Environment, Migration and Adaptation

Evidence and Politics of Climate Change in Bangladesh

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দ্বিতীয় অধ্যায়। বাংলাদেশের পরিবেশ, রাজনৈতিক অর্থনীতি এবং জীবনযাত্রার পরিবর্তন

Brooke A. Ackerly, Mujibul Anam and Jonathan Gilligan। *ব্রুক আকর্লি, মুজিবুল আনাম, জোনাথন গিলিগান*

বাংলাদেশের দক্ষিণ-পশ্চিমাঞ্চলের রাজনৈতিক অর্থনীতি এবং জীবন-জীবিকায় মধ্যম স্তরের পরিবর্তনসমুহ পর্যালোচনা করলে একটি বিষয় স্পষ্ট হয় যে, প্রাকৃতিক পরিবেশে জলবায়ু পরিবর্তনের প্রভাব বোঝার জন্য আমাদের অবশ্যই পরিবেশ ও পরিবেশের সাথে জড়িত রাজনৈতিক অর্থনীতির গতিশীলতা সম্পর্কে স্বচ্ছ ধারণা থাকা প্রয়োজন। এদেশের প্রাকৃতিক পরিবর্তন বলতে সমুদ্রপৃষ্ঠের উচ্চতা বৃদ্ধি, মাত্রাতিরিক্ত লবনাক্ততা এবং সাইক্লোনের প্রগাড়তা বৃদ্ধি এগুলোতে বুঝানো যেতে পারে। ক্ষতিগ্রস্ত এলাকার প্রাকৃতিক পরিবেশে মধ্যম স্তরের রাজনৈতিক অর্থনীতি মানুষের আয়ের উৎস ও জীবন জীবিকায় ক্ষতিকর প্রভাব রাখে এবং ফলশ্রুতিতে তাদের এই পরিবর্তিত প্রাকৃতিক পরিবেশের সাথে খাপ খাইয়ে নেয়ার সামর্থ্যও প্রভাবিত হয়। এই গবেষণায় গবেষকগণ অন্তর্বর্তী রাজনৈতিক অর্থনীতিকে পর্যবেক্ষণ করেছেন এবং যার ফলাফল স্বরূপ দেখেছেন যে, অন্তর্বর্তীকালীন রাজনৈতিক অর্থনীতি বাংলাদেশে মানুষের শ্রম স্থানান্তর পরিকল্পনাকে তাদের জীবন-জীবিকার পরিকল্পনার সাথে একীভূত করে।

CHAPTER 2: ENVIRONMENT, POLITICAL ECONOMIES AND LIVELIHOOD CHANGE

Brooke A. Ackerly[1a*], *Mujibul Anam*[b] *and Jonathan Gilligan*[c]

SUMMARY FOR POLICY MAKERS

Between the national and household factors, community or "meso-level" changes in political economy and livelihoods in southwestern Bangladesh illustrate that in order to understand the impacts on people and nations of climate change-related environmental changes – changes that are expected to include rising sea level, saline inundation, and increased likelihood and intensity of cyclones in Bangladesh – we need to understand the dynamics of the built and natural environment and the political economies these sustain. Meso-level political economies affect the sources of income and livelihood available in distressed environmental conditions, and therefore influence how well the people in them can adapt to changing environmental conditions. In this study we have seen the underlying political economies whose dynamics, and not slow onset environmental changes or disastrous environmental events, are pushing Bangladeshis to incorporate migration strategies into their livelihood strategies.

Keywords: climate change, political economy, human-environment coupling, scale

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1. INTRODUCTION

In a statement delivered to the World Meteorological Organization on May 16, 2011, Sheikh Hasina outlined the ways climate change is impacting Bangladesh:

> "Today, climate change poses a serious challenge to human existence. Among the frontline countries confronted by the impacts of climate change, stands Bangladesh. For several decades we have been experiencing the gradual increase, frequency and erratic pattern of floods, river erosion, cyclones, earthquake murmurs, tidal bores, encroachment of salinity in the low lying coastal areas due to sea rise, and desertification. These natural disasters have been threatening our food, water and health security, biodiversity, ecological balance, as well as diminishing livelihood options and income levels."(Hasina 2011)

Even while climate scientists might dispute the relationship between anthropogenic climate change and the environmental conditions of Bangladesh, there is no disputing that Bangladesh is on the "frontline" of climate change. Therefore, studying the impact of climate change on people means studying the impacts of environmental change on the people of Bangladesh.

