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Structural Change, Trade and Development: Agrifood and Aquaculture in Bangladesh

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Abstract

This paper examines the ongoing process of structural change in Bangladesh from the lens of agricultural productivity and rural development, emphasizing the need to adapt and diversify its economy preceding and following its graduation from least developed country (LDC) status. We present the case to modernize, diversify and upgrade Bangladesh's secondary agri-food sector to continue its structural transition, production and exports, thereby further raising incomes and reducing poverty, particularly in the rural non-farm economy. The development of and productivity gains in the fish aquaculture sub-sector illustrates the secondary agri-food sector's productive capacity and potential. The article demonstrates that the prospects for structural change in the agricultural processing sector remain promising, and that there is a need to expand agricultural value chains into value-added, secondary processing, agri-food, and high-value products.

Keywords: agriculture, aquaculture, Bangladesh, LDC, structural transformation

1. Introduction

The role of agricultural productivity in economic development and industrialization has long been debated. In the traditional model of economic development, labour and capital move from low-productivity activities, usually agriculture, to higher productivity manufacturing or services sectors (see, e.g., Chenery, 1960, 1975, 1979; Herrendorf et al., 2013, 2015; Hirschman, 1958; Kaldor, 1957, 1978; Lewis, 1954, 1979; Myrdal, 1957a, 1957b, 1968; Paul, 2018). The modern thinking in economic development revolves around structural transformation, where resources move from lower value, lower productivity economic activities to those of higher value and productivity. These then create broad productivity growth across a range of sectors and services.

Agriculture's linkages through the economy to other sectors and activities are significant and unique to the sector. In early stages of economic development, increasing farm incomes alleviate poverty, particularly for the poorest, and creates demand in other sectors, forming consumption linkages. As the sector develops, it demands greater goods and services from suppliers, creating backwards linkages. Forwards production linkages also develop as agriculture becomes a supplier to other sectors requiring agricultural inputs. Agriculture's modernization and diversification provides productivity gains and employment mobility, from typical primary subsistence production (low productivity) to cash and specialty crops, value-added products and agri-food processing (higher productivity). In this manner, the productivity growth in agriculture is the driver of poverty alleviation, growth and structural transformation and due to multiplier effects, creates forward and backward linkages between agriculture and non-agricultural sectors.

Bangladesh has undergone major economic changes over the last four decades. The composition of gross domestic product (GDP) has changed significantly. Agriculture's share of GDP declined from over 60 per cent to under 15 per cent while industry's share increased from as low as 7 per cent to 28 per cent, arguably following the traditional model of economic transformation. It has also markedly increased its productive capacity as the manufacturing sector grew. On one hand, Bangladesh has enjoyed phenomenal growth in manufacturing exports (mainly ready-made garments), an important contributor to GDP and per capita gross national income (GNI), which stood at 12.3 per cent and US\$ 1,827, respectively, in 2018. On the other, agriculture employs nearly 50 per cent of the total population and contributes 17.5 per cent of total GDP

(FAO, 2021). The Bangladeshi market is growing rapidly and consumers are demanding diversified products as incomes rise and diets change.

This article examines the ongoing process of structural change in Bangladesh, arguing that the linkages *within* the agricultural sector towards secondary production cannot be overlooked or underestimated in its continuing economic development trajectory. Given the growth and further potential of the fish aquaculture sector, upgrading Bangladesh's agricultural productive capacities through the secondary agri-food processing sector could propel the cycle of structural change, increase food production, improve domestic food security, contribute to poverty alleviation and grow Bangladesh's exports of agricultural products. Such diversification is critical given the country's high dependence on ready-made garments (RMG) manufacturing, its looming graduation from LDC status in 2026 and the associated loss of preferential market access for its RMG exports.

The structure of the paper is as follows: Bangladesh's path of economic growth is discussed as is the development of its agricultural sector. The fish aquaculture sector in Bangladesh is then provided as a case study in the development and diversification of a primary agricultural sector into one that includes secondary production and agri-food processing. The potential of and constraints to export are discussed. We highlight the importance of modernizing Bangladesh's agri-food value chains and list factors that impede their optimization. Finally, we offer conclusions.

1.1 The Fundamentals of Structural Change and Ongoing Shifts in Agriculture

Agriculture in most LDCs is characterized by low wages and productivity, slow production growth and sharp annual output fluctuations. Studies show that the structural transformation process in most LDCs does not focus on agricultural production and export diversification, thereby leading to inequality, food insecurity and lack of value chain development in the agricultural sector (UNDP/FAO, 2007). Structural transformation in developing countries is increasingly transitioning from agriculture to services, in a shallow form of industrialization (as compared to that achieved by highly developed countries) that is skipping or truncating their periods of manufacturing, with reduced levels and intensity of industrialization (Gollin, 2018; UNCTAD, 2020). This type of economic development poses a potential productivity trap where the economy stays in a low productivity agricultural sector that offers many employment opportunities, in combination with some transition to manufacturing employment, but also transitions to a highly heterogenous, low productivity services sector typified by high levels of informality and weak integration into global value chains, all of which mutes the impact of structural change on real GDP per capita (UNCTAD, 2018a; 2020).

Economists studying economic growth accept that structural transformation and sources of growth can be attained from any sector so long as productivity increases. The basic challenge facing developing countries is to generate sustained productivity growth to drive economic development, not only in a few sectors but across a broad range of industrial sectors and services. To achieve this, they also must garner a critical mass of skills and broad institutional capabilities. Herrendorf and Valentinyi (2012) find that total factor productivity (TFP) differences between rich and poor countries are most prevalent in equipment, construction and food, rather than in manufacturing – implying that manufacturing is not the sector where poor countries most need to catch up to rich countries. That growth in agricultural productivity, rather than manufacturing, is the key to growth, industrialization, employment specialization and structural change has been a long-standing debate in agricultural economics. Johnston and Mellor (1961), Mellor (1995, 2017), Johnston and Kilby (1975), Johnston and Nielsen (1966), Timmer (1988, 2002), de Janvry and Sadoulet (2010), Haggblade et al. (2002, 2006a) and others illustrate that poor economies are constrained from moving into other sectors by low productivity in agriculture. In the evolution of the agricultural sector, as resource movement from primary agriculture to secondary agri-food production and processing occurs, it could be argued that structural transformation is multidimensional as resource reallocation and change can occur via linkages *within* the same sector rather than only moving from one sector to another (Meijerink and Roza, 2007; Gay, 2021; Roy and Roy, 2017), suggesting that the process could spur an additional boost in an economy's overall structural transformation.

For example, the general collective development path of the Asian LDCs as a group most resembles a classical process of industrialization (UNCTAD, 2020; Gay, 2021), where agricultural transformation is the initial driver for economic growth, followed by rapid industrialization. Expanding manufacturing production, employment growth and productivity gains in labour lead to poverty reduction, income growth and higher living standards. They have also achieved positive change in social outcomes. While manufacturing has been highly successful in using preferential market access to export manufactured goods to foreign markets, the sector has not accrued much in terms of endogenous technological capacity. For Asian LDCs, the industrialization process will not be sustainable unless they can broaden their industrial development and deepen their entrepreneurial and technological capabilities. This is particularly important given the impending loss of LDC-specific trade preferences once they graduate from LDC status (UNCTAD, 2020).

