



# CHRONIC POVERTY IN THE SOUTHWEST COASTAL BELT OF BANGLADESH

Where the southwest coastal region of Bangladesh was once a prosperous agricultural hub, today it is an area ravaged by salinity, natural disasters, poverty and an inability to cope with recurrent shocks. The introduction of the embankment system in the 1960's and subsequent spread of shrimp farming throughout the region has caused dramatic levels of environmental degradation and poverty.

Today, communities face a regional depletion of natural resources including safe drinking water and struggle to maintain livelihoods. Both natural<sup>1</sup> and human-induced disasters as well as the effects of climate change place increasing pressure on the region, hindering development. It is the combination of these factors that prevent stable and sustainable livelihoods, disaster resilience including the capacity to recover quickly and efficiently following disasters. This in turn perpetuates chronic poverty in the region.

This paper presents the main findings of a survey made in collaboration with the local NGO **Uttaran** in the southwest coastal belt of Bangladesh. The survey

occurred between November 2011 and June 2012 and consisted of a series of initial assessments, follow-up participative assessments and SOLIDARITES INTERNATIONAL (SI)/Uttaran workshops. The survey was conducted in Assassuni, Shyamnagar, Dacope & Koyra Upazilas (UZ's) in Khulna and Satkhira Districts. Both coastal belt frontline communities severely affected by the 2009 Aila cyclone and less affected inland communities were assessed.

The objective of this study was to capture the main challenges, impacts and effects of climate change on livelihoods in this region as well as identify levels of disaster resilience and existing coping strategies being utilized. What was found was a much more complex array of interlinking factors which together, present significant barriers to livelihood opportunities and sustainable development for communities, and the region as a whole.

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<sup>1</sup> Within this document 'natural' factors include the effects of climate change. While SOLIDARITES INTERNATIONAL fully acknowledges that climate change is in large part due to human practices, for the sake of simplicity, these have been categorised together. While we distinguish human induced factors from 'natural' ones, we are also fully aware that this distinction is artificial and that they all are inter-linked.

## **BANGLADESH, RESILIENCE AND CLIMATE CHANGE**

Situated amidst the vast Ganges, Brahmaputra and Meghna river basins, Bangladesh is a flat deltaic land covering an area of 144,000 square km's<sup>i</sup>. 80% of the country is categorized as floodplain and most areas, except the highlands, are exposed to monsoonal flooding for several months every year. With approximately 150 million people, Bangladesh is one of the most densely populated countries in the world.

Economically, the UN classifies Bangladesh as a Least Developed Country, having over 20% of the population below the \$1 per day poverty line and 84% of the population below the \$2 per day poverty line<sup>ii</sup>. Relying heavily on its agricultural industry, Bangladesh has made modest economic gains over the past decade with 6% GDP growth per year of which agriculture contributes 21% and employs approximately 48% of the workforce.<sup>iii</sup>

Environmentally, Bangladesh is considered extremely fragile and one of the world's most vulnerable countries to the negative effects of climate change and natural disasters. Agricultural production is already being affected as interviewed participants reported monsoon rains becoming erratic and the frequency of dry spells and temperatures increasing. According to the World Bank, 60% of global deaths caused by cyclones in the last 20 years occurred in Bangladesh<sup>iv</sup>. In 2012 Bangladesh was ranked fifth in the World Risk Index for natural disasters<sup>v</sup>. Two recent tropical cyclones Sidr (2007) and Aila (2009) caused extensive damage to the southwest. Sidr struck the region on the 15<sup>th</sup> of November 2007,

affecting 2.3 million households and causing damage and losses estimated at approximately US\$ 1.7 billion. Aila struck the southern coast on 25 May 2009, affecting nearly 5 million people and causing infrastructure damage of approximately US\$600 million.

While natural disasters have significant impact in Bangladesh, human-induced slow-onset disasters such as salinity are having an increasingly detrimental effect in the southwest in particular. It is the combination of both natural and human-induced disasters that perpetuate chronic poverty in the delta. As a result, 32.1% of people living in Khulna District are living below the poverty line<sup>vi</sup>.

