

Agrifood Systems Policy Research

HISTORICAL EVOLUTION OF AGRIFOOD SYSTEMS IN BANGLADESH

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ABOUT THIS NOTE

This study presents evidence from secondary literature and archival sources on how the current agrifood systems in Bangladesh were developed and the obstacles and opportunities that have influenced their transformation since the 1850s. It lays out the politico-economic context of these systems, allowing for a comprehensive understanding of their current state.

KEY STUDY FINDINGS

1. Prior to 1947, when Bangladesh was a part of the Bengal Presidency under British rule, poor land administration and the extraction of high revenues resulted in the fragmentation of land, poor agricultural growth, and low food production. As a result, the country experienced lower purchasing power and high food inflation, which ultimately resulted in famine deaths. There are important disconnects between agricultural performance and social objectives like the eradication of hunger and reduction in rural poverty, and many of these are rooted in historically-inherited patterns of regional and social inequality.
2. After gaining independence from the British, Bangladesh was established as East Pakistan under the administration of West Pakistan. Although public institutions were set up and high-yielding varieties (HYV) of seeds were introduced in East Pakistan, their adoption was limited due to a lack of capital investment in associated technology that was needed for increasing agricultural productivity. This led to disparity and discontentment among people living in East Pakistan. The colonial land and irrigation systems administration created formal division of the rural community in Punjab into 'agricultural' and 'non-agricultural' tribes/castes, elevating the former and marginalising the latter.

3. Bangladesh eventually became an independent country in 1971. Subsequently, a series of paradigm shifts in agricultural policies and technology adoption ushered in the green revolution in Bangladesh, which played a pivotal role in breaking the cycle of declining food productivity and shortage of food supply. The Green Revolution achieved significant improvements in harvests and yields through the application of inputs but not overall productivity - its main drivers were exhausted by the 1990s
4. Access to groundwater for irrigation, initially supported by the state and later through private investments by enterprising farmers, led to the “boro rice revolution”. This revolution transformed Bangladesh from a food-deficit nation to a food-surplus one. Furthermore, the liberalization of the import of pumps and the removal of restrictions on groundwater pumping boosted further rice cultivation.
5. Heavy dependence on groundwater can have major consequences, such as high energy costs that lowers net returns, and likely to threaten sustainability of groundwater resources in the future. Climate change projections suggest that there will be less rainfall and higher temperatures, which will increase irrigation demand and further exacerbate the issue. While the increasing costs of groundwater irrigation due to diesel use are established, the rate of depletion of groundwater aquifers and the impact of climate on groundwater resources remain inconclusive in the scientific literature.
6. There is a historical path dependency in agrarian systems, agrarian relations, and even policies that try to effect changes. The constraints remain the same as in the 1850s – rural poverty and lack of capital coupled with scarcity of land and small landholdings. Bangladesh’s history of famine and starvation continues to shape its food policy, which aims for food security through subsistence-based agriculture.

INTRODUCTION

Bangladesh is popularly referred to as ‘Sonar Bangla,’ which means ‘Golden Bengal’ in Bengali. The phrase gained popularity during the independence movement in Bangladesh and is now a part of the country’s national anthem. It remains a poetic reference to the cultural, historical, and natural richness of the region. ‘Sonar Bangla’ takes its name from the soil of Bangladesh, which is believed to be as valuable as gold due to its natural alluvial fertility. The flood plains of Bangladesh are annually replenished with fertilizing silt

from the hundreds of interlacing rivers of the Padma-Brahmaputra complex and abundant monsoon rainfall, which make the people of the land prosperous. Double-cropping in agriculture has been common in the region since historical times, and the land had never experienced a shortage of food or starvation before the East India Company took over the administration.

Present-day Bangladesh can be described as having a high population density, low to medium agricultural productivity, and concentrated rural poverty. The country is often quoted as

classic example of 'scarcity amidst plenty' since its agricultural production system has remained inefficient and sluggish due to its agroecology, agrarian structure, and public policy (Bose 1993; Boyce 1987; Palmer-Jones 1992). The country emerged from a long phase of agrarian stagnation in the mid-1980s (Rahman 2003; Turner and Shajaat Ali 1996; Hossain 2009; Talukder 2018) and access to water for irrigation and control over it has had a major role in it. It liberalized the import of pumps following a catastrophic drought in 1986–1987 (Rahman and Parvin 2009; Hossain 2009; Justice and Biggs 2013) and has become food self-sufficient ever since.

Bangladesh has demonstrated promising agricultural growth and remarkable progress in overall population growth control, yet it faces acute shortages of agricultural land to feed its population of 163.05 million people (World Bank 2021). Productive agricultural land is acknowledged as a critical resource, with arable land decreasing gradually (Barkat et al. 2007). The ability to produce enough food will be affected by the growing competition for land, water, and energy, as well as the urgent need to reduce the impact of food systems on the environment. Moreover, production must keep up with unpredictable production shocks and subsequent price effects arising due to changing weather patterns, disappearing arable land, and an increasing number of people to feed (FAO 2017; Mainuddin and Kirby 2015; Majumder et al. 2016). This becomes more challenging when the economy is agriculture-based, characterized by scarcity of land, has high human-land

ratios, fragmented landholdings, a high degree of landlessness, predominance of production for subsistence, and a high dependence on family farm labor.

At present, Bangladesh faces a dual challenge of meeting the food grain needs of a growing population and producing enough food grains with optimum resource utilization through environmentally efficient technology. Although the country has undergone a green revolution and has overcome the cycle of declining food productivity and unprecedented food shortages following a series of paradigm shifts in agricultural policies and technology adoption, there is no denying that Bangladesh's current agrifood system is rooted in its colonial legacy. Bangladesh continues to follow its historical journey in pursuit of remaining a food-secure nation. Achieving sustainable food security remains the most prominent socioeconomic goal and political priority of the government (Faisal and Parveen 2004; Mainuddin et al. 2014) and calls for a well-informed and prudent policymaking process that is infused with historical knowledge and scientific data.

RESEARCH QUESTIONS

This study is an attempt to understand how the existing agrifood systems of Bangladesh came to be what they are and what path-dependent impediments and opportunities they may have faced and/or continue to face in transforming these systems toward sustainable futures. It discusses major drivers of food production and food security in Bangladesh charting the evolution of agrifood systems in

the country. It traces major political, economic, and social developments that have taken place since 1850 that have determined the agrarian relations and outcomes for the region. Further, it discusses the major climatic events since the 1850s, particularly droughts and floods, that have influenced the food production and livelihoods of rural communities and highlights the temporal continuities and discontinuities in agrarian relations and technological transformations in agriculture.

By analyzing various academic discourses from the pre-independence era to the present, this historical review looks at the nuances of the drivers of food production processes. The decision-making in these processes is determined by ecological factors, particularly climatic events, climate variations, and the risks of disasters. Additionally, modern agrifood systems are intrinsically related to the evolving agrarian political economies. In this context, it is pertinent to understand the economic, social, political, and structural barriers and opportunities that these historical developments have provided for the transformation of the present agrifood systems.

Historical path dependencies are intrinsic to a sustainable agrifood system to ensure equitable access to sustained healthy diets and resilient and remunerative farmers' livelihoods without depleting or degrading land, air, and water resources.