The linkages and multiplier effects that agriculture develops within itself as well as towards other sectors in rural areas are essential for economic growth and poverty

reduction in developing countries. Meijerink and Roza (2007), de Janvry and Sadoulet (2010), FAO (2002), World Bank (2007), Haggblade et al. (1989), amongst others assessed the development of the rural non-farm (RNF) economy and its role in structural transformation and development. Growth in the RNF economy occurs in two general forms. Rural areas undergoing higher agricultural growth appear to experience more robust RNF growth (Haggblade et al., 2002; 2006a; 2006b) and much of the new activity is located in and around smaller towns and cities (Hazell and Haggblade, 1990; Renkow, 2006; Hariss, 1987; Emran and Shilpi, 2018). The prevalent view is that agriculture's various production, consumption, capital and labour market linkages integrate the development of non-farm and farm activities together, leading to multiplier effects of productivity growth in agriculture and elsewhere. As agricultural productivity begins to increase, it drives growth in non-farm activities in the same areas (Toufique, 2017; Mellor, 1976; Ranis and Stuart, 1973; Haggblade et al., 2006b; Johnson, 2000).

There is a large body of work assessing agriculture's multiplier effects across individual countries. For example, Dzemydaite (2017) assessed sectoral linkages and multiplier effects of agriculture in Lithuania, Rodrik et al. (2017) provided analysis of agriculture's role in structural change for India, Vietnam, Botswana, Ghana, Nigeria, Zambia and Brazil while Mardzuki et al. (2014) conducted an analysis of agriculture's inter-sectoral linkages in Malaysia. Bustos et al. (2016) and Marconi et al. (2016) performed the same for Brazil. Liu and Shi (2020) modelled demand driven, multi sectoral linkages in manufacturing and producer services in China, Huong (2019) assessed linkages in Vietnam while Gersak and Muhaj (2016) did the same in Slovenia. Meijerink and Roza (2007), Akram-Lodhi (2008), UNIDO (2009), WTO (2013), Khorana et al. (2010), Kimbugwe et al. (2012), and Yeung et al. (1999) amongst others show agricultural exports from developing countries to global markets also provide significant growth opportunities in the path of development.

As development proceeds and agriculture has achieved some structural transition, the forwards linkages towards agri-food and secondary food processing as well as in nontraditional agricultural products such as specialty crops, horticulture, aquaculture, floriculture, could become the next phase in transitioning away from primary agriculture. Rodrik et al. (2017) note however that for these non-traditional products, the record of labour absorption is not encouraging. They could not present any countries that have successfully developed through diversification in agriculture alone. Traditionally, agricultural transformation is the initial driver for economic growth that is followed by rapid industrialization, without which, growth peters out. They also note given inexorable trends in urbanization, labour absorption in new jobs created will occur in urban rather than rural areas.¹ Hence, they conclude agriculture's role in

structural transformation is unlikely to be more than a bridge to a more sustainable urban-based strategy (Rodrik et al, 2017).

Gollin (2018) makes the case that in select countries and regions thereof, the value of an agriculture-centred growth process cannot be discounted. Particularly in agricultural activities that hybridize between services and manufacturing. They give the example of food preparation and processing, considered a service activity in wealthy countries, that can be partly or entirely replaced with packaged food exports, considered a manufacturing activity, from developing countries. This would include chopped packaged fruit, filleted frozen fish or frozen assorted seafood exported from Vietnam or Sri Lanka to restaurants and hotel chains in North America for instance. If conducted in a developed country, the same work is treated as a service but if undertaken in a developing country, becomes a manufactured export (Gollin, 2018). In this vein, Bangladesh has experienced some success in exporting frozen shrimp to the EU (Hobbs et al., 2023). This may be the case for Bangladesh, with the fish aquaculture sector as a case study of agri-food productivity growth, its multiplier effects and development of the RNF economy. It illustrates that Bangladesh could realistically develop its agri-food, secondary processing and non-traditional agricultural products subsectors to diversify its economy in the face of its impending graduation from LDC status. It has already achieved a critical mass of productive capacity through the RMG sector which could now be applied to agri-food.

2. Structural Change

2.1 The Case of Bangladesh

Bangladesh is a remarkable LDC success story, growing from the world's second-lowest per capita income country in 1975 to a lower middle-income country in 2015. Since 2010, Bangladesh has tripled GNI per capita, increased the Human Assets Index (HAI) by 40 per cent, and has the lowest Economic Vulnerability Index (EVI) among LDCs (UNCTAD, 2018b). Between 2000 and 2018, real GDP per capita increased by 130 per cent, from US\$ 525 to US\$ 1,203 (World Bank, 2019a). Poverty rates declined from 44 per cent in 1991 to 15 per cent in 2016 (World Bank, n.d.). In February 2021, the United Nations Committee for Development Policy (UNCDP) recommended Bangladesh graduate from LDC to a developing country, scheduled for 2026. Bangladesh is the only graduating country to meet all three graduation criteria (GNI per capita, EVI and HAI), exceeding the minimum requirements. Bangladesh's per capita GNI was nearly US\$ 1,827 in 2020 against the threshold of US\$ 1,230. It scored 75.3 points in the HAI, above the required 66, and 27.3 on the EVI, which must be less than 32 points (Dhaka Tribune, 2021).

Between 2000 and 2018, Bangladesh's economy underwent substantial transformation² from an agriculture-based to an urbanizing economy.³ Bangladesh's economic transformation is attributed to agricultural policy decisions in the 1960s and 1980s, including market liberalization reforms such as fertilizer liberalization, irrigation and water reforms, followed by strengthening of the seed subsector in the 1990s. The introduction of high-yielding varieties (HYV) of rice, initiatives such as input subsidies and public procurement of rice, increased productivity and production. In the 2000s, additional policy reforms, market liberalization, investment in agricultural research, prioritizing human capital and social development, combined with infrastructure spending on roads and the entrepreneurial efforts of Bangladeshi households, enabled the rural economy to develop and grow. Increased access to rentable land for farmers, fixed-rent tenancy, longer-term leasing, adoption of new technologies and greater mechanization changed agriculture's market structure, which in turn led to sustained growth and higher farm incomes (Iqbal et al., 2019; World Bank, 2016; 2020). Sustained productivity improvements in the factors of production, and increased technical innovation and mechanization, resulted in growth of the agricultural sector, and the private sector was able to benefit from government policies. Agricultural production shed labour towards industrialization and Bangladesh has become a major exporter of RMG.

