Bangladesh

Promoting Agri-Food Sector Transformation in Bangladesh

Policy and Investment Priorities

May 27, 2020

AGR
Acknowledgements

This report was prepared by a core team of Mansur Ahmed (Task Team Leader), Jean Saint-Geours, and Ciliaka Gitau, with contributions from external experts: Kunduz Masylkanova, Andrew Sergeant, and Andrew Graffham. The team thanks John Keyser, Madhur Gautam, Manievel Sene, Christian Berger, Samina Yasmin, and Ashfaqul Haq Choudhury for their invaluable support and inputs throughout the preparation of this report. The report also benefitted from inputs from Kateryna Onul, Arnau Gallard-Argusti, Samjhana Thapa, Mainul Hoque, Saiful Islam, Cora Dankers, Gerard Sylvester, and Jahangir Alam.

The study was undertaken under the overall guidance of Loraine Ronchi, Willem Janssen, Mercy Tembon, and Dandan Chen. The team especially wishes to thank peer reviewers Christopher Ian Brett, Bradford L. Roberts, and Eli Weiss for their insightful and constructive comments that greatly helped improve the report. The team gratefully acknowledge the support from the World Bank-FAO Collaboration Programme.

The team benefited greatly from consultations and discussions with, and suggestions from, Hosna Ferdous Sumi, Rajesh Rohatgi, Thomas Farole, Felipe Dizon, Gayatri Acharya, Parmesh Shah, Pushina Kunda Ng’andwe, Maria Eugenia Genoni, Johannes Hoogeveen, and Nazmul Hoque. Thanks also to Narayan Das and Dewan Ashraful Hossain for their assistance in the access to the 62-village panel survey and the Department of Agricultural Marketing (DAM) market price database. The team also wishes to thank all the representatives from public and private sectors who participated in the stakeholder consultations organized for this study and who provided valuable inputs for the report. The team appreciates very much the efficient administrative and logistical support of Jinia Sultana, Taskin Hafiz, John Prakash, and Md Abul Fayez Khan.

The team would like to thank officials from the Ministry of Agriculture (MoA) for a very productive collaboration over the course of preparing the report. A technical steering committee, formulated by the ministry, provided a platform for exchange and productive discussions that enhanced the report immensely. Special thanks go to the coordinator and members of the committee: Dr. A.S.M. Abdur Razzaque (Department of Agricultural Extension), Shila Wadud (Department of Agricultural Marketing), Md. Jamal Uddin (Bangladesh Agricultural Development Corporation), and M.A.H. Sorwar Jahan (Bangladesh Agricultural Research Institute).
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Acronyms

ADB  Asian Development Bank
ASD  Agriculture Strategies Development
BAPA  The Bangladesh Agro-Processors Association
BARC  Bangladesh Agricultural Research Council
BARI  Bangladesh Agricultural Research Institute
BBS  Bangladesh Bureau of Statistics
BDP  Bangladesh Delta Plan
BDT  Bangladesh Taka
BFA  Bangladesh Fertilizer Association
BKB  Bangladesh Krishi (Agriculture) Bank
BPC  Bangladesh Planning Commission
BBRAC  Bangladesh Rural Advancement Committee
C&F  Carriage and Freight
CBB  Central Bank of Bangladesh
CPF  Country Partnership Framework
CSA  Climate Smart Agriculture
CSAIP  Bangladesh Climate Smart Agriculture Investment Plan
DAE  Department of Agricultural Extension
EU  European Union
FAQ  Food and Agriculture Organization of the United Nations
FOB  Free on Board
GAP  Good Agronomic Practices
GDP  Gross Domestic Product
GHP  Good Hygienic Practices
GMP  Good Manufacturing Practices
GoB  Government of Bangladesh
Ha  Hectare
HACCP  Hazard Analysis Critical Control Point
HIES  Household income and expenditure survey
HYV  High yielding variety
ICT  Information and Communications Technology
IFPRI  International Food and Policy Research Institute
IPM  Integrated Pest Management
kg  Kilogram
MFD  Maximizing Finance for Development
MOA  Ministry of Agriculture
MOFL  Ministry of Fisheries and Livestock
Mt  Metric ton
RMG  Ready-made garments
US$  US dollar
USA  United States of America
USAID  United States Agency for International Development
USDA  U.S. Department of Agriculture
VAT  Value Added Tax
WB  World Bank
WeCARE  Western Economic Corridor and Regional Enhancement Program
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Executive Summary

Agriculture plays a central role in Bangladesh’s economy especially in rural areas.

The agriculture sector has been critically important in reducing poverty in Bangladesh, and further progress in agriculture will remain important as Bangladesh’s economy continues to evolve. In the last two decades, Bangladesh recorded impressive economic growth and poverty reduction. Real GDP per capita increased from USD 525 in 2000 to USD 1,203 in 2018. In the meantime, rural areas registered significant poverty reduction from 52.3 percent in 2000 to 26.7 percent in 2016. The agriculture sector contributed 69 percent of total poverty reduction between 2000 and 2010, while the contribution was more modest from 2010 to 2016 (27 percent). However, poverty remains relatively skewed to rural areas compared to urban areas.

Declining agricultural productivity growth poses substantial risk to the development of the rural economy. The slowdown in agriculture growth in the most recent decade has been mainly driven by a slowdown in total factor productivity (TFP) growth – from 2.4 percent in 2001-10 to 1.0 percent in 2011-16 – along with a continuous decline in the growth of inputs use. Given the high labor intensity in agriculture, the slowdown in agriculture growth has been one key reason behind the declining role of agriculture in rural poverty reduction and the slowdown in rural employment growth. In addition, the rural non-farm economy also depends on the performance of agriculture and hence, the sector’s slowdown is posing serious challenges for overall rural economic development.

Bangladesh has made significant agricultural policy reforms since the 1980s, which largely contributed to achieving self-sufficiency in rice production. These policies are however contributing to a strong bias against a more diversified production. Reforms have been made for agricultural input market liberalization in the 1980s (particularly fertilizer and irrigation), followed by reforms in the seed sector through the National Seed Policy in the 1990s (Gautam and Faruqee, 2016). However, the agricultural policy support focused significantly on rice production through input subsidy and public procurement of rice. Thus, repurposing the agricultural policy and support will be key to balance the incentive structure across crops and promote diversification in the sector.

There are substantial market opportunities for productive diversification and increased value addition for the agri-food sector in Bangladesh. With rapid urbanization and fast income growth, dietary patterns are changing in Bangladesh. Average cereal intake is declining and the demand for nutrient-dense foods is growing. A projection of increased demand for food commodities shows that total demand for eggs, fruits, meat and fish will rise by more than 50 percent by 2030 compared to current consumption levels. However, domestic production faces challenges in meeting that growing demand for higher value commodities and thus, Bangladesh’s agricultural imports multiplied by three to US$10.7 Billion from 2007 to 2017. The private sector is gradually getting more involved making significant investments in processing and improved marketing to meet this growing domestic demand. Still, further productive diversification in agriculture and modernization along the agri-food value chain are needed to allow the sector to seize these emerging domestic market opportunities.
The agri-food ecosystem analysis carried out for this study identifies critical constraints to the diversification and modernization of the agri-food sector. These constraints fall under three broad categories: i) On-farm productivity constraints; ii) Off-farm value addition and commercialization constraints; and iii) Cross-sectoral enablers. Bangladesh is currently not competitive in terms of yields for many products with the notable exception of paddy rice, when compared to regional peers and world averages. Bridging these productivity gaps will be essential to increase production and cost competitiveness for these products. Major productivity constraints include land fragmentation and informality in land rental markets, limited access to quality seeds for non-paddy crops, limited knowledge and adoption of GAP reflected in imbalanced use and overuse of inputs, and limited use of farmer aggregation models, which constrains the delivery of extension services, accessing finance, and linking with markets. Similarly, some key constraints are preventing off-farm value addition and commercialization in the agri-food sector. Such constraints include the limited number of formal off-takers, inadequate and costly marketing infrastructure and logistic services, inadequate upholding of appropriate food safety practices and product quality standards, and poorly designed export subsidy policy. These productivity, value addition, and commercialization related constraints are exacerbated by other cross-sectoral issues such as access to finance and overall investment climate and competitiveness challenges.

Evidence from the maize, potato and mango subsectors illustrates both the untapped potential to better serve the domestic market and the need to address key constraints. Using an in-depth assessment of selected subsectors, the study confirms that several crops would offer farmers an opportunity to diversify to higher margins crops. For each of the analyzed subsectors, however, a specific subset of the key constraints identified for the overall agri-food sector prevent actors along the value chain from increasing production and value addition and from reaching higher value markets.

The Covid-19 crisis has hit Bangladesh’s economy and its agri-food sector hard and lasting impacts can be expected on the sector. The International Monetary Fund (IMF) has projected a reduction of economic growth to 2 percent in 2020 against an earlier projection of 7 percent. A recent study shows that, beyond the 20.5 per cent of the population officially recognized as poor, an additional 23 percent of people descended into poverty since the Covid-19 outbreak. The Covid-19 pandemic has impacted the agri-food sector through supply chain disruptions and contracting demand. With markets closed, trade disrupted, and travel limited, many producers have nowhere to sell their produce and are losing their livelihoods. During and in the direct aftermath of the crisis, relief measures will be needed to ensure that the population can afford and access nutritious food, while the agri-food sector keeps its ability to supply food to the domestic market. In the longer-term, a well-functioning agri-food ecosystem will be important to enhance the resilience of the agri-food sector for improved readiness to future pandemics and disasters. When on the recovery path, it will therefore be strategic to promote a sustainable agri-food ecosystem, notably by addressing some of the structural constraints identified before the crisis started.

Promoting greater diversification and modernization of the agri-food sector in Bangladesh will require increasing private investment along the agri-food value chain and in support services to that value chain. This will in turn require implementing the following recommendations to overcome the key constraints identified.
**Strategic options for greater on-farm productivity**

Aggregation models such as productive partnership, contract farming, or producer group, among others need to be encouraged to facilitate economies of scale. While public extension services can encourage and promote such aggregation models for efficient inputs and service delivery to farmers, the private sector can also lead the organization of such models for improving good agricultural practices, traceability, economies of scale, etc. Also, a review of the agricultural land rental market is important to identify private solutions for longer-term rentals of agricultural land.