The study will aim to answer the following research questions:

1. What are the major political, economic, and social developments in the country that have taken place from 1850 to recent times that have determined agrifood policy and institutional outcomes for the country?
2. What are the major climatic events in historical and current times (e.g., droughts and floods) that have influenced the trajectory of the evolution of food systems?
3. What are the temporal continuities and discontinuities (in agrarian relations and outcomes) between 1850 and the contemporarily prevailing contexts?
4. How have the evolving agrarian political economies determined the current drivers, production processes, consumption patterns, decision-making, and ecological factors of modern agrifood systems?
5. What political and structural barriers and opportunities do these historical developments provide for transformations of the current agrifood systems?

DATA AND METHODS

The study relied on a review of literature, which included historical studies, available colonial and royal archival documents (gazettes, commission reports, etc.), policy reviews, and post-independence policy and planning documents relevant to the agrifood sector. An interpretive historical inquiry method was followed for the analytical and thematic assessments. Key informant interviews provided a nuanced understanding

and helped contextualize the published literature. Feedback from local stakeholders through stakeholder workshops helped bridge informational gaps relevant to the thematic areas under study.

STUDY FINDINGS

Why does a country such as Bangladesh face food shortages and starvation despite being located on the flood plains of a major river system of the world and naturally endowed with annually replenishable alluvial fertility, abundant monsoon rainfall, and excellent rechargeable groundwater reserves? Why is Bangladesh an epitome of 'scarcity amidst plenty'? Historically, Bangladesh had the resources required for a rich, self-sustained, and sustainable agrifood system, but it also has an equally long history of struggle for food. What went wrong?

According to Carl Sagan (1980) , "You have to know the past to understand the present." This is especially true in the case of Bangladesh, its history sheds light on both present-day and future Bangladesh. It is also a testimony to the fact that food productivity and availability are not determined by the presence of resources such as land, water, and labor but by their appropriate and optimum utilization – there is a historical path dependency on the decisions that led to resource utilization and its effects on agrifood systems.

Bangladesh has been under the rule of three administrative systems with different political ideologies and national goals. Each of these ended

with major socioeconomic discontent in the country, which eventually led to the war of independence. It also resulted in streams of refugees in 1947 and 1971. Although Bangladesh became a separate country in 1971, the heritage of its Bengal Presidency and East Pakistan continues to be a living reality. This is because the terms Bengal Presidency and East Pakistan are not just geographical expressions – the incentive structure for production that Bangladesh inherited as its historical baggage continues to determine its development trajectory, even as it is in the process of scripting its growth path. They resulted in food shortages and low agricultural productivity due to a lack of state investment in food production. The chronology of socio-political milestones in Bangladesh can be visualized in the context of the changing nature of agrifood systems resulting from diverse policies over resource use and the advancement of technology and infrastructure for the purpose of providing food to its population. The findings of the study are presented chronologically in five parts.

Bangladesh Under the British Rule till 1947: Labor as the Prime Factor of Food Production

Being the first seat of British colonialism, Bangladesh, as a part of the Bengal Presidency, had to face extreme exploitation, which resulted in primitive accumulation. It witnessed one of the worst forms of deindustrialization and starvation deaths even after producing surplus grain hitherto unknown in the history of food grain production. The East India Company appropriated the produce from this area for use in its

wars of expedition; in later years, it was used to compensate for the budget deficits of the Madras and Bombay presidencies (Gupta 2012).

The most important factor in determining the incentive structure in the Bengal Presidency was its land tenure system, where intermediaries were permanently settled as zamindars between the state and the tenant. The tenorial structures under the Permanent Settlement of 1793 had far-reaching consequences in areas of surplus generation as well as capital accumulation. British officers presumed that the creation of a landholder class with permanent settlement would strengthen colonial rule and that the landholders would undertake the responsibility of improving agriculture. The British followed the model of agricultural development prevalent in Britain at that time, where agricultural production was led by British landlords who were responsible for the innovations in British agriculture. However, permanent settlement led to the demise of the traditional system of zamindaris, which crumbled under the weight and inflexibility of this arrangement.

Over the years, the new zamindars sublet their estates to many intermediaries – such as *jotedars* and *talukdars* – whose main function was tax collection. If they were unable to collect the tax, they were expected to divide and sell the estates to pay taxes to the British administration. With the increase in the number of middlemen, the share of profits reduced, and debts increased for peasants. The new zamindars bought these estates with unproductive capital and turned them into prosperous, rent-extracting assets with absentee landlords who resided mostly in urban metropolises (Dutt

1947). On the one hand, the taxes increased, and on the other, there was no investment in agriculture to increase productivity. Land was viewed as a resource that could automatically produce more and generate tax money. Without any further investment in the land, the total burden of production fell on the peasants who were tilling the land. There was a common notion that the land in Bengal was already fertile – it was Sonar Bangla, after all – and needed no further improvement. Therefore, it was the responsibility of the peasants or the common people to grow food for themselves and pay some as revenue to retain the land for the next year.

The British administration failed to realize or maybe did not want to realize, as long as they were getting their taxes, that the new Bangladeshi zamindars were mostly absentee landlords and the real cultivators were small and marginal landholders or tenant farmers. Agricultural production continued to be village-based, and neither the zamindars nor the *jotedars* cared about improving farming with new and efficient inputs. As a consequence of the low investment in agriculture, productivity suffered a setback. The actual cultivating class was not left with any resources to improve the conditions of the land. Additionally, they were burdened by an oppressive system, which eroded their net returns in the form of land tax due to the intermediary ownership of the land. In the permanent settlement areas, even entrepreneurs from among the peasant-proprietor class could not enter the agri-business since moneylenders and zamindar generally skimmed off the surplus of the peasantry to increase their wealth (Bagchi 2000) rather than invest it back into agriculture.

The British government introduced the Bengal Tenancy Act in 1885, which recognized the rights of the raiyats (peasants who cultivated their land) to land and correspondingly curbed the authority of the zamindars, at least theoretically (Chakraborty 1992). It created an opportunity for the economically weaker raiyats to mortgage or sell their holdings at times of distress or scarcity to other comparatively well-off raiyats, who subsequently became *jotedars*. This introduced a dynamic land market at the village level. Economic marginalization of the Bengal peasant society eventually led to peasant indebtedness and landlessness (Chakraborty 1992).

The second quarter of the nineteenth century saw the emergence of the land magnates. The Patni Regulation of 1819 strengthened the practice of granting sub-tenures and under-tenures. According to Huque, “more subordinate taluks were created till a system of profit-upon-profits with one shifting the burden of rent-collection on to the next, created a complex hierarchy of sub-in feudatories in the Bengal land system” (1939, 250). In short, the present structure of small landholdings in Bangladesh has its roots in the Permanent Settlement and Bengal Tenancy Act of the British era.

The British government remained wedded to *laissez-faire* and free trade because such policies benefited the important constituents within the imperial structure back home and in Bangladesh. Three key factors defined the changes in Bangladesh during the colonial period: the expansion of commercial crops for exports, the land revenue collection system, and the destruction of indigenous industries (Siddiqui 1996). The Bangladesh

peasantry was forced to grow opium, cotton, and indigo instead of traditional food crops for export to China to pay for Britain’s imports (Trocki 1999). The constant need for tribute and the increasing costs of imperial wars required Bangladesh, then part of British India, to raise exports and increase its land revenue. Although few farmers shift to commercial crops under pressure from the government, agricultural production remained static, while the demand for land revenue increased manyfold. Moreover, revenue was collected before the harvest ignoring the uncertainty in agricultural outputs due to natural disasters such as floods and droughts (Ahuja 2004). Unlike under the Mughals, the British government did not provide any relief to the peasants during droughts or floods, in form of tax rebates and waivers. Therefore, they were left with no choice but to borrow and mortgage their land. As a result, peasants had little capital to make long-term investments in the land, while the myopic absentee landowners found that returns on money lending were higher than returns on long-term investments for agricultural productivity.

