

CLIMATE-RESILIENT AGRICULTURAL CHOICES FOR SOUTHWEST BANGLADESH

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PART 1: Understand and recognize the population and climate challenges in southwest Bangladesh and their subsequent impacts on local agriculture

a) Read the following information at home prior to the course:

Bangladesh is a densely populated and low-lying deltaic country. With 2,600 inhabitants per square mile, it is the densest populated country in the world (Streatfield and Karar, 2008). Apart from its huge population, the country is also challenged by climate change, which can jeopardize Bangladesh’s current social and economic progresses and development trajectories. Climate change has contributed to be one of the most vulnerable countries in the world (Rahman, 2011). Bangladesh is now extensively exposed to sea level rise, and increased frequency with floods, droughts, cyclones, salinization in land and water, and water logging etc. Prognosis says that 1 meter sea level rise can cost the landlessness of 14.8 million people along with internal displacement of 40 million people forever due to the loss of 30,000 km² of land area or 17% of the whole country (Brown, 2011).

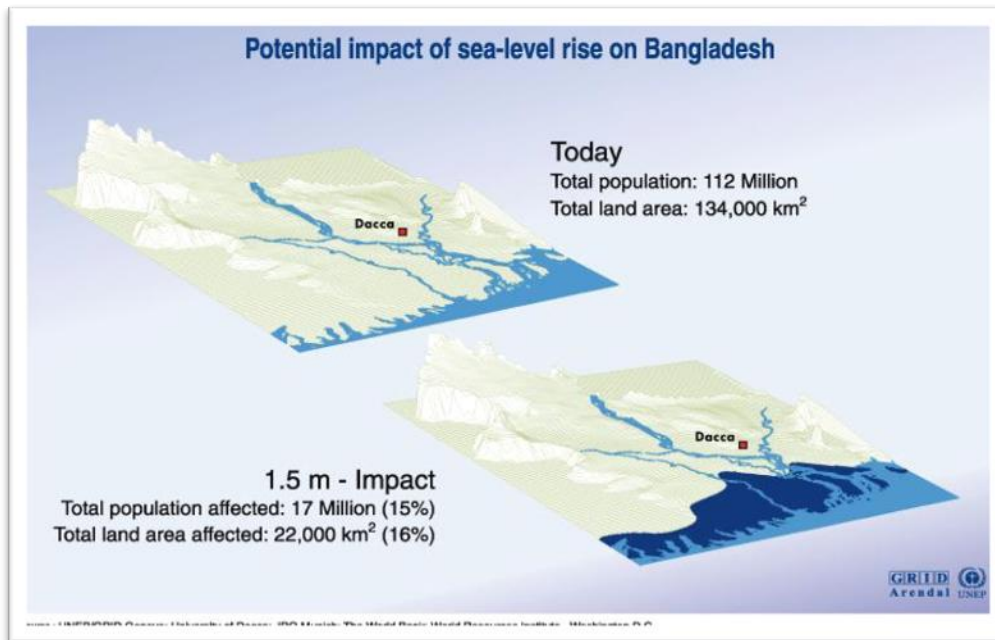


Figure 1: Potential impacts of sea-level rise on Bangladesh.

Source: UNEP (2006)

In this situation, agriculture, which is one of the major economic bases of population's majority, can be impacted severely and can lead to damages of many other livelihood opportunities (Brown, 2011). The loss of land due to this global environmental change will comprise a large share of the country's prime agricultural lands, where land is already an extremely scarce resource. Apart from that, agriculture is a climate-sensitive sector in Bangladesh. The climate variability, which will tremendously impact the regional monsoon patterns, will have enormous implications on local agriculture and agriculture practice. Within the country, not many people still depend on modernized agricultural practice, and that is even more visible when it is close to the sea (Bay of Bengal) or remote rural regions in southwest Bangladesh. The majority of farmers in those regions is marginal and practice traditional forms of agriculture without using modern agriculture technology and equipment, such as plowing with the help of animals (Fig. 2) or depending on monsoons for irrigation etc.



Figure 2: Traditional cultivation in Bangladesh.

Source: Mahalder (2010)

Any adverse impact of climate change will make even more marginalize these local farmers, who already struggle for their basic livelihoods. Not often these marginalized farmers receive government agriculture subsidies, information or skills to maintain or proceed to modern agricultural practice.

For this case study, we will focus on the southwestern region of Bangladesh. The region is the home of approximately 10 million people, which is 647 people per square kilometer (Bangladesh Bureau of Statistics, 2009).