Hassan et al. (2010) illustrate how trade liberalization helped Bangladesh's manufacturing firms (mostly in textiles and RMG) become more efficient and increased total factor productivity. With ample low-cost labour, the RMG subsector became the driver of Bangladesh's remarkable export-led growth. RMG exports grew at an average annual rate of 15 per cent, compared to other exports' 3–4 per cent (Nath, 2012; Sattar, 2015). With preferential access to developed countries' markets and liberalized rules of origin, manufacturing became the largest contributor to Bangladesh's economic growth. Its share of GDP rose from 13 per cent in 1981 to 17 per cent in 2015 (Sumi and Reaz, 2020). Concurrently, the RMG sector created employment as well as backward and forward linkages in the economy, thereby reducing poverty (Bhattacharya et al., 2002). Manufacturing and employment became highly concentrated in RMG. RMG and textiles accounted for more than 90 per cent (US\$ 42.8 billion) of Bangladesh's total exports (US\$ 47.2 billion) in 2019 (OEC, 2021). In 2021, RMG and textiles accounted for US\$ 43.7 billion (88 per cent) of total exports valued at US\$51.8 billion (OEC, 2023). That labour resource shift has increased overall employment and raised overall income (Sattar, 2015). However, the transition of resources from low-productivity agriculture to high-productivity manufacturing did not fully occur; rather it was distributed between high- and low-productivity manufacturing and low-productivity

services. This is the low productivity trap where insufficient higher productivity labour opportunities were created, instead, a large volume of employment opportunities typified by low productivity, high levels of informality and weak integration into global value chains were manifest, which in turn contribute to muting the ability of structural change to raise real GDP per capita (UNCTAD, 2020; 2018a).⁴

Mujeri and Mujeri (2021) also show that Bangladesh's manufacturing sector could not create the required number of jobs to generate rapid absolute and relative productivity gains in the overall economy. The high dependence on RMG manufacturing combined with the sector's lack of endogenous skills and productivity development dulled the structural transition into industrialization. Labour's transition into the services sector has since led recent GDP and employment growth but is typified by low average productivity. Consequently, further structural transformation led by growth in these subsectors is likely to be less robust than necessary to create further rapid labour absorption and economic growth.

UNCTAD (2020) summarizes Bangladesh's structural transformation as a classical process of industrialization, typical of Asian LDCs with caveats. A rising share of manufacturing in GDP and employment, manufactured exports, significant labour productivity growth, poverty alleviation, and social and human development are achieved. However, Bangladesh's share of manufacturing in GDP and employment is less than that of middle-income developing countries, and industrial performance is also comparatively less. Industrialization is shallow where manufacturing is maintained without domestic technological capacity and is concentrated in RMG and textiles. Such sectoral concentration increases vulnerability to external shocks. This form of structural transformation is less sustainable, suggesting that economic activities must be broadened, while entrepreneurial and technological capacities must be improved for sustainable growth.

Bangladesh's impending graduation from LDC status will result in the loss of preferential market access to developed markets for its manufactured exports. As its manufacturing firms face the shock of greater competitive challenges, they will rationalize their work forces. Displaced workers, particularly urban ones, risk landing in lower productivity services industries and informal activities, slowing economy wide growth (Rodrik et al., 2017; McMillan and Rodrik, 2011). Bangladesh must create greater employment opportunities in other sectors.

2.2 Consequences of Structural Transformation

Figure 1 provides a schematic overview of the relationship between Bangladesh's policies and its structural transformation from agriculture to manufacturing, and the associated effects on social, political, cultural, and societal change through the

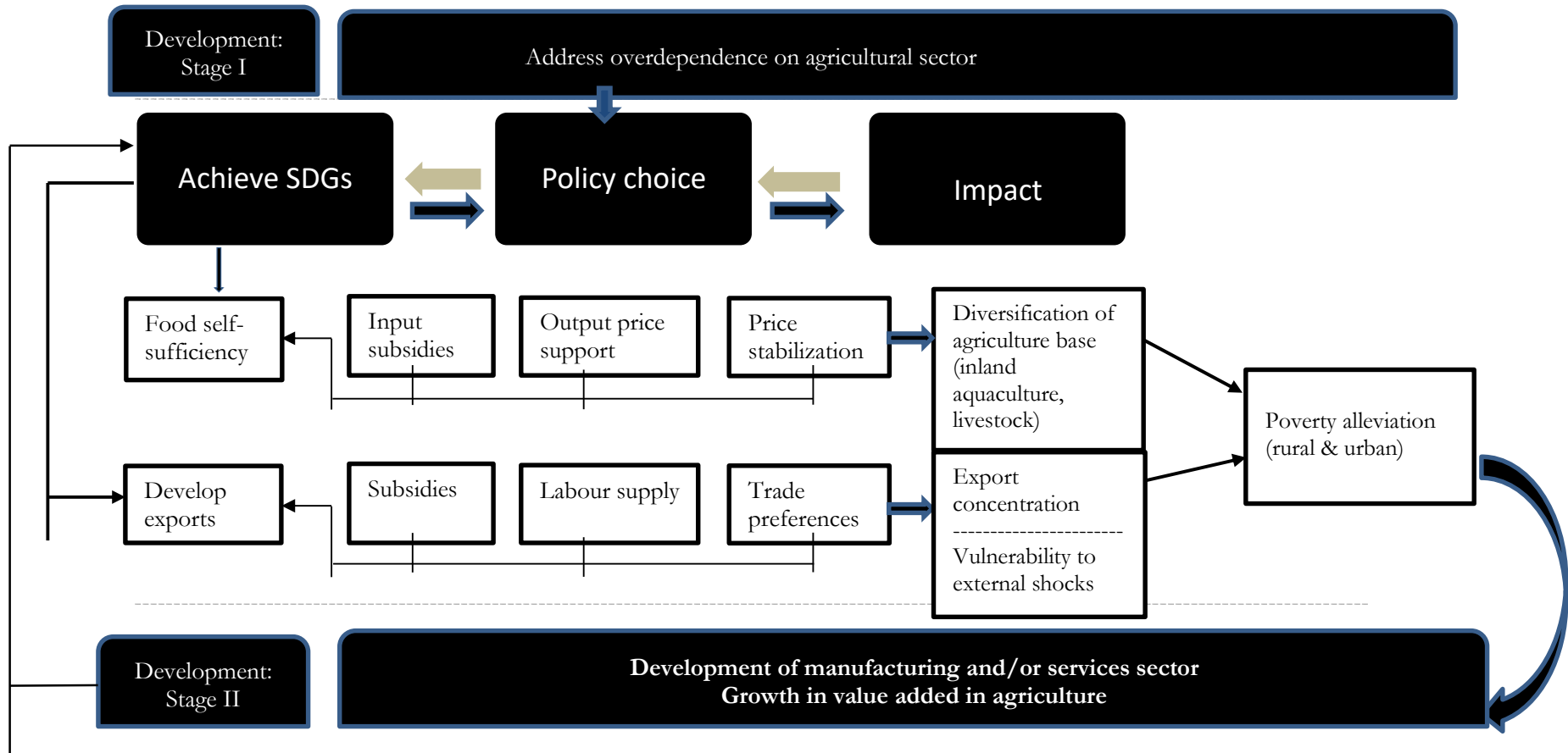
Sustainable Development Goals (SDGs). For the policy areas of achieving food self-sufficiency (SDG 2) and export growth (SDG 8), the framework considers the likely impacts of Bangladesh's policy measures.