**Removing regulatory barriers to private sector participation in seed market along with increased oversight on the seeds quality standards is important.** There is a need to review the regulation preventing private sector actors from breeding and producing seeds for notified crops. There is also a need to increase public and private coordination on quality seed supply for notified crops. To stimulate farmer’s demand for improved genetic materials there is need to increase market transparency regarding seeds quality, which should in turn encourage the private sector to invest in this field.

**Local good agricultural practices (GAP) standards should be developed and adopted through public-private collaboration to address the misuse and overuse of certain inputs like fertilizer and pesticides along with other food safety concerns (see recommendation on food quality standards).** They should also be aligned with environmental and social sustainability. Subsequently, GAP should be the key area of focus for both public and private extension service delivery to farmers. Also, improvements to current extension services are needed to get information on new techniques and innovations down to farm level in a usable form.

**Repurposing the current agricultural support policies (including fertilizer subsidy) is a key priority for agricultural diversification and modernization, especially for the sector’s long-term sustainability.** A phased approach can be adopted to reform the policy on fertilizer and other subsidies and increase direct support to farmers. This will improve efficiency of the public support for agriculture and to incentivize farmers in taking market-driven production decision.

**Actions for Better Market Access and Post-Harvest Value Addition**

The development of market infrastructure and logistic services for agriculture supply-chains should be led by the private sector, while policies and incentives could be implemented to support private businesses that are interested to take business opportunities in the development of marketing infrastructure. A public-private partnership (PPP) framework for agricultural marketing infrastructure (such as regional market hubs, cold storages, warehouses, cool chains including railway cool chain) would contribute to giving private sector greater policy certainty and government support for market infrastructure development.

**Improvement in the food safety regulatory and oversight system along with support to the private sector for adoption of appropriate food safety standards and practices are urgent.** Substantial efforts in streamlining both the legal and regulatory framework for food safety, as well as the control and enforcement system appear needed, ideally in close coordination with the private sector. There is a need
to support the private sector in coming together to develop industry-wide harmonized commercial standards, that comply with minimum legal food safety standards, for both primary production and food processing. Success would be derived from the public sector supporting the harmonization process, and for the public and private sectors to work together to ensure close linkages and harmony between regulatory requirements and the private standards. Also, to promote the development of more formal off-takers such as food processors and supermarkets, the public sector could support increased demand for higher quality and safer food via consumer awareness about the importance and safe food, and better enforcement of food safety standards.

**Other Cross-Sectoral Solutions**

Some key cross-sectoral challenges such as better investment climate and access to finance need to be addressed to facilitate private investments along the agri-food value chains. Interventions to improve access to finance for agri-food value chain actors could be wide-ranging, from the opportunity to further develop innovative tools like warehouse receipt financing for post-harvest financing to addressing broader issues like strengthening the secured transactions regime or supporting the use of rental land as collateral. Improvement in broader investment climate and competitiveness challenges would encourage the inflow of foreign direct investments, which would greatly benefit the agri-food sector in terms of knowledge transfers, structuring of domestic value chains and the ability to target and meet export market requirements.
1. Overview

1.1 Context of the Study

Bangladesh has experienced robust and steady economic growth since 2000, with a growing role of manufacturing and services in the economy. Between 2000 and 2018, real gross domestic products (GDP) per capita increased by 130 percent—from 525 USD in 2000 to 1203 USD in 2018 (World Bank, 2019). In the same period, the structure of Bangladesh economy has also undergone substantial transformation. The share of agriculture in GDP has declined by 10.8 percentage points—from 25.6 percent in 2000 to just 14.8 percent in 2017—and the shares of industry and services in GDP have increased from 24.3 percent and 50.2 percent to 30.9 percent and 54.3 percent respectively in the same period (Figure 1-1). Agriculture still accounted for 41 percent of total employment in 2017, down from 65 percent in 2000.

Despite decreases in poverty rates in rural areas, poverty remains more pervasive in rural areas compared to urban areas. The agriculture sector plays a key role in the rural economy by driving poverty reduction, creating employment for the majority of the rural workforce, and providing a large share of households’ incomes in rural areas. Rural areas have registered impressive declines in poverty rates in last two decades, from 52.3 percent in 2000 to 26.7 percent in 2016 (Hill & Genoni, 2019). Agriculture contributed 69 percent of poverty reduction nationally between 2005 and 2010; while the contribution was more modest in the most recent period, 27 percent between 2010 and 2016 (Hill & Genoni, 2019). The head-count poverty rate was however markedly lower in urban areas at 19.3 percent in 2016.

Agriculture has performed sluggishly in recent years. The trend growth of agricultural output has declined consistently since 2010 and remained much lower compared to the growth of the rest of the economy (Figure 1-2.). Given the high labor intensity in agriculture, the slowdown in agriculture growth has been one key reason behind the declining role of agriculture in rural poverty reduction and the slowdown in...
rural employment growth\(^1\) between 2010 and 2016 (Hill & Genoni, 2019) (Farole, Cho, Bossavie, & Aterido, 2017). Over 24 million, out of 47 million employed people, in the rural areas are engaged in agriculture and the sector is the source for 38 percent of rural households’ incomes (Bangladesh Bureau of Statistics, 2019).

The rural non-farm economy also depends on the performance of agriculture. Evidence suggests a 10 percent increase in agricultural incomes generates a 6 percent increase in non-agricultural incomes through strong forward and backward linkages (Gautam and Faruqee, 2016). As a result, the slowdown in agricultural growth is posing a serious challenge for the rural economy.

Over the past 50 years, the increase in agricultural productivity in Bangladesh has led to quasi-self-sufficiency in rice. In the 1970s, Bangladesh was producing 10 million ton of rice/year (World Bank 2016), which has now increased to about 37 million ton in 2018/19 (USDA, 2019) meaning that Bangladesh is almost self-sufficient in rice. Through research and extension activities, investments in irrigation, and favorable agricultural policies to ensure food security, the public sector has made a considerable contribution to achieving this self-sufficiency in rice production.

Food production has also started, albeit slowly, to diversify to crops with higher margins for farmers such as vegetables and maize responding to emerging new market opportunities on the domestic market (Gautam and Faruqee, 2016). With rising urbanization and increasing incomes, Bangladesh’s population is transitioning from cereals to higher value and nutritious agricultural commodities (Dizon et al., 2019). However, domestic production faces challenges in meeting that growing demand for higher value commodities and thus, the agricultural trade deficit has been continuously growing overtime (Figure 2-24.). From 2007 to 2017, Bangladesh’s agricultural imports have multiplied by three to US$10.7 Billion, with cooking oils, cereals, and sugars accounting for 60% of these imports (Error! Reference source not found. and Figure 2-22). During the same period exports decreased by 9 percent to just US$0.9 Billion, due predominantly to a decline in fish exports (FAOSTAT). The private sector is gradually getting more involved making significant investments in processing and improved marketing to meet this growing domestic demand, as seen with the increase in market intermediaries along the agri-food supply-chains of horticulture produce (Gautam and Faruqee, 2016). However, further productive diversification in agriculture and modernization along the agri-food value chain are needed to allow the sector to seize these emerging domestic market opportunities.

Bangladesh’s agri-food sector needs to overcome some critical constraints to accompany this transition toward higher value and nutritious food products, such as small farm sizes, a limited use of aggregation mechanisms, persistent policy focus on rice production, weak market infrastructure and costly logistics, mostly informal marketing channels for food products with a limited number of established off-takers, food safety and food quality definition and enforcement issues, vulnerability to climate shocks, among others. The country’s farms are some of the smallest in the world on average (current per capita agricultural land is less than 0.10 ha (FAO, 2020) and there is no potential to expand agricultural lands.

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\(^1\) While the Bangladesh rural economy added about 5.6 million additional jobs in five years between 2005 and 2010, it could add only 1.3 million additional jobs in the next six years (BBS, 2017). Currently, about 5.5 million, around 13 percent of entire rural work force, are looking for jobs and employment opportunities.
The sector depends on the crop subsector, which in turn is dependent on a single crop – paddy rice – limiting its income generation potential and its role in achieving the sustainable development goal (SDG) of nutrition security in the country. Potential for further productivity and efficiency improvements in paddy is largely exhausted. Performance of the livestock subsector has not shown significant improvements. The fishery subsector performed remarkably well in the past decades, but climate events and human-induced factors (overfishing, mono-fishing, poor farming practices) increasingly pose risk to its sustainability.

Bangladesh has made significant agricultural policy reforms since the 1980s, which largely contributed to achieving self-sufficiency in rice production. These policies are however contributing to a strong bias against a more diversified production. Reforms have been made for agricultural input market liberalization in the 1980s (particularly fertilizer and irrigation), followed by reforms in the seed sector through the National Seed Policy in the 1990s (Gautam and Faruqee, 2016). However, the agricultural policy support focused significantly on rice production through input subsidy and public procurement of rice. Thus, repurposing the agricultural policy and support will be key to balance the incentive structure across crops and promote diversification in the sector.

Climate change is expected to further exacerbate the challenges facing agriculture given the sector’s extreme vulnerability to climate change. Environmental degradation caused by mono-cropping, overuse of chemical fertilizers, and overexploitation of groundwater resources coupled with increased climate events and natural hazards pose additional risks to sustainable development of agri-food system to enhance farm incomes, food security, and nutritional outcomes. Bangladesh is increasingly vulnerable to climate change. Rising temperatures mean existing varieties are less well adapted and are susceptible to increasing pest and disease pressure (World Bank. 2019). Increased soil and water salinity due to sea level rise is projected to result in a 15.6 percent yield reduction in high-yielding rice varieties by 2050.

Moreover, the Covid-19 crisis has hit Bangladesh economy hard. The International Monetary Fund (IMF) has projected economic growth of the country to be only 2 percent in 2020, against an earlier projection of economic growth of 7 percent². A recent study shows that, beyond the 20.5 per cent of the population officially recognized as poor, an additional 23 percent of people descended into poverty since the Covid-19 outbreak³. According to a survey conducted by LightCastle Partners, more than 80 percent of rural low-income population has experienced a fall in earnings in March 2020⁴. The main impacts of the Covid-19 pandemic on the agricultural sector are the supply chain disruptions and contracting demand. The supply chain disruptions and panic buying have led to food price hikes. In addition, with markets closed, trade disrupted, and travel limited, many producers have nowhere to sell their produce and are losing their livelihoods (see Box 1 for detailed Covid-19 implications for the agri-food sector).