Regionally, the southwest coastal belt of Bangladesh is an intricate system of biodiversity which includes the Sundarbans, the largest mangrove forest in the world. The coastal zone spans over 580 km of coastline and is prone to multiple hazards. Cyclones, floods, tidal surges, periodic water-logging and land erosion are common throughout this region significantly shaping the lives and livelihoods of local communities. According to the World Bank (2012), 'Sixty-two percent of coastal land has an elevation of up to three meters and eighty-three percent up to five meters above mean sea level' making this region also extremely vulnerable to sea-level rise. The region constitutes 32% of total land area in Bangladesh and hosts nearly 28% of the population (i.e. nearly 42 million)<sup>vii</sup>.

## **SHRIMP FARMING & THE DECLINE OF LIVELIHOOD RESILIENCE IN THE SOUTHWEST**

Over the past 60 years, human modifications made to the natural environment throughout the southwest have significantly influenced livelihood opportunities

in the region. These modifications have caused extensive environmental damage to the point where today, both livelihoods and the natural environment

are extremely fragile and under increasing pressure from both human-induced and natural disasters as well as climate change. As a result, communities in the southwest have become more vulnerable to hazards and less capable of coping when disasters do strike.

**Pre-1950's** Prior to the 1950's farming activities in the southwest were centred around the natural tidal system which occurred throughout the regions river and canal system. Soil was rich and fertile, benefiting from the sedimentation which built up throughout the year, making agricultural farming profitable. Population density was low and livelihoods were able to adapt to the slightly saline natural state of the region. Agricultural farming was the primary livelihood option and was often diversified with a variety of different crops. Many farmers supplemented this income with other, complimentary activities such as livestock rearing and homestead gardening. Shrimp cultivation occurred on a small scale and indigenous farming practices were utilized.

**1950's** While this natural tidal system worked to enhance the fertility of the region, it was nevertheless vulnerable to hazards such as floods and cyclones.

In the 1950's a series of devastating cyclones struck the region causing the Government of East Pakistan's Water and Power Development Authority (EPWPDA) to convert the area into a dry zone and work towards enhancing protection of the coastal belt.

**1960's** With the goal of enhancing resilience in the region, the World Bank assisted East Pakistan (and later the Government of Bangladesh (GoB)) to establish a series of polders and embankments designed to enhance agricultural production and protect the region from the intrusion of saline water, floods and other disasters. The coastal embankment project constructed a series of approximately 125 polders with 5,355 km's of embankments throughout the region<sup>viii</sup> including a series of canals and sluice gates for tidal management.

**1970's** During the 1970's some farmers, entrepreneurs and the GoB recognised the opportunity for an expansion of commercial shrimp farming in the region. With an increasing demand and high price for shrimp on the international market, shrimp farming was seized upon as part of a 'Blue Revolution', seen as an opportunity to bring economic stability and prosperity to both the southwest and the national economy alike.

During the early stages of development in the 1970's, shrimp farming was mainly restricted to peripheral land between flood embankments and the main river systems. As the embankment system expanded over time, the newly built coastal polders provided an opportunity for intensive shrimp farming. Farmers quickly began to establish shrimp farms further inland, trapping and storing large bodies of salt water for shrimp cultivation. Studies have shown that shrimp farming has the potential to increase soil salinity levels by up to 500% and have proven to be 'the main constraint in...crop production' in shrimp farming & agricultural areas.<sup>ix</sup> Whilst originally constructed to protect agricultural land from the inundation of salt water, what ensued was the intentional flooding of land by small, medium and large shrimp farmers. The conversion of vast areas of previously agricultural land into shrimp ponds or *ghers* quickly increased the salinity levels of soil in the southwest bringing with it environmental decline.

**1980's** Twenty years after its implementation and under increasing pressure, the embankment system began to struggle. Maintenance of sluice gates and management of sedimentation build-up within the river and canal systems were poor. Further upstream, river management systems were established (e.g. India) making river flow irregular and uncontrollable. Elsewhere, *khaslands*<sup>2</sup> and natural wetlands including mangroves and marshes were appropriated for conversion to shrimp farms and extensive numbers of trees were cut down. The

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<sup>2</sup> Government owned land

natural environment, under increasing pressure, further degraded and livelihood options became more limited.

