

Bangladesh Under Possible Climate Change Threat

13

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Abstract

Food security in Bangladesh depends on agricultural growth and development, yet this sector faces a number of obstacles that prevent development and cause growth rates to stagnate. Some of these issues include: the gradual loss of arable land; declining soil fertility and salinity; inadequate investment in agricultural research and training; inadequate credit support for farmers; an unfavorable land tenure system; an exploitative market price for farmers that resulted in post-harvest crop loss; a large output gap; recent emigration and labor shortages in rural areas; and lack of capital. The primary challenge in Bangladesh is to assist farmers in switching from low-yield rice cultivation to higher-yielding, diversification, improved mechanization, water conservation, and better irrigation efficiency on the farm. Mass exports of potential agricultural products abroad are prevented by suboptimal adoption of good agricultural practices and flawed transportation/conservation systems. Bangladesh is the nation most impacted by climate change, according to the Global Climate Risk Index. Sea-level rise and saltwater intrusion, an increase in mean temperature (1.7 °C by 2050), greater precipitation variability, and an increase in the frequency and severity of extreme weather events are all likely to have a negative influence on the nation both now and in the next decades. Each of these will significantly affect the nation's agricultural output, and this chapter will go into great length on each of them. Many farmer-developed climate smart agricultural techniques are mentioned and described.

Keywords

Bangladesh · Climate smart agriculture · Climate change

13.1 Bangladesh Under Possible Climate Change Threat

Bangladesh's economy is heavily reliant on agriculture, with 14.7% of its GDP coming from this sector. The major industry in terms of employment in the nation is agriculture. According to the World Bank (2016b), 87% of rural residents make at least some of their money from agricultural pursuits. Since the 1980s, Bangladesh's population has doubled, and as of 2021, there are roughly 170 million people living there. This population growth has put significant pressure on arable land, which has decreased from 0.11 ha/capita in 1980 to 0.05 ha/capita in 2014 due to a high and growing population density (1100 people/km²), increasing urbanization, and infrastructure development for industrialization (World Bank 2016a). With an average area of less than 1 hectare and 0.04 hectares of land per person, 99% of Bangladeshi farms are small and dispersed (BBS 2017).

13.1.1 Land Use

Approximately 9.1 million hectares, or 70% of the nation's land, is used for agriculture in Bangladesh. 6.5% of that area is used for permanent crops, while about 60% is thought to be arable. Approximately 11% of Bangladesh's land is forested, compared to 5% for permanent pastures, which are likely to decline as crop output increases (FAO 2015a, b). During the monsoon (July–October), water covers the remaining other lands. In the meantime, intensification has greatly grown, with double cropping occurring in the majority of regions, resulting in an average cropping intensity of 194% across the entire nation (BBS 2017). High-yielding

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cultivars of rice, wheat, potatoes, sunflower, vegetables, mustard, maize, and mungbeans can be produced on some higher elevational terrain that is less subject to monsoon flooding (BBS 2017). Bangladeshi farmers currently cultivate more than 200 major and minor crops throughout the year for both family consumption and financial gain.

13.1.2 Agricultural Productive Systems

Bangladesh is a remarkably diversified nation in terms of geography, soil, and climate despite its modest size (147,570 km²). While many locations have a shortage during the dry winter months, water resources are abundant during the wet season. The nation's nutrient-rich alluvial soils are extremely fertile, enabling the year-round cultivation of a wide range of food and crops. Bangladesh's agriculture historically focused on subsistence farming. The production of higher-value crops, livestock, and aquaculture has, nevertheless, transitioned toward more commercial production over the past 10 years. Most farms raise animals like cattle, goats, ducks, and chickens in addition to crops and vegetables (including those grown in backyard gardens), trees for fuel, fruit, and timber, and crops and vegetables. Numerous farmers in Bangladesh are also engaged in commercial shrimp farming in salt-water areas of the southwest districts and aquaculture production in ponds (Razzaque and Hossain 2007).

