the presentation of the material, do not imply the expression of any opinion whatsoever on the part of WWF concerning the legal status of any country, territory, or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The authors are solely responsible for the accuracy of the content of this report. The views expressed in this publication are those of its authors and do not necessarily represent those of WWF (or partner organizations for whom the report was produced, or whom were involved in the production of this report); or the individuals who contributed to the production of the report.

WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

Table of Contents

FOREWORD BY WWF – PAKISTAN....4

1. INTRODUCTION....6

2. DEFINING METRICS FOR RESILIENCE AND VULNERABILITY....7

3. OUTLINE OF WWF'S APPROACH TO CLIMATE ADAPTATION....12

3.1. WWF'S APPROACH TO ADAPTATION.... **13**

3.2. WWF'S METHODOLOGY OF EVALUATING CLIMATE CHANGE IMPACTS.... **14**

3.3. EXPOSURE, SENSITIVITY AND ADAPTIVE CAPACITY.... **15**

3.4 CONCLUSION.... **18**

4. BEST PRACTICES IN COASTAL ADAPTATION IN THE INDIAN OCEAN BASIN....19

4.1 BANGLADESH.... **19**

BOX 1: OBJECTIVES OF CBACC-CA....22

4.2 INDIA.... **23**

BOX 2: LIVELIHOOD DIVERSIFICATION IN COASTAL GUJARAT....25

4.3 SRI LANKA.... **27**

BOX 3: BIO-REMEDIATION....28

4.4 THAILAND.... **29**

BOX 4: ORGANIZATIONAL AND SCALING UP ACTIVITIES IN PRED NAI....30

4.5 AFRICA.... **31**

5. KEY ADAPTATION LESSONS FROM THE CASE STUDIES....34

6. CONCLUSION....37

REFERENCES....39

FOREWORD BY WWF – PAKISTAN

The World Wide Fund for Nature Pakistan (WWF – P) has from 2010 onwards taken on scientific research into the climate change adaptation response of Pakistan's coastal communities and on the determinants and impacts of climate change adaptation in agriculture intense sectors of Pakistan's economy. Concrete results expected from these 3-5 year long initiatives concluding in 2015 include recommendations to planners and policy makers on food security, in the latter case, and, in the former case, the implementation of union-council level adaptation plans for coastal communities residing in Thatta, Karachi, and Gwadar districts. The approval by the Federal Cabinet of a climate change policy in April 2012 can only support such initiatives, by no means standalone initiatives, through provision of institutional engagement and the kind of momentum needed for Pakistan to better define its interests and priorities in the face of climactic variability and change.

The Building Capacity on Climate Change Adaptation in Coastal Areas of Pakistan (CCAP) project (2011-2015) is made possible through the generous support of the European Commission. This paper represents the efforts and joint works by partners LEAD Pakistan and WWF UK and associates in Bangladesh, Iran and India. It forms part of a series of papers destined to empower stakeholders with factual, up to date, and non-partisan information required to elaborate, notify, and begin implementing union-council level adaptation plans in coastal districts from 2013 onwards. Other papers in this series that are to be published in 2012 include: 1) an Indus River environmental flows study; 2) a graphic information system based hazard map of coastal areas including the Indus delta; 3) a climate data modeling study forecasting trends in sea level rise, precipitation, and temperature specifically in coastal areas; 3) a political and institutional analysis to assist practitioners to mainstream adaptation measures at the provincial and federal levels; 4) a community based vulnerability assessment to help define the adaptation priorities of villagers at Keti Bunder, Kharo Chan, and Jiwani and suitable interventions in this regard; 5) a socioeconomic baseline against which to measure progress and impacts achieved by the CCAP project; and, 6) a series of other ballasting studies and tools, such as a study to assess the extent of salinization of productive agricultural lands and its expected adaptation impacts, and, a decision support system to supply historic sub-district level time-series data on rainfall and temperature.

CCAP is proud to release the present study and the project staff anticipates that it will greatly assist those involved in the design and implementation of adaptation plans. The goal of the present study is to distill from reliable literature lessons that Bangladesh, India, Sri Lanka, Thailand and Mozambique have to offer in the area of coastal climate adaptive practices. As you will appreciate, the paper extends the boundaries of climate change adaptation work to date. The authors do this by contributing to the field as a whole an essential tool for those, like WWF, concerned with recognizing and promoting best adaptation practices. In this instance, the tool is a set of operationalizable metrics for measuring adaptation as needed for guiding adaptation programming. The vulnerability resilience indicators put forward by the authors are a very useful tool for practitioners, as are the detailed descriptions and evaluations of adaptation practices undertaken by different organizations whose work is reviewed. Of great interest to WWF is the evaluation of its own performance by the authors in the field of effectiveness of conservation and livelihoods diversification within climate change adaptation.

Rab Nawaz
Director - Sindh
WWF Pakistan
Karachi

1. Introduction

Effective adaptation to climate change is ultimately about building resilience of socio-ecological systems and reducing vulnerability to adverse outcomes for the same. Accordingly then, the twin lenses of resilience and vulnerability are used to organize and interpret the best practices of coastal zone adaptation throughout the Indian Ocean basin in the following paper.

Climate adaptation is inherently a human endeavor and consequently its best practices have to be human centered instead of biophysical centered. Biophysical systems' natural adaptation to humanly induced climate change can be measured, but a normative judgment on the desirability of that adaptation is only meaningful insofar as it impacts the social systems that depend upon the ecosystem services, as well as the protections that the biophysical systems afford against hazards. The paper is accordingly more concerned with human systems' adjustment than non-human organisms' response to change.

The analysis presented in this paper is the outcome of reviewing extensive published refereed and other major organizational non-refereed literature on coastal adaptation in the Indian Ocean basin. The focus is on poorer countries on mainland Asia and Africa. Richer countries, such as Australia and Island nations have been excluded altogether since different sets of institutional and biophysical parameters impact upon their adaptation than the sample under review.

The concern in this paper is with the effectiveness of Disaster Risk Reduction (DRR) and to a lesser extent of sustainability and diversification of livelihoods in the coastal zones as indicators of effective adaptation. Yet even for effective DRR or livelihoods to be analyzed through the twin lenses of vulnerability and resilience, appropriate parameters have to be defined. We shall be defining those parameters in this paper in the section entitled "Defining Metrics for Resilience and Vulnerability".

Whilst the concept of resilience has its genesis in the systems sciences, the concept of vulnerability sprawls across multiple intellectual terrains--from biophysical to political economic.

A more hybrid approach of 'vulnerability of a place', developed by Susan Cutter (1996), has been used to understand the combined effect of biophysical and political economic conditions of vulnerability. From both the vulnerability and resilience perspectives, specific metrics developed by Mustafa *et al.* (2010) for vulnerability and Pelling and Mustafa (2010) for resilience have been synthesized and used to measure the impacts of the best practices documented in the literature. The documentation of best practices is with an eye towards teasing out the dynamic interplay of various factors in determining the success or failure of adaptive practices.

The first section of this review outlines and justifies the vulnerability and resilience based parameters for interpreting best practices. The following section provides a brief critical evaluation of World Wildlife Fund's (WWF) approach to Climate Adaptation. The main section of the report distills the best practices reported in the literature with regard to DRR and sustainable livelihoods from Bangladesh, India, Sri Lanka, Thailand and Mozambique. The final section of the paper outlines broad principles for climate adaptive practices at the interface of ecological and social systems in coastal zones.

2. Defining Metrics for Resilience and Vulnerability

Vulnerability and resilience have differing interpretations in different contexts. Instead of providing an extensive literature review of the various definitions of the terms, we simply propose the most widely accepted and in our view, the most comprehensive definitions of the two terms in the context of climate change.

"Vulnerability" for our purposes is defined as, susceptibility to suffer damage from environmental extremes and the relative inability to recover from those extremes (Mustafa 1998). The susceptibility to suffer damage is a function of an individual or communities' location and proximity to sources of danger, as well as the social positionality, class, gender and political economy of the society within which the individual or the community is based (Cutter *et al.* 2000).

Following Moench (2005), we define “resilience” as the capacity of a socio-ecological system (which may yet be undergoing fundamental transformation) to absorb sudden shocks, environmental and/or socio-economic stress without causing major declines in production, distribution of resources or access to resources and/or losses of key environmental values. In other words if in a socio-ecological system, environmental or social stress causes increases in poverty and long term environmental degradation then the system will not be considered resilient. Furthermore, the above definition accepts shocks and changes within the system as part of its existing dynamic— also accepting the notion of fundamental transformations as part of system dynamics, in our case coastal socio-ecological systems.

“Adaptation” for our purposes is “an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2007). Vulnerability and resilience research, despite their different intellectual antecedents, have converged under the climate change adaptation agenda (Adger 2006). While the earlier vulnerability research had two dichotomous approaches to vulnerability: as an outcome of an environmental extreme; and as a preexisting context within which environmental extremes are experienced, the present report takes an integrative approach of vulnerability of socio-ecological system in a place (Adger 2006). By virtue of this approach we hope to be attentive to both the physical stressors and drivers of vulnerability, e.g., hurricanes, salt-water intrusion, sea level rise and the social contexts within which those stressors are experienced, such as overfishing, upstream water diversions causing fresh water shortages in deltas, migration and globalization.