The land rent and extraction of surplus were so exorbitant that peasant indebtedness and hunger rose to hitherto unknown and unprecedented levels. Six devastating famines between 1876 and 1878 claimed the lives of more than 60 million people (Roy 2016). The 1943–1944 famine (the last famine before independence) killed nearly four million people. The famine was not triggered by any natural disaster (Sen 1982) or crop failure, yet millions died due to problems related to food distribution and not food availability..

On one hand, the colonial government was not answerable to the people, and hence, their welfare was not a priority. On the other, common people were stuck in a vicious cycle of vulnerability due to low investments, low productivity, and low purchasing power. Bangladesh's economy and agrifood systems became much more dependent on seasonal monsoon whims.

Commenting on the large-scale famine deaths in British India, Winston Churchill remarked, "I hate Indians... The famine was their own fault for breeding like rabbits." (Quoted in Choudhury 2021, 1). This quote, in a nutshell, summarizes the British administration's indifference toward the Bangladeshis at the time. It implied two important aspects of food security during British rule in Bangladesh. First, it shifted the onus of food (in)security on the local population, and second, it made it implicit that food insecurity was 'inevitable' and 'expected'. On the demand side, Bangladesh was chided for a high fertility rate that resulted in an uncontrolled surge in demand for food grains, which was bound to surpass food production. On the supply side, Bangladesh was again blamed for its 'subsistence agriculture,' which had remained subsistent because it had not taken advantage of the new opportunities provided by the British administration, such as the export of commercial crops. Export-oriented agriculture had few takers as it did not allow the common people to prosper due to faulty marketing practices and lower competitive prices. Growing subsistence rice was low risk and that at least took care of their household food requirements.

Government officials attributed the low agricultural productivity and food

shortages to the irrational values and uneconomic behavior of peasants and the imbalance in factors of production such as disguised unemployment, poor quality of the agricultural stock, and the fragmented and uneconomic size of the holdings (Ray 1973). The prevalent presumption was that low production was due to 'lazy farmers with bad farming decisions' (Roy 2016). In other words, it was believed that farmers of Bengal had 'uneconomic behavior' because they were averse to new techniques of cultivation and were unwilling to put in more labor than the amount that would just suffice to meet the bare requirements of subsistence.

Toward the end of the nineteenth century, a new discourse emerged about introducing new technology in agriculture to solve the problems of low productivity and food shortage. It was steered by the Bengali youth who had returned from England with new ideas and a foreign education. However, they had no understanding of how to deliver such knowledge to the peasantry (Roy 2016). From the mid-1930s, another distinct perception of agricultural issues emerged – the left and peasant movements in Bengal, who believed in land distribution and land reforms but did not emphasize agricultural modernization. Hence, when the colonial rule ended, land distribution was the main priority of the new government as per popular demand. Up till then, the public discourse was about correcting the injustice that had happened with regard to land alienation and securing tenure.

In the new discourse, 'population' was central to all narratives on agriculture – be it the colonial British narratives or the ones that followed. For instance, the population was considered the

determining factor of 'food security,' 'more labor for more production,' and 'more people with more food demand.' It was believed that agricultural production would automatically increase if the peasants had access to land and could secure land tenure, as this would incentivize them to improve the productivity of the land. In other words, once access to land was guaranteed through land distribution and allocation of secure land tenure, farmers would be incentivized to produce more by putting in more labor and investing in land.

Hence, in the next phase of Bangladesh's history as East Pakistan, land became the most important resource for development, and access to it was synonymous with gaining 'food security and prosperity.' It is noteworthy that the already impoverished peasants did not have anything except their labor to invest to increase productivity. Without any savings, they were dependent on the state to invest in production-augmenting techniques and kickstart an agricultural revolution to break the vicious cycles of low productivity and starvation.

Bangladesh Under Pakistan Rule, 1947–1971: Land and its Size Become the Prime Factors of Food Production

The British colonial rule ended in 1947 with the partition of India and the creation of two independent countries – India and Pakistan. Pakistan became a unique geographical territory consisting of two wings, East Pakistan (Bangladesh) and West Pakistan, separated by more than a thousand miles of India. In the absence of a power-sharing formula between East and West Pakistan, the first few years following independence were marked by constitutional crises that persisted until 1958. The region also witnessed

sporadic outbursts of violence (Khan 2013).

At this juncture of major historical development, Bangladesh experienced land reforms by default. When the Hindu zamindars migrated to India after partition, the government of East Pakistan took possession of their land and distributed it among Muslim peasants. Under the political leadership of West Pakistan after 1947, there was not much scope for drastic economic or social reforms in Bangladesh (Jabbar 1974). However, after decolonization, Bangladesh was able to increase food production substantially, and efforts were made to accelerate economic growth. The economy was diversified by promoting export industries, particularly those relating to readymade garments and shrimp (Gupta 2012).

At this time, two important developments were initiated by the state that had an enormous impact on food production. First, public institutions were established and assigned responsibility for distributing subsidies on agricultural inputs, research, and development. Second, HYV seeds were introduced to boost food production. The most important investment in resource use was the introduction of large-scale irrigation projects that were based on the legacy of the flood control programs of the British administration. Therefore, in the first decade of the irrigation system of Bangladesh as East Pakistan, canals were built for flood control, drainage, and irrigation. At this point, it was clear that productivity could only be increased with state leadership and investment. Irrigation, in terms of using water resources for agriculture, was considered just a supplementary or risk-reducing agent. It was not yet

identified as a crucial resource or even a prerequisite for adopting HYV seeds. Land and the size of landholdings were still considered the most crucial modes of production as well as a prerequisite for further investment in agriculture. This was the reason why the central government in West Pakistan considered the small size of farm holdings in East Pakistan, as compared to the large-scale production systems in West Pakistan, a serious impediment to any further investment in land. Consequently, it never invested as much in the development of a green revolution in East Pakistan as it did in West Pakistan. Hence, the spread of HYV seed coverage in East Pakistan was just about 5% during that period (Khan 2013).

With time, it was apparent that public institutions set up by the government were ineffective, shrouded in bureaucracy, and with a large staff whose powers and expertise were too limited. Tragically, the rate of economic growth was much slower in East Pakistan than in West Pakistan. The central government of Pakistan was fully engaged in the spread of green revolution-led wheat and rice technologies in West Pakistan but neglected East Pakistan. Following decolonization, East Pakistan became dependent on West Pakistan for food imports. One of the major grievances of East Pakistan citizens was the unequal public investment between the regions (Khan 2013).

By 1961, nearly 98% of East Pakistani farmers owned all or a portion of the land they operated (Elkinton 1970). Yet, the questions remain: if the structural mechanisms of revenue generation and land alienation were the key to low agricultural productivity, then why did the abolition of the zamindari systems

and the successful redistribution of land fail to bring about anticipated gains in production? Labor was abundant, and the land was also now acquirable. What was needed was the technological breakthrough of the green revolution, which was being experienced by other countries in Asia. This required assistance from the state in the form of enormous capital investment and subsidies and loans for the ubiquitous adoption of HYV seeds.