The country is divided into 30 agroecological zones (AEZs) depending on the topography, floodplain, and soil type. 535 agroecological units and 88 agroecological subregions make up the remaining AEZ. The majority crop in the nation is rice (80% of all farmed land). Bangladesh consumes 200 kg of rice annually (about 417–454 g per person per day), making it the second-largest per capita rice eater in the world. In the nation, there are three primary types of rice systems: Aman (dependent on the tropical monsoon rains, which typically fall between June and October); Boro (during the winter dry season, which is completely irrigated since it is dry and does not receive any rain); and Aus (in spring, when it starts to rain as pre-monsoon rain showers in mid-April). 70% of Bangladesh's land is used to grow Aman monsoon summer rice (FAO 2015a, b). While using predominantly high-yielding varieties (HYVs) that are planted between December and May and take up around 60% of the acreage, boro rice is 100% watered during the dry season. Because it is primarily grown in the dry season just before spring storms, floods, or hurricanes, boro is sometimes thought of as being risk-free. As a result, it produces the most rice, 8 tons/ha, more than twice as much as monsoon rice. Only 20% of the space used for Aman rice is taken up by the third type of rice, aus, a direct-sown and rain-fed variety. Due to the expansion of conventional types, heavy weed

infestation, and increased risk of storms and hurricanes this season, out-of-rice yields in Bangladesh are often the lowest. According to Shelley et al. (2016), the production of Aus, Aman, and Boro rice made up 7%, 38%, and 55% of the nation's total rice production in 2014, respectively. Instead of an increase in acreage, improved agricultural productivity in recent years has been mostly linked to increased rice yields from HYVs and hybrids.

13.1.3 Agriculture and Climate Change

13.1.3.1 Potential Economic Impacts of Climate Change

Food security in Bangladesh depends on agricultural growth and development, but this sector faces a number of obstacles that prevent expansion and cause it to stagnate. Some of these issues include the gradual loss of arable land, declining soil fertility, and salinity; inadequate investment in agricultural research and training; inadequate credit support for farmers; an unfavorable land tenure system; recent out-migration; labor shortages in rural areas; the need to deal with the growing effects of climate change; and the requirement to deal with these issues.

Supporting farmers to migrate away from low-yield rice cultivation and toward higher yields, diversification, improved mechanization, water conservation, and improved irrigation efficiency on farms is Bangladesh's main problem. In South Asia, Bangladesh currently has the highest level of tillage mechanization, with two-wheel tractors imported from China handling more than 95% of the tillage. Promoting even more appropriate mechanization in Bangladesh must be viewed as a potential strategy for rehabilitation, mitigation, and adaptation to address the dwindling time between cropping systems and climate-vulnerable ones as well as a way to replace the country's limited rural labor force with machinery for reasons of profitability and efficiency, assist farmers with transportation and livelihoods, as well as the speedy planting and harvesting of crops (Mandal et al. 2017).

In Bangladesh, crop yield has been required to rise in order to maintain food production due to declining land availability. In an effort to accomplish this, the government subsidized the use of urea fertilizers in the nation, which led to a dramatic increase in fertilizer use from 0.36 kg/ha in 1995 to over 298 kg/ha in 2007 and a nearly tripling of crop yields per hectare over the same period (Rana and Titumir 2014; FAO 2012). The habit of growing rice primarily in monoculture, along with an unbalanced use of chemical fertilizers and poor irrigation management, led to a reduction in soil fertility and soil organic matter even though this helped the country achieve rice self-sufficiency (Rana and Titumir 2014; Shelley et al. 2016).