The climate change community has increasingly taken on resilience as a key concept for adaptation, a number of substantive convergences have emerged within the evolving vulnerability field. In both resilience and vulnerability thought, “hazards” are no longer aberrations to normal life, but are rather part of the continuum of human environment relations, something that the society will have to accept as ‘normal’ and adjust to, especially in a climate change future. Resilience thinking may have been more technological centered and directed towards understanding system attributes, but when coupled with vulnerability, the new hybrid approach is just as attentive to issues of social power and power knowledge that determine

who is more or less likely to be able to adapt, and where. These new convergences notwithstanding, both fields have had a local scale orientation holding local histories and contexts as the ultimate determinants of resilience and vulnerability (Pelling and Mustafa 2010). It is these convergences that we leverage in this paper to propose a hybrid Vulnerability/Resilience framework for evaluating best practices in coastal adaptation in the Indian Ocean Basin.

The issues of measurement of vulnerability and capacities and, defining metrics[1] for resilience, however, remain important, as does the issue of risk perception and differential experience of vulnerability in a climate change context, which is relatively information poor with regard to local level future impacts. Following Anderson and Woodrow (1989), Mustafa *et al.* (2010) outline a quantitative Vulnerabilities and Capacities Index (VCI) that groups 12 broad indicators of vulnerability into three categories of material, institutional and attitudinal vulnerabilities at the household and community scale. Pelling and Mustafa (2010) in the same vein define 10 indicators of resilience to climate change when evaluating pro-poor environmental management in Asia. The vulnerability and resilience indicators (VRI) are distilled into five indicators with specific associated metrics for identifying and evaluating the best practices in coastal adaptation in the Indian Ocean Basin (Table 1).

Table 1: Indicators and metrics to evaluate Indian Ocean Basin adaptation practices

Indicator	Metrics
Diversity	Diversification of livelihoods Access to diverse ecosystem services Protection of ecosystem diversity
Ecosystem services	Protection of access to ecosystem services for the poor Policy knowledge Policy valuing of ecosystem services Resistance to unsustainable ecosystem management

[1] By metrics we mean criteria or standards for measurement.

Indicator	Metrics
Equity	Governance systems that enhance participation across scales Allowance for participation of the weak & marginalized Enhancing access and opportunity across genders
Social Capital	Mobilization of local organizations Empowerment through organization Organized resistance to undesirable outside interventions Preparedness and knowledge exchange
Infrastructure	Early warning systems Communication infrastructure Water supply and sanitation Rescue, relief and health

The first of the VRIs, Diversity, is premised upon extensive vulnerability research documenting the importance of diverse livelihoods versus enhanced or expanded livelihoods, which has been the focus of most development interventions (Moench and Dixit 2004, Mustafa *et al.* 2010). Of particular importance are non-local livelihood opportunities often realized through migration. In the event of an extreme event remittances and material help from extra local earning family members are an important component of a household's coping strategy (Khan and Mustafa 2007). Even locally, dependence on diverse ecosystem niches can compensate for loss of services from other niches, e.g., diminishing of sea or estuarial fishing from loss of fresh water or algae bloom can be compensated from land based agriculture or trading, or loss of surface fresh water can be compensated by groundwater. Bio-diversity within ecosystems can be a guarantor of continued provision of ecosystem services, and therefore should be accounted for when evaluating diversity within a socio-ecological system.

Ecosystem services are similarly important for livelihoods, somewhat most directly for the poor, who need to have direct access to high quality fisheries, land, and water to maintain adequate levels of nutrition and wellbeing. The inclusion of this indicator also has a political motivation of drawing attention to Southern environmentalism, which is about maintaining and protecting environmental quality so as to preserve the stream of benefits that society derives from it. This is in contrast to the more Northern/Western environmentalism, which partially being steeped in

cultural/romantic and partly in naturalist/scientific discourses, tends to put a premium upon a more biophysical centered notions of environmental quality at times divorced from their human social context (e.g., see Oelschlager 1992, Guha and Martinez-Alier 1997). Knowledge of the significance of these ecosystem services to the poor by the policy establishment of a society, and valuing of the same can be deemed to be evidence of the potential for ensuring environmental quality and climate resilience for the most vulnerable segments of a society.

Equity requires resilience-building programs to consider distribution of vulnerabilities and capacities as a result of an intervention. Equity can be realized through equality of outcome, e.g., equal access to fishing grounds, or equal income, or through redistributive policies for example through targeted investment in infrastructure, land reforms, or social investment (Pelling and Mustafa 2010). Needless to say responsive participatory democratic governance systems are better at providing pathways for the weak to articulate their subjectivities and vulnerabilities across class and gender lines.

Social networks and social capital that they represent can contribute to resilience by being conduits for information, preparatory measures, relief, livelihood opportunities and also resistance against bids for resource capture by local and non-local elites (Bosher *et al.* 2007, Fussell 2007, Twigg 2007). There is substantial evidence to suggest that socially constructed gender roles across the globe make women differentially more vulnerable to environmental extremes, as demonstrated by their higher relative fatalities and injuries in disasters (Neumayer and Plumper 2007). Specialized gender based social capital can be particularly helpful in more patriarchal societies for mobilizing women's productive capacities as well as sources for social support, knowledge exchange and building resilience (Sen 1990, Agarwal 1992).

Lastly, despite emphasis on adaptive capacity through institutions, social learning, governance and social organization, the significance of warning, protective, communication and services infrastructure cannot under estimated. Provision of such infrastructure over time in the coastal zones will be considered an additional indicator for climate adaptation.

With the above indicators in mind in the following section we outline WWF's approach to climate adaptation as harvested through literature. The approach will then be a benchmark to be adjusted in view of the climate adaptation best practices documented in the following two segments.

3. Outline of WWF's approach to Climate Adaptation

From their founding in 1961, the WWF has placed wildlife and ecological preservation at the forefront of their international operations— contributing financial support, expertise and manpower to "reconcile the twin claims of human material prosperity and the survival of the enduring values of wildlife within our developing civilization" (WWF, 1961). In the subsequent years, the global environment has entered a dynamic and rapidly changing period, substantially altering its physical and human landscape. This presents a unique set of challenges to both ecosystems and the communities existing within them. In recognition of these changes, the WWF has adapted their conservation strategies to include stronger engagement with governmental bodies in the 70's, the creation and implementation of their own projects in the 80's, and the formation of climate adaptation strategies in the 90's, which directly addressed the ongoing co-adjustment of both human and ecological systems (Hails, 2006). The current focus of the WWF is to reduce biophysical vulnerability by defining and implementing adaptive approaches regarding environmental instability (WWF, 2007; WWF, 2011). The development of a multi-faceted and diverse set of adaptive capacities that build on the resilience of socio-ecological systems are "critical to the WWF's mission for conservation and sustainable resource management, as to ensure that today's work remains relevant into the future" (WWF, 2011). Currently, there are few published studies regarding WWF's coastal adaptive practices in Pakistan, although the organization has undertaken research regarding the adaptive approaches of other regions. This report will benefit from these examples. The ultimate objective is to minimize risk and promote resources to help various bionetworks become more resistant to the detrimental effects of climate change.

3.1. WWF Approach to Adaptation

The concept of adaptation can be broken down into two distinct processes. First are the 'selective pressures' that strain a system or region, followed by the subsequent "agency-driven innovation," which aims to address this stress. (Monech and Dixit, 2007). Human and biophysical systems "experience selective pressures or perceive opportunities and most commonly act pro-actively or 'adapt' within the limits of their capacities, perceptions and priorities" (Monech and Dixit, 2007). The foundational theory behind much of the WWF's recent adaptive policy emphasizes the complex interplay of often-chaotic social-economic, ecological and political systems. Their framework suggests the need of wide-ranging involvement from scientists, local communities and development practitioners for successful implementation to occur. As such, the WWF defines their adaptation strategy in three broad terms (Hansen and Biringer, 2003):

- Protection and conservation of ecosystems
- Limiting all non-climate related stress
- Using adaptive management and strategies to combat climate change

Protection of sensitive ecosystems against external stressors is the fundamental mission of the WWF and is seen as the primary focus of their work within the field. Their overall goal is two-fold— lobbying for the reduction of greenhouse gasses to stabilize at 2 degrees Celsius above pre-industrial standards, while simultaneously implementing multiple reactive frameworks on the ground (Hansen and Biringer, 2003). No timeframe has been set for these objectives, but the recognition of rapid implementation is expressed. The examples presented in their work provide both valuable strategies, as well as room for discussion regarding further adaptive approaches. In conjunction with the VRI indicators established by Pelling and Mustafa (2010), we can begin to define areas of strength when evaluating the ecosystem management and approaches of the WWF.