**1990's** By 1994 the GoB, in favor of the shrimp industry, declared the coastal area a “free zone” for shrimp cultivation. Quickly, the most powerful villagers and outside business people entered the region and established extensive illegal pipes and gates to trap brackish water to cultivate shrimp in agricultural land. Installing these piping systems through embankment walls significantly weakened infrastructure, obstructed the flow of water and increased the risk of flood from embankment breach or collapse.

The introduction and proliferation of shrimp cultivation and increasing salinity caused trees and vegetation to die and increased soil erosion and sedimentation in the river and canal systems. As salinity infiltrated the soil and water table, crop yields began to decrease. Faced with few alternatives, small struggling rice farmers accepted offers from private companies and entrepreneurs to lease their land for shrimp farming. More and more land was absorbed through this process as rice farmers were offered long-term lease agreements with large shrimp farming entities for sums of money greater than what they could generate in income from the land themselves at the time.

Land was also often converted by force with large shrimp farmers intentionally releasing saline water into agricultural lands of other small and medium rice farmers to destroy crops (a practice that was reported to still be occurring today). The remaining *khaslands* that were used by the poor to graze livestock were also converted into shrimp farms. Consequently, wide scale land use conflict emerged and social protests ensued.

Slowly, communities began to realize that shrimp farming for small and some medium farmers was not as profitable as they first thought. As time went on and salinity levels continued to rise, people also

realized that their ability to convert back to rice farming would be extremely difficult.

**TODAY,** shrimp production in Bangladesh is highly concentrated in the southwest with Satkhira, Khulna and Bagerhat producing 80% of Bangladesh's *bagda* (saltwater) shrimp. Intensive shrimp production has led to a substantial decrease in diversified livelihood options, reduced resilience and enhanced the vulnerability of communities.

Significant environmental degradation and the monopolization of land by a small number of large-scale shrimp farmers has increased poverty levels throughout the region. The rapid expansion of shrimp farming has sparked land disputes within communities as land values increased rapidly and traditional land regulation systems were altered. In some villages, participants reported 80% of farmers were leasing their land for shrimp farming. In some areas like Shyamnagar Upazila, 30% of the population consulted claimed they were living on *khaslands*. The lack of legal ownership by those inhabiting these lands results in heightened vulnerability to displacement and considerably restricts the will of farmers to invest in those lands and manage them in a sustainable way.

The rice sector, previously the pillar of regional livelihoods has been severely affected by the introduction of shrimp farming. Crop yields suffer and daily labor opportunities have decreased as shrimp is less labor-intensive. People struggle to rear livestock due to a shortage of pastoral lands and cattle feed from rice husks. Homestead gardening has also become increasingly difficult.

As saline water now infiltrates local water tables, many communities are facing safe drinking water crises. As a result, women and children are required to walk longer distances to fetch fresh drinking water or are forced to rely on rain water collection or on water vendors.

High salinity levels are also affecting people's health. Women in particular reported a rapid increase in skin and genital diseases due to pollution and the use of

salty water for washing. A reduction in diversity of agricultural products also has serious health implications for rural communities with diets in shrimp farming areas reported to contain less meat, eggs, milk, vegetables and fish than before the industry's introduction. The decline of livestock breeding is particularly detrimental for children's nutrition in terms of reduced availability of milk and meat. Consequently, according to FAO data 49.8%<sup>x</sup> of children are underweight in Khulna district. Poor

nutrition in shrimp farming areas has been linked to birth defects, stunted growth, night blindness, increased incidences of childhood diseases and increases in miscarriages, maternal morbidity and mortality. Other indirect health affects as a result of shrimp farming include increases in waterborne diseases as a result of less frequent boiling of water due to decreased sources of fuel such as wood.

## THE IMPACT OF CLIMATE CHANGE AND NATURAL DISASTERS

The effects of climate change have already begun to increase barriers to growth in the southwest. Rising sea-levels as observed by communities through increasing high tide levels not only adds additional pressure on the embankment system but further enhances the penetration of salinity inland via the river and canal systems. The potential repercussions of sea-level rise in Bangladesh and the southwest in particular are significant. A 1 meter relative sea level rise (90 cm sea level rise and 10 cm subsidence) would inundate 14% of agricultural land,<sup>xi</sup> devastating the lives and livelihoods of many communities, undoubtedly resulting in high levels of migration to other parts of Bangladesh.