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Box 1: Implications of Covid-19 for the agri-food sector

The Covid-19 related risks of rising food insecurity remain high, with impacts on both the demand and supply of food. The primary sources of risk are income losses and breakdowns in the domestic food supply chain. Loss of income and jobs reduces people’s ability to buy food. Decline in demand for perishable goods and livestock products such as vegetables, poultry, eggs, and milk exacerbate the food security situation for the people engaged in these activities which, in turn, may create future supply shortages. Government of Bangladesh has enlarged the food assistance program to help the most vulnerable people.

The current crisis has led to input and labor shortages and agricultural growth is projected to slow down. Due to movement restrictions, social distancing rules, and the disease itself, labor shortages have started to impact producers, processors, traders and logistics companies along the food supply chain. The enforcement of lockdowns restricted seasonal workers’ movement across the country causing disruptions in the harvesting of staple foods like maize, potatoes, Boro rice and onions. Disrupted inputs and feeds markets are expected to affect outputs and propagate further food shortages.

The Pandemic has exposed the inadequate infrastructure supporting the agri-food sector. The pandemic has brought bare some of the key constraints facing the agri-food sector including the lack of post-harvest storage, cooling technologies, processing infrastructure, and formal marketing channels. With the disrupted travels and reduced demand, most farmers have experienced significant losses especially for perishable products like vegetables that have a short shelf life.

Going forward, it is critical to rebuild a more resilient agri-food sector. During and in the direct aftermath of the crisis, relief measures will be needed to ensure that the population can afford and access nutritious food, while the agri-food sector keeps its ability to supply food. In the longer-term, a well-functioning agri-food ecosystem will be important to avoid food scarcity and to enhance the resilience of the agri-food sector for improved readiness to future pandemics and disasters. Therefore, on the recovery path, it will be strategic to put in place policies and institutions that support a sustainable agri-food ecosystem. This will require concerted public and private sector efforts to address key structural constraints along the agri-food supply chain such as food safety challenges. This report identifies and discusses these key constraints, as well as opportunities to foster a transformation of the agri-food sector in Bangladesh.

With this context, the sector needs, more than ever, a balanced and forward-looking agricultural diversification and modernization strategy in anticipation of changing consumption patterns, emerging market opportunities, and resource and climate change constraints to facilitate post-Covid-19 recovery in the medium term and resilience in the longer-term. Given the country’s limited scope for arable land expansion, and the current high intensity of land use, future agricultural growth will need to be driven by a combination of higher agricultural productivity, greater agricultural diversification towards high-value crops, and more integration towards a modern agri-food supply chain.

Sustainable development in agriculture generally requires a mix of complementary production approaches for stronger resilience, higher efficiency of resource use, and improved food security and nutritional outcomes that include diversification, specialization, and intensification (see Box 2). While all approaches are applicable to all subsectors (crop, livestock, fisheries and forestry) in Bangladesh at various degrees, diversification is particularly relevant to the crop subsector as it is dependent on a single low value food grain, paddy, despite an untapped potential for diversification that could increase farm incomes, improve nutritional outcomes, and generate export earnings (Gautam and Faruqee, 2016). Diversification is relevant to aquaculture too as existing environmental and ecosystem degradation
caused by monoculture and intensive production pose risks to its sustainability. Potential for diversification in the livestock subsector is relatively limited, while the potential for intensification and vertical diversification remains considerable as in other subsectors.

**Box 2. Sustainable farming approaches**

*Diversification* in farming refers to re-allocation of productive resources to a mix of multiple farm and post-harvest value-addition activities in response to risks (climate, production, market) and opportunities (market, technology). It is a strategy to improve resilience, maximize incomes, stabilize consumption and dietary diversity. Diversification can be horizontal and vertical or both (FAO 1998; 2001). In crop production, horizontal diversification involves expansion of crop and/or variety base by substituting or adding more crops and varieties into the existing cropping systems, whereas vertical diversification involves expansion of processing and marketing systems for higher value addition. Complementing vertical and horizontal diversification facilitates highest returns with greater growth impact on overall rural economy. Diversification benefits may vary depending on farm’s resource endowments (FAO 2017). For resource-constrained small farms, it may strengthen their resilience.

*Specialization* in fewer commodities may offer higher returns for larger and resourceful farms through higher efficiency and economies of scale (FAO 2017; World Bank, 2005). Specialization at higher scales can facilitate greater economic efficiency and development of entire commodity systems (World Bank, 2005).

*Intensification* in agriculture refers to an increase in agricultural production per unit of inputs (land, water, labor, inputs, time) or maintaining the same production level while using fewer inputs.


Moving forward, the priority is to identify the constraints and opportunities for diversification and modernization of the agri-food sector to support faster agricultural growth and promote investment in market-oriented agricultural value-chains. To achieve this, it is important to broaden the focus from only agriculture (on-farm) to the broader agri-food system. Productive diversification in agriculture and modernization along the agri-food supply chain will require a strategic re-orientation of policies, institutions, and public investments, as well as greater investments and involvement of the private sector along the agri-food value chain and in key support services to that value chain. For such strategic repurposing of public agricultural support, it is important to better understand business opportunities and constraints facing private investors along the agri-food value chains and identify the most impactful set of enabling policies and public investments for a diversified (across crops and non-crop products) and modernized agri-food system to support growth, employment, and ultimately nutrition security in Bangladesh.

### 1.2 Agri-Food System Transformation: Where Does Bangladesh Stand?

*Over the past two decades, Bangladesh has moved from the stage of an agriculture-based economy to the transforming stage and is now heading towards a more urbanized economy.* As economies grow, the shares of agriculture in GDP and employment tend to decline, but the decline in the employment share is generally slower than the decline in the GDP share. As the level of income varies across countries, so does the level of structural transformation. Based on the level of economic transformation, the World Development Report 2008 on agriculture classified countries into three groups: i) Agriculture-based countries where agriculture contributes significantly to GDP, and the poor are concentrated in rural areas;
ii) Transforming economies where agriculture contributes less to GDP, but poverty remains largely rural; and iii) Urbanized economies where agriculture plays only a little role to economic GDP, but poverty is no longer a rural phenomenon (World Bank, 2007). With data from 2001 and 2018, such patterns of economic transformation are observed in many countries in Asia and Africa, and the shares of GDP and labor in agriculture have declined at a varying degree in many countries since 2001 (Figure 1-3.). It appears that Bangladesh experienced fast transformation over the last 18 years compared to other countries in South Asia and entered in a stage where major South East Asian countries were in 2001. Though agriculture accounts for a small share of GDP of the country, majority of rural people are still engaged in agriculture and poverty remains largely rural. In most countries, the transition stage is marked by a decreasing percentage of people working on the land, more professional and larger farming units, increased sophistication and mechanization leading to increased value-addition, greater awareness of the importance of food safety and exports, especially of processed goods, becoming more important.

As the economy continues to transition towards a more urbanized economy, the off-farm aspect of the agri-food sector will expand and the share of agri-food manufacturing and services will grow. Therefore, more jobs are expected to be created in the downstream of the agri-food supply chain and the labor share in agriculture will gradually decline over time. Urbanization and per capita income growth typically offer significant new opportunities with increased demand for diversified high-value agricultural products and the resulting creation of new jobs in the agri-food sector beyond the farm (Townsend, et.al., 2017). Such patterns have already been emerging in Bangladesh and the job dynamics in the agri-food sector between 2005 and 2016 offer some insights on the transition happening in the agri-food sector.

Figure 1-3. Share of Employment and GDP in Agriculture

Source: World Development Indicators.

Note: Bangladesh(BGD), China(CHN),India(IND), Indonesia(IDN), Nepal(NPL), Pakistan(PAK), Philippines(PHL), Thailand(THA), Vietnam(VNM), Upper middle income(UMI), World(WLD), Sub-Saharan Africa(SSA), Lower middle income(LMI), and Low income(LI)
While primary agriculture still dominates agri-food sector jobs – 68 percent of agri-food sector jobs are in agriculture –, majority of new jobs in the agri-food sector are created in off-farm activities. Between 20005 and 2016, 7.5 million new jobs – from 28.4 million in 2005 to 35.9 million in 2016 – were created in the agri-food sector, of which 53 percent were generated in agricultural services and another 9 percent in agri-food manufacturing (Figure 1-4. Error! Reference source not found.). Primary agriculture still continues to accommodate new workers (38 percent of new jobs) and accounts for over two-thirds of workers in the agri-food sector (Figure 1-4.). These numbers show that the agri-food sector in Bangladesh is transitioning, albeit slowly, towards more jobs coming from downstream activities of the agri-food supply chain.

Figure 1-4. Distribution and Changes of Agri-Food Sector Jobs between 2005 and 2016

Source: Labor Force Surveys 2005 and 2016, BBS.

As an economy in transition, expanding opportunities for the manufacturing and service components of the agri-food supply chain will require identifying and addressing market failures and major constraints that are preventing agribusinesses and private actors more generally from fully materializing the full development potential of the agri-food sector. Market failures along the value-chain are often exacerbated by poor performance of support services and weak business climate that need to be addressed to attract private investments along the value chain in line with the Maximizing Finance for Development (MFD) framework.
East Asian and South-East Asian countries offer good lessons for Bangladesh’s agri-food sector transformation process. So far, Bangladesh has followed a similar trend to those of most South-East Asian countries, which managed to transition from being dependent on agriculture to becoming major global industrial and service hubs. These countries managed to achieve a rural economic development mainly driven by increased on-farm productivity and better commercialization of agricultural products. This development was typically done in two phases. First, the intensification of rice production to achieve self-sufficiency in pursuit of ensuring food security and increasing agricultural incomes. Second, the diversification of the agricultural sector by expanding production to high-value crops and increasing value-adding activities to serve both domestic and international markets. Agricultural diversification policies were complemented with the development of post-harvest systems such as storage, processing and other value addition activities, transportation, and marketing, as well as strengthening institutions to link farmers to remunerative markets.