Many case studies have proven extremely effective in illustrating sustainable management coupled with the integration of livelihoods, which frequently depends on the utilization of

environmental resources. In South Africa, the WWF mobilized and empowered communities— specifically women— by employing them in numerous campaigns to offset land degradation, raise awareness and control wetland erosion (2005). Their research showed that these participants often lacked dependable income prior to hiring and the WWF provided multi-year contracts for close to 1,500 people. By creating the 'Working for Wetlands' initative in 2000, the WWF was able to combine traditional conservation efforts with job creation and poverty alievation (2005). Similarly in China, the goal was to diversify livelihood resilience in the Lake Dongting Floodplain. By alternating farming practices, all of the 147 participant-families recorded an increase in income of over 100% since 2000, which has remained steady in the years since (Boekhorst et al., 2010; WWF, 2005) Other regions such as the Ganga Basin have WWF projects that utilize vulnerability assessments that take socio-economic and demographic data as the foundation of their adaptive strategy (WWF, 2011b). As the WWF aims to transition frameworks into hybrid approaches that include participatory conservation, there is clear evidence that this process has proven successful in building resilient regional socio-ecological systems.

3.2. WWF's Methodology of Evaluating Climate Change Impacts

Adaptive capacity has a wide application that can focus on the environmental and human dimension of climate adaptation, and regularly intersects between the two. Depending on the interests of those that define it, the concept of *who* or *what* adapts and *how* it is done often revolves around variations on similar themes (Smit and Wandel, 2006). The WWF's mission is to identify the vulnerabilities inherent to ecosystems and create adaptive measures that address these concerns directly. The organization relies on the IPCC's outline for adaptation, which is defined as "an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (2007). As such, they summarize the impact of climate change on biophysical systems as

"Exposure + Sensitivity — Adaptive Capacity = Vulnerability"

---WWF, 2011

Climate change and DRR literature often describes *vulnerability* as an interaction between a system's *exposure* and *sensitivity* to climate change in relation to its *adaptive capacity* in addressing the stresses that occur (Cutter, 1996; Kelly & Adger, 2000; Smit and Wandel, 2006; WWF, 2011; Pelling & High, 2005). Identifying the level of biophysical vulnerability is key to understanding the WWF's methodology. The organization has adopted this model as the foundation on which to test, confirm and improve on mitigation strategies concerning biophysical sustainability and conservation (WWF, 2011). Their approach to adaptive management is not to develop new plans but in "modifying a conservation plan based on incoming data or changing conditions that must incorporate climate change among the set of threats and drivers affecting resource management" (WWF, 2011). There is however, a disconnect in their biophysical oriented methodology and their newer emphasis on resilience of combined socio-ecological systems. Their emphasis on building human resilience as a pathway to protecting ecology is not matched by concomitant methodological tool box for assessing vulnerability of humans in addition to biophysical ecosystems. The tool box on assessing vulnerability and building resilience on the human side needs to be compatible to its ambitions to focus on human resilience as a conduit for ecosystem resilience.

3.3. Exposure, Sensitivity and Adaptive Capacity

Exposure and Sensitivity are intimately related, as they are both dependent on the interaction of the ecosystem, as well as the potential hazards produced by climate change (Luers, 2005). Direct or indirect exposure to external stimuli highlights the ability of an ecosystem to respond to these changes. Gallopin defines sensitivity as "the degree to which the system is modified or affected by an internal or external disturbance or set of disturbances" (2006). Most systems will have various sensitivities to the shifting climate that affect its capacity to adapt. Moreover, it is difficult to precisely assess the extent of 'threats' posed to the environment (i.e. drought or temperature change) but data can be accurately mapped for patterns of exposure (WWF, 2006). The WWF characterizes the elements of biophysical exposure and identifies the conditions that make a system sensitive to these shifting dynamics. A detailed understanding of site-specific vulnerabilities is the WWF's first response for developing an adaptive framework (2007).

The effects of biophysical exposure are not always apparent upon initial assessments. Determining an ecosystem's adaptive capacity is an ongoing process that requires reflexive evaluation of an area's reaction to exposure and sensitivity, in an effort to recognize the capacity of a system to "self-organize, respond flexibly, convert assets and shift strategies as risks emerge or during the period following disruptive events. This is, in turn, depends in an absolutely fundamental manner on the presence and functioning of underlying systems" (Monech, 2007). An environment's coping range is flexible and responds to both positive and negative stimuli within the region. The WWF looks to past instances of biophysical adaptation to determine how the system responded to extreme climatic influence and proceeds from there. The key to their approach relies in strengthening institutional capacity

As previously noted, the organization frequently examines and tackles the socio-economic and political factors that are intertwined throughout the creation of adaptive capacities for the biophysical world. This is evident throughout much of their literature (WWF, 2005; WWF, 2008; WWF, 2011). Nevertheless, the adaptive practices proposed in many WWF field guides have a tendency to focus too narrowly on the biophysical side of resilience and may overemphasize the ability to sustain biophysical interests (Gelbard, 2005; WWF 2003; WWF, 2008). Due to the philosophical foundation behind the creation of the WWF, the emphasis on fieldwork remains largely focused on the construct of ecological 'conservation', which may overlook the co-adjustment of both ecological and human systems in regards to climate change. Literature produced by WWF has, at times, revealed a disconnect between the conceptualization of adaptation as lying at the intersection of human environment interactions and the practical programming on adaptation, that seems to solely stress the biophysical side. As Pelling and High suggest, "the importance of socio-economic context is not only in determining access to the resources to undertake adaptation but also in stimulating adaptation to non-climatic stimuli that nevertheless influence capacity to adapt to subsequent climate related stressors" (2005). Amongst the important non-climatic stimulai could be techological change that may render the livelihoods of local communities redundant, or changes in market or property relations that may further marginalize vulnerable groups.

This dichotomy can be seen in the WWF's work on grassland vulnerability and resilience. It points to a series of adaptive options that require heavy levels of conservation and 'buffer

zones" to be created to stem overuse by local farmers (Gelbard, 2005). It also suggests changing road patterns to avoid vulnerable areas, in addition to implementing land-planning strategies within the local farming community. The function of grasslands is one of the most important aspects of agriculture livelihoods. Without taking into account the utilization of grasses for grazing and food production, these strategies may aggravate socio-economic conditions, resulting in higher instances of poverty or a local response that may ignore conservation plans outright (T'Mannetje and Jones, 2000; Doward et. al, 2003). Ecosystem resilience occurs when the vulnerabilities of all stakeholders are addressed within the process. Additionally, areas where the agricultural system is already stressed by climate change and producing low yields may not be able to fund new farming practices or create additional transportation routes. This case study does not address the potential human vulnerabilities that are intertwined with the protection and utilization of grasslands. By the same token, additional WWF case studies regarding the creation of resilient marine and freshwater ecosystems offer no adaptive capacities that engage with communities or directly benefit the local population (WWF, 2003; WWF, 2008). They point to human overexploitation in regions of Brazil and Costa Rica as a reason for land degradation and fishery decline— without providing diverse adaptive approaches to address this. In fact, by denying access to key fish populations and land sites as suggested, these actions can often serve to exacerbate the socio-economic conditions of the poorest communities.

The general sense that one gets from reviewing WWF's programming and literature is that it has a rather narrow understanding of what constitutes conservation. Conservation has had multiple meaning since the original coining of the term in the late 19th and early 20th century. In fact, right up to the 1960s conservation actually meant maximizing use. Recall that forest conservation as practiced in South Asia, for example, like the rest of the world, has never really been about preservation but rather optimizing and then maximizing use. In the 1980s through the 1990s conservation came to mean something different from its genesis. It came to be confused with preservation and protection from humans. Two decades of failed policies based upon the latter understanding and more than a century of resource policing along the lines of the earlier formulation have taught us that humans are as much a part of the solution as they are of the problem (Guha and Martinez-Alier, 1997; Harris, 2011; Newmann, 2002;

Sundberg, 1993). The question is what human institutions and structures are at play and with what motivations? Contemporary literature on the environmentalism of the poor reminds us that ensuring sustainable and equitable livelihoods and human well-being is the only morally and functionally desirable conduit for ensuring quality of the biophysical environment. Recognizing this as a fundamental necessity for conservation can be the key to successful design and implementation of future WWF projects.

3.4 Conclusion

At the intersection of climate change and adaptation remains a host of nuanced factors that overlap and influence one another, existing throughout environmental and social levels. Regarding their contribution to ecosystem resilience, the WWF may have exposed a potential gap in their work relating to social structures that affect the environmental health of ecosystems. Assessing adaptive capacity through the lens of disaster risk reduction should broaden the concepts of exposure and sensitivity to one that fully addresses the complex social, political and economic conditions that often directly or indirectly influence a vulnerable outcome. To isolate adaptive measures that are exclusive to biophysical systems overlooks the recognition of multiple stimuli that affect the extent to which systems can adapt and how. By virtue of holistic adaptive management, the hope is to address the physical uncertainty of climate change, i.e.: floods, droughts, heat waves etc., in conjunction with the social circumstances that effect and are affected by such change. Depending on the project, this can be achieved through a host of more participatory approaches that assess the intersection of socio-eco vulnerabilities. This can include capacity building on a community level that incorporate influences as varied as engaging government authority and proper infrastructure, to the diversification of livelihoods that reduce stress on sensitive ecosystems— while promoting economic resilience (Monech, and Dixit, 2007; Pelling and Mustafa, 2010). It is clear that the WWF is attempting to do just that, even as the complexities of this process cannot be overstated. Adaptation must “reflect the likelihood of the system experiencing the particular conditions and the occupancy and livelihood characteristics of the system which influences its sensitivity to such exposure” (Smit and Wandel, 2006). The capacity to adapt on both an ecological and human scale is interdependent and should also be addressed as such. With

such a strong understanding of biophysical adaptive measures, it is likely that the remaining gaps in the WWF's adaptive practices can be filled through reevaluating current measures that can incorporate a more dynamic set of influences and stakeholders.