According to farmers, rain patterns have also changed in the last decade, most noticeably in the last 5 years. They noted dry spells, a reduction of winter season rainfall and a sharp increase and erratic pattern of monsoon rains. Increasing temperatures and erratic monsoon patterns negatively affect shrimp, agriculture (including rice) and homestead gardening. Rice farmers now struggle to predict rainfall patterns which has resulted in reduced crop yields when irrigation is not possible or affordable.

While not scientifically proven as yet, it is predicted that the frequency and ferocity of cyclones will increase in Bangladesh with climate change. 'The

UNDP has identified Bangladesh as the country most vulnerable to tropical cyclones<sup>xii</sup> with approximately 53% of the global deaths due to tropical cyclones having occurred in Bangladesh.<sup>xiii</sup> 'The year 2007 was indicative of the vulnerability of coastal populations and the development challenges faced by the government. Severe flooding from July to September along the Ganges and Brahmaputra rivers affected over 13 million people and caused extensive damage to agricultural production and physical assets. This devastating event was shadowed by cyclone Sidr which made landfall across the southern coast on the 15<sup>th</sup> of November, causing a further 3,406 deaths<sup>xiv</sup>. The cyclone destroyed over a million tonnes of rice and incurred over US\$1.6 billion in damages and losses<sup>xv</sup>. Just two years later, on the 25th of May 2009, Cyclone Aila struck the same region, causing damage worth US\$552.6 million (2009 USD rate).

Cyclone Aila damaged or fully destroyed many embankments in the southwest coastal belt region, allowing salt water to inundate the land for months at a time. While the Water Development Board, GoB and other civil society actors worked hard to rebuild these protective walls, many were either poorly reconstructed or not addressed quickly enough. As a result, many people were displaced for months or in some cases, years afterwards. Many other parts of

the affected areas experienced flooding twice daily with each high tide for up to two years following Aila.

During this period, many communities were also unable to cultivate crops and communities suffered. For an area already struggling with salinity, the inundation of lands with salt water for such an extended period of time has had devastating effects. While most embankment walls have been repaired, communities continue to face serious income and food security issues with crop production struggling as a result of soil quality and salinity. Many farmers are still only able to produce a single crop per year (*ek fosholi*) and many struggle to engage in supplementary income-generating activities such as homestead gardening.

As a consequence, many small farmers have been forced to obtain loans in order to buy food or replace vital assets lost in the cyclone(s). Often, small farmers, with few alternative options, have been forced to either give their land as guarantee for loans from large shrimp farmers or to accept extensions on land leases in exchange for immediate cash payments. Most of them are still unable to pay back their debts and are trapped in a vicious cycle of indebtedness and poverty.

Although the combined efforts of the GoB, (I)NGOs and UN agencies to repair roads and embankments greatly contributed to the recovery of the area, some households and communities continue to be

displaced in 2012. Embankment walls continue to breach or collapse in some regions (e.g. Koyra), perpetuating the effects of Aila, causing continued destruction of communities, livelihoods and further exacerbating the salinity problem.

In 2012, many communities continue to live in a post-disaster setting with livelihoods such as shrimp farming, rice farming and other agriculturally-based activities continuing to suffer. Daily high tides, unsustainable salinity levels, drinking water crises and few alternative income-generating options mean people in some areas are still engaging in negative coping techniques and are unable to successfully develop effective adaptation strategies.

Regional vulnerability to cyclones and other natural disasters is significant with many people still unable to access appropriate shelters when necessary. Ongoing extreme poverty levels reduce people's resilience and recovery capacity and increase the likelihood of food insecurity in post-disaster settings.

While the GoB has made efforts to improve the early warning systems (EWS) including establishing or re-establishing communication & access channels since Aila, these remain extremely poor in some areas, leaving people isolated and unprepared for major climatic events.

## **COPING STRATEGIES AND EXIT ROUTES**

On a very practical level, disasters and climate change in the southwest has forced individuals to use different strategies to survive.

Some of these coping strategies have in fact made people and communities more vulnerable to natural and climatic disasters in the long-term. These strategies are undertaken in the immediate aftermath of a disaster and are often negative or detrimental in

the medium to long term if engaged in on an ongoing basis.

Exit routes, however, are strategies which enable a household or individual to move out of poverty. Exit routes from poverty can be implemented through long-term livelihood strategies, through education, improved health or access and control over assets, enabling households to be resilient to shocks.