The growth rates of grain crops have slowed recently, and rice yields are still below those seen in other South Asian nations. Future imports of wheat and corn into Bangladesh are anticipated to stay steady in order to satisfy domestic demand. In 2018, Bangladesh was the world's fourth-largest importer of wheat. Historically, many farming households were at danger of malnutrition due to a lack of diversification due to the predominate concentration on rice production (which accounts for 75% of the country's agricultural output) (FAO 2012). The government decided on a program to diversify crops in 2008 to combat this. Farmers are currently seeking to diversify their production more and more, concentrating in particular on high-value crops like flowers, fruit, vegetables, corn, oilseeds, or new potatoes. Creating new markets and including additional cattle in agricultural systems.

For instance, farmers in the Northwest forego growing monsoon rice in favor of planting early potatoes, which sell for much more than they would during the normal potato season. Providing services for animal health, as well as pertinent livestock research. Almost 50% of all animal deaths in the nation are caused by illnesses. The performance and size of subsectors are further constrained by the scarcity of permanent grazing pasture, ineffective livestock marketing techniques, and lack of access to improved livestock breeds (Ali and Hossain 2016). Cattle fattening became less lucrative as a result of the smuggling of local cow species from India, which contributed to some of this. Since India banned the export and smuggling of cattle in 2015, improved breed cattle fattening has gained popularity and economic viability in rural areas. Along with several local farmers who keep a few cattle in their homestead region for the purpose of selling them during the annual festival season (Edid-ul-Azha), there are three big beef firms that advertise better meat quality in the nation and even export beef.

Bangladesh is the nation most impacted by climate change, according to the Global Climate Risk Index (Harmeling 2011). Sea-level rise and saltwater intrusion, an increase in mean temperature (1.7 °C by 2050), variations in precipitation, and an increase in the frequency and intensity of extreme weather events are all anticipated to have an effect on the nation both now and in the next decades (CIAT 2017). The agricultural output of the nation will be significantly impacted by each of these variables. Bangladesh, an alluvial delta plain, features five major river systems, which have seen many location changes throughout the ages due to siltation and currents. Because of this, the nation is extremely vulnerable to inland water salinization and sea-level rise. By 2030, salinization is anticipated to advance 8 km further north in the nation, substantially diminishing the amount of land suitable for agriculture. Rather than sea-level rise brought on by climate change, transboundary flow factors will provide a greater infusion. Brine shrimp production has

expanded over the past 20 years due to its higher profitability compared to other crops like rice, even if the injection of brine into rivers and canals continues to be a challenge for crop production (BRAC 2014). Only 4% of Bangladesh's annual rainfall falls during the winter months of November to February, with the majority of rain falling during the summer months between June and October. For instance, the early monsoon rains of April 2017 destroyed tender boro paddies in northeastern Haor (vast expanses of low-pressure depression). Climate change is predicted to cause an overall 9–12% increase in rainfall in Bangladesh by the year 2050 (CIAT 2017).

In South Asia, especially Bangladesh, large losses in rice harvests can occur if typical monsoon patterns are disrupted since summer monsoon rice yields depend on consistent, predictable rainfall. For instance, rain-fed monsoon rice, which accounts for approximately 38% of Bangladesh's total rice production, is extremely susceptible to changes in water supply brought on by variations in the timing of the seasonal monsoon (Mahmood et al. 2004). On the one hand, the early monsoon can result in flood damage if rice seedlings are inundated in the water during the early stages of growth, especially if farmers are not employing flood-tolerant varieties. A postponed monsoon, on the other hand, can cause water stress. The CERES rice model's findings demonstrate that excessive water stress throughout the flowering and ripening stages can cause yield losses in rice of up to 70% (Iqbal and Siddique 2014). Boro or winter rice cultivation may benefit from an increase in atmospheric carbon dioxide concentration, but these benefits will likely be offset by reduced yields during the winter harvest season and by increased temperatures during the flowering season. Variations in rainfall are less likely to influence the boro rice crop because this winter's crop is entirely irrigated. Floods and cyclones are two examples of extreme weather that Bangladesh is predicted to experience more frequently and intensely (Collins et al. 2013; Ramírez-Villegas and Jarvis 2008; Ramírez-Villegas and Thornton 2015). The amount of rice lost as a result of the cyclones in 2007 and 2009 was estimated to be over two million tons, or enough to feed ten million people. Bangladesh's southern, southwest, and southeast coastal regions are becoming more and more susceptible to powerful tropical storms and the ensuing saltwater intrusion.