4. Best Practices in Coastal Adaptation in The Indian Ocean Basin

4.1 Bangladesh

Any discussion of coastal adaptation in tropical and Monsoon Indian Ocean Basin has to start with Bangladesh. It is a country that is most exposed to environmental extremes and has very high population densities to exacerbate the physical exposure. Beyond the physical exposure is the social vulnerability of its populace by virtue of low human development, poverty, patriarchal and socially hierarchical structures, and relatively non-participatory and weak formal governance structures (Paul and Rahman 2006, Khan and Rahman 2007, Alam and Collins 2010). Partially because of its physical challenges, and partially because of long experience of, at times, catastrophic losses from environmental extremes, Bangladesh is also a country with considerable strengths and innovative lessons to teach the rest of the world when it comes to climate adaptation in an economically poorer part of the world. Even partial successes in Bangladesh are instructive for other countries with relatively less challenging physical environments, lower susceptability to climate hazards, and lower population densities.

Much of the literature focuses on external interventions and how they propel adaptive action in the global South. What is obfuscated through that monochromatic lens of externally driven adaptation at the local scale is the ingenuity, social capital, and capacities of the populations to help themselves and each other during times of stress. In an admirable review of such practices of coastal adaptation in Bangladesh, Alam and Collins (2010) document how some of the following adaptive actions by the local populations, in fact, have contributed to steadily declining damage figures in Bangladesh from coastal hazards over the past two decades.

First, in terms of anticipatory pre-disaster adaptive action it is a common practice among low-lying coastal areas' residents to build their houses on elevated plinths. The heights of the plinths is typically a function of the housing unit resident's past experience of storm surges and as observed by Mustafa (2002) in the context of Pakistan, also of labor and/or cash resources available to the home owner to build the house on an elevated plinth. In this situation strong

social and kinship networks can come in handy for the residents to build higher plinths and therefore ensure greater protection from storm surges for their families, possessions and very importantly farm animals. These plinths are often supplemented with tree planting around the elevated mound for protection against winds and also at times to anchor the physical structure of the house in high winds. The built structure can at times be enclosed in crossed beams of bamboo that are then tethered to the surrounding trees with strong ropes to keep the structure from blowing away. This particular infrastructure improvement, however, is contingent upon the existence of strong social capital whereby communities come together to help build and maintain each other's plinths or rarely if the person can afford to hire people to build those plinths. Poorer people who might be at the social margins of a community may be at a disadvantage in terms of benefiting from this infrastructural improvement.

Second, animals are the most valued possession and investment of any rural household in the global South and Bangladesh is no exception. Alam and Collins (2010) document how animals are let out of their pens if the warning level exceeds a certain threshold so that they have a better chance of surviving the winds and the storm surge. Paul (2009) however, documents how the government of Bangladesh, NGOs and occasionally communities have also built elevated earthen platforms (*killas*) for protecting livestock during cyclones. Most of these *killas* are rarely maintained by the government or the NGOs and are susceptible to failure during storm surges. *Killas* stabilized by trees and vegetation, however, have greater stability and also end up providing habitat and storm shelter to assorted wild animals such as small mammals and snakes. Furthermore, there is some concern about their physical location since at times they can be built far away from storm shelters and hence not very practical to use for their animals, by the people who use the storm shelter (Paul 2009).

Third, the government of Bangladesh, along with a vibrant and increasingly influential NGO sector, has managed to mobilize resources for construction of storm shelters across the coastal zones of the country. Prior to the catastrophic Cyclone Gorky in 1991, which killed 140,000 people there were only 512 storm shelters in Bangladesh. Cyclone Sidr in 2007 was comparable to Gorky in terms of strength and the density of population that was exposed to it but, the total number of fatalities from it were 3,406. Part of the difference could be explained by the existence of 3,976 shelters in the country in 2007.

Fourth, infrastructural development in terms of storm shelters, by itself is not the biggest factor. Besides most of the population does not use them anyway. More important is the existence of timely warning and then people's knowledge of, faith in, and capacity to respond to those warnings in a timely manner. This is partially a function of public education and partially again of social capital. While the proliferation of electronic media can be partially credited for people's increased knowledge of, and credence in cyclone warning, the impact of past experience and even more importantly the existence of community based volunteers to convey warnings cannot be dicounted. By 2007 there were more than 43,000 volunteers of Bangladesh's nationally run Cyclone Preparedness Programme (CPP)--this is more than double of 20,000 volunteers that were present in 1991. These volunteers in turn also mobilize other community activists both for warning and then post-disaster search, rescue and recovery activities (Paul 2009, Khan and Rahman 2006). Again strengthening of social capital is the key in this case as well. It is little wonder that it has been repeatedly documented that people living in isolated farmsteads, often because of land distribution issues, instead of clustered communities, tend to be physically distant from community knowledge and information exchange mechanisms and therefore much more vulnerable (Mallick *et al.* 2011, Alam and Collins 2010).

In terms of outside interventions Khan and Rahman (2006) argue that climate adaptation and DRR are high priorities for the Government of Bangladesh (GoB) and there is a fairly well articulated institutional set up for disaster management, beyond relief and rescue. But that well articulated institutional structure is not very effective because of lack of human resources within the government, cosmetic participatory frameworks, and divisive politics at the national and local scales. Nevertheless, Rawlani and Sovacool (2011) document the case of a GoB, United Nations Development Programme (UNDP) and Global Environmental Facility (GEF) funded, 'Community Based Adaptation to Climate Change through Coastal Afforestation' Program (CBACC-CA) that has been successful in increasing equity, improving access to ecosystem services, reinforcing social capital and diversification of livelihoods and ecosystems--four of the five VRIs identified earlier in this report. The key objectives and the most successful aspects of the program are listed in Box 1.

Box 1: Objectives of CBACC-CA

"The project is based on four components. **First** is enhancing the adaptive capacity of coastal communities and protective ecosystems through community-led interventions focusing on coastal afforestation and the diversification of community livelihood. **Second** is strengthening national, sub-national, and local capacities of government authorities and sectoral planners so that they better comprehend climate risk dynamics in coastal areas and implement appropriate risk reduction measures. **Third** is reviewing and revising coastal management practices and policies with a view on increasing community responsiveness. **Fourth** is developing a functional system for the collection, distribution and internalization of climate related knowledge" (Rawlani and Sovacool 2011: 857).

Of the above objectives the most successful thus far has been the first one which has made a substantive contribution to diversifying the coastal ecology and people's livelihoods, while at the same time ensuring greater protection against, storm surges and coastal erosion, damage to monocultural mangroves from pests and, giving the communities a real stake in the project.

"The CBACC-CA creates community and social responsiveness by offering subsidies to vulnerable communities and attempting to diversify economic training to include forestry, fishing and farming. One especially innovative dimension of this component is its focus on the "Triple F" model of "Forestry, Fisheries, and Food." The coastal communities most vulnerable to rising sea levels—the places where mangroves need to be planted and forests replenished—are also those where farming and forestry are the primary sources of income. The "FFF" model attempts to maintain community livelihood and adapt to climate change at the same time by integrating aquaculture and food production within reforested and afforested plantations. The FFF model currently accommodates 15 families per hectare and provides an opportunity to grow vegetables such as country beans, cucumbers, and gourds (cucurbitaceous vegetables) and other creeper vegetables. Quick growing and early yielding fruit trees such as Baukul and Apple Guava can also be planted between mangroves and mounds and produce 10–20 kg of fruit per tree within 2 years of planting (or an extra average income of about $700 per mound per year). The ditches between mounds and mangroves creatively support 150 kg of fish with an annual income of about $300 per ditch per year. Some communities have even supplemented these efforts by producing palm oil. *The central premise behind FFF activities is that adaptation efforts must also generate a continuous flow of income for local communities* [emphasis added]. Indeed, respondents calculated that investments in the CBACC-CA will already provide jobs and income generating activities for 1,150 families and community training related to nursery management and plantation establishment to 12,200 coastal people" (Rawlani and Sovacool 2011: pp. 859-60).

The accomplishments documented in Box 1 notwithstanding, the remaining objectives of the project continue to meet daunting challenges, which are generally not unfamiliar to practitioners working in the types of post-colonial institutional environment that exists in Bangladesh and almost of the rest of the global South. Lack of inter-ministry coordination, slow

pace of government responsiveness and lack of human resources within the government are some of the key challenges that seem to beset the project in terms of meeting its full range of objectives. The emphasis on combining ecological diversity with income diversity and then disaster risk reduction, however, is the key take home message of this fine example of a coastal adaptation in vulnerable communities.