## Coping with disasters

Coping capacity of affected communities following Sidr and Aila has been very poor. Many households reported the loss of all assets and livelihood options and as a consequence were forced to engage in negative coping strategies such as reducing their daily meal intake to survive. 61% of households reported reducing their daily meal intake to two meals per day and 31% reporting reducing their intake to just one meal per day. A Joint Needs Assessment conducted in the area in 2010 found that not only were people reducing their intake but that they were unable to afford food items beyond rice and lentils<sup>xvi</sup>. This in turn dramatically affected their nutritional intake. Women in particular were the most severely impacted as they often reduced their meal intake or food diversity to preference household income-earners (usually the male of the household) or their children.

40% of interviewed participants also reported being forced to sell personal possessions to obtain fast cash in the immediate aftermath.

Damage caused by Sidr and Aila to shrimp, rice farms and the fisheries industry was extensive. As a result, daily labor opportunities on farms and fishing boats were severely impacted forcing many to migrate to other areas to find work. Generally in recent years, the decline of paddy production has deprived thousands of households of labor opportunities. Some farmers have found limited alternative income and employment as brick makers, rickshaw drivers, and unskilled labourers. Cross-border migration to India is increasingly common (as the daily wage is double). The average duration of yearly economic migration in and out of the country is of 6 to 8 months, fragmenting families and increasing the number of female-headed households.

While accessing credits and loans from various sources is widely utilized among poor households in the southwest, the devastating effects of Sidr and Aila resulted in many more being forced into unsustainable debt to cover their urgent needs with 30% of interviewed participants obtaining loans

during the post-disaster period. Some households have reached levels of indebtedness so great that at one point will, or already has forced them to sell assets such as land to be able to repay their debts.

While the Sundarbans are protected under conservation law, many assessed communities living close to the region rely heavily on its natural resources both before Sidr and Aila and even more so afterwards. The Sundarbans are used for fishing, crab fattening, extracting leaves, firewood, honey and fruits according to the seasons. Those who are forced to go to the Sunderbans to collect wild products are highly vulnerable to tigers and pirate attacks.

It should be noted that whilst relief efforts aim to limit the need for communities to rely on negative coping strategies, recurrent provision of aid and assistance within this region has resulted in some households becoming aid dependent: when interviewed, 25% of community members reported dependency on cash for work or payment-in-kind schemes over the past two years.

## Moving Forward...Adaptive Strategies

Households in the assessed areas continue to seek appropriate and effective exit strategies, attempting to overcome barriers to escape poverty. Some small land owners have begun reclaiming previous leased land to begin shrimp farming themselves. While this action brings income back to some of the poorest segments of the community, it also continues to add to the salinity problem which in the long run will only continue to have detrimental effects on the lives of everyone in this region if not addressed.

In Gabura Union and Singhortoli village, small land owners are converting land back to rice after many years of shrimp farming using innovative strategies. With access to a water table and the ability to make a small investment, they are introducing irrigation to crops and homestead gardening which previously did not require it, e.g. Aman rice. Moreover, through the

introduction of irrigation, farmers are no longer reliant on inconsistent monsoon rains and can pump their fields should they become too full to avoid drowning crops.

The development and introduction of saline-resistant rice varieties has and will continue to be critical to the continuation and growth of the rice industry in the southwest. Successful implementation of new saline-resistant varieties (such as the Bangladesh Rice Research Institute (BRRI) dhan 41 & 42 as well as the BR10 & BR23) have demonstrated the ability of these varieties to produce the same yield levels as ordinary rice in moderately saline environments.<sup>xvii</sup> However, farmers often reported insufficient knowledge or capacity to introduce alternative or saline-resistant crop varieties by themselves. Where people were attempting to introduce new techniques or seeds variety, it was noted that further technical assistance would be beneficial.

While paddy has been the traditional agricultural practice in the region, alternative crops have also been introduced recently. According to a recent study by the Bangladesh Centre for Advanced Studies, 91% of surveyed households in Khulna and 85% of

households in Satkhira reported having recently introduced saline-resistant crop varieties as a method of adaptation to increasing salinity levels.<sup>xviii</sup> Saline-resistant crops such as date palm, sweet gourd, wild water chestnuts, chickpeas, reed and sweet potato are just some options for further investigation.