Such agricultural transformation processes have been observed in both China and Japan in the early stages of their development. China developed smallholder-based farming technologies and developed new crop varieties with high yields, high quality, early maturity and greater adaptability. Japan enacted an agricultural act stipulating a mechanism of transforming the agricultural product mix. The government aimed to implement appropriate measures to diversify and selectively expand farm production of crops with expected higher demand driven by envisioned changes in dietary habits. Between the 1960s and 2000s the per capita consumption of rice and starchy foods decreased sharply while that of fresh vegetables and fruits, eggs, and milk increased substantially. The Government proactively supported development of related infrastructure and support services, which increased domestic market access and attracted many farms to shift to production of these high-value products (Ito, 2015; Pingali, 2006).

Bangladesh seems to be experiencing a similar turning point and there is a need to develop a conducive environment to realize full potential from diversification. With Bangladesh realizing near rice self-sufficiency, acceleration of rural growth will be stimulated by diversification to high value products and development of non-farm rural commercial activities. However, agricultural transformation has been delayed or has stagnated in many countries and it is important for Bangladesh to get it right to leverage its potential in realizing middle-income status.

1.3 Objectives of the Report

Agriculturally, Bangladesh is now at a transitional stage where it needs to build on the fundamentals established, pursuing a more modern and sophisticated sector that creates off-farm revenue and jobs, feeds an increasingly urbanized population, and expands agricultural exports. To effectively pursue this agenda, a better understanding is required of business opportunities and constraints facing agribusinesses and private investors along the agri-food value chain. Moving ahead, Bangladesh needs to realign agricultural policies and support to make the agri-food sector more diversified and modernized, while keeping a balanced approach towards food security.
The overall aim of this report is to identify policy and public investment opportunities for increasing agricultural diversification and creating an enabling business environment for private sector investment along the agri-food supply chain using the Maximizing Finance for Development (MFD) framework. Hence, the report identifies critical policies, institutions, and public investment options that will promote agricultural diversification and enable private investment to bring modernization along the agri-food value-chain, with the ultimate goal of supporting farm and off-farm incomes and nutrition security in the country.

The report is intended to provide guidance to the Government of Bangladesh (GoB) to implement and operationalize the strategic priorities of agricultural diversification and commercialization, as outlined in National Agricultural Policy 2018, to improve farms’ incomes, create rural jobs, and attain nutrition security in the country. The report is also intended to inform the World Bank’s strategies and dialogue for agriculture and rural development in Bangladesh and sharpen priorities for future engagement on agri-food sector modernization initiatives.

1.4 Analytical Approach and Data
The analytical framework is cognizant of the evolving consumer demand, emerging disruptive technologies, new business models and the challenges and opportunities they create in the system. These trends are transforming agriculture and agribusiness markets requiring public and private parties to adapt and build capabilities to respond to consumer demand. In addition, as Bangladesh’s structural transformation continues to progress, the role of agribusiness becomes more essential to support all other sectors.

To explore policies and investment opportunities to boost agricultural diversification and modernization in Bangladesh, the report adopted a multi-pronged approach. The study utilized primary and secondary qualitative and quantitative data to analyze the constraints and opportunities for agricultural diversifications. Analysis of secondary macro and micro data provided key aspects of agricultural sector performance and challenges in the agri-food ecosystem, using the framework in Figure 1-5.

Figure 1-5. The Agri-Food Sector Ecosystem
Following this framework, the report assessed and discussed the performance of the different nodes along the agri-food value chain, the performance of key support services, as well as the business climate as it relates to the agri-food sector to identify potential constraints and opportunities to increase private investment and promote diversification and modernization of the sector towards more sustainable and inclusive agri-food transformation in the country. The micro-level findings discussed in this report are based on in-depth analyses of micro-level data from: (i) the district level representative Household Income and Expenditure Survey (HIES) 2016 conducted by the Bangladesh Bureau of Statistics (BBS); (ii) the Agriculture and Rural Survey 2018 conducted by BBS; (iii) 62-village panel survey data conducted by BRAC; and (iii) market price information from the department of marketing (DAM) of the Ministry of Agriculture.

To ground the policies in specific contexts, three subsector analyses informed by field visits and stakeholders’ consultations were conducted. Key stakeholder consultations were organized with various agents along each subsector’s value chain including policy makers, farmers, traders, and processors. Further consultations were engaged with policy makers in relevant ministries. At policy level, cross-cutting issues were analyzed, identifying investment opportunities that have high potential of unlocking agricultural diversification and modernization.

1.5 Structure of the Report

Following this brief introduction, Chapter 2 provides a detailed analysis of the agricultural performance and transformation in the past decades and focuses on the opportunities and potential of productive diversification for agricultural development and improved nutrition in the context of changing diets and rising urbanization in the country. This exploration of diversification opportunities is followed in Chapter 3 by a discussion on the key challenges and constraints along the agri-food value chain that need to be tackled to support the sector’s diversification and modernization. Chapter 4 presents an assessment of three indicative products and their value chain from the fruits, vegetables, and livestock feed subsectors to illustrate the challenges and constraints discussed in Chapter 3. The final chapter lists priority recommendations, especially in relation to strategic priorities for public investments and policies to mobilize private sector investments along the agri-food value chain.
2 Agri-food Sector Transformation in Bangladesh

Successful transformation of the agri-food system depends on there being opportunities for agricultural diversification horizontally (e.g. growing more high-value agricultural commodities) and vertically (e.g. post-harvest processing, value-addition, etc.). Perceived market opportunities for productive diversification seem to exist when considering the growing domestic market for high-value food products. With growing affordability and awareness, the demand for nutrient-dense high-value agricultural commodities has been consistently growing and the existing agri-food production system faces challenges to meet this demand, which is reflected in the growing deficit in agricultural trade of the country. Potential for increasing exports appears more limited. This chapter reviews past performance of the sector in the lens of diversification and discusses both market and agro-ecological opportunities for diversification that could be exploited to increase farmers’ incomes and move toward attaining nutrition security in the country. Chapter 3 will then discuss the key constraints preventing market actors from seizing these opportunities.

2.1 Agriculture and Its Past Performance: Self-Sufficiency in Rice

In the last two decades, Bangladesh’s agriculture has undergone some profound transformation and achieved laudable success in attaining almost self-sufficiency in rice, its main staple. Total production of rice has doubled in the last two decades: from 17.7 million MTs in 1995-96 to 36.2 million MTs in 2017-18. Import of rice went down significantly in the same time. However, the import of wheat has been consistently growing over time, from 0.5 million MT in 2000-01 to 5.6 million MT in 2018-19 (Figure 2-1).\(^5\) The increase in rice production was achieved in great part thanks to GoB’s food security-focused agricultural policies and public investments, which supported intensification, irrigation expansion, and the introduction of new high-yielding varieties (HYV) of rice. This support helped consistent increase of rice yield over time.

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5 The continuous increase of wheat import was mainly driven by farmers’ switch from wheat production to rice production and the expansion of coverage of various programs under the public food distribution system, which predominantly rely on wheat.
Agricultural growth has slowed down since 2010 and the average growth rate has declined to near 3 percent for the period of 2011-17 from over 5 percent during the period of 2000-10.

The slowdown in agriculture growth is mainly driven by a recent decline in agriculture’s total factor productivity (TFP) growth along with continuous decline in the growth of input use since 1990s. The evidence shows that the annual growth of input use decreased to 0.9 percent in the period of 2011-2016 from 3 percent in 1991-00 and 1.2 percent in 2001-10. The agricultural TFP growth has declined substantially in the most recent decade, from 2.4 percent in 2001-10 to 1.0 percent in 2011-16 (Figure 2-2.). To put this sectoral performance into context, the average annual growth of agricultural TFP in Bangladesh was the highest in South Asia between 2000 and 2010 and was comparable with the agricultural TFP growth in many middle-income countries in South East Asia including China, Thailand, Viet Nam, and Indonesia (Figure 2-3.). While many of these countries experienced decline in agricultural TFP growth since 2010, Bangladesh experienced a much sharper decline.
Yet, agriculture continues to contribute to rural households’ incomes and plays an important role in providing livelihoods and jobs to the rural poor. Decomposition of households’ income growth between 2000 and 2014 indicates that agriculture contributed, on average, 40 percent (1.7 percentage point) of the per-capita income growth (4.2 percent annually) of rural households (Figure 2-4). At sub-sectoral level, non-crop agriculture was the second most contributing sub-sector across farm and non-farm economy, just after remittance earnings. Crop agriculture was not an important contributor of rural income growth, despite majority of farmers engaged in crop farming.

The rural economy and Bangladesh’s agriculture sector are in a transition stage where the role of primary agriculture to national GDP and rural households’ income is declining. Figure 2-5, presents the composition of rural households’ incomes in 2000 and 2014 at division level and the figure highlights the growing role of non-crop agriculture and remittance earnings in rural incomes across the country. While the share of incomes from agriculture remains high in most divisions, it declined in all divisions except Rajshahī.

For details on the decomposition method and data, please see Ahmed and Gautam (2020).

Districts of newly formed Rangpur division were included Rajshahī division-the formal division of these districts.
The agriculture sector is dominated by the crop subsector and within the crop subsector, by one crop, paddy rice. This dependence on rice increases the sector’s already high vulnerability to natural hazards and increasing adverse climate events. From 2000 to 2017, the crop subsector underperformed in comparison with other subsectors with the lowest annual growth rate of 2.9 percent on average, whereas the livestock subsector grew at 3.9 percent, slightly lower than the sectoral average growth rate of 4.1 percent. In a stark contrast, the fisheries and forestry subsectors grew by more than 5 percent per annum throughout the period. Yet, the crop subsector accounts for more than half of agricultural GDP. It is important to note that the agriculture sector performed very well in the decade of 2000s and average growth was higher than the overall GDP growth between 2000 and 2005.