In addition to the above outside interventions, Pelling and Mustafa (2011) also review examples of provision of post-disaster micro-credit to disaster victims in Bangladesh. Bangladesh probably has one of the most well developed non-governmental micro-credit system in the world. They report that after the 2004 floods households that were members of the Bangladesh Rural Advancement Committee (BRAC) micro-finance scheme had twice the value of post-disaster savings than non-BRAC members thereby increasing their coping capacity. Furthermore, access to post-disaster credit can allow quicker recovery. Micro-finance schemes have come under criticism recently for, at times unscrupulous lending practices (Maclean 2010, Bateman 2010). But provision of seed, fertilizer, farm implements or even fishing equipment is typically all based upon credit in Bangladesh, as it is in most of the global South. Equitable and accountable micro-credit programs must be a part of any coastal adaptation initiative.

4.2 India

Moving on from Bangladesh to the bigger neighbor India with its extensive coastline, there are many adaptation best practices to report. The first is from coastal Gujarat state in Western India, where an NGO Utthan's work in collaboration with an international action research network, Institute for Social and Environmental Transition (ISET), has spawned some pro-active adaptation related activities in three coastal villages of Katpar, Sartanpar and Tarasara. Two of the villages, Katpar and Sartanpar have active local level leadership heading the village councils (*panchayats*) with strong participation of women in the council's activities. Tarasara's village council, however, is hobbled by factional fighting and community conflict (Ahmed and Fajber 2009). Utthan was formed in 1987 and has a very strong gender focus which, it has brought to its activities and programming in the three villages. Because of the local contexts all

of Utthan's activities have not had an even impact across the three villages but they are noteworthy where they have indeed succeeded.

One of the keys to active adaptation programming in coastal Gujarat by Utthan/ISET was the importance of recognizing and then measuring differential vulnerability across gender, class and caste lines. Multiple exercises to assess variant vulnerability across intra and inter household, and then inter-community level, whilst testing many vulnerability assessment tools allowed Utthan to see a variegated picture of who was vulnerable, to what types of stress and why. Two of the more effective tools in the vulnerability assessments were, 'Shared Learning Dialogues' (SLDs) and the use of a quantitative Vulnerability and Capacity Index (VCI) (Mustafa *et al.* 2010, Ahmed and Fajber 2009). Some of the more differentially vulnerable groups to emerge from the assessment exercise were women at the intra-household level, especially where gender intersected with caste and at time lack of social support. Also, physically marginal lower caste groups living at some distance from the center of the villages were also deemed to be more vulnerable because they at times won't be allowed shelter in the local temple, which also served as a storm shelter, because of ritual pollution concerns. The same disadvantaged groups could also not get information on oncoming threats because of their physical and social isolation. It also emerged from the vulnerability assessment exercises that sometimes gender and caste related vulnerabilities were compensated by strong social capital amongst women (Ahmed and Fajber 2009).

Armed with a relatively nuanced understanding of differential vulnerability in the communities and their drivers, Utthan was quick to focus its programming on building capacities through livelihood diversification, adaptive infrastructure for water supply and sanitation and participatory disaster governance structures (Ahmed and Fajber 2009). The livelihood diversification activities are detailed in Box 2 as per Ahmed and Fajber (2009: 41-42).

Box 2: Livelihood Diversification in Coastal Gujarat

Given increasing salinity and declining agricultural productivity, the shared learning dialogues facilitated by Utthan and ISET clearly indicated the need for poor women and men in these villages to look for alternative livelihoods.

The coastal belt of Gujarat is suitable for spiny or rock lobsters, which are commonly found along rocky shores. With the support of the non-profit company, the Coastal Salinity Prevention Cell, 10 pilot demonstration projects on lobster fattening were implemented by Utthan at two selected sites. This involved women and men from two self-help groups (within which 70 per cent of the members come from households below the poverty line). Prior to Utthan's intervention, the majority of lobsters caught in this area used to fetch a lower price in the market as they weighed only around 100 grams. After one project cycle of six months, the fattened lobsters (weighing 150 grams) could command a better price in the market.

This program so far has directly benefited 48 families, and has generated employment for 120 people-days per household in a year. Loans of about $130 were provided to each participating family for a one-time investment in the cages, or pits, in which lobsters are reared. The recurring cost associated with feeding the lobsters is primarily for the fish, which women and men catch locally. While both women and men do lobster rearing, marketing is almost entirely women's responsibility--mostly in local markets and nearby villages. However, over time they have been able to negotiate better prices from buyers as a collective. The buyers are now coming directly to the sites to buy from them, saving them the trouble and cost of travel; public transport is limited, and private options are costly.

Following this pilot demonstration, the National Centre for Sustainable Aqua- culture and the Marine Products Export Development Authority have both shown interest in copying and scaling up this activity in other coastal villages. The first round of loans to the self-help groups has been repaid, and a federation of self-help groups involved in fishing is in the process of being registered. Training on the technical, marketing, and management aspects of lobster rearing and fattening is being planned for fisher-folk from the three pilot villages, and another ten villages.

In Katpar village, many small and marginal farmers, and some fisher families, are involved in rope-making from mill cotton waste, as a source of supplementary income. Recently, an exposure visit was organized for a group of 11 men and four women from Tarasara. The Katpar families are ready to help them initiate this activity, and have suggested that the Tarasara group take the raw material and market it through Katpar's existing contacts initially, prior to making their own contacts. Efforts are also being made to engage women's self-help groups in rope-making by linking them up with Area Level Federations of self-help groups, so that they can give them training on rope-making, and help facilitate access to raw materials and to markets.

On the sanitation front, Utthan has facilitated the construction of communal cement latrines for women and children where they can take care of their sanitation needs in privacy and dignity. The latrines are elevated and designed such that they can be accessed and used during coastal flooding episodes and are also resistant to salt-water erosion, thereby providing a much needed facility for women and children, that they had themselves identified as a priority during the vulnerability assessment exercises. The families that use the latrines also keep them clean (Ahmed and Fajber 2009).

With regard to water supply, Utthan is supporting village water committees, which have proactive involvement by women. The committees are partnering with the government Water and Sanitation Management Organization to develop infrastructure and management systems to provide water for all. The water supply and sanitation activities have largely been successful in Katpar and Sartanpar, but not so much in Tarasara for the reasons discussed above (Ahmed and Fajber 2009).

Utthan has been active in capacity building for disaster governance. Towards that end it has instigated the formation of Village Level Disaster Committees (VLDCs) after six months of negotiations with the communities' leaderships and different interest groups. Each VLDC has six sub-committees namely, Communication, Health, Rescue & Relief, Water and Sanitation and Temporary and Permanent Shelter. The VLDC are operational in all the villages, though each of the six member sub-committees were to have at least three women members and two of the members were to come from disadvantaged groups in the community. In practice, however, there is only nominal women's membership in all the VLDCs, with the highest proportion being in the more cohesive village community of Sartanpar (Ahmed and Fajber 2009).

The take home lessons from the adaptive practices and interventions speak to many components of the VRI. The programming on livelihood diversification speaks directly to the diversity indicator, whilst also developing an ecosystem service--lobsters and addresses equity by overwhelmingly engaging women and children from disadvantaged communities. Furthermore, the social capital developed around the adaptation activities has allowed women

to negotiate better prices from the market. Water supply and sanitation project has contributed to needed infrastructure development, as well as social capital formation, and equity in terms of building partnerships between the local and the meso scale governmental organization. In terms of the VLDCs again, there are obvious advantages to community mobilization for knowledge exchange and disaster management, though under representation of women and disadvantaged community members means that no major equity gains are being realized. Obviously the resilience benefits from the committees, too, remain inequitably distributed.

4.3 Sri Lanka

More often adaptation can be the outcome of relatively unrelated interventions than from specific climate adaptation focused interventions. The ‘Green Coast Project’ funded by Oxfam Novib was implemented by four organizations: Both ENDS, WWF, Wetlands International and the IUCN Netherlands committee. The project was primarily directed towards facilitating rehabilitation of coastal communities in South and South-East Asia in the aftermath of the Boxer Day Tsunami. The project was focusing on the green coast concept involving replenishing coastal ecosystems and facilitating community based rehabilitation activities. One particularly relevant example of adaptation gains in the region of Kalmunai on the East coast of Sri Lanka. The communities in the region were relatively affluent, and that affluence was partially manifested in housing construction all the way to the coastline at the expense of any vegetation to buffer the effects of winds and coastal flooding. The 2005 Tsunami destroyed most of the housing stock, salinated and otherwise polluted most of the dugwells, which were the main source of drinking water for the area in addition to significantly destroying livelihood opportunities for the local residents (Ekaratne and Vidanage 2008).

A small grant from the Green Coast project funded the establishment of a 3.5 km long greenbelt in four local communities. Care was taken to use plant species that were similar to the littoral scrub forest in the area. The developing greenbelt has already become a perching spot for Indian broad bill Rollers and many Red Vented Bulbuls, in addition to various other types of fauna including an occasional Tiger, which has also been sited there (Ekaratne and Vidanage 2008).

Besides the greenbelt, the project also involved 1001 families from the area in a forestry program to effect bio-remediation (Box 3) of drinking water wells. After removing the debris, silt and contaminated water from the wells, deep-rooted species of native trees and shrubs were planted around the drinking water wells. Water quality readings taken in 2006 after almost a year of the initial planting showed considerable gains in water quality. While the exact scientific links between plants and water quality are not quite clear in this particular case, the plants were certainly popular with the local population, especially women (Ekaratne and Vidanage 2008).