It became clear that the West Pakistani government had too much control over every operation and investment made in agriculture in East Pakistan – something mirroring the legacy left by the British administration. Though the Bangladeshi farmers now had better access to land, the expected gains from it could not be achieved due to state apathy and lack of support. East Pakistan experienced military rule from 1958 to 1971. Despite the green revolution and the introduction of seed technology, Bangladesh was left on the brink of starvation again at the time of its independence in 1971 when the war of liberation with Pakistan resulted in the resettlement of ten million refugees who had fled to India during the war.

The Pakistan rule ended with the realization that since land is a fixed asset, its productivity can only be increased through land-augmenting techniques. What was needed then was investment in research and development and support for farmers in the form of subsidies and soft loans, functions only the state was equipped to perform. This was in line with the food policies of all developing countries in Asia and Africa that adopted the new seed technology transferred from America.

FIGURE 1. TIMELINE OF IMPORTANT EVENTS AFFECTING AGRI-FOOD SYSTEMS IN BANGLADESH



Bangladesh as a New Nation, 1971–1979: HYV Seeds Become the Prime Factor of Food Production

The most serious challenge to Pakistani nationalism was the economic disparity between East and West Pakistan, which led to strong protest movements in East Pakistan and culminated in an armed struggle and eventual independence of Bangladesh from Pakistan in 1971. Pakistan was bifurcated to create the new state of Bangladesh out of its eastern wing. By 1971, there was no monopoly capital in Bangladesh, as 85% of its industries had been nationalized and were now within the purview of the government of Bangladesh. A land reform program was in the offing. With an increase in population and the lack of investment in agricultural modernization, Bangladesh was under pressure to produce more food for its growing population. It was a food-deficit nation and was importing food to meet its domestic demand.

After its independence, Bangladesh adopted a state-managed planned economic development model and nationalized several key industries. It also established a central planning commission with a mandate to formulate short-, medium-, and long-term economic development plans. The commission launched the First Five-Year Plan in July 1973 (Misra 2012), with a special focus on the rehabilitation of the war-ravaged country and an increase in food grain production to ensure food security for the rapidly growing population. It followed import-substitution policies to protect the domestic agriculture and industrial sectors.

Bangladesh introduced a series of

policy reforms to modernize agriculture. Its technological push, which included multiple cultivations of HYV rice using chemical fertilizers, irrigated water, and dynamic techno-managerial strategies, led to an intensification of agriculture while reducing the environmental constraints on agriculture. This human-induced intensification doubled total food production, ensured food security, and increased farm income, triggering rural social change.

On the political front, 1971–1975 was a period of failed attempts to institutionalize a one-party populist authoritarianism. This period was marked by increasing fragility and high levels of violence as powerful groups grabbed resources abandoned by the previous regime. It culminated in a military coup in 1975. From 1975 to 1990, military leaders formed political parties and ruled through rent distribution within competitively constructed parties and occasional elections. During this period, the government controlled all investments, and every transaction was slow, cumbersome, and rent-seeking. Even with the introduction of the green revolution technologies, productivity was low, as access to these technologies, as well as their adoption, were low. The state was engaged in large public investments in irrigation, which were mostly donor-funded but still geared toward flood protection rather than crop production.

Gradually, it was realized that to augment land, cropping intensity must be increased. This could only happen with the third rice crop – *boro*. Since *boro* was a winter crop, it required controlled irrigation. It is hard to say if *boro* cultivation inspired groundwater irrigation or vice versa.

The government introduced groundwater irrigation by heavily subsidizing deep tube wells (DTWs) and low lift pumps (LLPs) (2 cusecs) in the early 1970s, both of which were owned, operated, and managed by the government. Initially, these water extraction technologies led to productivity gains. However, as their number grew, they became unwieldy to manage. The irrigation system became inefficient due to poor management, rent-seeking behavior of government officials, and lower-capacity utilization of the machines at the hands of inefficient and undisciplined farmers' cooperatives. Moreover, due to the lack of expansion of surface irrigation projects, LLP development did not pick up.

By this time, there was a growing realization that cropping intensity could be increased further with the expansion of groundwater irrigation. It was believed that being capital-intensive, tube wells were not economically feasible for adoption in small and marginal landholdings. Ghulam Mohammed, a noted Pakistani agricultural economist, surveyed the potential for tube well irrigation in Bangladesh and argued that a total of 26,000 private tube wells could be installed if the size of the holding was the main criterion (Hossain 2009). Eventually, policymakers concentrated on expanding irrigated areas by surface water irrigation to increase crop production rather than prioritizing groundwater irrigation.

Unfortunately, the large-scale irrigation schemes of the government failed to control the flooding of agricultural lands and improve food production due to the low capacity of canal irrigation (Pal et al. 2011). Many scholars believe that the sheer scale of these

schemes made them cumbersome to manage, making them ineffective and underutilized (Boyce 1987). The major constraint to the rapid expansion of the green revolution technology was an inappropriate irrigation method. During the monsoon crop season, the land was flooded due to heavy rains, and in the dry winter crop season, there was no water due to a lack of irrigation infrastructure. Investments in irrigation development had followed the large-scale strategy, but small-scale groundwater technologies gradually grew in importance. The semi-governmental organization responsible for the procurement and distribution of modern irrigation equipment (Bangladesh Agricultural Development Corporation or BADC) had sole control over the procurement and distribution of not only irrigation equipment but also fertilizer, improved varieties of seeds, and other types of agricultural machinery.

It is important to note that in this phase of agricultural development, farmers had better economic conditions than before but did not have the means to further production and increase their agricultural income. The prerequisite of HYV *boro* production was controlled irrigation, which could only be achieved through groundwater irrigation, and this water extraction machine (WEM) could only be better managed and controlled if it was owned privately by the farmers.

Bangladesh Under the Surge of Privatization After 1979

In 1979, multiparty elections were reintroduced in Bangladesh. Economic organizations in the new sectors under this reformed political set-up were formed without direct support from the dominant coalition.

. This new organizational reform began to drive growth in the economy (Khan 2013) and facilitated the privatization of agriculture. While policy reforms continued into the 1990s, some of the major reforms in the agricultural input markets came about in the early 1980s. Two important elements of these reforms were the reduction of subsidies and the increased participation of the private sector in the procurement and distribution of inputs. In the 1980s, the government liberalized the input markets, gradually eliminated subsidies on agricultural inputs, and removed the bans on private-sector imports of agricultural machinery.

These policy changes encouraged private investment in small-scale irrigation, such as shallow tube wells and power pumps, all of which contributed to the faster growth of the (dry) winter season irrigated *boro* rice. The paradigm shifts in the governance facilitated the privatization of groundwater irrigation, which contributed to the expansion of cultivated areas, an increase in cropping intensity, the diffusion of HYV seeds and fertilizers, and an overall increase in agricultural productivity (Rahman and Parvin 2009; Hossain 2009; Rahman 2003; Justice and Biggs 2013). Driven mainly by the expansion in *boro* rice cultivation, total rice production in the region has more than tripled in the last three decades while the population has increased by only about 60%. This gap in demand and production has helped Bangladesh become self-sufficient in food production.