Other proven strategies to reduce salinity and enhance diversification of livelihood options include the introduction of crop diversification and short-lifecycle crops.

Expansion of the GoB funded beehive initiative observed in Singhortoli village not only assists in livelihood diversification but reduces the need of people to risk their safety collecting honey in the Sundarbans.

For communities close to the Sundarbans or who have access to rivers, canals or a large body of water, crab cultivation is another diversification option. Crabs can be used for household food consumption or sold at market, generating income. Communities in the assessed region have previously established floating gardens and utilized other traditional practices as a means of ensuring crop yields in an environment so prone to flooding as well.

## CONCLUSIONS & RECOMMENDATIONS

This study has demonstrated the intricate landscape of compounding factors working against those attempting to lift themselves out of poverty in the southwest coastal belt.

The unique tidal wetlands of the southwest have always maintained some level of salinity yet the soil remained fertile and rice production was high. It was not until the embankment system and subsequent introduction, promotion and proliferation of shrimp farming that salinity became such a serious problem. Today, the southwest faces a development-induced disaster as salinity infiltrates soil and water tables,

threatens crops and kills vegetation. Shrimp farming perpetuates and increases salinity levels in the region, reducing options for livelihoods diversification and daily labouring opportunities. People are now often forced to migrate for work. Salinity affects homestead gardening and agricultural farming, making it more difficult to produce strong yields and in some observed cases, making it impossible to grow anything at all anymore. As livelihoods become less diversified they become more vulnerable to both natural disasters and the effects of climate change.

Salinity levels are also threatening safe drinking water with communities reporting crises in the area. A lack of fresh water is forcing women and girls to travel greater distances to access drinking water which not only causes health complications but also exposes them to greater risks of abuse and exploitation.

Compounding this problem, the effects of climate change are adding increasing pressure on this fragile environment. The threat of future natural disasters such as cyclones Sidr and Aila is increasing. Sidr and Aila destroyed people's homes, assets and livelihoods. They broke embankment walls, allowing saline water to inundate the land, exacerbating the salinity issue. Flooded for up to two years following Aila, many communities were displaced for months or years at a time following this event. As a result, this region continues to be in a state of post-disaster recovery.

Communities are also now reporting increasing temperatures, high tides, erratic rain patterns and unpredictable weather events. In a region already experiencing extensive chronic poverty, coping and adaptation capacity under these circumstances is extremely limited as farmers struggle to protect crops against changing weather patterns.

**Establishing and enhancing livelihoods resilience, maintaining food security and fostering development are now the main priorities for the region.**

The existing method of reactive, short-term aid delivery is insufficient in the current circumstances. The complexities of this situation require a long-term approach designed to strengthen community resilience, as well as recovery and adaptive capacity to the changing environment. A bottom-up approach to encourage agriculturally-based action could begin to address some of these critical weaknesses.

Supporting the introduction of saline-resistant rice varieties and facilitating links between farmers and relevant government and private agricultural service providers (such as Sub-Assistant Agricultural Officers (SAO's) from the GoB's Department of Agricultural

Extension (DAE)) would enhance the communication and knowledge sharing channels between community and government. Ensuring information and knowledge reaches community level through frequent and effective communication between SAO's and farmers would provide sustainable support to farmers wishing to implement innovative farming techniques in the region.

Additionally, whilst GoB policy and programs attempt to address climate change and disaster risk reduction nationally, advocacy for a regionally specific, climate adaptive agricultural extension service by the DAE as well as the strategic utilization of all existing institutional instruments is required.

In 2012 the World Bank announced that it will fund the GoB's Water Development Board in *the Coastal Embankment Improvement Project* which aims to repair, reinforce and improve the general maintenance of the embankment system in the southwest. This project is expected to take upwards of 15-20 years in a multi-phase approach worth \$365 million. With the World Bank and GoB addressing one of the regions inherent weaknesses, utilization of this opportunity to promote and strengthen sustainable livelihood options is critically important.