Box 3: Bio-remediation

The term bio-remediation refers to the use of biological agents, such as bacteria, fungi, or green plants, to remove or neutralize contaminants, as in polluted soil or water. Bacteria and fungi generally work by breaking down contaminants such as petroleum into less harmful substances. Plants can be used to aerate polluted soil and stimulate microbial action. They can also absorb contaminants such as salts and metals into their tissues, which are then harvested and disposed of. The use of green plants to decontaminate polluted soil or water is called phytoremediation.

Source: http://biobasics.gc.ca

The above physical interventions were supplemented with community organization efforts leading to formation of community groups for mobilizing savings, information exchange for organic farming and environmentally friendly waste disposal. The bio-remediation plots often doubled as kitchen gardens with women as the main managers and beneficiaries of those kitchen gardens. The gardens have become a source of supplementary income for the local women in addition to improving nutrition intake of their families (Ekaratne and Vidanage 2008).

Of the 34 groups that the project helped establish at the outset about 12 are defunct but 22 are still operative and active in providing micro-credit services to their membership of more than 330, in addition to being conduits for knowledge exchange. The groups have increased their collective incomes three fold since they started operations (Ekaratne and Vidanage 2008).

The above case study is narrated by IUCN, one of the implementation agencies for the project and there is no independent confirmation of their claims. That issue notwithstanding, reading the evidence as is, in this case the social capital formation facilitated diversification of income opportunities, led to ecosystem enhancement and bio-diversity, besides improvement of access to cleaner drinking water. The designation of women as the main beneficiaries of the interventions addresses one of the key adaptation criteria of equity across genders. Many of the adaptation indicators of social capital, ecosystem services and diversity of livelihoods outlined above are addressed by this case study. There doesn't seem to be any evidence however, that the local social capital has scaled up or linked up with higher tier formal or informal governance structures which leaves a question mark around the sustainability of the social capital that the project has generated. However, the benefits accruing from kitchen gardens, bio-remediation and coastal greenbelt seem very attractive, but their sustenance too depends upon the sustainability of the local social capital.

4.4 Thailand

In South East Asia the key adaptation indicators of social capital for resistance and community mobilization, are exemplified in the Pred Nai village in coastal Thailand. The village has used its social capital to diversify livelihood through enhancing and sustaining ecosystem diversity. The village is in the Trat province near the Cambodian border and home to the last surviving mangrove forest in eastern Thailand. Commercial logging since 1940s had significantly degraded the forest near the village until 1986 when villagers concerned with diminution of their livelihood basket dependent upon harvesting crabs, fish, shellfish as well as forest products, organized to prevent commercial logging. The village's efforts were successful in 1987 when the logging company was ousted from the village, though legally the company's concession was not terminated until 2000. Even though the logging company's activities were curtailed the village community continued to fight against unregulated extraction by people from surrounding communities and even people from within the village who had started shrimp farming in the degraded mangroves (Kaewmahanin *et al.* 2007). Along the way, the village formed a savings management group, which became the source for developing management

and organizational skills for realizing subsequent organizational, livelihood generation, and scaling up activities detailed in Box 4 below from Kaewmahanin *et al.* (2007: 147-148).

Box 4: Organizational and Scaling up Activities in Pred Nai

Nervous about any harvesting, local leaders prohibited harvesting in a conservation area that comprised a small part of the mangrove. Harvesting regulations for the grapsoid crab (Metopographus sp.)—a small crab harvested for sale and rarely consumed by the collectors—were developed in 1997. These regulations involved closing the harvest during the breeding period in October.

A forest management group for the mangrove was formed in 1998. Its activities included resource mapping and forest patrols. Drawing on the strengths of local traditions and village elders, Pred Nai villagers built on some of the organizational and institutional skills developed as a result of a village savings fund started in 1995, with the support of a respected monk. First, the villagers planted trees in the denuded mangrove area; some stands began to regenerate naturally under strict village protection. Second, villagers set out to increase the production of mud crab (Scylla serrata)—another economically important aquatic animal—by starting a "crab bank." People who caught egg-bearing crabs were asked to place them in one of the cages established by the management group in the canals.

A more detailed mangrove management planning exercise began with the technical support of the Regional Community Forestry Training Center for Asia and the Pacific (RECOFTC) from 2000.

The villagers also acted to prevent destructive fishing practices. In addition, they are experimenting with thinning the dense natural stands of Ceriops. The villagers exchange ideas with fishery researchers to help with the monitoring methods and the col- lection of relevant data. The process and results are analyzed and reflected in the subsequent planning cycle. This conscious learning process is an important aspect of the group's success.

The villagers realized that the people of a single community could not implement successful and sustainable forest management because boundaries were not demarcated and there were no regulations on forest use. A mangrove network was developed with some other local villages. The network was first initiated and facilitated in villages sharing boundaries with Pred Nai and later expanded to many other villages. The communities all became members of the Community Coastal Resource Management Network, Trat Province. Through the exchange of knowledge and experiences, the villagers have learned from their successes and failures. Their collaboration has allowed them to initiate new ideas and practices that respond to community needs.

The movement to regain control of the mangroves was initiated by residents of Pred Nai who sought support from some local politicians. Subsequently, in 1998, RECOFTC was invited to provide technical support, especially for management planning. This was formalized and increased in 2000 through a small support project funded by the Toyota Foundation. The activity began as and remained a local initiative.

As a result of the above activities considerable increase in biodiversity in the local mangrove ecosystem was recorded. The biodiversity gains have allowed the villagers to enhance their incomes from breeding and harvesting of mud crabs. Pred Nai's conservation efforts have always had local livelihoods as a priority, not to mention the protection from coastal flooding that the mangroves afford. Community' efforts at conservation have led to a diversified income basket, which includes running a rubber plantation, fruit gardens, cultivating shrimps, fishing and day labor. The poorer community members in particular have benefitted from enhanced opportunities for generating income from collecting crabs and fishing. Women have been proactive in community organization and are reportedly one of the key beneficiaries of the community's conservation efforts. Pred Nai has served as an example and an inspiration for neighboring villages that are beginning to cooperate with Pred Nai to regulate destructive fishing activity in the coastal zone. While the government does not officially recognize Pred Nai's community organization, local officials have unofficially been cooperative and have facilitated their work (Kaewmahanin *et al.* 2007).

The above example fulfills the adaptation criteria of diversification of livelihoods through bio-diversity, recognition and realization of ecosystem services for the poor, equity by generating income opportunities for the poor, and increased participation of women in community organization. Even the unofficial scaling up of this community initiative is exemplary in terms of adaptation practice. Unfortunately the exact mechanisms for scaling up and details of various organizational efforts remain elusive and could usefully be the subject of detailed ethnographic research.

4.5 Africa

Relocation is typically said to be the worst possible option regarding adaptation to climate change (Mustafa, 2005). Due to the dire consequences that flooding often has on coastal regions, remaining sustainable in the face of such disastrous environmental impacts is not always a viable option. The link between DRR and migration is a long-established adaptive approach to climate change (Monech and Dixit, 2004). When floods severely disrupt lives and

livelihoods of those in its path, it is likely that “temporary measures will no longer be sufficient and that traditional livelihoods will need to undergo more radical transformations, including long-term and permanent migration to different regions” (Traconi, 2007). This, of course, is never the best-case scenario, nor should it be the first option when developing adaptive strategies, but nevertheless, it is often the only way forward for many communities to survive. Diversifying income and livelihoods is the central concept of migration and is frequently the route of increased access to work for vulnerable families (Moech and Dixit, 2004). If migration and disaster risk management are to be successful adaptive strategies, governments and development practitioners need to take into account a variety of factors and stakeholders in the process. When possible, migration needs to be voluntary and institutions must be willing and able to support migrant communities over time and through a diverse set of initiatives.

The case below may offer a best practice option when relocation is the only feasible alternative to save lives. The east African country of Mozambique has shown a relatively successful cross-scale response regarding disaster risk reduction. The tropical cyclone Favio in 2007 caused catastrophic flooding, displacing over 100,000 coastal residents, destroying homes and harvests in its wake (Warner et. al, 2009). In the aftermath, the government response encouraged communities to resettle away from floodplains while providing economic incentive to diversify livelihoods and strengthen infrastructure. Additionally, these measures were enhanced by the proactive agricultural initiatives established by international NGOs and the government, which have attempted to strengthen local livelihoods and capitalized on social networks. By leveraging the high amount of social capital, this case study provides one example of how a program can lessen the trauma of relocation, while contiuing to promote livelihood reslience (Oshbar et al. 2008).