Groundwater development in Bangladesh is largely associated with the diffusion of shallow tube wells (STW) and hand tube wells (HTW) in a decentralized manner, largely driven

by enterprising farmers who had access to private investments. After liberalization, publicly owned and bureaucratically managed systems were replaced by privately owned and managed irrigation systems (Zohir et al. 2002). Once restrictions on importation, standardization, and placement of tube wells and pumps were removed, a virtual 'tube well revolution' took place. The increase in the number of shallow tube wells fielded was spectacular and beyond projections. De-standardization and reduced import duties made less expensive Korean, Chinese, and Indian engines available to farmers, and the increased competition caused a general fall in the prices of tube wells. The improved availability of cheaper irrigation equipment resulted in a rapid expansion of groundwater irrigation. In 1980, less than 13% of cultivated land was irrigated. The share had risen to 30% in 1990 and to more than 50% by the turn of the century (Zohir et al. 2002). Since the landholding size was small and the groundwater aquifer shallow, the most scale-appropriate technology was the STW. At present, minor irrigation covers more than 90% of the total irrigated area in the country.

Improved control of water facilitated the adoption of modern varieties of rice as well as fertilizers. While the proportion of cultivated land covered by modern varieties increased from approximately 20% in 1980 to 65% in 2000, the use of the NPK (nitrogen (N), phosphorus (P), and potassium (K)) fertilizer rose from 30 kg/ha to 99 kg/ha during the same period (Zohir et al. 2002). The green revolution technologies paved the way for market integration for peasant producers, as the adoption of these technologies forced them to sell their surpluses in the market to meet the increased costs

of chemical-intensive and irrigation-based farming. These technologies enabled the intensive cultivation of rice up to three times a year (Misra 2017).

As Djurfeldt and Jirström (2005) rightly contend, the green revolution in Bangladesh was a 'state driven' and 'market mediated' process. Bangladesh's agricultural sector has transformed since the early 1970s: its total food grain production has increased from 10 million tons in 1972–1973 to 35 million tons in 2012–2013 (Hossain and Bayes 2009). The country has made commendable progress in achieving food security over the past 40 years despite frequent natural disasters and population growth (World Bank 2016). Its agricultural sector responded positively to productivity growth supported by policy reforms in the 1980s that facilitated rapid irrigation expansion through groundwater pumps that led to enhanced adoption of high-yielding plant varieties and fertilizer application. These reforms accelerated better connectivity and linkages to packaging, processing, and widespread mechanized markets for farm products through investments in logistical and market infrastructure (Shahabuddin 2017).

Structural Adjustment Programs and Market Liberalization in Agriculture

The ultimate goals of the extensive reforms and adjustment programs introduced in Bangladesh's agriculture sector during the 1980s and 1990s were to alter the historical trajectory of the country and set it on the path of industrialization by generating an impetus for pro-market reforms led by the private sector (Misra 2017). The reforms aimed to transform the fundamentals of the country's agriculture. The areas where the reforms had a deeper impact were the

marketing and distribution of agricultural inputs, food trade, curtailment of price control by the government, and reduction of tariff rates for agricultural imports and exports. The reforms liberalized and deregulated the agriculture sector and government gradually downsized the operations of several state-owned enterprises devoted to delivering agricultural inputs to farmers (Like BADC), and started reducing agricultural subsidies in pursuit of economic reforms gearing for these structural adjustment policies.

The reform process took several years, but by the mid-1990s, the privatization of the input distribution system was largely complete. Hitherto, the BADC, now dismantled, had an absolute monopoly over the inputs procurement and distribution systems. At present, the agricultural inputs business is fully privatized since private sector businessmen control trade in the fertilizer, seed import and distribution, and agricultural machinery domains. There are a few government controls over fertilizer and sugar production as well as on wholesale trade, but these are of relatively minor economic significance. The government allows the private sector to import fertilizers and food grains from foreign countries directly. In addition, the subsidies to agriculture have been reduced greatly. As in the manufacturing sector, the private sector initiatives remain the focal point of agricultural development.

The wide range of reforms, which were drafted to facilitate private sector-led agricultural development, has resulted in the unprecedented disintegration of regulatory practices in Bangladesh's agriculture. Previously, agricultural inputs, output markets, and the public

pricing of major products had been the exclusive prerogatives of the government. As the government began to downsize the volume of subsidies, input prices rose correspondingly while rice prices at the producer level remained depressed. This did not create many problems for the wealthy farmers but was a financial burden on small peasants, who found it tough to invest in expensive machinery and other necessary inputs (Misra 2017).

It is noteworthy that the pace of reforms was faster in Bangladesh than in its South Asian neighbors. This can be attributed to the political economy of the agricultural policies and the historical legacy of peasant oppression and food shortages. These two factors have been discussed in greater detail in the next section.

CURRENT DRIVERS OF PRODUCTION PROCESSES AND DECISION-MAKING IN PRESENT AGRIFOOD SYSTEMS

Bangladesh has tripled its rice production from 12 million tons in the 1970s to 36 million tons in 2019 and is even exporting rice (Islam 2020). The analysis of its agricultural history presents four factors that drive the contemporary process of food production in Bangladesh as well as the decision-making related to augmenting production. These are discussed as follows:

Subsistence Agriculture Determines Food Security

The contradiction that resides in the state's reluctance to do away with peasant agriculture has a lot to do with Bangladesh's memories of famine and

starvation, which continue to haunt and shape its policy regime (Pinstrup-Andersen 2000). As Sen's seminal analysis of the 1943 and 1974 Bengal famines (1981a, 1981b) shows, the spectacular failures of the colonial administrations and the post-independence state, respectively, to redistribute food among the rural populace on the eve of their loss of 'entitlements' amidst a market failure led to the death and starvation of several million people. In both instances, the ruling regimes were subsequently overthrown, as the deaths undermined the legitimacy of these regimes. The fear of a recurrence of popular revolts resulting from a malfunctioning market underlies the state's steadfast refusal to relinquish its power to control the economy. At no time did the state's distrust for the market become as evident as it did during the 2007/08 food crisis, when the state dispatched the army to indiscriminately round up rice traders on account of illegal hoarding and syndication charges without the necessary approvals of the courts, sending shockwaves through the market. Another factor that compels the state to protect the subsistence sector is the inability of the formal sectors (industrial and service) to absorb the massively surplus labor force that will be released following the agrarian reforms (Misra 2017).

Population Growth and Decreasing Land-to-Person Ratio

Population growth is considered one of the most powerful driving forces of changes in the agrifood systems and agricultural growth in Bangladesh. Since land is a fixed asset, population growth will inevitably decrease the land person ratio. In other words, the same parcel of land will have to provide food and livelihood to a greater

of people. Bangladesh's agriculture experienced stagnation in the 1970s under extreme population pressure and severe environmental constraints (Ahmad 1985; Ali 2007). Further population growth during 1975–2000 prompted farmers to intensify agriculture via technological change, which meant cultivating HYV rice multiple times using chemical fertilizers, irrigation water, and varying techno-managerial strategies. This human-induced intensification has doubled total food production, ensured food security, and increased farm income, occasioning a rural social transformation.