However, climate change is happening on a time scale of decades, with impacts that will persist for tens of thousands of years (Solomon et al. 2009; Matthews and Solomon 2013), whereas people deal with most environmental conditions on a seasonal scale. Moreover, the changes in the impacts of environmental conditions on people's lives has a lot to do with social, economic, and political conditions as well as the engineered or built environments, which have a long history and which change at yet other temporal scales – some annually, some seasonally, some in response to foreign aid construction projects, some with generational changes in social norms. Additionally, climate change is often discussed at a global scale whereas environmental conditions, including changing climatic conditions, are experienced at the level of community. This study addresses the mismatch between the scale on which climate change takes place and the scale at which it is experienced: the community.

Although climate change is bringing new environmental pressures or enhancing existing ones, Bangladeshis have always lived in a dynamic physical environment. People have always adapted their livelihoods to environmental opportunities and risks. Sometimes that has been through feats of engineering. Sometimes that has meant adopting seasonal migration strategies or long-term migration for employment or education for certain family members. In addition, there has been a trend of rural to urban migration. Given a background context of reengineering and migration for livelihood, it is difficult to assess the relationship between environmental change and a *change* in migrationpatterns. While it may be easy to see trends in increased migration following changes in certain aspects of rural life, the *difference* in migration caused by these changes – or caused by climate change – cannot be discerned without measures of the differences in the differences of all of the relevant variables.

Given these dynamics, we had no preexisting hypothesis to test.[2] Rather, this study is a theory-seeking study designed to identify principle patterns in the relationship between environmental change and human adaptation. Studying this relatively new area of social change requires applying existing social science tools to new questions *and* bringing together existing methods in new ways. In this article we describe meso-level mixed qualitative methods for observation of social, economic, political, and engineered conditions to understand the dynamic changes in these conditions. Meso-level data are data that speak not to broad "macro" national or global patterns, nor to "micro" household patterns. Rather meso-level analysis provides insights into the dynamics within and among *communities*. Analysis of multi-sited meso-level data enables us to study how people respond, adapt, and bring about change in how they live together. Some meso-level observations can be made with a studied eye or with elite interviews. But other aspects of meso-level dynamics can be observed only with more nuanced qualitative methods, which can reveal the complexity of these dynamics. Second, using grounded analysis of such qualitative data, and triangulating across data sources and methods, we use feminist tools of analysis, particularly intersectional analysis to review the complexity of forces that effect how we live together, some of which seemingly have no direct bearing from climate change or on migration.

Focused on meso-level processes, we draw on research from the first two years of an interdisciplinary and trans-institutional research partnership to reveal findings about the dynamics of community-level political economy and the experience of environmental change. Sited in the southwest of rural Bangladesh, an area vulnerable to cyclones and undergoing significant changes in land use, the study finds that the relationships between environmental change and migration and between environmental change and other livelihood changes (including changes in sources of income as well as changes in well-being) are dynamic at the community level.

2 This research is part of ISEE Bangladesh, a multi-disciplinary, multi-university (Vanderbilt, Columbia, Dhaka, Khulna, and Jahangirnagar) project studying community and regional resilience to environmental change in the coastal Bangladesh. The partnership is funded by the U.S. Office of Naval Research. Vanderbilt IRB approval 120454 (http://www.vanderbilt.edu/ISEEBangladesh/about.php). The data and analysis from this research referenced in this article were collected from 2012 to 2014 using Qualitative Comparative Analysis of forty communities in the southwest of Bangladesh, selected based on their vulnerability to cyclones and inadequate fresh water throughout the year. The study includes the study of the sedimentology, hydrology, sociology, economics, and politics in historical perspective. Additional data collection and analysis is still ongoing. Persons whose efforts significantly contributed to the data analyzed in this article include S. Goodbred, L. Wallace, J. Ayers, J. Gilligan, "L." Mujibul Anam, S. Md Saikh Imtiaz, B. Mallick, and A. Carella. The research was made possible by Sayed Md Saikh Imtiaz and Md Mujibul Anam leading the social research teams, Steve Goodbred leading the collection and analysis of physical science data, and Jonathan Gilligan partnering in integrating our analyses. Preliminary research by Bina D'Costa, Gouranga Nandy, and Steve Goodbred was essential for site selection and the development of a research design that focused on hypothesis generation.