The first step designed policies to achieve SDG2 (i.e. food self-sufficiency) through policy interventions targeted at the agricultural sector, particularly the paddy rice crop, which included a price support system, price stabilization schemes and input subsidies⁵ to protect farmers from price falls and consumers from price increases.⁶ The Government of Bangladesh targeted agricultural policies to achieve food security, and supported intensification, irrigation expansion and the introduction of HYV rice to raise yields. Further, stabilization policies provided rice farmers with floor price guarantees, subsidized inputs and price support. Rice crops are less prone to price volatility and carry less price risk than higher value crops and commodities, consequently, Bangladesh's support and policy focus on rice reduced farmers' risk and increased food security.⁷ This pattern is ongoing and risk-averse producers continue to focus on rice crops despite lower margins rather than choosing to diversify or modernize (World Bank, 2020).

Diversification and development of the domestic agri-food sector away from primary crops such as rice is a promising and achievable means of economic diversification for Bangladesh. The development of linkages between the farm and RNF economy as well as increased employment in RNF (to avoid the low productivity services trap) is essential to this process. Bangladesh has been moving forward in this regard. Shilpi and Emran (2016), Emran and Shilpi (2018), Deichmann et al. (2009) and Iqbal et al. (2019) found significant positive impacts that Bangladesh's agricultural productivity gains have had on RNF employment growth and structural transformation. All found that informal, small-scale manufacturing and skilled services employment increased in the RNF economy when agricultural productivity improved. The findings of Deichmann et al. (2009) also support this rural small-town development dynamic in Bangladesh. They illustrate that people are more likely to be employed in well-paid wage employment and self-employment in the RNF sector if they are closer to urban centres. Those who are further away from such centres are less likely to be in well-paying non-farm jobs if they are living in areas with greater agricultural potential.

Iqbal et al. (2019) report that with increases in Bangladesh's agricultural productivity, average labour productivity was higher in the RNF economy than in agriculture but experienced a wider range. RNF incomes were more salary based and rural towns experienced growth. They show that rural land ownership has become less bound to income and sources of rural household incomes have changed.

Figure 1: Relationship between Bangladesh’s Policies and Structural Transformation



There are now more purely RNF income earners, and overall wage earners. More rural households earn mixed source incomes (farm and RNF) rather than purely one or the other. Those earning income purely from RNF sources has doubled since 2005. RNF enterprises have expanded, particularly in transport and storage, which have grown 30 per cent between 2001-2013. Construction follows at 12 per cent growth in the same period. Transportation and storage in the RNF sector are now major employers. As the number of RNF enterprises increases, the numbers employed per RNF enterprise has also increased. DFID (2014) found consistent evidence of the multiplier effect from agricultural growth to the rural non-farm (RNF) economy. It reports that a higher proportion of increased income in the RNF sector is likely to be spent locally and on locally-produced goods and services. Under such circumstances, the impact of increased agricultural incomes on the poor not directly involved in agriculture in rural areas is likely to be greater.

Bangladesh's RNF sector has been undergoing structural transition and gaining productive capacity. Linkages have formed in production, consumption, labour and capital both forwards and backwards. Incomes have risen and households are diversifying. These are critical steps in Bangladesh's efforts to modernize, diversify and broaden its agri-food system. Since 2008, there has been a gradual diversification of the agricultural crop profile. The emphasis has shifted to producing fruit, flowers, fibres, spices, pulses, wheat, maize and fodder, but these remain a small portion of overall production and acreage. Vegetable production has experienced much slower growth. The share of high-value agriculture (horticulture, livestock, and fisheries products) has grown, albeit slowly. Active policy initiatives to diversify agriculture are needed. Bangladesh's agriculture sector now requires a second wave of systemic improvements in productivity and diversification as well as increased supply chain sophistication and modernization to sustain growth and development (World Bank, 2016). World Bank (2020) indicates there are significant opportunities to constructively diversify the agri-food sector with product diversification and value-added processing. Ongoing structural transformation in Bangladesh's agriculture can organically occur from two reinforcing drivers—supply (production) and demand (consumption), using the example of the fish aquaculture subsector as a case study.

3. The Silent Transformation in Bangladesh's Agriculture

3.1 *The Ongoing Change*

Bangladesh's domestic agri-food market is evolving. As incomes increased, consumers' consumption patterns have changed, implying that the agri-food sector will need to

adapt and modernize as rising incomes and urbanization continue driving demand for higher value food products. Bangladesh now needs to shift towards agri-processing, agri-services and higher-value agriculture, including horticulture, livestock, poultry and fisheries, to foster future growth and take structural transformation in agriculture a step further.

With rapid urbanization and rising incomes, Bangladesh's dietary patterns are changing. Accompanying increased purchasing power is a greater awareness of food's nutritional value. Average cereal intake is declining and the demand for nutrient-dense foods is growing. Dizon and Ahmed (2019) report that the share of cereals in total food spending declined, from 41.9 per cent in 2000 to 29.2 per cent in 2016, while average daily rice intake per person fell by 20 per cent—from 459 grams to 367 grams over 2000–2016.⁸ An analysis of dietary patterns shows that the consumption of vegetables, fruits, fish, meat, onions and eggs increased considerably over the same period (Dizon and Ahmed, 2019). The demand for eggs, fruits, meat and fish is forecast to rise by more than 50 per cent by 2030 compared to current consumption levels (World Bank, 2020). This change in consumer demand is a powerful catalyst for structural transformation, as evidenced by the domestic fish aquaculture subsector. As consumers continue to demand better nutrition, higher quality and more variety in their food products, structural transformation will occur in other agri-food subsectors, with multiplier effects in forwards and backwards linkages throughout the agri-food sector and the economy as a whole. At some point, Bangladesh should be able to replace some agri-food imports with domestically supplied substitutes.⁹ This would be of monetary benefit given the high-cost exchange rates impose on imported food stuffs, particularly in times of high inflation.

3.2 Drivers in Action: Bangladesh's Aquaculture Sector

Bangladesh's growing population is exhibiting increased demand for fish as part of a nutritionally complete diet which is the catalyst behind the rapid development and transformation in the fish aquaculture subsector. Household expenditures on fish as a proportion of total food spending has increased across all income classes from 2005-2010 (Toufique and Ahmed, 2013). Aquaculture producers increased supply in response to this growing domestic demand. The price of fish has fallen, increasing accessibility and consumer consumption, which in turn has increased the population's food security and nutrition (Rashid et al., 2019b). Growth continues as the productive capacity of the fish sector increases.

Between 2000 and 2010, aquaculture fish production more than doubled, then quadrupled between 2000 and 2019. Aquaculture's share of overall fish production rose from 30 to 47 per cent from 2000 to 2015 with an annual growth rate of nearly 9 per

cent. As supply increased, prices for commonly cultured species declined by 45 per cent and per capita consumption increased from 13 kg in 2000 to over 20 kg in 2016. Consumption of cultured fish in both rural and urban areas increased faster than other forms of fish production from 2000 to 2010 (Rashid, 2019c). Given its increasingly dominant role in fisheries, the aquaculture subsector's growth and structural transformation are powerful in multiplier effects and impact on employment, income, food security and nutrition.