Programs which encourage the conversion from predominantly shrimp to a more diversified agricultural system could have substantial impacts. Communities openly acknowledged the potential benefits of returning to rice farming. The reintroduction of rice would help to reduce salinity which in turn would allow vegetation and homestead gardening to flourish once more. Livestock rearing would become easier, generating cattle feed from rice husks. Straw could be used to build roofs, daily labor opportunities would increase and people would have other alternatives than going to the Sundarbans for resources. Over time with the decrease in shrimp farming, salinity, and therefore the threat to safe drinking water, would decrease.

This shift from shrimp to rice or agriculture is costly though and most small and medium farmers in the

delta are currently trapped in a vicious cycle of poverty. As a result, support is needed by government and civil society to assist those wanting to make the conversion to do so.

One recommendation would be to target small landowners and farmers in communities with an existing mix of shrimp and paddy farms to encourage a return to balanced agricultural activities such as rice farming and/or saline resistant varieties of vegetable and/or sweet water prawns/fishes. The introduction of crop diversification and short lifecycle crops would enhance resilience and the ability of farmers to recover quickly after disasters.

Activities would require strong local government support and be closely linked with relevant

government departments (such as the DAE). Training and education on the use of flood irrigation techniques to reduce salinity levels to allow rice and vegetable cultivation would be a priority focus. Market acceptance analysis of different crop and rice varieties should be undertaken as well as support for horizontal knowledge-sharing between farmers on saline-resistant crop varieties and appropriate variety selection.

Action research on factors contributing to effective recover and enhanced resilience in the region should also be undertaken simultaneously.

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<sup>ii</sup> United Nations Development Programme (UNDP) (2007) '*Human Development Report 2007/08: Fighting Climate Change: Human Solidarity in a Divided World*'. Basingstoke, United Kingdom: Palgrave-MacMillan.

<sup>iii</sup> Department of Environment, Ministry of Environment & Forests (2009) '*Adaptive Crop Agriculture Including Innovative Farming Practices in the Coastal Zone of Bangladesh*'. Dhaka: Climate Change Cell.

<sup>iv</sup> World Bank (April 2011) '*Climate risk and adaptation country profile*', The World Bank Group.

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<sup>vi</sup> Bangladesh Bureau of Statistics (2010) '*Report on the Household Income and Expenditure Survey 2010*'. Dhaka: Bureau of Statistics. Available at: <http://www.bbs.gov.bd/PageWebMenuContent.aspx?MenuKey=320> (Accessed 15<sup>th</sup> August 2012).

<sup>vii</sup> World Bank (2012) '*Project Information Document: Coastal Embankment Improvement Project - Phase 1(CEIP-1) (P128276)*'. The World Bank Group. Available at: <http://web.worldbank.org/external/projects/main?pagePK=64283627&piPK=73230&theSitePK=40941&menuPK=228424&Projectid=P128276&cid=3001> (Accessed 17<sup>th</sup> June 2012).

<sup>viii</sup> Bangladesh Water Development Board (2012) Coastal Polders. Available at: [http://www.bwdb.gov.bd/index.php?option=com\\_content&view=article&id=167&Itemid=177](http://www.bwdb.gov.bd/index.php?option=com_content&view=article&id=167&Itemid=177) (Accessed 10<sup>th</sup> July 2012).

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<sup>ix</sup> Environmental Justice Foundation (2004) *'Desert in the Delta: A report on the environmental, human rights and social impacts of shrimp production in Bangladesh'*. London, UK: Environmental Justice Foundation. Available at: <http://eifoundation.org/shrimp/desert-in-the-delta> (Accessed 24th June 2012).

<sup>x</sup> Agriculture & Consumer Protection Department (2010) *'Nutrition Country Profile: Bangladesh'*. Food & Agricultural Organisation (FAO) of the United Nations, Available at: [http://www.fao.org/ag/agn/nutrition/bgd\\_en.stm](http://www.fao.org/ag/agn/nutrition/bgd_en.stm) (Accessed 5<sup>th</sup> July, 2012).

<sup>xi</sup> Mahtab, F.U. and Karim, Z. (February 1992) 'Population and Agricultural Land Use: Towards Sustainable Food Production', *AMBIO, A Journal of Human Environment*, XXI(1).

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<sup>xvi</sup> Joint UN multi-sector assessment & response framework (June 2010) as cited in Bernon, N. (2011) *'Technical Assessment Report: Bangladesh: Aila Affected Areas'*. Paris: SOLIDARITES INTERNATIONAL.

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