13.1.4 Development of Climate Smart Agriculture (CSA) Technologies and Practices

Agricultural sector expansion, economic growth, and climate change mitigation are all possible with CSA technologies and practices. If a practice advances food security and at

least one other CSA objective (adaptation and/or mitigation), it is said to be CSA. The term “CSA” refers to thousands of methods and technologies used all over the world.

In response to increased flooding and hurricanes, farmers on the southern coastal plains have long implemented many of the CSA methods outlined for Bangladesh. For instance, traditional gher farming in an aquaculture pond in non-saline wetlands with high dikes has evolved into a more complex method for growing vegetables while still enabling the production of shrimp, fish, and shrimp. On the trellises that span the pond, climbing vines are also frequently grown. The ancient method of stacking water hyacinths with soil in floating food gardens has now also been adopted at gher in tidal flooded areas as a climate protection measure. Kangkong (water spinach) has traditionally been grown close to ponds, and productivity can be increased with new kinds. Farmers in Bangladesh have historically used a variety of ridge and furrow techniques in low-lying, swampy areas. The Sorjan method, for instance, is a variation on pyramidal farming that consists of high beds (30–90 cm) for the growing of vegetables and crops, alternated with furrows or ditches that are home to plants that can withstand submersion or are used to raise fish. In Bangladesh, the practice of raising small native fish in these canals is becoming more widespread, providing even small pond owners with access to wholesome food and higher income. Additionally, concrete paddy field fish rings or paddy field fish rings that shield fish from harm when paddy fields dry up have been put into place (Hossain et al. 2015). Even though these customs have been around for a while, they are currently gaining popularity quickly.

The problem of saltwater intrusion into Bangladesh’s tidal rivers has gotten much worse during the last 40 years. Changes in sea level are quite likely to make the issue worse. Therefore, it’s crucial to use high-yielding, salt- and submersion-tolerant varieties. The lengthy time between seed release and use in Bangladesh limits access to enhanced seeds (it takes roughly 15 years for producers to easily obtain released breeder seed). As a result, there has been little nationwide acceptance of rice types that are salt- or submersion-tolerant. The availability of flood-tolerant rice varieties, which first appeared on the market 7 years ago, has dramatically increased in recent years in response to losses brought on by changes in monsoon seasonality, especially for farmers in regions of the Northwest vulnerable by flash floods. After the monsoon, Bangladesh’s winter is dry and mostly devoid of precipitation. As a result, any salt present in the soil evaporates to the surface, turning it salinous. To address this saline issue, bamboo and plastic were used to vegetable tower potted vegetables. Farmers in Bangladesh’s flooded floodplains are not the only ones benefiting from CSA practices. Cattle were once used as draft animals and were eventually sold once they could no longer pull the plow. Currently, raising calves, goats, sheep, and buffalo for

3–6 months while giving higher quality feed, such as urea (a nitrogen molecule) and molasses feeding, has become a significant industry for young people. Others use intercropping and low and minimal tillage conservation agriculture techniques for grain crops.

The limited access to credit, the unfavorable ratios of advisory staff to farmers for the dissemination of new technologies and practices, the limited adoption of novel financing mechanisms, and the lack of safety net protections are all obstacles to the adoption of these and other CSA practices by small farmers in Bangladesh. For instance, Oxfam and a private insurer collaborated to construct index-based crop insurance, but the GoB or private businesses still find it challenging to scale up such interventions due to the absence of a clear business model.