The factors behind aquaculture's transformation can be grouped into (a) technical advances such as modern fish varieties, improved farming practices and post production marketing practices; (b) reduced transaction costs such as improved infrastructure, better access to information, reduced marketing risks, roads, access to telecommunication, and rural electrification; and (c) innovation in the value chain such as the development of service providers and input specialists (Rashid, 2019c). Essentially, the more efficient use of water and labour triggered the boom in the aquaculture sector (Fan, 2019). Hernandez et al. (2018, 2019) evaluate the transformation in Bangladesh's fish aquaculture value chain from subsistence to commercial production. As the sector commercialized, household pond production for home consumption shifted to selling at nearby markets, then at distant urban markets. The rapid rate of commercialization is illustrated by the fact that 75 per cent of households are fish sellers, compared to 57 per cent in 2015. The swift increase in aquaculture farms together with the development and proliferation of off-farm actors created clusters of value chain stakeholders and service providers. These clusters consist of upstream actors such as hatcheries, feed milling, feed wholesale and retail, and farms, as well as midstream and downstream actors such as transport, rural and urban wholesale markets, traders and retailers. Each segment presented robust and accelerating enterprise development, which has increased the breadth, depth and reach of the linkages in the value chain. As the sector commercialized, its value chain has lengthened, thickened and branched out, much like a growing tree. The growing availability of sector-related service providers and actors enable the specialization of labour where farmers and other value chain actors can focus on their operations, accruing the benefits of economies of scale, scope and agglomeration, thereby gaining efficiency (Hernandez et al., 2018, 2019).

Another aspect of the sector's structural change occurred because of technical advances such as product innovations, or mix. These have increased overall production and yields as production became more efficient, for example by reducing losses through hardier varieties. The transition from capture of wild stocks to farmed culture production initiated the first change. As more farms increasingly utilized ponds for

commercial aquaculture, the species of fish farmed evolved. Non-native species such as pangasius and tilapia or niche species previously of limited supply in the capture fishery could now be farmed (Toufique and Ahmed, 2013; Hernandez et al., 2018, 2019). Production is also becoming more capital intensive throughout the value chain. As the farm level transitions away from traditional subsistence production towards commercial production, capital intensification in hired labour and the increased use of formulated and purchased feed, medicines, equipment, purchased fish seed (fingerlings) and chemicals are occurring. Up- and downstream in the value chain, input suppliers and service providers also underwent capital intensification, particularly in feed providers and hatcheries. A larger selection, more diverse stock, species-specific differentiation, and a higher number of dealers are present in the feed segment, while hatcheries have diversified the types of species offered (Hernandez et al., 2018, 2019).

Of particular note is that commercial aquaculture has a higher demand for hired labour per unit of land than rice paddy production (Belton et al., 2014). Aquaculture's role in creating employment opportunities cannot be understated. The fisheries sector in general accounts for about 4 per cent of national GDP, and 23 per cent of agricultural GDP. The sector employs 17.8 million Bangladeshis, including 1.4 million women, in full- and part-time jobs, equating to about 11 per cent of the total population and more than 23 per cent of the working population (Rashid et al., 2019a). Even in 2010, RNF employment in Bangladesh was nearly 50 per cent higher than all urban employment combined and was growing faster than urban employment, and three-quarters of rural households had at least some form of non-farm income (BBS, 2010). The aquaculture sector can continue to create RNF employment opportunities, raise income levels and alleviate poverty.

The entirety of the domestic fish value chain in Bangladesh is rapidly expanding. The number of actors in every segment of the value chain is increasing with corresponding increases in output and production. There has been a concurrent deepening and intensification of capital investments by a wide range of actors, the majority of which are small to medium-sized enterprise (SME) or micro-SME in the value chain (World Bank, 2020; Khan et al., 2021; UNCTAD, 2017), creating opportunities for more actors. Consequently, employment and income in the sector have increased, and further growth opportunities have been created.

Increased consumer demand has led to substantial investment through the forwards and backwards linkages of the aquaculture value chain, as the sector strives to increase supply to meet demand. As cultured fish is consumed domestically, this growth not only created employment and income within the value chain, but it has also contributed to economic development, while improving food and nutritional security for the general

population. As cultured fish is consumed by both rural and urban consumers, value chains linking rural to urban areas also developed. Hence aquaculture has facilitated rural transformation involving farm and non-farm actors without necessarily causing de-agrarianization (the delinking of livelihoods from agriculture) while also creating urban linkages (Hernandez et al., 2018, 2019).

Toufique and Ahmed (2013, p. 50) summarise aquaculture's impact on the RNF area they studied: "Aquaculture offers diverse livelihood opportunities for the poor in the Mymensingh area... A range of associated groups, such as fish farmers, hatchery operators, fry traders, feed producers, fish harvesters, traders and day labourers have benefited from fish farming. A network for fry trading, such as the hatchery operators, transporters and fry traders all gain from this network. A network for fish feed marketing has also established. Overall, the supply of fish feed has generated a number of employment opportunities, in transport, distribution and marketing activities. A similar network for fish distribution and marketing systems, including local agents, suppliers, transporters, wholesalers and retailers all derive benefits from this system. The opportunities for day labourers to find work have also increased greatly in as much as labour is required for pond construction, hatchery operation, feed production in industries, fish harvesting and marketing. A number of day labourers work in fish markets to perform post-landing tasks that include cleaning, sorting, grading and icing of fish. They also work to carry ice from the ice factories, break it up, mix ice with fish and load fish on to the vehicles."

The creation of forwards and backwards linkages are clear as are the gains in food security, income and employment. Hernandez et al. (2018, 2019) indicate that this structural transformation and growth of the aquaculture sector has occurred organically through private initiative and market forces rather than through sector-specific government policies, regulations, standards or contracts. Forecasts and projections for the fish aquaculture sector indicate that further growth opportunities and production increases will be more than sufficient to meet increasing domestic demand (Dorosh and Comstock, 2019).

A host of factors, however, impact further development of fish aquaculture and potential future exports. These include requiring greater connectivity in a diffused industry spread amongst many small producers, with a lack of extension services, an insufficient number of off-takers, deficient transportation and storage facilities, poor energy infrastructure and high electricity costs, and a lack of finance or credit for small operators (Toufique and Ahmed, 2013; Dey et al., 2010; Khan et al., 2018; Shareef et al., 2020; UNCTAD, 2017). Leasing arrangements for inland culture fisheries must increase certainty to incentivize long-term sustainability (World Bank, 2016). While

some improvements have occurred, there remains limited knowledge on input usage, information dissemination, and technical information at on-farm producer level (Khan et al., 2021).