Resettlement in Mozambique is a “policy of last resort,” after a series of devastating coastal and Zambezi floods occurred in both 2001 and 2007 (ibid, 2010). Population migration has been a frequent necessity for many east African nations (Tacoli, 2007). Although there are clear trade-offs regarding resettlement—such as loss of livelihoods and disruption of social structures—the government and humanitarian organizations have been somewhat successful

in implementing a series of diversification initiatives that aim to protect the vulnerable and help them to thrive in the new circumstances. Diversification of livelihoods is widely recognized as a way to reduce the risk of loss and increase income-generating agricultural practices throughout an area (Adger, 2006; Osbahr et al. 2008; Pelling and Mustafa, 2010). Self-organized dual land-use systems were promoted by the government, which utilized multiple small plots of land in various elevations throughout the country. Whereas the higher sandy lands are often more severely affected by climate disruptions, they are used to produce 'insurance crops,' such as fruit and maize, and offer additional produce when the season permits. More vital are the lowlands that are irrigated and worked for sturdier vegetation with a higher commercial value (ibid, 2008). More options mean a greater likelihood of survival and resilience. As was noted by Osbahr et al., both types of diversification efforts "were responsive to the environment and household circumstance but helped to create livelihood security and flexibility" (2008). Additionally, in exchange for the manpower needed to increase infrastructure, the government "promised to pay for other construction materials and technical assistance for new houses and multi-purpose community buildings" (Warner et al., 2009).

Mozambique has always relied on social capital and more informal institutions in response to climate disturbances and shock. The majority of the population is dependent on natural resources and in times of crisis there is a high level of engagement with villages and distant family members. Maintaining relationships that are mutually beneficial is an important coping mechanism for communities in Mozambique and has served them well over the last few decades (Osbahr et al., 2008). Reciprocal engagement between different villages includes the exchange of manpower during shortages or illness, as well as sharing of food and supplies when needed. Money almost never changes hands. Adaptive capacity is often 'responsive' when it concerns those who are limited financially and cannot make sustainable long-term plans due to economic constraints. Many view this type of system to be unstable. However over time, the local communities have capitalized on the benefits of social networks, increasing their ability to remain resilient despite a host of ecological disturbances (ibid, 2008). This practice has helped most families stay afloat during tough times. However, there is an

undeniable disparity seen between households with multiple laborers and those with fewer resources to exchange, such as the elderly.

The government of Mozambique has implemented policies that take advantage of this already strong social connection in regards to local adaptive capacity. The PROAGRI program, initiated by both governmental and humanitarian organizations in 2003, offered programs ranging from “micro-finance to communication, and set out to support small scale farming in rural areas by supporting technical extension training, infrastructure development and local organizations” (ibid, 2008). Successful resettlement of populations can only occur with long-term financial and structural support from outside organizations that insure a stability of livelihood options (Tacoli, 2007). The PROAGRI strategy aimed to address local vulnerability by promoting and funding community organizations that offered continued access to land, technology, and knowledge of current agricultural practices in newer regions. Micro-loans were frequently offered for those to ‘experiment’ with different farming techniques, in hopes of diffusing beneficial planning and knowledge across the community if the risk paid off (ibid, 2008; Warner et al. 2009). As environmental uncertainty continues to plague Mozambique, it seems apparent that further adaptive capacities regarding migration and resettlement will play a larger role in both government and developmental policy in the future.

5. Key Adaptation Lessons from the Case Studies

In retrospect we were a little too optimistic as we set out to look for best practices in climate adaptation in the coastal regions of the Indian Ocean basin. We were surprised at how few general adaptation case studies documenting best practices were there in the refereed literature, let alone adaptation in the coastal zones. Bangladesh is clearly better documented than most other countries and hence two case studies feature from that country. But the biggest surprise was India, where one would have expected a number of case studies given the vastness of its coastline and the scholarly attention to the country. Despite that documented best practices were limited to viginettes in mostly non-refereed literature. There were few studies that went into details of how adapatation practice was playing out on the ground. The paucity of refereed literature on practice was part of the problem, which was

further accentuated by our search for case studies which, touched upon at least two of the five major indicators listed in the metrics for measuring adaptation outlined in the second section of this report. The case studies that we have outlined in our view demonstrate how might different adaptation components may be brought together in a package to build more climate resilient communities.

As we distill the key lessons below, we will also refer to some case studies that we reviewed but rejected, because there were insufficient details about the interactions between different indicators of climate resilience to merit inclusion in this report. There were nevertheless interesting interventions that do merit mention and are therefore mentioned in the key lessons from the case studies listed below:

1. Diversification of livelihoods is key to sustainable climate resilience. Developmental interventions have to go beyond livelihood enhancement to diversification. In the aftermath of a disaster or during environmental stress communities typically do not have the capital to invest in their existing livelihoods, which have often been disrupted by the environmental extremes. In such circumstances communities, development practitioners and policy makers have to think creatively and devise ways of supplementing existing livelihoods with other opportunities, which may not necessarily be place based, e.g., computer training for the poor in coastal Tamil Nadu (see Opitz-Stapleton 2009). The best examples listed in this report for example the CBACC-CA project in Bangladesh bring together various ecosystem services to create a more diverse set of livelihood options for the coastal populations. The example along with those from Thailand and coastal India illustrate how ecosystem diversity complements livelihood diversity and the two aims if pursued simultaneously are the best guarantee for diversified livelihoods. People in coastal environments undertake income diversification regardless. The point is to recognize them and support them.
2. Social capital is a key conduit for facilitating interventions for example in the case of the two coastal villages in Gujarat India. Recognition of such social capital and strengthening it can be a conduit for more robust interventions, e.g., in case of Mozambique. But the same social capital can also be highly efficacious in resisting predatory resource

extraction practices by outsiders for forestry or fisheries, as in case of Pred Nai in Thailand.

3. One cannot underestimate the importance of infrastructure in coastal adaptation. The example of storm shelters and warning system from coastal Bangladesh is a case in point. In a country like Pakistan with high cell phone penetration, that network could also be usefully leveraged to improve coastal storm warning systems, especially when populations are highly dispersed.
4. Relocation is typically the worst option, but when it does become necessary because of catastrophic land degradation from salt water intrusion or downright sea level rise, it must be voluntary and the state must provide appropriate support preferably through existing social networks, as in case of Mozambique. The relocation should not be a way of severing people's ties to their previous homelands. They ought to be supported in making productive use of their assets, land and resources in their previous location, as exemplified by the Mozambique case study.
5. Equity continues to be a challenge in adaptation in general. Enhancing economic power and livelihood opportunities of previously disadvantaged groups such as lower caste fishermen, or women is essential morally and functionally. The Sri Lanka case study was a good example of enhancing ecosystem services while at the same time improving the livelihoods of women.

The above key lessons and their incorporation in WWF's approach and methodology for conservation as well as adaptation programming will go a long way towards addressing some of the gaps we have identified in their approach in this paper. But beyond WWF's programming these principles that are theoretically driven but empirically validated by the case studies presented in this paper, as well as by political ecological literature in general, could go a long way towards creating a safer, biologically diverse and socially equitable future for coastal communities in a climate change future.

6. Conclusion

One of the key conclusions to emerge from the documentation of adaptation best practices is that there are not enough of them in the refereed literature. The ones presented in this paper represent both autonomous and planned adaptation (Ahmad and Fajber 2009). The former exemplified by one of the case studies in Bangladesh and then the one from Thailand. The remaining case studies illustrate more planned adaptation interventions. But in the real world it is more than likely that there are more examples of autonomous adaptations than planned adaptation. The challenge for organizations like WWF is to recognize, study and document such autonomous adaptations in the first instance and then become advocates and supporters of the same.

To even recognize and encourage autonomous adaptation the challenge is to identify operationalizable metrics for measuring adaptation. This paper has undertaken one such attempt so as to guide adaptation programming. Regrettably none of the 'better' practices discussed in this paper satisfactorily address all the indicators identified by the VRI, especially equity. The neglect of equity is somewhat worrying, but not unexpected. The unreasonable romanticization of the 'community' in development discourse and practice might be partially to blame for it. Communities are not homogenous collectivities of people but rather have their own, at times highly insidious, faultlines of social power along gender, class, caste and ethnicity lines. To adequately address equity, any outside intervention will have to avoid the pitfall of reinforcing and/or legitimizing local power structures, just because it is functionally convenient or conceptually simpler.

Focus on biological conservation without due regard for the human context of it is guaranteed to fail in meeting even its narrow defined objectives. Such a narrow focus can at times in fact, be counter-productive. As some of the case studies listed in this paper illustrate, it is possible to mobilize an understanding of ecology and couple that with insights on social vulnerability and exposure. This can then provide a base to design programmes that address biological diversity objectives and at the same time address ambitions to build resilience and reduce vulnerability.

The key message of the global environmental change agenda is that previous climatic norms are not going to hold into the future. Globalization, increasing penetration of capitalist relations of production and exchange, as well as monetization of indigenous economies ensures that on the human side too the past normals will not be useful guides to action in the future. In such a dynamic environment, human values and experience will have to define sign posts around which, we hope to negotiate future challenges. We believe that the VRI is a step towards capturing the human values that must inform our adaptation to environmental challenges--present and future. Addressing vulnerability, inequity, predatory resource use here and now are not only moral imperatives but the best guarantees for a safer, reslient and fulfilling future for all--humans and non-humans.

REFERENCES

Adger, W. N. 2006. Vulnerability. *Global Environmental Change.* 16: 268-281.

Ahmed, S. and L. Fajber 2009. Engendering adaptation to climate variability in Gujarat, India. *Gender and Development*.17(1): 33-50.

Alam, E. and A. E. Collins 2010. Cyclone disaster vulnerability and response experiences in coastal Bangladesh.*Disasters*. 34(4): 931-954.