1. These dynamics are caused by a changing political economy, which is both causing and responding to environmental conditions, and not by environmental change understood as an exogenous (outside) shock.
2. These dynamics have an effect not only on incomes, but also on the non-monetized sources of livelihood.
3. These dynamics and macro-level factors have contributed to the declining reliability of some traditional sources of livelihood and to increased reliance on other sources.

While certain communities may exhibit dynamics similar to those found in one or another community, the generalizable substantive finding of this study is that the study of the human adaptive response to environmental, social, and economic conditions is contingent. Some of these contingencies such as foreign aid and global economic trends are external. Others are internal and have to do with local political economies. The generalizable methodological finding is that the study of climate change and migration at the scale of being observable through social science in our lifetime is a study of contingencies and meso-level dynamics, not just broad cross-national patterns.

While climate change is a global phenomenon, the experience of it is local and strongly affected by the local social, economic, political, and engineered environment (Parry et al. 2007). More narrowly connected to the theme of this book, environmental change mediated by the local social, economic, political, and engineered environment and its effects on livelihood – not the environmental changes directly – are the likely sites of influences on migration. Bangladeshis' livelihoods often include sources of income related to seasonal or long-term migration of some or many family members, and these sources of income vary by community, religion, and region. However, given these dynamics, it is difficult to assess the incremental effect on mobility that might be caused even by those environmental changes, which people connect to climate change.

2. METHODS

Although there are political and expository reasons for focusing on the broad patterns of climate change, the story gets more complex, more interesting, and more telling when we disaggregate from the global patterns of insecurity due to poverty and climate change, to discuss the changing socio-political economies of particular communities. This study uses meso-level data where the "meso-level" is the community-level. At the community level we can observe the complexity of social, economic, political, and environmental dynamics. The study uses Qualitative Comparative Analysis (QCA) to identify those factors at the community level that function in relation to one another.

Site: Meso-level and interdisciplinary observations

Southwestern Bangladesh is a globally relevant site for studying the localized ways in which certain global trends are experienced because it is a site of enduring poverty, of anticipated local pressures due to climate change, of the global export market for shrimp which might be considered a climate adaptive economic strategy, and of vulnerability to seasonal flooding and severe cyclone events which are expected to increase. During the decade of advancement toward the Millennium Development Goals, the southwest of Bangladesh did not see the same improvements that other regions did. Additionally, when countries discuss the impacts of climate change globally, they often cite the populations of the low-lying river delta of Bangladesh as those at the greatest risk of being significantly affected. In these two ways the region of southwest Bangladesh is already important on the global stage. However, as the following discussion shows, much of what is relevant for global climate justice about the circumstances of the people who live in Bangladesh is not currently being discussed on that same stage.

In 2010, a small team began researching the dynamics among environmental change, human adaptive response, environmental impacts, and human action.[3] We situated this research in Bangladesh where we had combined decades of experience and where we understood these dynamics to be pressing matters of human and environmental sustainability. The initial research, in the context of teaching a class, led us to realize that understanding the physical and social dimensions of these dynamics required data at the local scale *and* data on the broader systemic forces of which the local is a part. We began to focus on the southwestern region and the external forces influencing its political economy, its human-built infrastructure, and its nature-constructed environment. In September 2011, an advance field team led by Bina D'Costa and guided by Gouranga Nandy revealed the complex nature of the underlying political economy. These included changes in land use related to shrimping and political activity related to resisting shrimping. These also included variability in the national response to the impacts of low-mortality, high-damage cyclones and the impact the storms and recovery efforts had on local economies. Satellite imagery of our region of study before and after a major storm (cyclone Aila May 2009) drew us to focus our initial study on a place where, affected by the same storm, some communities were able to recover quickly and others were not.

3 This team was led by Brooke Ackerly, Jonathan Gilligan, and Steve Goodbred and, as mentioned in the text, began as part of a course in which students from Dhaka University and Vanderbilt University participated.