13.2 Production System: Transplanted Monsoon Rice (T.aman)

The majority of the arable land is planted with transplanted aman rice, which is grown from July to December. It is a relatively inexpensive rice because it is primarily farmed with rainwater. Rice from T.aman is crucial for southern Bangladesh, where salt during the dry months is an issue. However, the river/canal water and soil turn non-saline with the arrival of the monsoon rains. As a result, the climate is favorable for rice farming. The CSA practice of using short-duration, high-yielding T.aman rice is appropriate for small- and medium-sized farmers, according to Table 13.1, where its climate smartness score is 1.94. Since the approach makes it possible to obtain early-season rice when farmers are experiencing a crisis of cereal food security, the impact on production is obvious. Traditional local T.aman rice is harvested in December, which is around 1 month later than short-duration varieties. In order to increase yields, farmers can cultivate high-value winter crops after the rainy season (also known as the rabi season) with the use of this CSA approach. The CSA technology is useful in adaption cases to prevent biotic stress and late-season climatic shocks like cyclones or tidal surges. The lifespan of this T.aman rice field is roughly 1 month shorter, which helps to prevent late-season dryness and increases water efficiency. Through ensuring healthy canopy and root growth, this method also contributes to a modest reduction in GHG emissions.

During the late monsoon, when heavy rains, upward receding water, and extra tidal water (full moon and new moon period) coincide at the same time, southern Bangladesh frequently experiences water congestion. This causes a significant loss in rice production since the cultivable area, which is mostly used for T.aman rice, submerges for several days to weeks. The above-water submersion shock can be prevented by implementing the recently adopted CSA prac-

Table 13.1 CSA practices of different rice crops for southern Bangladesh

Production system/Crop name (% area)	CSA practice	Applicable farm category	Climate smartness score ^a	Impact on		
				Productivity	Adaptation	Mitigation
1. T.aman rice (70)	1. Short duration high yielding (HY) varieties for facilitating timely planting of rabi/ winter crops	Small and medium	1.94	Increased and early season rice yield. Ensured winter crops planting	Resilience to biotic stress and climate shocks. Enhance water use efficiency	Moderate reduction in GHG emission
	2. Submergence-tolerant HY varieties	Small and medium	2.03	Increased and economic yield	Can endure tidal surge/ flood	Carbon sink increased
2. Boro rice (61)	1. Saline-tolerant HY varieties	Small and medium	2.60	Significant yield increase	Can endure soil and water salinity	Carbon sink increased
	2. Application of USG (urea super granular) as the N fertilizer for saving N and reducing N ₂ O emission	Small and medium	1.71	Slight increased yield	Less N-fertilizer needs, sustained production	Reduced GHG emission
	3. Use of Axial Flow pump for irrigation to reduce irrigation cost by 30–40% in tidally flooded non-saline areas	Small and medium	1.80	Economic and increased yield	Better quality water, sustained yield	Reduced GHG emission
3. Aus rice (14)	1. Direct dry seeding for saving time, energy, and water	Small and medium	2.23	Slight increased yield	Reduces soil degradation, erosion	Reduced GHG emission
	2. Drought-tolerant, short-duration HY varieties	Small and medium	1.35	Increased yield	Tolerant to drought	C-sink increased
	3. Lodging tolerance taller varieties	Small and medium	2.29	Increased yield	Can cope with sudden water rise	C-sink increased

Source: Ali and Hossain (2019)

HY high yielding, GHG green house gas

^aThe average climate smartness score is calculated based on the practice's individual scores on eight climate smartness dimensions that relate to the CSA pillars: yield (productivity); income, water, soil, risks (adaptation); energy, carbon and nitrogen (mitigation) (CIAT 2017)

tice of choosing submergence tolerant high-yielding varieties. This method yields a score of 2.03 for climate smartness (Table 13.1), with higher yield and profitable return. The cultivation of these submergence-tolerant rice cultivars of crop ensures grain yield, root and canopy growth, increasing C-sink.