Other impediments include resource degradation, overexploitation, overuse and run-off of pesticides, agrochemicals, and industrial waste (Dey et al., 2010; Toufique and Ahmed, 2013; Shamsuzzaman et al., 2020). While wholesalers and marketers indicate this is not an issue for domestic sales (Hernandez et al., 2018), a common problem is lack of linkages and cold supply chains that lead to high losses and wastage. Value-added processing is unheard of as fish is consumed whole and fresh. Quality and food safety standards, traceability, processing and food safety systems remain virtually unknown in the domestic fish aquaculture value chain or even throughout the domestic food system (Agrilinks, 2020; World Bank, 2020; Ali, 2013; Dey et al., 2010; World Bank, 2016; Ponte et al., 2014; Shamsuzzaman et al., 2020; UNCTAD, 2017).

Should the fish aquaculture sector be developed for export, it will require significant improvements in production to implement quality control, traceability, standards and food safety protocols such as traceable cold storage connectivity through the value supply chain. At some point, development of export processing capacity, including value added, will be needed, with accompanying higher productivity labour, infrastructure and quality control to meet the specific food safety and quality standards of most foreign markets (Hobbs et al., 2023; World Bank, 2020; Ferdous and Ikeda, 2018; Ponte et al., 2014; UNCTAD, 2017; von Uexkull and Gregg, 2011).

4. Modernizing and Optimizing Bangladesh's Agri-Food Value Chains for Structural Transformation

The evolution in Bangladesh's aquaculture sector is a compelling example of how demand and supply can initiate structural transformation. By responding to changing consumer tastes caused by rising incomes, the sector increased production and yields, broadened product offerings, adopted innovations, developed supporting services and inputs, grew, and underwent structural transformation. It is now a vibrant and dynamic contributor to the rural economy, employment and incomes while simultaneously improving the nutritional profile of Bangladesh's food supply. The sector will continue to transform and evolve in response to ongoing stimulus and demand in the domestic market.

Those same changes in consumer demand, for better quality, variety and nutritional composition of food, will only increase as Bangladesh's population and per capita income increase. The demand for eggs, fruits, vegetables, meat and fish will only grow. These market drivers precipitated fish aquaculture's structural transformation and are the catalyst for further structural transformation in other

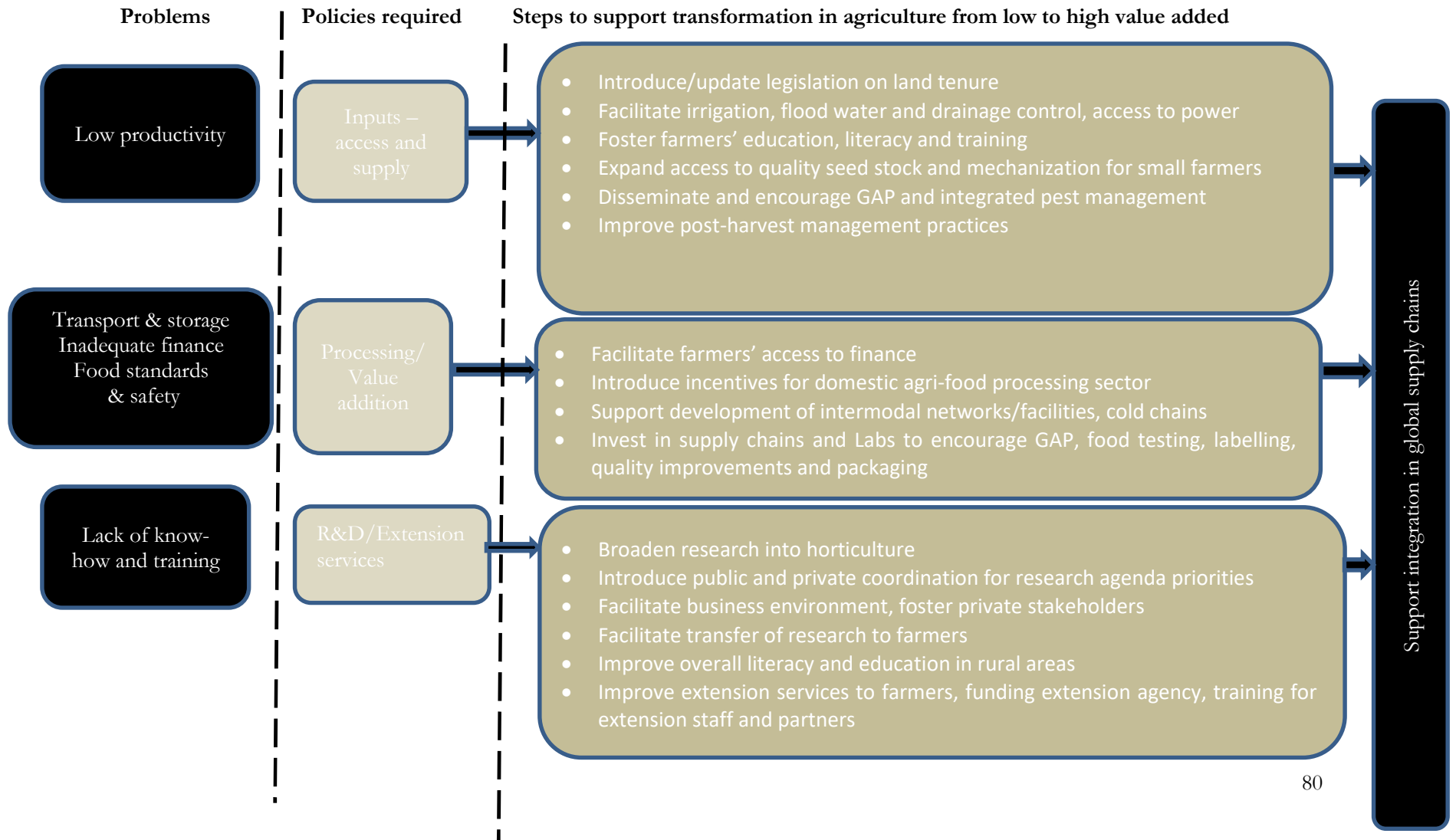
agricultural subsectors. These subsectors should be able to replicate the process that aquaculture underwent to improve productivity and develop value chains, which will concurrently diversify and modernize the agriculture sector as a whole. The process happened organically in fish aquaculture, with little government or non-governmental organization (NGO) involvement, which is an indicator of Bangladesh's private sector capacity to capitalize on market opportunities. If the more efficient use of inputs such as water and labour triggered the boom in the fish aquaculture sector (Fan, 2019), the same should occur in other agricultural sub-sectors. For example, in 2015 the agri-food processing sector accounted for 22 per cent of manufacturing production and employed 20 per cent of the labour force. At the time, it was comprised of SMEs that were strongly linked to their local producers but it showed high potential for greater processing, value addition and export (Latif et al., 2015). Hence agri-processing should be well placed to respond to the demand stimulus from consumers.