Table 2-1. Annual growth of GDP (period averages at constant prices) and Sectoral Share of GDP

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Annual growth of GDP</th>
<th>Sectoral Share of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>5.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Agriculture, forestry and fisheries</td>
<td>5.6</td>
<td>5.1</td>
</tr>
<tr>
<td>Crop and horticulture</td>
<td>2.6</td>
<td>4.4</td>
</tr>
<tr>
<td>Livestock</td>
<td>4.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Forestry</td>
<td>4.6</td>
<td>5.1</td>
</tr>
<tr>
<td>Fisheries</td>
<td>2.7</td>
<td>4.7</td>
</tr>
<tr>
<td>Services</td>
<td>4.9</td>
<td>5.9</td>
</tr>
<tr>
<td>Industry (including construction)</td>
<td>5.7</td>
<td>8.1</td>
</tr>
</tbody>
</table>

Source: Masylkanova, 2020

Agricultural growth in past decades was mainly driven by the expansion of irrigation access, fertilizer use, machinery use, and with the introduction of new HYV rice varieties, especially in the face of continued decline in crop land per agricultural labor. Since 1981, cropland per agricultural worker has declined by 33 percent—from 0.48 hectare in 1981 to 0.32 hectare in 2016 (Figure 2-6). On the other hand, the utilization of irrigation, fertilizer, and agricultural machinery has increased substantially over the same period. However, the growths of irrigation and fertilizer uses have been slowed down in recent years. The fast increase of the use of agricultural machinery in agricultural operations indicates the potential of the sector moving towards a more modernized phase.

Persistent agricultural support and strategic focus on ensuring food security facilitated achieving near self-sufficiency in rice production but created a bias against non-rice high value
agricultural commodities\(^8\). The past success in tripling rice production since the 1980s was mainly driven by successive agricultural policy reforms and the persistent focus of agricultural policies on increasing rice production in the country. While empirical measurements explaining the drivers for the increase in rice production are rare, perceived factors are key reforms in agricultural input markets that have facilitated rapid irrigation expansion through groundwater pumps, increased participation of private sector in fertilizer and seed markets, and fast expansion in agricultural mechanization through power tiller (Gautam and Faruqee, 2016). Food security remains at the center of the government’s agricultural strategies and it continues to maintain incentives for rice production input subsidies, output price support, and price stabilization. Between 2012 and 2014, agricultural subsidies accounted for 80 percent of the total public recurrent expenditure for agriculture, livestock, and fisheries sector (World Bank, 2015). For instance, agricultural subsidy in 2017-18 was estimated around US$1.1 billion\(^9\). The slow progress of diversification also partly reflects this emphasis of agricultural strategies on food security through increased domestic staple production, which created a bias against more diversified production systems. Moving forward, creating a balanced incentive structure across crops is important to promote productive diversification and bring private investments along the agri-food supply chain.

2.2 Agricultural Diversification in Bangladesh: Past Trends and Patterns

Agriculture production is very much focused on rice paddy production. Three fourths of the cropland are covered with cereals (Figure 2-7.). Rice paddy represents 71% of the production area and 59% of total crop value. Potatoes generate the second highest crop value (9.5% of the total). Fish and crustaceans generate 73% of total animal production value, with aquaculture generating 68% of fish value. Goat generates the second highest meat value (6% of the total).

Figure 2-7. Crop and animal production in Bangladesh

Source: FAOSTAT

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\(^8\) For detail on agricultural policy reforms and their impacts on agricultural growth, see Gautam and Faruqee, 2019.  
2.2.1 Agricultural Diversification Within Each Subsector

Crop subsector

The crop subsector is dominated by paddy, which occupies around 11.6 million ha or 77 percent of gross cultivated area (GCA). It is produced in three agricultural seasons: aman (monsoon), boro (winter), and aus (spring). Boro paddy accounts for 53 percent of production and 41 percent of GCA followed by Aman paddy (40% of output and 50% of GCA) and Aus paddy (6% for both). Total amount of rice production in Bangladesh has become more than double since 1995-from 16.8 million MT in 1994-95 to 36.3 million MT in 2017-18 (Ministry of Finance, 2019). Boro was the major contributor to this impressive growth in rice production. The production of Boro rice has tripled over the same period, while the production of Aus rice and Aman rice have increased by 51 percent and 65 percent, respectively, over the same period.

Considerable gap still exists between attainable and actual yields in paddy rice production despite very high adoption of high yielding varieties (HYV) and hybrid seeds (99 percent in Boro, 75 percent in Aman and 79 percent in Aus). The Bangladesh Rice Research Institute (BRRI) estimates the yield gaps in the range of 25 percent for Boro and 75 percent for Aman and Aus paddy (Gautam and Faruqee, 2016). Potential for reducing the yield gap exists at the farm field, especially for Boro paddy, if underlying causes were to be addressed. These are: i) Overuse and imbalanced use of fertilizer resulting in declining soil fertility; ii) Lower technology adoption in Aman and Aus because of flooding risks; iii) Inadequate farm knowledge and practices; and iv) crop pest and diseases (Bangladesh Planning Commission, 2018; Gautam and Faruqee, 2016).

Since 2000, the crop subsector experienced gradual diversification towards non-paddy crops through crop substitution and intensification (Table 2-2). During 2000-2005, major floods in 1999, 2004 and 2005 caused considerable decline in production of all crops. Yet, there was substantial shift towards horticulture through substitution of oil crops, pulses and fibers. During 2006-2011, the trend continued but through both intensification (72%) and crop substitution (28%). The trend was reversed during 2012-2016 during which crop substitution - mainly of cereals and fibers with other crops - became the major source of diversification (82%) followed by intensification (18%).
The gradual move towards diversification of the sector has also been observed from the changes of areas under major crop groups between 2008 and 2018 (Figure 2-9). During this period, areas under fruits, flowers, fiber, spices, and pulses have increased more than 60 percent while the increase in total cropped area was 29 percent, implying a large expansion of areas under these high-value agricultural commodities. The areas under maize, fodder, and wheat have also increased at a higher rate than the increase in total cropped area. However, the shares of area under these high-value crops remain low. Moreover, the worrying trend is that the area under vegetables experienced much slower growth than that of the total cropped area.

The positive changes towards high-value agricultural products was primarily driven by increased availability of quality and modern seed varieties, which resulted from the seed sector liberalization in late 1990s, and steady expansion of irrigation facilities across the country. While farms with irrigation access are generally more diversified, irrigation access is strongly associated with the level of diversification among marginal, small, and medium farmers (Figure 2-10). The government has initiated another import substitution policy with an aim to reduce dependence on imports of oilseeds, pulses and spice crops, including through provision of a short-term loan facility at subsidized rates. The latter policy aimed also at addressing groundwater depletion. These policies facilitated sharp increases in production of target crops.

Livestock subsector

With the exception of poultry, livestock farming is largely smallholder with low productivity and relatively slow growth compared to other subsectors. The subsector’s performance was poor in the past decades and, with some improvements since 2012, compounded annual growth in milk productivity was negative at 1.5 percent between 2000 and 2016 (Masylkanova, 2020), whereas, productivity growth in goat, sheep, buffalo and cow meat was broadly flat. As the livestock subsector growth was slower than...
population growth in the past decades, the country continues to depend on imports. In FY15-16 alone, the country spent around US$249 million for imports of dairy products.

In terms of diversification of livestock production, only the poultry subsector has shown real dynamism in recent years, with the expansion of commercial poultry production. Between 2001 and 2011, broiler meat production and egg production grew 8.8 percent and 7.7 percent annually (Hamid, et.al., 2017)

Near 80 percent of rural households are engaged in either livestock or poultry production, though mostly for own consumption (Figure 2-11.Error! Reference source not found.). The engagement of rural households in livestock production is higher in Rangpur, Khulna, Rajshahi divisions where poverty rates are higher. Recognizing its importance role in the rural economy, the World Bank is supporting the subsector with US$500 million of investments, which are expected to foster a market-led transformation of the subsector by promoting modern technology, encouraging private sector investments along the value-chain, and improving the overall ecosystem for value chain development through support for key infrastructures including markets, access to market, access to insurance and financial products, livestock services, and capacity building and knowledge base.

Fisheries subsector

The fisheries subsector showcases a private sector-led diversification success story, with Bangladesh having become the world’s third largest producer of inland capture and fifth in inland culture fisheries (FAO 2018). The country has massive marine, coastal and inland water resources for fish production. Within the subsector, inland capture fishery is the largest accounting for 56 percent of total production and 3.91 million ha of water spread areas (WSA) (Figure 2-12.Error! Reference source not found.). Inland aquaculture is the second largest with its share at 28 percent in total production and WSA of 0.79 million ha. Marine fishery accounts for 15 percent of national production. The latter is likely to increase as the country negotiated new maritime boundary with India, which provides additional 11.9 million ha of maritime water with great potential for expansion of marine fishery.
Inland aquaculture transformed substantially in last three decades and the farmed-fish market experienced a 25-fold increase in three decades driven by demand from the domestic market (Rashid and Zhang, 2019). Between 2004 and 2014, fish pond area and the number of fish farmers increased by 30.4 percent and 63 percent respectively, while fish production increased by 117.4 percent in the same period (ibid). This impressive success in aquaculture was mainly driven by the private sector. The number of wholesale markets, feed dealers, and fish traders have more than doubled and capital intensity in the sector has increased substantially in the same period. Expansion of the rural road network, rising affordability, and access to new technology have been the crucial factors for sustained high inland aquaculture growth. The domestic market has been the main trigger behind aquaculture transformation in Bangladesh as over 90 percent of farmed fish (excluding shrimp) are sold on the domestic market.

Commercial shrimp production was scaled up considerably as well generating the third highest export earnings after the textile sector and the leather sector. Some species of shrimp and prawn with higher commercial values were adopted. Growth-wise, the fisheries subsector performed particularly well among all subsectors (Table 2-3). Between FY05/06 and FY17/18, annual production of inland aquaculture grew at 8.1 percent due to both productivity improvements and expansion of WSA. Production growth in inland capture fishery was moderate at 2.1 percent, while growth in WSA was negative. Despite remarkable performance, sustainability of inland capture and culture fisheries is at risk due to environmental and ecosystem degradation that resulted from destructive fishing practices, overfishing of species with high commercial values and poor resource management (UNCTAD 2017). Climate change poses additional risk to the sector’s sustainability, especially for coastal aquaculture.