In this region, poverty is often shaped by the ecological conditions and requirements. Southwest Bangladesh is treated as the most disaster-prone region in the country due to its exposure to extreme climate events in the coastal areas, such as salinization, tropical cyclones, tidal surges, floods, repeated water logging etc. Overall, the country has extensive exposure to heavy monsoons almost every year. These excessive monsoons or floods usually have tremendous negative impacts on agriculture, such as it can delay the plantation of paddy, and/or can make significant loss of potential rice production. It is worth considering that the flood in 1998 caused the reduction of agriculture production by 45 percent, which was a huge food security issue in this populous country (Fig. 3).

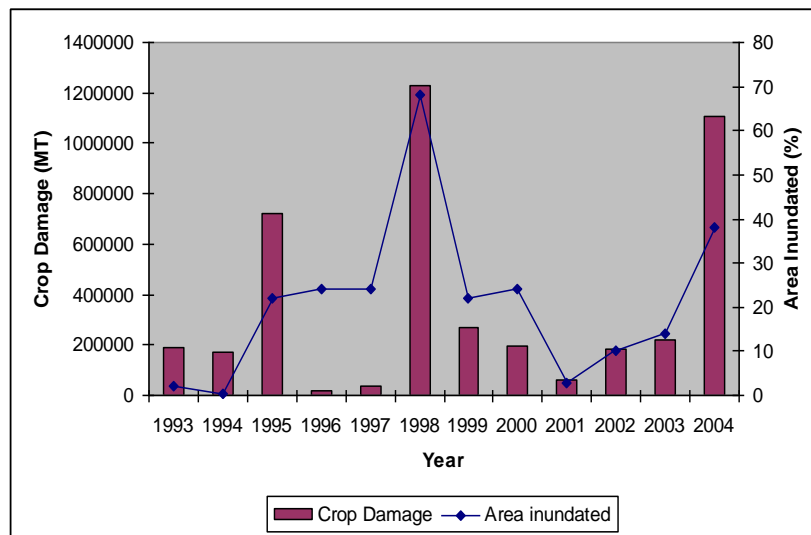


Figure 3: Crop damage (MT) due to historical flood

Source: Madhu and Jahid (2010)

Apart from floods, cyclones and storm surges can make substantial damage to region’s agriculture and agricultural production. The Cyclone Sidr struck the region on 15 November 2007, and the total crop damages was approximately 28.4 billion Bangladesh Taka (78 BDT = 1 US\$). In addition to that, the total loss of production in all crops was 1.3 million metric tons (Madhu and Jahid, 2010).

In Table 1, the climate impacts on crop yield in Bangladesh are summarized in two future scenarios.

Table 1: The potential impact of Sea Level Rise and Flooding on Crop Yield.
Source: Madhu and Jahid (2010)

Scenario	Crop Yields	Sea Level Rise	Flooding
Current Climate			In 1988, yields were down by 45% due to flooding.
2020	Based on interpolation of published data to be consistent with climate change scenarios; rice yields have increases of up to 5%. With less optimistic assumptions about the CO ₂ fertilization effect, generally have yield change -5% to +1%.	Based on interpolation, a 0.1 m SLR ³ would inundate 0.2 MMT ⁴ of production < 1% of current total.	Monsoonal floods increase yield loss.
2050	Based on interpolation of published data to be consistent with climate change scenarios; rice yields have increases of up to 10%. With less optimistic assumptions about the CO ₂ fertilization effect, generally yield changes from few percent increase to 10% decrease. Pests and crop disease could reduce yields further.	0.3 m SLR inundate 0.5 MMT of production ~ 2% of current total.	Monsoonal floods increase yield loss.

The country is experiencing a rapid decline of prime agricultural land by 1% per annum mostly due to the non-farm, land use change. In the country, currently the population growth is 1.48% per annum, which already supports the argument with land use change for people and society (Ahmed, 2010). However, the dilemma is, the country needs to proceed towards more modernized agricultural production to feed its burgeoning population. But that is not the case everywhere and in addition to that, the country already has started to experience climate change

³ SLR: Sea Level Rise

⁴ MMT: Million Metric Tons

impacts in its agro-ecological zones. In this situation, Bangladesh is exposed to food security challenge for its large and mostly poor population.

Therefore, it is very important for the country to focus on climate resilient farming practice through some agricultural intensification as part of country's overall efforts to ecological modernization. However, it is important to note, that agriculture intensification or modernization often brings some ecological additions to and/or withdrawals from nature. This can be the further reason for the loss of fertility of prime farm lands and release of chemicals to nature. These effects also cause some social disorganization, such as, loss of fertility of prime farm lands might cause further marginalization of poor farmers and the local traditional forms of family-farm practice can be handed over to big corporations. Therefore, it is important to treat climate resilient farming as a coupled human and natural system, not just a segregated policy or environmental solution. It is also important to understand and integrate indigenous knowledge to develop socially, politically, economically and -ecologically compatible ways of farming techniques as adaptation strategy to climate change.