Qualitative data

The findings reported here are from qualitative data collected before the monsoon season in 2012 and 2013. The time of year was selected because employment opportunities are low and the opportunity cost to a villager of participating in our research was low. We studied thirteen sites with varied political economies. The communities of study were close enough to each other that we were able to study inter-community dynamics as well as intra-community dynamics. All of the communities are in the poldered region of southwest of Bangladesh; most of the population of these communities lives within those polders, though our study is also informed by those living outside of the polders on land that has accrued due to the deposits of river sediment. All of the communities were in the path of Aila.

The definition of "community" was determined using a grounded approach. In a qualitative method called a "village transect walk," at each site, researchers walked throughout the community, asking villagers to identify its landmarks, boundaries, neighborhoods, fields, water sources, and other infrastructure. We used three other qualitative methods designed to provide us with a rich understanding of the community dynamics without becoming part of the community and deploying more ethnographic methods. The first were key informant interviews. Key informants were defined broadly as those with particular knowledge of an aspect of village life. We interviewed at least one person experienced in each livelihood that community members relied upon in the community, including migrants, day laborers, and the unemployed. Key informant interviews generally lasted up to an hour and were conducted following an open format.

We used participatory rapid appraisal methods in three ways: to provide a village map, to develop a seasonal calendar for each village, and to map the mobility and seasonality of movement of villagers.

In addition, we supplemented these methods with targeted focus group discussions, usually topically oriented. In each community these included a women's focus group.

This range of qualitative data enabled us to develop an understanding of the social, economic, political, and environmental dynamics of a village from the villagers' perspectives, without relying on only a handful of sources.

Qualitative Comparative Analysis

Qualitative comparative analysis (QCA) is a method that uses more than two cases but too few for statistical analysis in order to identify configurations of factors that generate different outcomes. The method is useful when studying processes and relationships that are not generally understood. In addition to determining what factors are important, QCA helps us determine which are important in relation to one another.

Generalizability to other contexts

The concern with meso-level analysis and QCA of a small number of sites might be that the findings are not generalizable across contexts thereby making it difficult to draw policy implications. Certainly, there are some community-level findings which are not generalizable, which might in fact be read as particular description. However, as we will see in the discussion of findings, QCA reveals the importance of analyzing local contexts in relation to exogenous shocks or dynamics that operate at a larger scale than the given context. *This methodological finding* is very important for the study of the relationship between humans and their environments, particularly when the goal is to understand how people survive stresses and respond to opportunities coming from outside.

3. FINDINGS

The dynamics between humans and their environment in coastal Bangladesh are nested contexts of global, regional, and local forces – some of which are human-led, some of which are environment-led, some of which are events, some of which are trends. These dynamics are visible at the meso-level context of study.

Background of the changing human-altered and nature-altered landscape

The area of study sits just north of the Sunderbans mangrove forest, the largest mangrove forest in the world. The UNESCO World Heritage Site covers parts of Bangladesh and the Indian state of West Bengal. It contains valuable natural resources that communities abutting the Sunderbans have relied on for years, including crabs, honey, fish, (formerly) wood, and golpata which locals use to build their roofs. Use of these resources is controlled by permit.

The population of the rural southwestern region of Bangladesh (and of the rural east of West Bengal) has historically adapted to storms and seasonal variation in sources of livelihood, smoothing out their consumption, not without hardship, but generally without unrest. There have, however, been a couple of economic changes and responding social movements that have affected the physical landscape and arguably the political landscape.

People were engaged in seasonal agriculture and fishing. The people had developed a practice of seasonally building embankments to protect the rice fields from excess water in the monsoon and post-monsoon seasons, and from saline tidal river water in the dry season. However, for approximately four months out of the year, when the tidal water is sweet, but not so voluminous as to inundate the fields, they let the sweet river water irrigate and deposit sediment in the fields.