2.2.2 Spatial Patterns of Crop Diversification

Overall, diversification in agriculture is gradually increasing across the country with regional disparities. Local agro-ecological conditions, availability of highland lands, access to irrigation, exposure to disasters and proximity to markets jointly determine diversity in agricultural production system across the country. Area-based diversification measure, known as Simpson Index, is high among districts of Dhaka, Rajshahi, Khulna, and Rangpur divisions with urban proximity, largest highland areas and good irrigation coverage, which are critical elements for increasing cropping intensity (Figure 2-13.). Farmers in Dhaka division are also close to the largest market, the capital city, in the country. While Rangpur division has even higher availability of highlands than Rajshahi and similar (or lesser) exposure to droughts, it is less diverse compared to Rajshahi primarily due to lower irrigation coverage (32% against 90%). The degree of diversification is very low among districts in Sylhet, Mymensingh, and Barisal divisions with the largest share of lowland areas where cropping intensity is also low. Districts in the ‘haor’ belt in Sylhet and Mymensingh divisions, which grow mainly Boro rice in the winter season and remain under water for

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Table 2-3. Annual growth (%) in fisheries area, output and yield, FY05/06 and FY17/18

<table>
<thead>
<tr>
<th></th>
<th>Area</th>
<th>Production</th>
<th>Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capture</td>
<td>0.25</td>
<td>1.89</td>
<td>2.15</td>
</tr>
<tr>
<td>Culture</td>
<td>3.08</td>
<td>8.07</td>
<td>4.84</td>
</tr>
<tr>
<td>Marine</td>
<td>n.a</td>
<td>2.40</td>
<td>n.a</td>
</tr>
</tbody>
</table>

Source: Masylkanova, 2020

10 The Simpson diversification index is calculated as $\text{SID} = 1 - \sum_{i=1}^{n} P_i^2$, where $P_i$ is the proportionate area (or production value for a value-based index) of the ith crop in gross cropped area (total production value).
much of the other seasons, have shown much less diversification. The geo-spatial pattern of diversification highlights the importance of intensification for crop diversification. The share of area under rice also shows similar spatial patterns of diversification (Table A 1 in Annex).

Figure 2-13. Simpson Diversification Index by districts

The map in the right panel of Figure 2-13. presents changes in crop diversification index across the country between 2014 and 2018. Despite the short span of time, there is a sign of positive changes towards crop diversification across the country, except in select districts. Most districts have shown positive changes in crop diversification and a noticeable change is observed among coastal districts of Khulna and Barisal divisions. The increased diversification among districts in the coastal region is likely to be the outcome of rising salinity and climatic events such as tropical cycles ‘Sidr’ and ‘Aila’ which forced farmers in the area to gradually diversify towards more saline-tolerant varieties and products for increased resilience.
2.2.3 Diversification at Household Level and Price Volatility

Regional diversity is also reflected in household data for diversification. The study looked at the diversification patterns with household survey data using Household Income and Expenditure Survey 2016 of Bangladesh Bureau of Statistics (BBS). This allows looking at the diversification at household level and how the level of diversification is associated with farm size, access to markets, inputs use, etc. Expectedly, the level diversification observed at household level, also measured by Simpson Diversification Index, is lower than what is observed from district level data on land use for different crops. For instance, the average for the Simpson Index of diversification at aggregate level in 2018 is 0.46, while the average is just 0.23 at household level in 2016. However, the spatial patterns of diversification is similar in both measures-households in Dhaka, Khulna, and Rajshahi divisions demonstrate higher level of diversification compared to households in other districts (Figure 2-14.). Expectedly, diversity in production is higher among large farmers as they have more scope to spare land towards non-paddy crops.

Households with larger farm sizes are more associated with diversified production behaviors. Similar diversification pattern is observed both spatially and by farm size when the proportion of farm households growing only rice is considered (Figure 2-15.). The proportion of farmers growing only rice is high among small and medium farm households compared to large farm households as the share of subsistence farmers is high among smaller farm households.

![Figure 2-14. Simpson Diversity Index by Household Data](source: Hoque and Ahmed, 2020)

![Figure 2-15. Proportion of Farm Households Growing Only Rice](source: Hoque and Ahmed, 2020)
Access to markets is also key to agricultural diversification. Farm households with market exposure, as measured by the accessed markets to sell their agricultural produce, are generally more diversified than the farm households that did not sell their products in markets (Figure 2-16. Error! Reference source not found.). This pattern is more prominent in Dhaka and Khulna divisions. Regression results presented in Annex Table A 3 also suggests that access to markets along with transportation, agricultural machineries, hired labor, and agricultural credits are significantly associated with the crop diversification level of farm households.

Overall the low level of diversification and the excessive concentration in rice production seems linked with the risk exposure of farm households to price variability\textsuperscript{11}. The production of rice and wheat carries much lower price risks than other high-value agricultural commodities as the price volatilities for cereals are much lower than those of non-cereal agricultural commodities (Figure 2-17.). Both time-related price volatilities and spatial price volatilities are higher for non-cereal agricultural commodities. One key driver, among others, behind the more stable cereal prices is strong public policy support in the form of inputs support, procurement support, and research & development to ensure food security. Such policy support towards growing cereals creates a bias against the production of non-cereal commodities and farmers continue to grow cereals due to low risk involved with it, despite lower gross margins compared to other agricultural commodities.

\textsuperscript{11} The price volatility of selected agricultural commodities is assessed both at the spatial level of administrative divisions as well as at the national level as a time-series. The former exploits variation in monthly wholesale crop prices within a division and thus gives a cross-section picture of the pattern of volatility. The later measure is constructed exploiting the variation in crop prices across geographical locations within a month-year, which would reveal how the prices of a specific commodity have changed overtime. To calculate volatility, the measure of Coefficient of Variation (CV) is used.
2.3 Potential and Scope of Agricultural Diversification

As it has been demonstrated in preceding sub-sections, the agriculture sector in Bangladesh has been rather static with limited diversification to high-value products, with the notable exception of the fisheries subsector, despite the need to meet new demands imposed on the sector by shifts in consumer preferences. With a population in excess of 165 million people with rapidly growing household incomes and increased health consciousness by consumers, there is a rapidly expanding local market for fruits, vegetables, proteins, and processed foods (Dizon, et al., 2019). These consumers also require higher level of food quality, safety and hygiene and hence there is need for modernization along the agri-food supply chains. The recent EAT-Lancet global report further elevates the radical transformation needed in the agri-food sector to deliver healthier and sustainable diets at the global level (Willet et al., 2019). In contrary, current agriculture systems, except aquaculture, are predominantly subsistent and are yet to rise to this diversification challenge.

There are some structural advantages in the country that could be leveraged to boost diversification. First, the existing irrigation infrastructure can be reoriented to support other crop needs. More than 80 percent of agricultural land has access to water for irrigation on the edge of the fields (Gautam and Faruqee, 2016). This is especially useful during the dry season and for other crops such as fruits and vegetables that are sensitive to water levels. Evidence in earlier section demonstrated that farms with irrigation access are more diversified. Second, an increasingly educated and innovative population provides the opportunity for entrepreneurism vital to the modernization of the agri-food sector. It also makes the introduction of new technologies, especially off the farm, easier and more sustainable. Bangladesh has a very dynamic countryside with many small businesses emerging.

However, productive diversification in agriculture requires a better understanding of market opportunities, natural resources and agroclimatic conditions, and an enabling policy framework to mobilize farmers and private sector along the agri-food value-chain.

2.3.1 Perceived Market Opportunities

Domestic market

With rapid urbanization and fast income growth, dietary patterns are changing in Bangladesh. Dizon et al. (2019) have shown that the consumption patterns in Bangladesh have been changing fast since 2000, partly due to increased purchasing power and partly due to improved awareness for nutritious food, and have highlighted the need for transformation in the agri-food system to ensure supply of more diverse, nutritious, and safer foods to the increasingly urbanized population. Average cereal intake is declining fast and the demand for nutrient-dense foods is growing. Since 2000, average daily rice intake per-person has declined by 20 percent—from 459 grams in 2000 to 367 grams in 2016 (Figure 2-18.). In contrast, consumption of vegetables, fruits, fish,
meat, onion, and eggs increased considerably over the same period. Yet, the present daily rice intake, which may be underestimated according to some studies (MOF 2012; Yunus et al. 2019). Also, the expenditure shares of non-cereals food groups (e.g. meat, milk, egg, fish, oils, etc.) went up noticeably since 2000. Cereals’ share in total food spending went down from 41.9% in 2000 to 29.2 percent in 2016 (Dizon et al., 2019).

It is expected that the daily rice intake will decline further, while the demand for high-value agricultural goods will rise in the coming years. A projection of increased demand for food commodities shows that total demand for eggs, fruits, meat and fish will grow by more than 50 percent by 2030 compared to current levels (Figure 2-19). At the same time, if the current declining trend of rice consumption continues, total consumption of rice will decline by 9 percent by 2030.

While Bangladesh meets current domestic demand for most food items locally, the country relies on imports for some key agricultural goods (Figure 2-20). A few selected items are responsible for most of the country’s agricultural imports, with 60% of Bangladesh’s imports composed of cooking oils, cereals and sugars (Error! Reference source not found. Figure 2-21 Error! Reference source not found. and Figure 2-22).
Bangladesh’s trade deficit in agricultural products has been widening, with a three-fold increase in imports combined with a slight decrease in exports over the past ten years. In 2017, Bangladesh had a total export of agricultural goods of US$0.9 Billion and imports of US$10.7 Billion, leading to a negative trade balance of -US$9.8 Billion (Figure 2-23.). Bangladesh imports have multiplied by 3 in the past 10 years, while exports have decreased by 9 percent (Figure 2-24.). The overall decline in food exports was caused by fish exports dropping from US$ 631 to 496 million. All food exports excluding fish grew from US$334 to 383 million over the same period.
Figure 2-23. Trade balance of agricultural products (US$ Billion), 1961-2017

Source: FAOSTAT

Figure 2-24. Import and export of agricultural goods (US$ Million), 2007-2017

Source: FAOSTAT
Export markets

Despite various export promotion policies to promote agricultural exports, they account for a low share of the country’s total exports. In 2018, over 90 percent of Bangladesh’s US$40.5 billion exports were, were ready-made garments (RMG). In contrast, the main agricultural-related exports were very small; frozen foods (US$500 million, 1.3 percent), agricultural products (909 million, 2 percent), leather and leather products (US$1020 million, 3 percent) and jute and jute goods (US$816 million, 2 percent) (Figure 2-25.).

Source: Export Promotion Bureau, 2020

More than 50% of Bangladesh’s food exports consist of fish and crustaceans, whether live, frozen or prepared (Figure 2-26. And Figure 2-27).