Participation in high-value agri-food value chains enhances overall sector growth, and improves the returns to farmers and food makers along the value chain (UNIDO, 2009; WTO, 2013). Increasing agricultural productivity through higher value chains would support the structural transformation process for two reasons. First, this will provide momentum to develop and promote the agricultural sector as a catalyst for industrialization and agribusiness development. Second, it will support better management and integrate the agricultural value chain from the farm to storage, transport, processing, marketing and distribution. This will not only improve food supply but also create value chain upgrades, additional revenues and jobs.

Bangladesh's agriculture sector does, however, face challenges in diversifying and modernization which also hamper its ability to expand into agri-processing. It is currently unable to meet the increasing domestic demand for food or to be highly competitive in export markets. The main factors to be addressed to make Bangladesh's agricultural sector more competitive are summarized in Figure 2.

There are a number of issues affecting agriculture's growth, diversification and modernization. Producers have limited access to key inputs such as seeds, equipment and labour, and have limited knowledge of Good Agricultural Practices (GAP), resulting in over- or inappropriate use of inputs. There is a lack of aggregation after the producer level, such as off-takers, cooperatives or collective traders, processors and distributors. This limits knowledge transfer and the use of quality standards or GAP, and reduces incentives for higher quality production to earn higher returns.

Figure 2: Modernization and Diversification Roadmap for Bangladesh’s Agri-Food Sector



Lack of aggregation also impedes the ability to pool and access information and resources. It also complicates product marketing, diffuses the reach of extension services and results in higher logistics costs as well as a disconnect from the final consumer (World Bank, 2020; World Bank, 2016; Karim and Biswas, 2016; Latif et al., 2015; Shareef et al., 2020).

Physical infrastructure constraints, such as transport and storage, must be addressed. Existing infrastructure is government owned and inadequate, being mainly for dry grains and horticulture, while cold storage is intended for potato seeds. There is limited farm-level storage and warehousing, hence farmers sell perishables immediately, often at a discount. To increase farm incomes and encourage diversification practices, cold chain storage must be developed in a public-private participation model as existing facilities are mainly privately owned. The lack of connectivity, intermodal networks and facilities must be addressed. Poorly maintained roads are the primary mode of transport, while inland water transport is abundant, it is underdeveloped and underutilized as a secondary mode. Railways handle insignificant freight volumes. High transport and logistics costs reduce agri-food competitiveness (World Bank., 2020; World Bank, 2016; Karim and Biswas, 2016; Latif et al., 2015; Shareef et al., 2020).

There is a lack of financing specific to the agri-food sector due to restrictive eligibility criteria requiring land ownership for collateral, high interest rates, and a lack of product mix suitable for small-scale farmers. Financial risk reduction strategies and land tenancy reform are needed to better incentivize producers' diversification to new untried crops or new production practices (World Bank., 2020; World Bank, 2016; Karim and Biswas, 2016; Latif et al., 2015; Shareef et al., 2020).

Research and development (R&D) and extension services need to be improved beyond paddy rice. Bangladesh has a well-equipped agricultural research sector but its primary focus has been paddy rice. Research and dissemination of results into higher value non-rice commodities specific to Bangladesh are needed. Providing extension services to farmers, funding the government extension agency, upgrading the training of extension staff and partners, and partnering with private operators to disseminate information to a large number of farmers scattered nationwide are all needed (World Bank., 2020; World Bank, 2016; Karim and Biswas, 2016; Latif et al., 2015; Shareef et al., 2020; von Uexkull and Gregg, 2011).

An important way forward is to improve overall literacy and education in rural areas. As most farmers do not keep production records, there is no ability to implement traceability, often a requirement in export markets and a useful food safety risk mitigation mechanism (World Bank., 2020; Ali, 2013; World Bank, 2016; Latif et al.,

2015; Shareef et al., 2020; von Uexkull and Gregg, 2011). Traceability, food safety and quality standards protocols or certification are virtually unknown at the primary production level or in the domestic food supply and domestic market (Agrilinks, 2020; Ali, 2013; FAO, 2023). The FAO is actively assisting to improve food safety in Bangladesh, including in food analysis, food standards, food risk assessment, inspection and enforcement and institutional capacity (FAO, 2023).

Bangladesh's existing agricultural and agri-food exports often encounter rejection at international borders due to standards violations (Hobbs et al., 2023; ITC, 2017). Traceability, food safety, process and quality standards, testing and certification are increasingly critical for agricultural and agri-food products exports; policies to address these must become a priority (Hobbs et al., 2023; Ehrich and Mangelsdorf, 2018; Hoffman et al., 2019; Medin, 2018; UNIDO, 2009; Ali, 2013). In Bangladesh, compliance, monitoring and testing are a challenge due to lack of testing facilities in general or of accredited ones sufficient for international markets. Further, non-compliance with the food quality and safety standards of importing countries is due partially to a lack of capacity on the producers' part, as well as a lack of testing and certification of products throughout the value chain. The government is developing BangladeshGAP, which is based on GLOBALGAP, to facilitate exports to high-value markets. However, most export markets demand GLOBALGAP rather than individual country standards, though private standards are proliferating globally. There is some private sector development of individual standards in Bangladesh, through private supply chains, including for compliance, food safety and quality assurance. This is occurring primarily in contract farming and export-oriented supply chains that can undertake monitoring for food safety and quality as they have access to or own laboratories that can conduct testing (World Bank., 2020; World Bank, 2016; Karim and Biswas, 2016; Latif et al., 2015; Shareef et al., 2020, Hobbs et al., 2023).

Achieving diversification and modernization in Bangladesh's agriculture and agri-food sector is dependent upon a number of interrelated factors. Some are specifically related to capacity and characteristics in Bangladesh's domestic agri-food sector and supply chains as discussed previously, while others pertain to cross-sectoral factors affecting the country's exports and economy in general. Cross-sectoral factors also play a role in hindering the agri-food sector's growth and development. The government has a fragmented diversification policy which diffuses the impact of scarce resources and capacity in government institutions. Policy is often implemented with insufficient data or trend analysis in the absence of a comprehensive, long-term strategic policy approach. There has also been a strong policy bias towards RMG. While this has been the impetus behind the country's remarkable economic growth, it has blunted

investment in other sectors, leading to economic and export concentration in RMG. Such concentration is highly vulnerable to external shocks as demonstrated by the COVID-19 pandemic. The tariff regime protects non-RMG domestic manufacturers, which has reduced their overall competitiveness, investment levels, skills development, productivity, quality, and ability to meet global standards. In addition, the tariff regime has reduced access to duty-free imports of necessary inputs for non-RMG sectors.

The domestic business environment in Bangladesh is cumbersome, scoring 168 in the World Bank's Ease of Doing Business Index in 2019 (World Bank, 2019b). The uncertain regulatory environment and lack of institutional support hamper private sector activity, particularly in the formal organized segment. Informal business operations flourish but are often of low productivity and unable to develop. A general lack of capacity in ports and rail, air and road networks increase delays and costs, reducing overall competitiveness as goods experience long shipping and transit times. There is a lack of navigability and a scarcity of multimodal connectedness, compounding transportation difficulties. Although improvements have been made, Bangladesh still suffers from frequent power outages due to an inadequate power supply, poorly managed energy firms and overall lack of power infrastructure. The economy tends to lack investment and finance tools, which has muted foreign direct investment (FDI), domestic investment activity and access to capital. Firms suffer from reduced access to credit, and experience difficult banking procedures and requirements, and high interest rates.