In the 1960s and 70s, following recommendations from the United Nations, and with financing from USAID and ADB, the government built embankments or "polders" around the river islands. Poldering is the practice of reclaiming intertid-

al lands – land along tidal channels that is submerged twice a day by high tides – with embankments, following the model of the Netherlands. In the 1950s and 1960s, upon recommendation by the Krug mission, the East Pakistan Water and Power Development Authority (WAPDA) was established and in 1964 it embarked upon a massive program of poldering, called the Coastal Embankment Project (Islam and Kibria 2006, p. 4). The plan was continued after independence by the Bangladesh Water Development Board (BWDB) (Thompson and Sultana 1996; Ali 2002). Communities still refer to the polders as "WAPDA." Poldering changes the dynamics of tides in the rivers and tidal channels and changes the transport, deposition, and erosion of sediment. In the natural landscape, the twice-daily inundation by tides constantly deposits fresh sediment and builds the land up as sea level rises or the underlying land subsides. With permanent embankments, this seasonal inundation is prevented, but without the annual supply of sediment, the landscape cannot adjust to subsidence or rising seas and may thus end up more vulnerable to catastrophic flooding should the embankments breach (which they did in 2009 due to cyclone Aila).

The clay soil of the region has properties that prevent water from seeping from the rivers and channels onto the land and, therefore, the land and water inside the polder is protected from the brackish (saline) water of the estuary. The difference in the height between the land and the rivers is such that people can control the flow of water onto the land with sluice gates which, when opened at high tide, let water run onto the land and when opened at low tide, let water run off the land. Initially, this poldering allowed these islands in an estuary to become part of the farmland of the green revolution. Rain catchment in internal canals and ponds during the monsoon season enabled people to have the necessary water for drinking and irrigation throughout the year, and they grew three seasons of crops. At the same time that it produces hazards, poldering also produces opportunities to expand agricultural production to land that could not otherwise be cultivated. It produces conflict over both control of and responsibility for maintaining and managing embankments and sluice gates that control the flow of water into and out of the interior.

Bangladesh has been rice self-sufficient, but growth in gross domestic product needs to be fueled by foreign exchange (Zaman 1983). These have been primarily remittances from Bangladeshis abroad and exports, primarily the ready-made garment sector, but fish and shrimp contribute to exports as well. Through enabling large-scale shrimp agriculture, the polders support the earning of foreign exchange and are part not only of disaster prevention but also of development initiatives funded by the World Bank and Asian Development Bank.

Southwestern Bangladesh has been experiencing on-going river migration and saltwater intrusion. This means that some people report that their field used to be a river bed, others that the river now covers their family home. These changes take place within the living memory of young people. In addition, this is a region that experiences seasonal flooding, though the severity varies by year, and occasional cyclones. The communities of this study felt the impact of cyclone Sidr (2007) and were severely affected by cyclone Aila.

Cyclone Aila (2009) further reduced the range of livelihood options in the region because agricultural fields were inundated with brackish tidal water from failed embankments. As mentioned above, external embankments let in river water and the force of the storm and subsequent tidal flows eroded internal embankments as well, making the satellite images of the region reveal tiny lines, which were the embankments with water on either side. Because the embankments were put in decades ago, the land within the embankments had subsided and, without renewal of sediments from seasonal flooding over those decades, was significantly lower than the river or channel, particularly at high tide. Until the embankments were rebuilt, people could resume neither agriculture nor aquaculture. The global economic crisis reduced government and foreign aid resources, and breaches in some of the reconstructed embankments meant that some embankments were still being rebuilt in 2012. In some communities affected by Aila land was intertidal and, therefore, inundated with salt for more than two years.

In a poldered context, cyclonic storm surges are one of many factors that threaten the integrity of the embankments. Waterlogging is one of many hazards that the embankments can both exacerbate and ameliorate, depending on the way they are designed and used. By altering the physical landscape, embankments also alter the social, economic, and political landscapes by defining the spaces in which people will live, travel, farm, and fish; by delineating boundaries between communities; and by creating economic and political power relationships surrounding the construction, maintenance, and control of the embankment.

It is important to emphasize that this does not imply that things would clearly have been better if the polders had never been built. Without polders, the entire island would most likely have remained intertidal, and thus might not have been capable of supporting a large population. The principal danger the polders created may have been to attract tens of thousands of people to live on an island that might otherwise have been only marginally habitable. Whether the tradeoff of increased vulnerability to extreme events, such as Aila, outweighed the benefits of decades of productive farming is not our judgment to make.

Changing political economy

The agricultural benefits of poldering the landscape persisted for a couple of decades but by the late 1980s, the region began to develop shrimp aquaculture for export. The region of southwestern Bangladesh was attractive for this purpose because of the poldering system. Land abutting a canal could be converted to shrimp aquaculture by letting in salt water at high tide and draining off the water at low tide, thereby making it easy to clean the shrimp ponds (Islam 2006).