13.3 Production System: Boro Winter Rice

Despite having a lesser area (61%) than T.aman rice, boro rice, also known as winter rice, is the major type of rice grown in Bangladesh today. The process of turning photosynthesis into grain takes longer and requires more insolation in boro rice. However, during the winter or the dry season, salinity in the water and soil frequently has an impact on southern Bangladesh. So it's crucial to introduce CSA-Praxis salt-tolerant cultivars to guarantee a high and cost-effective yield. The practice has a moderate climate intelligence score of 2.60 (Table 13.1) with a significant increase in yield. The C sink increases together with grain yield, crown development, and root expansion. By lowering the volatilization of urea fertilizer in the soil after application (by up to 30%), the application of USG (Urea-Super Granule)

in Boro rice is a CSA practice that lowers the needs of plants for nitrogen fertilizer. It applies to small- and medium-sized farmers and has a moderate climate smartness score of 1.71. The main advantage is the large reduction in nitrous oxide emission, which is typically released by the use of prilled urea fertilizer and is increased only little by the use of USG (Table 13.1). Central Bangladesh might save 30–40% on irrigation expenses (Table 13.1). Because AFP lowers the cost of irrigation and irrigation from surface sources uses superior quality water, larger economic returns are guaranteed. A centrifugal diesel pump is typically used for irrigation, which burns 30–40% more diesel than an AFP and results in higher greenhouse gas emissions. Thus, the usage of AFP has greatly decreased greenhouse gas emissions. The procedure has a 1.80 climate smartness rating and is relevant to small- and medium-sized owners.

13.4 Production Systems: Aus Rice

From March to July, 14% of the acreage is used to grow out or spring rice (Table 13.1). Droughts, storms, and other severe weather frequently affect it. In the early summer, it helps to secure the availability of grains for nourishment.

The CSA-Praxis-Direkt-Drocksaat aids in stock building at the ideal time, securing the yield. Similar to no-till farming, less disturbance of the soil results in less erosion and degradation of the soil. Additionally, it lowers greenhouse gas emissions because tilling the soil uses less energy. His rating for climate intelligence is 2.23. Short-term, high-yielding off-rice cultivars that are tolerant of drought may be used by the CSA to help prevent drought and ensure grain output. The C sink also rises because the culture's expansion is assured (Table 13.1). His Climate Smartness Score is 1.35. The CSA practice of housing tolerant, bigger rice varieties is suitable for the tidally inundated southern Bangladesh. Sometimes an impending rice crop is harmed by excessive tides or tide surges. Taller strains that can withstand submersion can therefore avoid this abrupt risk. More carbon sinks into the plant's canopy and subsurface root system as growth and yield are ensured. His high climate smartness rating of 2.29 (Table 13.1) is impressive.

13.5 Production System: Jute

In Bangladesh, jute is a significant fiber that covers 9% of the land in most communities. Summer through monsoon season (March to August) is when it grows. Jute is a crop with deep roots and luscious leaves that is considered essential for crop rotation. These leaves falling to the ground improve soil fertility for the following crop. It takes a lot of work to remove the fiber from the stick, and toasting it in pond or

canal water significantly reduces the quality of the water. When there is not enough water in the canals during drought years, the rotting of the jute fibers might become an issue. Only a small amount of water that has been stored is needed to roast the jute sticks when belt roasting. In order to get good-grade jute fibers, belt toasting of jute fibers is a viable CSA. Although this CSA only has a 0.71 climate intelligence score (Table 13.2), it helps to lower greenhouse gas emissions. Salinity during the dry season is a challenge for healthy plant growth in southern Bangladesh. A good substitute for farming in salt-stressed locations is the CSA option, which uses a salt-tolerant jute strain. In saline environments, it is advantageous to improve and profit from jute production in addition to better carbon sequestration. He only has a 0.60 Climate Smartness Score (Table 13.2).