Briefly, as part of climate resilient farming, we can focus on the following aspects of agriculture and agricultural practice in the local context: (1) climate stress, such as to floods, droughts, salinity, heat, cold etc. tolerant crop varieties; (2) short duration of crops; (3) changing patterns of crop cultivation, e.g. by floating cultivation methods; (4) crop diversification; and (5) alternative wetting and drying irrigation methods (Ahmed, 2010).

Therefore, we believe to engage in this case study example, which is a good evidence of social and ecological synthesis, it is important for the students to understand the coupling nature of social and natural systems more effectively to get better ideas of contexts, challenges and solutions.

b) In the classroom, listen to the *story of Karim Gazi*, a farmer in southwest Bangladesh:

“Karim Gazi is looking up to the sky. There are heavy clouds and he can already feel the next monsoon rain arriving. The 52-year-old farmer in southwest Bangladesh is worrying about how he and his son Ahmed, 13 years old, will be able to replant the rice seedlings in time. His biggest concerns are about feeding his family. Last year, he lost half of his yield due to heavy cyclones. His mother, living under the same roof, is constantly complaining about the storms which seem to touch the coast more often and heavier than in earlier times. Karim Gazi got relatively less lands from his father, who had to divide his land between 6 sons. For some other family issues, Karim also had to sell some parts of his land. With this limited land, he is already in trouble making enough food and support for his family. Recently, he faced new challenges. His lands became saltier, and he couldn’t get enough water for his irrigation from the well. Some people also told him a few days ago, the sea level will rise. Although his two younger kids go to school when not helping his wife Fatima, he himself never had the chance to learn how to read or write. Karim worries: If the rumors really turn out to be reality, - what is he supposed to do? Will he even have to sell all land of his ancestors and go to the big city or somewhere else to make a living?”

After getting exposed to this compelling story of a marginalized farmer in region, your instructors will provide you some slides with further background information. During the presentation you should write some key information for the following discussion:

c) With your group, discuss the following questions. For support, use some of the references in the list or look for own information sources online.

- (a) Imagine you are a farmer in the southwest Bangladesh. What are the recent changes of local and regional environment and what types of possible impacts you can encounter?
 - (b) As you imagine you are a farmer in Southwest Bangladesh: what could be the impacts of climate change on your land, your agriculture practice and above all on your family livelihoods? What are the changes you can see in your locality? *Sketch a short story and tell it to your group peers.*
 - (c) What do you think could be the combined effects of population growth and climate change on your life as a farmer in southwest Bangladesh?
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PART 2: Explore the impacts of agricultural modernization in society and environment

Population is a big issue in Bangladesh, and the country is always under pressure to enhance its agriculture production for feeding its large burgeoning population. Bangladesh adopted agricultural intensification by introducing more fertilizers and chemicals for larger productivity of lands as part of country's ecological modernization efforts. However, the additions of these chemicals and fertilizers have harmful impacts on lands and lands' productivity. Soils can become infertile due to the multiple or excessive uses of lands by planting multiple crops or cultivation of crops several times a year for the increased productivity and profits. Also, the soils, particularly the top-soils, can lose productive capacity for using excessive fertilizers. Intensive uses of fertilizers usually add chemicals to land and water, leading to ecological problems and also generate negative implications for human health. Apart from these, excessive aqua-farming of fish mostly for export and revenue along with crustacea can contribute to increase salinization of land and water.

Agricultural intensification can also be the reason for economic and social implications. The marginal farmers are not able to afford fertilizers in all instances, and consecutively remain with lower productivity, which also contributes to lower economic and social capacities. Sometimes, access to fertilizers and affordability of it can contribute to growing social tensions. These tensions can further marginalize the poor farmers by leaving their way of farming and living. In most cases the local farming decisions in the local context are determined by the extra-local agencies, which is very much top-down from the government with least or no consultations with the local farmers.

STOP and Discuss:

- (a) Based on the description you just read, identify the societal and ecological implications of agricultural modernization in Bangladesh.
 - (b) Try to understand different roles/views: Being a farmer/ a local stakeholder/ representative of seed industry/ representative of nature conservation NGO etc.: What have you experienced as part of agricultural intensification or modernization?
 - (c) How do you perceive these changes in agricultural practices are linked to social, economic and environmental dimensions?
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PART 3: Recognize interactions between ecological and social factors in an environmental issue (agriculture practice in Southwest Bangladesh).