However, this transformation affected different populations differently. For some, shrimp production could be quite lucrative. Outsiders sought to lease land for shrimp production, often using physical or other intimidation to secure the leases and not returning to the land owner the full promised returns. Landowners then sought to do the shrimp farming themselves with the goal of securing the

returns (which were higher than that for rice) for themselves. Disputes around entitlement to land use were not conflict-free, though in the interest of protecting our respondents we are not including details.

Shrimp production also changes the political economy in ways that exacerbate inequalities among people in poverty. Shrimp aquaculture is much less labor intensive than rice cultivation. Thus, among people in poverty, shrimp provides employment for some and forces others to find other sources of livelihood. Those displaced may shift to wage labor in the local fishing economy, migrate for seasonal agricultural work or to shrimp processing factories, or designate a family member to go for factory work in Khulna or Dhaka for a few years. Some of these opportunities existed prior to the growth in shrimping. Both kinds of factory work have been supported by growth in these export sectors.

Non-government organization microcredit institutions have not permeated this region. Some operated here prior to Aila. However, even when microcredit was available in the region, its terms – requiring immediate weekly repayments – are incompatible with the income streams generated by most of the local livelihood options, most of which require upfront payment for supplies, a period of labor, and then a return. Agriculture, fishing, boatbuilding, honey collecting, and golpata collecting all take this form. Additionally, the terms of microcredit programs do not favor the borrowing needs in the region, which are seasonal or related to lack of work or unexpected family emergencies, such as a health crisis or inadequate crop yield. In the rice economy middle class women, who are able to save extra rice in their homes, lend rice to families in need. In the shrimp economy, which is a cash and credit economy, middle class women do not have such rice on hand, meaning that poor families have to resort to more usurious sources.

The shrimp industry and the fishing economy (except for fishing for domestic consumption) have supply chains that do not favor those doing most of the labor. Some people work for wages, which are comparable to day wages in other work, 200 to 250 taka, but there are fewer of these jobs available than are generated by rice or cash crop agriculture. Those who collect and sell shrimp fry generally sell to middlemen on a per-shrimp basis and earn less than the typical day wage. Most shrimp farmers make an upfront investment with which they purchase inputs (shrimp fry) from a middleman who then buys the grown shrimp back at a price fixed at the time of the loan. These middlemen are often lenders. Because of this lending structure, some convert to shrimp farming after some personal event requires that they borrow money. In this system, a shrimp dealer loans money on the promise of shrimp production; the need to pay back with interest ties the new shrimp farmer to his lender-dealer.

In these ways the introduction of shrimp causes a shift in the local political economy and puts pressure on the more vulnerable in that political economy. Those most vulnerable in this context are those who depend on day wages (because there are fewer day-wage jobs in a shrimp economy than in the rice economy) and those who face a family crisis (because there are few lending options).

Shrimp impacts the political economy in additional ways that are not directly connected to the supply chain for shrimp. Because local rice is less available, fam-

ilies with some savings send a husband for seasonal employment in rice cultivation in other parts of Bangladesh, including Gopalgonj, Dumuria, and Norail. Paid in rice, these husbands enable their families to have rice even though they cannot cultivate rice at home or earn enough money to buy rice. This economic pattern means that in certain seasons, poor women are heads of household.

After Aila, reconstruction projects introduced new day labor opportunities. Women were able to take advantage of these. This enabled some families without savings to send a husband or son for seasonal agricultural employment, generally returning with payment in the form of rice. They also introduced the internal politics of distributing aid and work opportunities.

Environment, health and nutrition

In our context of study, some land use was almost completely devoted to shrimp aquaculture during the shrimp season; some communities had more variegated land use; others were completely agricultural. With some variation based on geography, other income sources include harvesting the resources (honey, crabs, golpata) of the Sunderbans mangrove forests, day fishing, commercial fishing, boatbuilding, and day labor.

While the built and natural environments have an effect on the range of livelihood options, the political economy of these livelihoods also affects the environment. Further, environmental conditions can affect well-being.