For firms active internationally, a lack of pre-shipment facilities (letters of credit, export cash credits) increases their exposure to exchange rate fluctuations. Modern equipment, machinery, inputs and components are expensive, partly due to bias against their import in the tariff regime, which deters their local adoption by the private sector. Productivity and innovation suffer. Similarly, labour in the private sector tends to be of low productivity, exhibiting a general lack of knowledge of modern production and management practices and have insufficient training and skill development. This is especially limiting in a competitive export-oriented economy (Sumi and Reaz, 2020; EIU, 2019; von Uexkull and Gregg, 2011).

5. Conclusion and Next Steps

This study suggests that Bangladesh has substantial potential to raise agriculture-generated incomes, increase agricultural productivity and improve the nutritional value of crops. Given the importance of agriculture as an employer, a balanced development strategy should be pursued for both farm and non-farm growth. This can be done through agriculture's diversification into high-value agriculture by promoting value-

added processing, horticulture, livestock, poultry and fisheries. For the fish aquaculture sector, growth can be achieved by increasing production volume as the population continues to grow and incomes increase. Diversification, modernization and sophistication will drive growth by, for example, utilizing different marketing avenues and product offerings and mix (i.e. fillets vs whole fish), changes to product characteristics, or by improving attributes such as food safety and quality standards for an increasingly discerning consumer base. Exports can eventually be targeted when sufficient capacity to meet more stringent requirements has been achieved. The fish aquaculture sector's capacity for growth, employment creation and income generation will continue contributing to Bangladesh's GDP, poverty alleviation, nutrition and rural development goals. For Bangladesh to diversify into high value agriculture, the priorities must be farmers' education and improving infrastructure to address upgrading value chains to speed the structural transformation process in agriculture. It is important to improve the policy framework and rebalance public expenditure priorities, given a large proportion of public expenditure is spent on subsidies. The government may also consider investment in research, extension services and markets, as well as in infrastructure to encourage private sector participation. Access to finance, power, roads, technology and information is needed. Policies to address traceability, food safety, process and quality standards, testing and certification must be a top priority.

Bangladesh's agricultural sector has substantial potential to expand beyond primary production to higher value production and secondary agri-food processing. Agri-food processing can evolve to be a dynamic and vital component of rural and urban economies, with cross-sectoral linkages to both agriculture and manufacturing. Agri-food is also conducive to strong upstream and downstream linkages to support cross-sectoral services such as input suppliers, wholesale and retail marketing, hotel and restaurant, facilities and transportation. It has the potential to be a large contributor to income and employment generation, and to stimulate agricultural productivity and enhance competitiveness (Latif et al., 2015, World Bank, 2020).

While sector-specific and cross-sectoral factors impacting agriculture and agri-food's growth and development may seem overwhelmingly complicated, it would be helpful to recall fish aquaculture organically achieved its quiet revolution in 20 years under these exact factors and conditions, without government or NGO intervention. Hence, the prospects for agriculture and processing remain promising. Again, the more efficient use of inputs, resources and labour combined with increasing domestic consumer demands can be sufficient impetus for structural transformation, growth and development. Government policies and support should seek a better balance between paddy rice and other crops.

The traditional model of structural transformation prevails as resources reallocate between sectors, usually from low-productivity agriculture to higher productivity manufacturing or services. Yet it is clear that substantial structural transformation can occur *within* a sector, as demonstrated by Bangladesh's fish aquaculture subsector of agriculture. Structural transformation is a multidimensional process that also occurs at different paces for different sectors. Within Bangladesh's aquaculture subsector, shrimp production was developed first, much more rapidly through government and NGO assistance, to be specifically targeted at exports (Hobbs et al., 2023) while fish aquaculture developed organically in response to domestic consumer demand. In agriculture generally, Bangladesh achieved food self-sufficiency through its emphasis on paddy rice, but other crop and commodity subsectors, including agri-processing, have not developed as quickly. Domestic consumers' rising incomes and demand can be expected to drive growth in these products. As its economy underwent shallow industrialization, agriculture and the RNF economy also concurrently developed to the extent that the capacity to support agri-food, secondary agri-processing and value added was created. In turn, this can contribute to Bangladesh's ongoing structural transformation and economic development as it approaches graduation from LDC status.

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Endnotes

¹ Empirical work shows recent trends in urbanization are not dominated by migration to large mega-cities as often envisioned. Rather, rural urban mixes are now highlighting a small town with large surrounding rural population and significant agricultural activity occurring in proximity. Such smaller cities and towns in rural settings have an important role in rural employment, growth, value chains and linkages (Emran and Shilpi, 2018; Hariss, 1987; Renkow, 2006; Haggblade et al., 2006b).

² The contribution of manufacturing and services increased from 24.3 per cent and 50.2 per cent to 30.9 per cent and 54.3 per cent in 2000 and 2018, respectively. Though agriculture's share in GDP declined from 25.6 per cent in 2000 to 14.8 per cent in 2017, it still accounted for 41 per cent of total employment in 2017, down from 65 per cent in 2000 (World Bank, 2019a). Over 87 per cent of rural inhabitants derive part of their income from agricultural activities and 65 per cent of households rely on both farm and non-farm incomes (World Bank, 2016). In 2021, agriculture employed nearly 50 per cent of the population and contributed 17.5 per cent to GDP (FAO, 2021).

³ The World Development Report 2008 classified countries into three groups based on the level of economic transformation: i) Agriculture-based where agriculture contributes significantly to GDP, and the poor are concentrated in rural areas; ii) Transforming where agriculture contributes less to GDP, but poverty remains largely rural; and iii) Urbanized where agriculture plays only a small role, and poverty is not a rural phenomenon (World Bank, 2007).

⁴ This has been the case in African LDCs where labour has reallocated from low productivity agriculture to low productivity services including in the informal, retail, tourism, food service or hospitality sectors (Gollin, 2018; UNCTAD, 2020).

⁵ Input subsidies include fertilizers, electricity and credit subsidies in addition to program-specific subsidies.

⁶ Stabilization is a particularly complex task for any government to undertake, with high associated costs. The mechanisms and costs of price stabilization depend on whether the commodity is internationally traded.

⁷ Which is measured not only financially but in terms of household food security, geography, market access, and required investment in time, and technical and managerial skills to learn how to grow new crops (World Bank, 2020).

⁸ Despite the decrease, the present daily rice intake, which may be underestimated according to some studies, is still above recommended levels for a nutritionally complex diet (Yunus et al., 2019).

⁹ It is worth mentioning that Bangladesh's agri-food imports tripled (to over US\$ 10 billion) between 2007 and 2017 and the private sector is increasingly investing in processing and marketing to meet the growing domestic demand (World Bank, 2020).