13.6 Production System: Spice Crops

No dish or curry in Bangladeshi cuisine could be made without chili, whether it was made with fish, vegetables, meat, or pulses. Approximately 7% of the agricultural area is devoted to growing spices. Its growth and economic output are hampered by both salinity and drought. Chili is a saline- and drought-tolerant spice crop that is used in CSA practices to ensure considerable output increases and a decrease in climate risk. C-sink is raised and GHG emissions are decreased with its cultivation. It has a 1.61 climate smartness score (Table 13.2).

Table 13.2 CSA practices of jute, spices, and oil seed crops for southern Bangladesh

Production system/Crop name (% area)	CSA practice	Applicable farm category	Climate smartness score	Impact on		
				Productivity	Adaptation	Mitigation
4. Jute (9)	1. Ribbon retting for jute fiber management (drought management and avoids water pollution)	Small and medium	0.71	Better quality fiber and market price	Suitable for less water area and reduced water pollution	Reduction of GHG-emission
	2. Saline-tolerant jute varieties	Small and medium	0.60	Increased and economic yield	Yield stability under saline conditions	Carbon sink increased
5. Spices-chilli (7)	1. Saline and drought-tolerant Chili cultivation in rabi and kharif I season	Small	1.61	Significant yield increase	Reduces climatic risk, so sustainable yield	Carbon sink increased and reduced GHG emission
6. Oilseed-Mustard (5)	1. Shorter duration and HY mustard	Small	2.90	Increased yield and income	Use of soil moisture, and avoid late rainfall	More C-sequestration and reduction of GHG
	2. Saline-tolerant HY mustard	Small	2.21	Increased production stability and income	Cope with climatic risk	Better C-sequestration

Source: Ali and Hossain (2019)

13.7 Production System: Oilseed Crop

The preparation of foods in Bangladesh uses a lot of vegetable oil, especially mustard oil, which also has some therapeutic benefits. Five percent of the land is used to grow mustard oilseed. Bangladesh now imports the majority of its other vegetable oils from other nations. At the end of the growing season, when the crop is planted later than usual due to a rise in temperature, mustard is frequently attacked by pests. For the next crop of boro rice to be grown on schedule, a short-season mustard crop is also required. In order to avoid climatic threats including early monsoon rain and pests, the CSA practice of adopting short-duration high-yielding (HY) mustard production is crucial. Additionally, it aids in lowering GHG emissions and increasing C-sink. The practice has a 2.90 climate smartness score (Table 13.2).

The salt-tolerant HY mustard variety is a prospective CSA strategy to obtain a greater and more cost-effective output in the salt-heavy southern region of Bangladesh. It can handle enhanced carbon sequestration as well as soil salinity in the winter and summer. It also has a 2.21 climate smartness rating (Table 13.2). See the link or CIAT reference below for a more thorough discussion of crops other than those included in Tables 13.1 and 13.2.

13.8 Other Potential Effects of Climate Change Besides Agriculture

Climate change is having a mixed effect on agricultural production in Bangladesh, according to an analysis using the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) (Robinson et al. 2015). For some crops, productivity gains and yield increases may result from climate change, while harvests may decline for others. In general, it is anticipated that climate change would have some impact on the majority of production systems in Bangladesh. The effects vary depending on the production method, with wheat, canola, and legumes/beans being the most impacted. By 2050, the model predicts overall production losses for grains, vegetables, jute, and wheat and yield gains for milk and meat, despite significant country-to-country heterogeneity. After then, the yields of wheat, rapeseed, and beans/legumes all decreased by 8.8%, 6.4%, and 6.3%, respectively. When compared to the No Climate Change (NoCC) value in 2050, the yields of rice, vegetables (as a whole), and other crops (including jute) are down 5.3%, 5.7%, and 3.3%, respectively. Both the CC and NoCC scenarios anticipate a significant increase from 2020 levels of about 52%; however, the growth under the CC scenario is

marginally bigger by 0.2 percentage points (pp). Pig, sheep, and lamb are just a few examples of the numerous animal species that are less adaptable and are predicted to suffer from climate change.