Market Liberalization of Food Crops

The third driving factor is that the increased market price for commodity crops has had a positive effect on agricultural growth as well as agrifood system changes. Over time, Bangladeshi farmers have responded to high world market prices and the demand for cultured shrimp, vegetables, and fresh fruits and cultivated them more frequently by transforming marginal lands and rice fields. Increased commodity production has increased farm income and allowed farmers to improve their socioeconomic conditions. However, market risk lends uncertainty to the rice production systems in Bangladesh – price volatility has been a frequent threat to sustained rice cultivation. On the other hand, the scope and profitability of many non-rice crops are increasing day by day. Commodity production's positive impact on agrifood systems can be seen in industries such as shrimp production, wherein the development of logistics infrastructure has improved socioeconomic conditions.

Growing Landlessness and Increasing Pressure on Land

It is established, or at least agreeable, that the region's growing landlessness has negatively influenced the agrifood systems and their productivity. The literature highlights that this phenomenon can be attributed to the prevailing demographic, environmental, social, political, and economic conditions (Khan 2004). Population growth and the operative law of inheritance have caused a rapid decline in the per capita land- and farm-holding sizes. Environmental constraints, such as riverbank erosion and sea level rise (SLR), also lead to landlessness. Natural occurrences such as crop failure – due to flood, drought, and soil salinity – and urgent social needs – marriage, education, and the cost of overseas migration – often force farmers to sell their land.

In the debate on efficiency, several studies analyzing district-level aggregate census data have reported an inverse relationship between farm size and agricultural productivity in Bangladesh (Boyce 1987; Griffin et al. 2002; World Bank 2021). However, regardless of efficiency, the benefit of nationwide agricultural growth and rural social change has been found to be biased toward large holders, while landless and smallholders have been found to suffer from growing unemployment and remain vulnerable to poverty (Ali 2007). The most important obstacle to uniform agricultural growth and agrifood system changes is the uneven distribution of land resources and the disproportionate access to capital and other institutional support (Boyce 1987).

Tenurial as well as redistributive land reforms have been implemented in

Bangladesh to remove this obstacle and redistribute land to landless farmers. The former has created fewer owners and many owner-cum-tenant and tenant farmers, while the latter failed due to the loopholes inherent in the reform administration (Byres 1981; Mahbub 1996; Griffin et al. 2002; Jannuzi and Peach 1980; Khan 2004). Agricultural economists dealing with agrarian reform have doubts about the efficacy of equal distribution of farmland among farmers of all categories on increasing land and labor productivity because they believe doing so will only create many small farmers (Khan 2004; Mahbub 1996). Transforming land and labor productivity among all farmers needs a radical agrarian revolution, which is utopian under the present circumstances. The most serious challenge for the future appears to be the declining area of agricultural land, about 1% of which is being converted for other uses each year. Productive agricultural land put to non-agricultural uses may lead to further pressure on cropped land.

Groundwater Technology Adoption and Water Resource Utilization

Soon after its independence in 1971, Bangladesh experienced a major paradigm shift in its water policy with the implementation of associated institutional and policy frameworks. The large-scale publicly financed surface water development projects were replaced by policies targeted at developing minor irrigation using LLPs to irrigate with surface water as well as STWs and DTWs to irrigate with groundwater. The spread of groundwater irrigation was responsible for the high growth of agricultural productivity, accompanied by the introduction of the new HYV of rice in the 1970s, which initiated the green

revolution in Bangladesh.

Liberalization of the irrigation machinery trade made pumping machines much cheaper. With the withdrawal of the norm related to tube well sites in 1992, STWs spread across the country. Mandal (1987, 1993) noted that the widespread ownership of STWs helped break the monopolistic control of landed rich farmers – who were labeled water lords by an influential civil servant in the early 1980s – over the supply of irrigation water. Mandal (1987) associates this with ‘the development of rural entrepreneurship’ and the spread of groundwater markets by STWs to ‘the growth of agribusiness services.’ The key advantage of the STW is that it is small-scale in operation, easily movable, easily repairable with spares or components of different makes, and easily sunk using local manual labor. Due to these advantages STW were conveniently adopted by small landholders leading to boos in their income making agriculture as a powerful driver of poverty reduction in Bangladesh (World Bank 2016), with agriculture accounting for 90 percent of the reduction in poverty between 2005 and 2010 (World Bank 2016).

There have been two peaks for groundwater irrigation development in Bangladesh. One was the gradual turnover of the ownership of WEM s from government to private hands in the 1970s, and the other was the revolution caused by the duty-free imports of Chinese pumps in the late 1980s. None of the studies in Bangladesh have challenged the government’s decision to reduce public expenditure on irrigation and transfer control of groundwater irrigation to private hands, barring a few studies that mention a lack of

support from the irrigation bureaucracy for privatization. Studies have supported this decision, as too many DTWs and LLPs became unwieldy to manage, making it costly and ineffective (Mandal 1993). Private investment was applauded because of the enterprising nature of the Bangladeshi farmers and the government's role in supporting them through subsidies and loans in the first phase, as well as lifting the ban on unstandardized equipment and eliminating import tax in the second phase.

Since land is scarce in Bangladesh, the necessity of maximizing output – particularly food – through intensive cultivation and diffusion of modern technology is regarded as paramount. Probably the most important driver of agrifood system production is the adoption of agricultural technology. The progress in agriculture production technology in Bangladesh has excelled with respect to the usage of HYVs of rice, chemical fertilizers, pesticides, equipment for land-tilling, and irrigation pumps. However, access to this technology is dependent on market forces discussed in the last factor. At the same time, the declining productivity of these inputs, owing to severe environmental constraints, must be highlighted. Agricultural productivity is also being negatively affected by climate change. Since land is a fixed resource with competing uses, Bangladesh must depend on water resources to optimize its agricultural production. However, Bangladesh faces great challenges in water resources management, experiencing water excess in the wet season and a lack of water in the dry season.

As long as rice remains the principal food crop of Bangladesh, demand for

irrigation water will continue to increase over time due to changes in rainfall and an increase in evapotranspiration. Due to the sustainability concerns of groundwater irrigation, the government of Bangladesh intends to reduce dependency on this technology by reducing groundwater pumping in several ways, but mostly by increasing the usage of surface water for irrigation (Qureshi et al. 2015; Hasan et al. 2019; Krupnik et al. 2017), introducing water-saving irrigation technologies (Krupnik et al. 2015; Krupnik et al. 2017), and replacing *boro* rice with other low water-consuming, non-rice crops (Rahman 2009; Ara et al. 2016).

Though there is no doubt that intensive use of groundwater has increased in the last five decades, whether its availability is a concern for Bangladesh is debatable. Some drought-prone regions of the country have recorded a decline in groundwater tables, but the recent evidence on 'the Ganges water machine' projects sustained availability of water in the shallow aquifers of the Indo-Gangetic plains, with periodic recharge from monsoon rainfall. Many scholars have argued that groundwater availability is still not a major concern for the country, with bountiful aquifer reserves and sufficient recharge (Islam and Rahman 2014; Kirby et al. 2015).

Cost of Energy for Irrigation

Though there is water availability in the aquifers, the greatest downside to heavy dependence on groundwater is the increasing energy cost of groundwater irrigation. Pumping costs have increased over time and, due to low uptake of electrification, most of the STWs in Bangladesh are diesel-operated.

On average, 40 liters of diesel were used to irrigate 1 ha of *boro* rice land in 2015. This equates to roughly 1.23 billion liters of diesel being consumed in a single season (Mottaleb et al. 2019).