In Parts 1 and 2 you learned a lot of background information. Use this information to understand, how social and ecological factors are closely tied and influence each other. In this part, you will work in groups and define some of the major driving forces and relations between social and ecological issues, focusing on agriculture practice in Southwest Bangladesh.

a) Read the following literatures for your better understanding on synthesizing the social and ecological system, which is embedded in our case study as a coupled human and natural system:

- Adger, W.N. (2000). Social and ecological resilience: are they related? *Progress in Human Geography* 24: 347. DOI: 10.1191/030913200701540465
- Carpenter, S., Walker, B., Anderies, J.M. and Abel, N. (2001). From Metaphor to Measurement: resilience of What to What? *Ecosystems* 4: 765-781.
- Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., Moran, E., Pell, A.N., Deadman, P., Kratz, T., Lubchenco, J., Ostrom, E., Ouyang, Z., Provencher, W., Redman, C.L., Schneider, S.H., Taylor, W.W. (2007). Complexity of Coupled Human and Natural Systems. *Science* 317: 1513-1516.
- Rogers, K.H., Luton, R., Boggs, H., Biggs, R., Blignaut, S., Choles, A.G., Palmer, C.G., and Tangwe, P. (2013). Fostering Complexity Thinking in Action Research for Change in Social-Ecological Systems. *Ecology and Society* 18(2): 31. <http://dx.doi.org/10.5751/ES-05330-180231>
- Stokols, D., Lejano, R.P., and Hipp, J. (2013). Enhancing the resilience of human–environment systems: a social–ecological perspective. *Ecology and Society* 18(1): 7. <http://dx.doi.org/10.5751/ES-05301-180107>
- Turner II, B.L., Matson, P.A., McCarthy, J.J., Corell, R.W., Christensen, L., Eckley, N., Hovelsrud-Brodah, G.K., Kasperson, J.X., Kasperson, R. E., Luers, A., Martellof, M.L., Mathiesen, S., Naylor, S., Polasky, C., Pulsipher, A., Schiller, A., Selink, H., and Tyler, N. (2003). Illustrating the coupled human–environment system for vulnerability analysis: Three case studies. *PNAS* 100(14): 8080-8085.
- Turner II, B.L. (2010). Vulnerability and resilience: Coalescing or paralleling approaches for sustainability science? *Global Environmental Change* 20: 570-576.
- Zurlini, G., Petrosillo, I. and Cataldi, M. (2008). Socioecological Systems. In Sven Erik Jørgensen and Brian D. Fath (Editor-in-Chief), *Systems Ecology*, vol. (4) of Encyclopedia of Ecology, 5 vols. pp. [3264-3269] Oxford: Elsevier.

b) STOP and discuss in small groups:

1. Discuss the coupled relationships between social and natural systems regarding agriculture practices in Bangladesh on the basis of all readings you did until now.
 2. Socio-environmental systems are tightly linked social and biophysical subsystems that mutually influence one another. Describe and/or diagram how the current agricultural challenges and/or practices are the examples of a socio-environmental system; include the parts of the system and indicate how they interact. Include the impact of climate change.
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c) One representative of your group sketches your diagram on the white board and explains it to the other groups. Do you recognize similarities or missing points?



PART 4: Synthesize information from the natural and social sciences

Synthesizing the information from natural and social sciences is always very challenging. However, this is very important to understand the systems and the challenges.

a) Listen and interact with your instructors on the theoretical and operational aspects of social and environmental synthesis.

b) Suggestions of group work:

Group A: Collect information on climate change impacts in the coastal regions of Global South with possible implications on community and agriculture.

Group B: Collect information about mitigation and adaptation strategies due to climate change in coastal zones of Global South.

Share your information and discuss:

1) What are the possible differences of climate change response, mitigation and adaptation potentials, particularly between the Global South and Global North, even though the implications of climate change in the Global North has not been addressed in the course?

2) Name some possible adaptation strategies Bangladesh might adopt in the next 10 years and mention potential obstacles for them. List them in a table. List them as:

Adaptation strategy	Potential obstacles
Installing dams or massive coastal forestation	No money; long bureaucracy; corruption
Citizens’ awareness on climate change	Illiteracy
Citizens’ engagement on climate adaptation	Lack of awareness and government publicity

c) STOP and Discuss:

1. How can you synthesize the social and environmental information (e.g., agriculture production trends, local environmental challenges, social and demographic information about the local farmers) for planning climate resilient agricultural choices in southwest Bangladesh?
 2. What could be the possible challenges of synthesizing that information?
 3. Which additional information can you derive after synthesizing the available information? Is the synthesis more than the sum of its single parts? Why and how?
 4. What are the broader implications of synthesizing this location-based case study towards the better understanding of global environmental change dynamics in other geographical context?
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