Source: FAOSTAT

Figure 2-25. Exports in 2017-18

Figure 2-26. Percent of export value by category (of total average export value of US$0.9 Billion, 2015-2018)

Figure 2-27. Top 20 products representing 88% of agri-food exports, 2015-2018.

Source: FAOSTAT
Shrimp is the second largest export product in the country and the shrimp exports reached their peak in terms of volume at 96,500 tons in FY11/12 gradually declining to 68,300 tons in FY16/17, mainly due to poor compliance with international food safety and quality standards (Figure 2-28.). The shrimp export industry has suffered from periodic bans and high incidences of alerts for Bangladesh imports (UNCTAD 2017). Despite government efforts in promoting Better Management Practices (BMP) and Good Agriculture Practices (GAP), raising awareness on international standards and HACPP, and food safety infrastructure (FAO 2016), compliance monitoring and enforcement need improvement.

Exports of horticulture products have also suffered from a lack of compliance with international food safety and quality standards, as illustrated by rejections from the EU and the US (WB 2014). In addition, government efforts toward addressing food safety and quality issues have been less pronounced for horticulture exports (UNCTAD 2017). World Bank, 2016 World Bank, 2018). Exports of horticulture products have also suffered from lack of compliance with international food safety and quality standards, as illustrated by rejections from the EU and the US (WB 2014). In addition, government efforts toward addressing food safety and quality issues have been less pronounced for horticulture exports (UNCTAD 2017). World Bank, 2016 World Bank, 2018).

Besides challenges to meet safety and quality standards required by export markets, a key impediment to Bangladesh’s export potential is that its productivity lags that of regional peers for most subsectors, thereby impacting its cost competitiveness. As shown in the figure below, over the past twenty years, yield growths have taken place across all key crops except for areca nuts. Animal items have however seen yield stagnation or declines, with eggs as an exception. However, on average, Bangladesh yields perform below regional and world averages, with the exception of rice paddy and mangoes, mangosteens, and guavas. Overall, Bangladesh underperforms in most animal items (Table 2-4).12 As discussed in Chapter 3, the lack of on-farm productivity competitiveness is further compounded by constraints affecting the off-farm cost structure such as high logistics and energy costs.

12 Yields were unavailable for aquaculture.
Figure 2-29. Yield evolution for selected products, in MT/Hectare or Kg/Animal, 1998-2017

Source: FAOSTAT
According to the International Trade Center methodology to assess untapped export potential for a country’s different sectors and subsectors, the main food and non-food subsectors with export potential are frozen shrimps and prawns, jute, and hides and skins (Figure 2-30. Export potential value (US$ Million)).

**Figure 2-30. Export potential value (US$ Million)**

Source: International Trade Centre (ITC)
However, in the short-run, diversification strategies appear to have greater potential focusing on the growing domestic market, while improving on-farm productivity and off-farm cost competitiveness and building strong compliance capacity for food safety and quality standards will be required to unlock export potentials, especially toward regional markets.

2.3.2 Diversification Potential at Farm Level

Bangladeshi farmers rely on paddy production, while experiencing very low margins for paddy production compared to assessed margins for other crops. In fact, farmers appear to have experienced losses in Boro production in recent years due to a persistent increase in agricultural wages in response to agricultural labor shortages in rural areas. A field survey estimated and compared gross margins for crops including rice, maize, soybean, gourd, potatoes, tomatoes and mango. The choice of these crops was careful to include a field crop, legume, and a horticultural crop (Table 2). This was undertaken to provide a broad indication of how potential diversification options compare with rice. As with any gross margin analysis, costs and yields will vary considerably depending on the farmer’s technical and managerial skills as well as the geographic location of the farm. This analysis demonstrates the broad sense of the opportunities for diversification and how the margins from alternative commodities compare with Boro and other rice crops. It confirms that many crops offer farmers an opportunity for higher margins than rice and it can be assumed to be the reason that many farmers are gradually diversifying towards non-paddy crops.

Table 2. Projected Gross Margins for rice and selected other crops in Bangladesh (US$/ha)

<table>
<thead>
<tr>
<th></th>
<th>Rice</th>
<th>Livestock feed crops</th>
<th>Vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boro</td>
<td>Aman</td>
<td>Aus</td>
</tr>
<tr>
<td>Yield (kg/ha)</td>
<td>4,000</td>
<td>3,200</td>
<td>3,000</td>
</tr>
<tr>
<td>Price (US$/kg)</td>
<td>0.16</td>
<td>0.21</td>
<td>0.21</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>659</td>
<td>678</td>
<td>635</td>
</tr>
<tr>
<td>Costs (US$/ha)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>41</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>89</td>
<td>59</td>
<td>53</td>
</tr>
<tr>
<td>Pesticide</td>
<td>47</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Machine hire</td>
<td>96</td>
<td>82</td>
<td>71</td>
</tr>
<tr>
<td>Irrigation</td>
<td>118</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other costs</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Labour - hired</td>
<td>282</td>
<td>282</td>
<td>259</td>
</tr>
<tr>
<td>Labour - family</td>
<td>56</td>
<td>75</td>
<td>56</td>
</tr>
<tr>
<td>Total costs</td>
<td>730</td>
<td>564</td>
<td>509</td>
</tr>
<tr>
<td>GROSS MARGIN</td>
<td>(71)</td>
<td>114</td>
<td>126</td>
</tr>
</tbody>
</table>

Source: Sergeant and Graffham, 2020
Potential gross margins are clearly not the only driver for farmers’ cropping choices, with issues of risk, including home food security, soils and climate, market access, level of investment and technical skills needed playing a part in the decision making. As the analysis clearly shows, the average margins associated with rice are slim, especially Boro, which the projections show as having negative margins. This finding is supported by Bangladesh Rice Research Institute (BRRI) data presented in a USDA Gain report,\(^\text{13}\) which shows that a farmer loses BDT1.2/kg on Boro rice (2017/18 data). This is further confirmed by a number of newspaper articles published in May 2019 that show farmers burning their rice crops in protest against the low, unprofitable, market prices. Despite these negative gross margin projections, the majority farmers were still planting Boro season rice for the 2019/2020 Boro season in the hope that prices would improve. Rice is a crop that they understand how to grow well, is worth more to the farmer for their own use than if sold on the open market and carries less risk (as indicated above). Alternatives also need higher levels of management skills and technology.

2.3.3 Agro-Ecology and Diversification Potentials

While potential for diversification through expansion is limited,\(^\text{14}\) diversification could be achieved through intensification of production and crop substitution. Intensification could be potentially increased in almost all divisions except Rajshahi with adequate investments and support. Potential investments will require substantial investments including in agricultural extension and research, irrigation and drainage, flood protection, soil management, and market access. However, declining groundwater availability is affecting pumping costs as well as availability of irrigation water in the northwest and in Dhaka. Diversification through Crop substitution can be achieved through closing the current yield gap. According to various studies, the gaps between agronomic potential yield obtained in research fields and farm fields are considerable ranging from 25 percent for Boro and 75 percent for Aus and Aman paddy (Gautam and Faruqee, 2016; BARI, 2016). A shift from Boro paddy to other non-paddy crops would address groundwater depletion in addition to water pollution issues. The government started promoting shift from Boro paddy to two kharif paddy cultivations of shorter duration and increased production of less water consuming pulses and oil crops under its import substitution policy.

Diversification potential in agriculture is considerable across all farming systems. Masylkanova (2020) highlights following diversification options for different farming systems. In the rice-based farming system, in lowlands there is great potential for expansion of vegetables, spices and oil crops in winter season, except in perennial wetlands. Whereas in some wetlands that are increasingly shrinking, possibilities exist for expansion of non-paddy crops. In higher elevation parts, both kharif and winter vegetables, spices and potato could be expanded. Sources of diversification in this system could include intensification, which is currently slightly below the national average, crop substitution and possibly expansion particularly in wetlands. The livestock subsector appears to have potential for vertical diversification. Diversification potential exists in shrimp farming which would, if adopted, strengthen sustainability of the industry and ecosystem.


\(^{14}\)Only possibility could be bringing back current cultivable wastelands of around 232,800 ha (largely charlands), if technically possible.
3 Agricultural Diversification and Modernization: Challenges and Opportunities

Many economies have realized agricultural transformation while others have delayed or stagnated. Systematically and strategically addressing critical sector and cross-sector constraints determines success of the diversification strategy. Bangladesh faces several agriculture ecosystem constraints but also opportunities at varying degrees. This chapter presents the ecosystem elements focusing on production factors, support services and business climate. Analyzing the push and pull constraints to competitiveness and productivity and hence agricultural diversification.

The agri-food sector in Bangladesh is characterized by a very strong focus on rice paddy production, low on-farm productivity compared to peers - with the notable exception of higher yields for rice paddy and a few other crops -, and limited food exports. The following chapter will attempt to identify the main constraints preventing greater competitiveness of the agri-food sector—via greater on-farm productivity, greater value addition and better connection of value chain actors to markets—on both domestic and export markets by analyzing the performance of the main components of the agri-food ecosystem: i) the agri-food value chain, ii) support services, and iii) the business climate as it related to the agri-food sector.

To identify and prioritize key policy and logistic bottlenecks along the main components of the agri-food system, the study organized a series of consultations with public and private actors along the value chain of each of the three subsectors covered in Chapter 4 including traders, large agro-processors, other agri-food related small and medium enterprises (SMEs), service providers, business organizations, financial institutions, farmers, policy-makers, research institutions, and development partners. In the consultations, separate sessions were organized on agricultural diversification, mechanization, agro-processing, agricultural marketing and trade, and food-safety and quality standards. Participants engaged in identification and prioritization of key binding constraints preventing production diversification and post-harvest value-addition. They also discussed and prioritized solution areas to address the bottlenecks to improve post-harvest value-addition.

Agribusinesses, along with other public and private participants, identified some key bottlenecks along the agri-food value chain, which included limited access to finance, weak food quality and safety standards, poor marketing and logistic infrastructures (such as cool chains, cold storage), costly logistic services, lack of good agricultural practices among farmers, and lack of quality and modern seed varieties, among others. Participants also highlighted some potential solution areas to address these bottlenecks. This chapter discusses these issues and solutions along with findings from relevant data analyses and a review of existing literature and government policies.
### 3.1 Performance of Agri-Food Value Chain

The agri-food value chain is characterized by the uneven performance of its different nodes and by the need to improve market linkages between these nodes.