Though declining groundwater levels by themselves are insufficient evidence of unsustainable groundwater use (Kirby et al. 2015), in the long run, such a continuous decline will necessitate deeper pumping technology, raising costs further due to the associated energy use and the requisite installations. Thus, the energy demands of groundwater pumping raise questions about the economic sustainability of its usage in Bangladesh (Qureshi et al. 2015). In this context, the price of diesel in the international market plays a crucial role in the cost of irrigation for diesel-operated farms, particularly for *boro* rice cultivation. Bangladesh has taken the initiative to establish solar irrigation pumps (SIPs) to overcome this bottleneck.

Energy prices will be one of the most important drivers of Bangladesh's agricultural economy and have the potential to affect its agrifood systems. Interestingly, the water–energy–food (WEF) nexus is not yet recognized in the policy documents of Bangladesh while conflicts over these resources are growing. Bangladesh's energy infrastructure is modest; it cannot yet meet the domestic demand and is poorly managed (Gain et al. 2015). The country already faces frequent power outages (Shah et al. 2004), as the demand for energy for rice cultivation increases every year (Islam et al. 2009).

Policies of Groundwater Governance

Many scholars had predicted that with an agrarian structure – dominated by marginal farmers and share tenants

who operate land in scattered, tiny holdings – technological investment and diffusion would not be possible in Bangladesh (Boyce 1987). However, the diffusion of rental markets for STWs made it possible to bring a massive area under STW irrigation (Mandal 1987; Palmer-Jones 2001) and defied such projections. Palmer-Jones (2001, 4) characterized these informal groundwater markets as “private provision of local public goods within a socially regulated contestable market embedded in local society.” Since groundwater irrigation is the prime factor of agricultural production in Bangladesh, access to it determines agricultural decisions.

Legally, groundwater is a common property resource under the ownership of the state. Till now, access to this resource was governed by the farmer's access to groundwater irrigation technology as well as the energy required for pumping. To govern the use of groundwater, the state has two kinds of policies, which it revokes from time to time: the tube well siting rule and the license to dig new wells. For example, the drought of 1983 compelled the policymakers to use the siting norms for banning the installation of new STWs in 22 districts to reduce groundwater draft. The 1988 cyclones reversed this order, lifting all bans to increase groundwater irrigation and augment food production. However, concerns about groundwater depletion have been stated in all policy documents since the late 1990s, which led to the eventual reinforcement of siting norms in water-scarce areas and for DTWs in 2013. In 2018, based on the Groundwater Management Act in Agriculture, procuring a license from the upazila parishad was made mandatory for all tube wells (STWs and DTWs) to be installed/already installed

for irrigation purposes. The act also mandates payment of a prescribed fee and that this license be renewed every three years .

Scholars have raised concerns that such acts, which must be implemented legally as well as administratively, incur high operative costs given the large number of tube well pumps in the country. Moreover, such a policy will restrict groundwater use and may negatively impact the livelihoods of millions of smallholders who use groundwater for agricultural production (Pandey et al. 2020). Such restrictive use of groundwater may pose another challenge for groundwater irrigation, especially for the pervasive informal groundwater markets in rural Bangladesh.

Since groundwater irrigation is directly linked to food production, it is seen as a resource 'important to everyone' in Bangladesh. Hence, its intensive use is seen as benefiting the entire nation. The negative consequences of the intensive use of groundwater have been noted by some scholars, particularly with reference to the declining water table in some regions, the increasing energy cost of pumping water, and the impending dangers of a rise in demand for groundwater irrigation due to rainfall variability and global warming . Most studies on the subject remain inconclusive, citing a lack of robust information on aquifer reserves, their withdrawal patterns, and changes in quality (Qureshi et al. 2015).

Climate Change

Being located almost entirely on the low-lying part of the Ganges-Brahmaputra-Meghna rivers, with the levels of poverty and population density that it has, Bangladesh is prone to almost every kind of adverse climate change impact including extreme

weather events such as floods, cyclones, drought, salinity, and SLR (Rashid and Islam 2007). Climate change-induced events, such as riverbank erosion, recurring floods, and droughts in the dry season, have been increasing this vulnerability, with profound impacts on crop yields and cropping patterns (Rokonuzzaman et al. 2018). All climate change-related shocks, floods, waterlogging, and river erosion have caused the largest loss to rice production in all the crop seasons (Thomas et al. 2013). Modeling projections for Bangladesh indicate that climate change is likely to have an adverse impact on the production of wheat and rice not only due to the direct effect of higher temperatures but also problems associated with extreme weather events (Wassmann et al. 2009). These problems will be especially acute in the coastal and delta regions, where flooding and salinity are more likely to increase (Ismail et al. 2010).

Climate change is projected to impact the hydrological cycle of Bangladesh significantly (Agrawala et al. 2003). The IPCC (2007) has predicted that rainfall patterns in Bangladesh will change due to rising temperatures. Another critical challenge for Bangladesh's agricultural sector is the rise in temperatures, which impacts crop growth and puts pressure on groundwater resources. Farmer income is extremely vulnerable to variations in rainfall and climate change will further increase variability of rainfall in Bangladesh (Nahar et al. 2018). . Climate change is expected to reduce yields, threatening food security and agriculture-dependent livelihoods in the next three decades (Hossain et al. 2023).

Though there are concerns about increased groundwater irrigation

demands due to climate change, the results remain inconclusive, with counterarguments suggesting that the impact of climate change on irrigation demand is much lower than the natural variability in the climate (Mainuddin et al. 2014). Maniruzzaman et al. (2018) have argued that there will be limited changes in irrigation water demand and surface water availability. The exact amount of change in water requirements for potential irrigation for crop evaporation or net irrigation remains uncertain due to the large variability in projected rainfall amounts and distribution. Only time will tell how accurate these projections are.

POLITICAL ECONOMY OF AGRICULTURAL POLICIES AND ITS HISTORICAL PATH DEPENDENCIES

There has been a progressive shift in agricultural policies in Bangladesh toward privatization, deregulation, and a reduction of input subsidies, which began in the mid-1970s and continues even today. Although trade liberalization has faced substantial opposition, Bangladesh undertook major reforms in trade policy, reducing tariffs for industrial products from the 1980s – especially in the early 1990s – and ultimately liberalizing private sector trade in rice and wheat. As a result, domestic output prices of rice – the main agricultural product in terms of value – and wheat have been set at near-border prices in most years since the early 1990s. As a result, price distortions in Bangladesh’s agricultural sector have averaged less than 5% of the value of domestic production since 1990, despite the prevailing price distortions for a few products – notably sugar cane – and inputs – chemical fertilizers. Bangladesh has reaped major benefits from trade liberalization in terms of food security, as private-

sector imports have helped stabilize the market after major production shortfalls. Setting the domestic prices of most agricultural commodities at near-border prices has resulted in overall efficiency gains in the agricultural sector (Ahmed et al. 2007).

Successive Bangladesh governments that formulated and implemented these policies, like all governments, have had to balance a variety of objectives against a range of constraints. Even if reform proposals are sound on economic considerations, they need to attain a minimum level of social and political acceptability for their implementation to be successful and sustainable. In the policymaking process, various interest groups exert pressures and counter-pressures on the government, and government responses are often conditioned by the mutuality of interests of the pressure groups and the ruling elites (Grindle 1989). In Bangladesh’s context, a few factors have been important in determining the influence of various interest groups on agricultural policies and reforms since independence. These include the relative political strengths of farmers versus urban groups; academic and political views on socialism and capitalism; internal debates within government across ministries; and influences of donors.