The model also predicts that Bangladesh may depend more on imports of wheat, beans, corn, other crops (such as jute), vegetables (as a whole), and legumes as net agricultural trade shifts. Other crops, including jute, are predicted to have a 0.09 percentage point decrease in import dependency under CC conditions compared to NoCC, while corn, beans/legumes, vegetables (as a group), and wheat are predicted to have increases in import dependency of 4.5 percentage points, 3.3 percentage points, 0.16 percentage points, and 0.64 percentage points, respectively. The modeled results also indicate that exports of beef meat will rise in both the CC and NoCC scenarios, albeit the difference between the two is minimal (+0.07 pp). The model results most importantly indicate that Bangladesh may switch from being a net importer to an exporter of rice under both CC and NoCC. Under CC, this change will probably be 34 pp more noticeable than it would be under the NoCC situation. Demand shifts are ultimately influenced by relative commodity prices in both domestic and international markets. This makes it crucial to look at changes in supply-side drivers.

13.9 Conclusions

Bangladesh's existing policies and international agreements show that adaptation and mitigation in the agricultural sector continue to be top concerns. Such plans must have efficient delivery methods and a clear path for obtaining the extra funding required to carry out the vision. The GOB's annual budgets must be the starting point for these funding mechanisms, with a focus on research and monitoring for climate changes in their agriculture. Given that each hot spot has different limits, the road map should involve tackling the issues in each of the six hot spot locations separately (Bangladesh Delta Plan 2100). Bangladeshis don't have a diverse diet because 70% of their calories come from rice. Bangladesh spends more than 12% of its annual national budget on importing high-value, nutrient-dense crops such as pulses, edible oil, spices, fruits, soybean seed, and maize (BBS 2021). Due to the fact that rice crops take up land, it is impossible to expand their areas given the current per-unit yield of rice. Thus, at least 20% of rice acreage might be released for the aforementioned high-value crops in order to raise farmers' incomes and achieve dietary diversity in order to decrease malnutrition and food insecurity. This could be

accomplished by greatly boosting per unit rice output and by decreasing per capita rice consumption. A national information, communications, and technology (ICT) plan was created by the government in 1997. It has evolved into a key force behind reforms, employment, sector growth, and better governance thanks to its ICT development process. Through those mobile phones and apps, the ICT, together with its highly competitive mobile phone and G3/G4 internet coverage, has the ability to encourage a higher adoption of CSA practices by farmers. Ninety-two million people currently have access to the internet and 156 million mobile phones are covered. A possible location to start in this regard is by strengthening village-level information centers as a part of the Department of Agricultural Extensions' Agricultural Information Service in the Union Parishad complex.

Boosting climate information services and making them easily accessible to farmers will considerably boost their capacity to adapt to change in addition to the ICT programs already stated. For instance, salt intrusion into the canals in southern Bangladesh may make it impossible to use them as irrigation for personal or commercial gardening. Farmers would be able to plan for suitable response tactics by being aware of where and when this salinity will occur through community-based data collecting, which would involve measuring the canal water with straightforward salinity meters. Given that the usage of briquetted urea (which can reduce urea consumption by 30%) is widely known, advising services on the technical application of more knowledge-intensive technologies like briquetted urea may allow farmers to significantly reduce agricultural emissions. However, it is crucial to improve and broaden the use of urea supergranular applicators in order for the technique to proliferate.

The creation of a clear, long-term vision for the nation's agricultural development depends on improving partner coordination. A step towards attaining this goal is the transparent provision and sharing of information through multi-stakeholder platforms, collaborative CSA activities, and regular opportunities for knowledge and experience sharing with various stakeholders involved in research, policy, and implementation.

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