Anderson, M. and P. Woodrow (1989) Rising from the Ashes: Development Strategies in Times of Disasters. Westview Press, London.

Bateman, M. 2010.*Why Doesn't Microfinance Work? The Destructive Rise of Neo-liberalism*. Zed Books: New York, NY.

Mallick, B., K. R. Rahaman and J. Vogt 2011. Coastal livelihoods and physical infrastrucutre in Bangladesh after cyclone Aila.*Mitigation and Adaptation Strategies for Global Environmental Change*.16: 629-648.

Boekhorst, D. et al. 2010, *Implementing Integrated River Basin Management in China* [online], Ecology and Society, pp. 1-18, Available from: http://www.ecologyandsociety.org/vol15/iss2/ .

Bosher, L., E. Penning-Rowsell and S. Tapsell (2007) 'Resources accessibility and vulnerability in Andhra Pradesh: caste and non-caste influences'. Development and Change.38(4).pp. 615–640.

Cutter, S. 1996. Vulnerability to Environmental Hazards [online], Progress in Human Geography. pp. 529-539. [Accessed: http://webra.cas.sc.edu/hvri/docs/Progress_Human_Geography.pdf].

Cutter, S., J.K. Mitchell and M.S. Scott (2000) 'Revealing the vulnerability to people and places: a case study of Georgetown County, South Carolina'. Annals of the Association of American Geographers.90(4).pp. 713–737.

Doward, A., Kidd, J., Morrison, J., Urey, I. 2003. A Policy Agenda for Pro-Poor Agricultural Growth [online]. World Development, pp. 73-89. Available from: http://www.sciencedirect.com/science/article/pii/S0305750X03001931.

Ekaratne, K. and S. P. Vidanage 2008. For Nature and People - A Helping Hand to Rise from the Debris. IUCN Sri Lanka Country Office, Colombo.

Fussel, H. (2007) 'Vulnerability: a generally applicable conceptual framework for climate change research'. Global Environmental Change.17(2).pp. 155–167. Gallopin, G. 2006. Linkages between vulnerability, resilience, and adaptive capacity [online]. Global Environmental Change. pp. 293-303. Available from: http://www.sciencedirect.com/science/article/pii/S0959378006000409.

Gelbard, J. 2003. 'Grasslands at a Crossroads: Protecting and Enhancing Resilience to Climate Change'. Buying Time: A User's manual. World Wildlife Fund. Washington D.C., pp. 15-42.

Guha, Ramachandra and Martinez-Alier,Juan (1997) Varieties of Environmentalism Essays North and South.London: Earthscan.

Chris Hails 2006, *WWF from 1961 to 2006* [online], WWF, Available from: http://wwf.panda.org/who_we_are/history/wwf_conservation_1961_2006/ .

Hansen, L., Biringer, J. 2003. 'Buying Time: A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems'. World Wildlife Fund, Washington D.C., pp. 1-246.

Harris, M. 2011. *Rambunctious Garden: Saving Nature in a Post-Wild World.* 1st edition. Bloombury Publishing. London.

Holling, C.S. 1973. Resilience and Stability of Ecological Systems [online]. Annual Review of Ecology and Systematics. pp. 1-23. Available from: http://www.jstor.org/pss/2096802.

IPCC 2007. 'Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change'. Geneva, pp. 1-104.

Kaewmahanin, J., S. Sukwong, R. Fisher, and S. Worrapornpan, 2007.Community mangrove management in PredNai Village, Thailand. In P. Steele, G. Oviedo and D. McCauley (eds.) *Poverty, Health and Ecosystems: Experiences from Asia*. IUCN, Gland, Switzerland and Asian Development Bank, Manila, Philippines.

Kelly, P.M., Adger, W. N. 2000, Theory and Practice in Assessing Vulnerability to Climate Change and Facilitating Adaptation [online], Climatic Change, pp. 325-352, Available from: http://nome.colorado.edu/HARC/Readings/Kelly.pdf.

Khan, M. R. and M. A. Rahman 2006. Partnership approach to disaster management in Bangladesh: a critical policy assessment. *Natural Hazards*. 41: 359-378.

Luers, A. 2005, The surface of vulnerability: An analytical framework for examining environmental change [online], Global Environmental Change, pp. 214-223, Available from: http://yaquivalley.stanford.edu/pdf/LuersGEC20051.pdf .

Maclean, K. 2010. Capitalizing on Women's Social Capital? Women-Targeted Microfinance in Bolivia.*Development and Change*. 41(3): 495-515.

Moench, M. and A. Dixit (eds.) (2004) Adaptive Capacity and Livelihood Resilience: Adaptive Strategies for Responding to Floods and Droughts in South Asia. Institute for Social and Environmental Transition, Boulder, CO.

Moench, M. and A. Dixit (eds.) (2007) Working With the Winds of Change: Towards Strategies for Responding to the Risks Associated with Climate Change and other Hazards. Institute for Social and Environmental Transition–Nepal and ProVention, Kathmandu.

Mustafa, D. (1998) 'Structural causes of vulnerability to flood hazard in Pakistan'. Economic Geography. 74(3).pp. 289–305.

Mustafa, D., S. Ahmed, E. Saroch and H. Bell 2010. Pinning down vulnerability: from narratives to numbers. Disasters. doi:10.1111/j.0361-3666.2010.01193.x. ISSN: 1467-7717

Neumayer, E. and T. Plumper 2007. The Gendered Nature of Natural Disasters: The Impact of Catastrophic Events on the Gender Gap in Life Expectancy, 1981–2002. *Annals of the Association of American Geographers*. 97(3): 551-566.

Newmann, R. 2002.*Imposing Wilderness Struggles over Livelihood and Nature Preservation in Africa.* 1st edition. UC Press. Berkeley.

Osbahr, H., et al. 2008, *Effective livelihood adaptation to climate change disturbance: Scale dimensions of practice in Mozambique* [online], Geoforum, pp. 1-14, Available from: http://www.sciencedirect.com/science/article/pii/S0016718508001000 .

Oelschlaeger, Max, 1991: The Idea of Wilderness, Yale University Press, New Haven, CT.

Paul, A. 2009. Why relatively fewer people died? The case of Bangladesh's Cyclone Sidr.*Natural Hazards*. 50: 289-304.

Paul, A. and M. M. Rahman, 2006. Cyclone mitigation perspectives in the islands of Bangladesh: case of Sandwip and Hatia Islands. *Coastal Management*. 34(2): 199-215.

Pelling, M., High, C. 2005. Understanding adaptation: What can social capital offer assessments of adaptive capacity [online]. Global Environmental Change, pp. 308-319, Available from: http://www.mendeley.com/research/understanding-adaptation-what-can-social-capital-offer-assessments-of-adaptive-capacity/.

Pelling, M. and D. Mustafa 2010. How to better protect the poor in hazard prone areas: implications of climate change resilience for poverty reduction and environmental policy, Background Paper for Conference on the " The Environments of the Poor", 24-26 Nov 2010, New Delhi[2]

Rawlani, A. K. and B. K. Sovacool 2011. Building responsiveness to climate change through community based adaptation in Bangladesh. *Mitigation and Adaptation Strategies for Global Change*. 16: 845-863.

Schipper, L. and M. Pelling (2006) 'Disaster risk, climate change and international development: scope and challenges for integration'. Disasters. 30(1).pp. 19–38.

Smit, B., Wendel, J. 2006, Adaptation, Adaptive Capacity and Vulnerability [online]. Global Environmental Change. pp. 282-292. Available from: http://www.uio.no/studier/emner/annet/sum/SUM4015/h08/Smit.pdf.

T'Mannetje, L., Jones, R. 2000. Field and Laboratory Methods for Grassland and Animal Production Research. 1st edition. CABI Publishing. Oxford.

Twigg, J. (2007) Characteristics of a Disaster-Resilient Community: A Guidance Note. Disaster Risk Reduction Interagency Coordination Group, Department for International Development, London.

World Wildlife Fund 2008, *Adapting water to a changing climate: An overview*, WWF, Switzerland.

World Wildlife Fund 2003, *Buying Time: A users manual for building resistance and resilience to climate change in Natural Systems*, WWF, Switzerland.

[2] For more information, see the conference website: http://www.adb.org/Documents/Events/2010/Environments-Poor/default.asp

World Wildlife Fund. 2011(a). Climate Adaptation: Mainstreaming in existing Conservation Plans. WWF. Washington D.C.

World Wildlife Fund 2005, *Freshwater and Poverty Reduction: Serving People, Saving Nature*, WWF, Switzerland.

World Wildlife Fund 1961, *Morgan's Manifesto*, WWF UK, Switzerland.

World Wildlife Fund 2011(b), *Vulnerability Assessments of People, Livelihoods and Ecosystems in the Ganga Basin*, WWF, India.

World Wildlife Fund 2007, *WWF Standards of Conservation Project and Programme Management* [online], WWF, pp. 1-37, Available from: http://wwf.panda.org/what_we_do/how_we_work/programme_standards/

World Wide Fund for Nature - Pakistan
606 - 607, Fortune Centre, Block 6, P.E.C.H.S., Shahra-e-Faisal, Karachi
Tel: 021 34544791-92, Fax: 021 34544790, www.wwfpak.org/ccap