Agricultural reforms have been implemented smoothly in Bangladesh without any hindrance. Rural Bangladesh is characterized by a lack of organizations and leadership that can unite the peasants and articulate their grievances against wholesale reforms in agriculture. Though they are spread across a large number of households, their geographical dispersion, internal differentiation, ideological orientation, and poor resource base contribute to making

them largely ineffective politically. They tend to be poor and lack the necessary funds to mobilize mass movements. The major political parties have peasant fronts, but rarely are the leaders from these peasant fronts drawn from the peasant class or living in rural areas. The so-called peasant leaders are mostly urban-based and remain indifferent to rural issues.

Weak representation of the interests of the peasantry within the major political parties, and the predominance of trading and industrial interests, have not only led to an excessively protected economic regime but have shaped the political economy of Bangladesh in a manner that permitted the policy regime to continue to discriminate against agricultural sector. This explains why conflicts of interest between agriculture and industry have consistently been resolved in favor of industry. For example, in the case of agro-based industrial raw materials such as jute, the policy has been to keep the price of the input low so that the relevant industrial products can be competitive. Export taxes and restrictions on the export of agricultural commodities have also contributed to the discrimination against agriculture. Even in the case of policy measures such as input subsidies, farmers failed to derive much benefit, as these funds were largely usurped by rent-seeking public officials in collusion with middlemen; the residual benefit was more than offset by depressing the farm output price. On the contrary, private investment in Bangladesh was highly appreciated for the enterprising nature of the farmers and the government's role in supporting them by providing subsidies and loans. Additionally, the lifting of the ban on unstandardized

equipment and the removal of import tax also contributed to this positive development.

Another important factor shaping agricultural and broader economic policy is the wide divergence of views on the issue of policy reform amongst social scientists and other professionals. There are critics of market mechanisms whose views were initially shaped by 1) the colonial experience – which was interpreted as exploitation by world capitalism; 2) the apparent success of the Soviet Union and, especially, China in transforming their economies; and 3) the experience of certain blatant examples of market failure such as the Bengal famine of 1943. The disintegration of the Soviet Union and the Chinese move toward a market economy has, in recent years, disillusioned many of these critics regarding the virtues of 'planning.' Nevertheless, an articulate anti-market lobby persists amongst intellectuals who effectively counter the sweeping, and sometimes simplistic, claims for the market made by its over-zealous votaries.

The policy process is further complicated by the lack of consensus between policymakers and implementers on the appropriateness of reform measures. Oftentimes, this happens due to the different social and political orientations of these two sets of actors. The unwillingness of the bureaucracy to relinquish the levers of control even when political leadership is committed to deregulation or rivalry between ministries may lead to such outcomes. For example, the ministry of commerce may obstruct liberalization measures proposed by the ministry of finance.

Finally, donors have had a major influence on government policy in Bangladesh because of the role of foreign aid in the development budget and balance-of-payments support. Within agriculture, donor support in terms of funding for agricultural research, rural infrastructure, and food aid was especially important in the 1970s and 1980s, contributing to the weight of donor perspective in policymaking. In particular, the World Bank, the Asian Development Bank, and the United States Agency for International Development have exerted a major influence on the formulation and implementation of agricultural policy in Bangladesh by tying program loans and import credits to the policy reform agenda (Ahmed et al. 2007).

Bangladesh's liberalized trade policy cannot automatically guarantee increasing incomes for farmers. One may argue that the reforms have diminished the state's capacities to the extent that it is now unable to make any meaningful development intervention even if it wanted to do so. To a certain extent, this argument holds merit. Yet, according to Byres (1981), while the state apparatus sides with the capitalist classes in negotiating the advancement of market principles in the predominantly peasant agrarian landscape of Bangladesh, it has saved peasants from mass dispossession by maintaining some form of protectionist policies. Therefore, the state continues to retain ways and means, however diminished, to intervene in the market. Public Food Distribution System (PFDS) is an example that substantiates this point further. Ensuring continued national food security will demand solutions to key challenges.

CONCLUSION AND FUTURE DIRECTIONS

Notwithstanding many problems and constraints, a quiet agricultural revolution has taken place in Bangladesh. Its agricultural sector has undergone significant structural changes, enabling the country to achieve its national food security targets. Nevertheless, the central goal of Bangladesh's agricultural policy revolves around self-sufficiency in food grain production. The economic development of Bangladesh depends critically on modernizing the agriculture sector further instead of neglecting it because the country's natural ambient and social structure supports an 'agriculture first' strategy, especially in the context of alleviating rural poverty and the ongoing 'self-sufficiency momentum.'

Rice production in Bangladesh has been constrained by resource limitations and vulnerability to climate. Given the dietary habits of the Bangladeshis, an increase in population will correspondingly increase the demand for rice even though per capita rice consumption is gradually declining in the country. Hence, achieving 'rice security' needs to equally address 'nutrition security' since rice is not only a carbohydrate-supplying food but also a major provider of protein, micronutrients, and other health benefits. Over the years, the government has attempted to incentivize rice growers to expand domestic rice production through various enabling policies issued from time to time. Investments in agricultural research and technology have been the primary focus in recent times to improve productivity and expand irrigated rice areas..

Since the adoption of modern rice technologies has reached a plateau, further advancements in the growth and supply of cereals require the adoption of newly evolved, stress-tolerant varieties in the unexploited stress-prone areas of the country (Islam 2020).

Agricultural productivity depends on the outcome of land, labor, and resource productivity. However, the scope of utilization of natural resources such as land and water is narrowing in terms of quantity and quality. Population pressure is exerting a further negative influence on the availability of natural resources. The country will need to increase its land productivity since the current production environment will change in the future, faced with decreasing cropland and increasing climate vulnerability. Yet, there is scope for improvements in post-harvest management and agro-processing. Moreover, investments in market infrastructure can complement agricultural prices and trade policies and can increase farmers' incomes in Bangladesh, even in the context of shifting world prices. It is essential to ensure a fair price of the food grains at the farm level to sustain production as well as the growth rate. The government should strengthen its pricing and market monitoring strategies to provide profitable value to food grain farmers (Islam 2020).

The historical evolution of agrarian systems and modes of production has established that the colonial state's idea of large-scale capitalist farming in Bangladesh failed. To date, the country's cultivation is small-scale, predominantly practiced with family labor and by tenants. Historians have

differed on the reasons for this. Some argued that the British expectation that the zamindar would be an entrepreneurial 'improving landlord' was fundamentally misplaced (Swamy 2011). It is true that the actual owners of the land are interested in investing their own money in production augmenting technologies if they benefit from those. The greatest example is the success of the green revolution in Bangladesh, which was ushered in by private investments in STWs by numerous small farmers. In 1988, the import taxes on diesel engines were eliminated to incentivize the use of diesel engines. However, with time, the price of diesel increased, making groundwater irrigation using diesel pumps very costly. Therefore, the National Agricultural Policy 2018 is now encouraging the use of solar energy, along with other renewable energies, for irrigation purposes.

Twenty years after the liberalization of inputs in the agricultural sector, a paradigm shift has taken place toward the sustainable use of resources, with an optimum cost for the sustainable foundation of food grain supply. The constraints remain the same as in the 1850s – rural poverty, the lack of capital, and scarcity of land and small holdings. A fine balance between capital investment, (appropriate) technology adoption, and sustainable water resource management will determine the sustainability of the agrifood systems in Bangladesh.

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