While it is common to think about "livelihood" as referring to sources of income, in contexts distant from major markets, income alone is not a good proxy for well-being. Domestic kitchen gardens can increase nutritional variety at low cost. The success of kitchen gardens depends on soil quality, surrounding land use and fresh water management. While a large proportion of the people in the communities that do not have shrimp farming are living in apparent poverty, despite their poverty, the flora and livestock of their homes and landscape exhibit a wide range of fruits and vegetables and more seasons of locally produced food (Datta 2005). Non-government organizations are supporting this diversification by reintroducing appropriate seed varieties. Due to the possibility of kitchen gardens even for the nearly landless, access to health and nutrition, including winter vegetables like cauliflower, tomatoes, radishes, and local varieties of leafy vegetables, the people of communities with kitchen gardens have richer bases for well-being than shrimp farming communities. Some sell their vegetables (and flowers for Hindu festivals) to neighbors.

Where shrimp cultivation is established, it is generally difficult for families to maintain healthy diverse kitchen gardens throughout the year because there are fewer fresh water reserves for irrigation; consequently, the sources of family nutrition decline. Additionally, local options for cattle grazing are diminished and families shift to chickens. Some send their cattle to a non-shrimp community for grazing. People in communities with heavy shrimp aquaculture are dependent on non-shrimping communities for variety in their diet.

Other macro-economic trends and local livelihood options

In addition to the *meso-level* changes in political economy – the shrimp aquaculture, post-disaster reconstruction labor, and the internationally funded rebuilding of the polders – the region is also experiencing some *macro-level* trends.

As mentioned above, rice farmers in the region are not able to irrigate from groundwater because the acquifer is saline. Therefore, they cannot get three seasons of rice. This puts pressure on them and those who labor in rice fields to find alternative employment.

In addition, the natural fisheries are less productive, which has led to a decline in legal fishing and an increase in illegal fishing. The illegal fishing technique uses nets that are more fine than allowed, which increases juvenile by-catch. Thus, fishing is a less reliable source of family livelihood and has contributed to an increase in migrant fishermen and piracy. Families "used to be able to fish for an hour to feed their family for a week." Now they cannot feed their families if they fish for a week.

And third, due to increased legal restrictions and increased illegal activities including extortion from pirates, the Sunderbans are no longer the rich source of livelihood they once were for so many.

Macro-level trends have also contributed new sources of income for people from the region. First, rice agriculture outside of the region provides seasonal labor and while certain regions may experience a less successful season in some years, there is always a demand for seasonal migrant labor in agricultural communities when the rice demands peak labor inputs. Second, as mentioned above, increased foreign aid for construction has increased the demand for day labor yearround, thereby enabling more families to be able to afford to send a seasonal migrant, the cost of which is the transportation cost and the cost of sustaining the family in the absence of the migrate worker. Third, growing export-oriented labor opportunities include regional shrimp factories and the growing garment industry in Khulna, Dhaka, and Chittagong. Fourth, in the past few years there has been an increase in and increased interest in cash crops, including watermelon and sunflowers.Each of these changes in livelihood options is felt locally, but is a function of significant outside forces.

4. CONCLUSION

Meso-level political economies are significant mediating factors for differences in the impacts of external forces on a community. These external forces include environmental events and external investment in infrastructure. The meso-level changes in political economy and livelihoods in southwestern Bangladesh illustrate that in order to understand the impacts of climate change-related environmental changes – changes that are expected to include rising sea level, saline inundation, and increased likelihood and intensity of cyclones in Bangladesh – we need to understand the dynamics of the built and natural environment and the po-

litical economies it sustains. For those with privilege in the global economy, the national and global scales are most important. However, as we have seen, meso-level political economies affect the sources of income and livelihood available in distressed environmental conditions and, therefore, influence how well they can adapt to changing environmental conditions.

In this study we have seen that it is the underlying political economies, more than slow onset environmental changes or disastrous environmental events, whose dynamics are pushing Bangladeshis to incorporate migration strategies into their livelihood strategies. This means that in order for climate adaptation and mitigation strategies to benefit local populations, they must consider their impacts on local political economies, particularly on the advantages and disadvantages *within the local populations*, as well as across the nation. How these plans are implemented and to whom their management isaccountable will have an impact on local livelihoods, perception of political security, and migration.

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