![Figure 3-1. The agri-food value chain](image)

**Research & Development and extension services:** The country has a strong agricultural research and extension base, particularly for paddy, which has brought the country into the status of near self-sufficiency in rice. The Agriculture Science and Technology Indicators (ASTI) reports that Bangladesh’s agriculture research expenditure is about 0.35 percent of GDP which is above the spending shares of India, Pakistan, Cambodia, and Viet Nam, but below the shares of China, Malaysia, and Sri Lanka (FAO, 2020). However, the share of agricultural researchers engaged in horticulture research is one of the lowest in the region. While past focus of R&D on food security has served well and produced good results in rice yields, there is a need to broaden the focus towards non-rice and non-crop agriculture where substantial yield gaps exist in almost all non-paddy crops.

Government through the research institutes and universities plays a vital role in determining the focus of the research agenda and setting research priorities for the sector. Greater coordination between private and public sector agencies would help inform the choice of these priorities. This is already being done to some extent via organizations such as the Krishi Gobeshona Foundation that provides a platform for coordination and information sharing on climate change.

The enabling environment could also be made more conducive to private sector research. Certification of technology takes around two years and the weak business environment for seed development is reflected in poor EBA score (18.5 out of 100, while the average of South Asia is above 50) of the country on supplying seed (World Bank, 2019b). Certain regulatory barriers remain preventing the acceleration of private sector participation in R&D for non-rice and non-crop agriculture to develop varieties and agricultural technologies that are tailor made for conditions in Bangladesh.

Another challenge is the ability to transfer the outcomes of agriculture research to farmers. Agriculture in Bangladesh is dominated by smallholder farmers, with some 60 million people operating 12 million farms

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15 The ASTI database includes Bangladesh, Cambodia, China, India, Lao PDR, Malaysia, Nepal, Pakistan, Sri Lanka, and Vietnam from the Asia-Pacific Region.
16 See analysis of the Business climate as it relates to the agri-food sector in Section 3.4 below.
of <0.69ha and approximately 5 million people living on farms with areas ranging from 0.69-3.0ha in size\textsuperscript{17}. In 2019 the official literacy rate for rural areas was 67 percent. In practice the literacy rates for male farmers ranges between 25-30 percent, the rate of illiteracy is higher for female farmers especially for growers above 60 years of age where literacy can be as low as 1 percent. In the medium-term improvements to education in rural areas will be an essential feature of any program to modernize and make agriculture more sophisticated and efficient.

In the shorter-term, improvements to extension are required in order to get information on new techniques down to farm level in a usable form. Part of the challenge is literacy. The other challenge is how best to get information out to around 15 million farms scattered across the country. The current DAE system is lacking resources to meet the challenge and current extension techniques and materials need improvement. Improved support for DAE extension staff is notably required with regards to updating agricultural knowledge and techniques for training. More support is needed for private sector-led training programs (e.g. PRAN), with a need for closer integration between DAE and the private sector to maximize efficiency of use of available resources, including support to private operators who routinely provide extension advice to farmers, like input suppliers, but who also need to be trained themselves.

Some innovations have already taken place along the agri-food value chain. Rapid uptake of plastic crates in place of woven baskets and jute sacks to handle high-value products such as mango reduces post-harvest losses. PRAN, a leading agro-processor in the country, provides advice and extension services to growers on good agricultural practices including quality and safety requirements. The company has also introduced a traceability system by labelling all crates with the growers’ name, which provides a trace back to a group of 15-25 growers via a unique reference code in the event of a quality or food safety problem. Innovations in service delivery have also been observed in some cases. For example, custom-hiring services of agricultural machineries helped rapid expansion of agricultural mechanization in the country.

**Input and Factor Supply and Access:**

- **Land**

Around 85 percent of farm households operate less than 1.01 ha which are highly fragmented\textsuperscript{18}. The country has around 7.9 million ha of net cultivated area (NCA), including wetlands and excluding cultivable wastelands (Table 3-1). Gross cultivated area (GCA) is approximately 15.5 million ha. The national average cropping intensity is 195 percent, but it ranges from 152 percent in hilly areas in the east to 220 percent in the northwest highlands.

\textsuperscript{17} FAO (2015)

\textsuperscript{18} FAO defines smallholder farm sizes at 2.0 ha or less. In Bangladesh, farms are grouped in three categories: (a) small farms are those with landholdings of below 1.01 ha; (b) medium farms are with landholding between 1.01 ha and 3.03 ha; and (c) large farms with landholdings of 3.04 ha and above.
Being one of the largest deltas in the world, Bangladesh has highly fertile soil and climate with multiple cropping opportunities for both tropical and temperate crops (BPC, 2018; Nasim et al 2017). Diversity in physiography, soil quality, climate and land level in relation to flooding is very high forming 30 agro-climatic zones. Around 71 percent of national cultivable lands are located in highland and medium highlands and remaining 21 percent of cultivable lands are located in different lowland categories (BBS 2017). However, over 80 percent of the land area in Bangladesh is a floodplain, crisscrossed by more than 450 rivers. As a result, agricultural lands are prone to flooding, droughts, cyclones, and tidal surges annually. Anticipated flood level and duration and elevation of farmland in relation to flooding guide farmers’ choices for cropping patterns.

Some farmers may have the opportunity to expand production by renting land from the few large landowners who may have scattered parcels around several villages. However, leasing agreements are normally for one to three years. Limited tenure thus discourages long-term investments in new production technologies and can even limit farmers from practicing proper rotations.

- **Water**

High rainfall during the monsoon season, combined with full-flowing rivers typically leads to extensive inundation of the floodplain, a situation which is exacerbated by slow impeded drainage. Around 22 percent of the country is inundated annually during normal flooding to depths ranging from 0.3 to 2 meters. Whereas severe floods affect up to 80 percent of the country. This creates both opportunities and risks - opportunity for crop and aquaculture production, but considerable risks from deep flooding, erosion and drainage problems. In a stark contrast, in the post-monsoon period, surface water availability is significantly constrained and this, combined with the erratic pre-monsoon rainfall, can cause serious

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19 Land levels are broadly grouped into: highland (above the normal flood level), medium highland (normally flooded to a depth of up to 90 centimeters during the flood season), medium lowland (normally flooded 90–180 cm), lowland (normally flooded 180–300 cm), very lowland (normally flooded deeper than 300 cm) and bottomland (wet throughout the year).
soil moisture deficits, which must be addressed through irrigation. Under these conditions, flood control and drainage are critical to agricultural production in the monsoon and post-monsoon seasons, while irrigation is vital to addressing water deficits in the pre-and post-monsoon season as well as during monsoon season in drought prone highlands.

Over 95 percent of 7.6 million ha of irrigated lands are irrigated with tube wells and power pumps\(^\text{20}\) (Table 3-2). However, the irrigation coverage is very low in hilly and highland divisions. Groundwater accounts for 75 percent of irrigation, while remaining 25 percent comes from surface water pumped from canals and rivers using small low-lift pumps (FAO 2013).

Groundwater storage is declining rapidly due to expansion of boro paddy. One study estimated 32 percent decline in the groundwater storage between 2003 and 2013 (Khaki et al 2018). Whereas, several districts in the northwest and Dhaka city reached critical points for groundwater depletion (ibid; BPC, 2018). To address this issue, the government started promoting shift from Boro paddy to two kharif paddy cultivations of shorter duration and increased production of less water consuming pulses and oil crops under its import substitution policy.

Diversification towards non-paddy crops, especially high value vegetables and fruits, requires better flood, water and drainage control by farmers. Between June and September, when about ninety percent of rainfall takes place, farmers need drainage. In low-lying areas production of non-paddy crops is difficult even with a good drainage. In higher elevation areas, there is a need for improved flood protection structures. In non-monsoon seasons, farmers need reliable and sufficient irrigated water supply. Existing small-scale pump irrigation can technically support required water control. Declining groundwater availability is affecting pumping costs as well as availability of irrigation water in the northwest and in Dhaka. A shift from Boro paddy to other non-paddy crops would address groundwater depletion in addition to water pollution issues

\* Labor

Crop diversification and the use of agricultural labor are strongly associated (Hoque and Ahmed 2020). While agriculture accounts for most of the rural employment, seasonal agricultural labor shortage is growing. Due to high migration from rural areas to both domestic cities and abroad, the rural labor market is continuously squeezing and thus, agricultural wage is rising faster than the general wage rate (Figure 3-3). Moreover, women are increasingly engaging in agricultural activities. The number of women engaged in agriculture increased by 45 percent in the last 10 years – from 7.7 million in 2005-06 to 11.2 million in 2015-16 (Error! Reference source not found.). Also, the share of women worker in agricultural employment has increased from 34 percent in 2005-06 to 44.1 percent in 2015-16. This trend is often identified as ‘feminization of agriculture’. Such compositional transition in agricultural workforce implies

\(^{20}\) Pumping using electricity or solar power (not diesel)
the need for agricultural diversification and modernization for better productivity and income opportunities for women in agriculture.

**Figure 3-2. Share of Female Agricultural Workers**

<table>
<thead>
<tr>
<th>Year</th>
<th>Employment (millions)</th>
<th>Employment share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-06</td>
<td>7.7</td>
<td>68.8</td>
</tr>
<tr>
<td>2010</td>
<td>10.5</td>
<td>64.1</td>
</tr>
<tr>
<td>2015-16</td>
<td>31.2</td>
<td>63.1</td>
</tr>
</tbody>
</table>

Source: Labor Force Surveys, BBS.

**Figure 3-3. Real wage Index (Base: 1969-70=100)**

Source: Bangladesh Economic Review, 2019

- **Agricultural mechanization**

Bangladesh is one of the most mechanized agricultural economies in South Asia (FAO 2013). Current mechanization rates for major operations are on par with highly mechanized countries in East Asia (Figure 3-4.). The country’s success with rapid and scalable mechanization was achieved through favorable policies that enabled the private sector to lead the service market development (CYMMIT 2012; FAO 2013; Diao et al 2014; Kennedy, 2018). The main policy actions were the elimination of import duties on most machines, shifting preferences from expensive high-quality machinery to more affordable machinery of ‘good enough’
quality, and provision of subsidies to support private players in manufacturing, and mechanization service providers (ibid).

Today over 80 percent of land preparation and primary tillage operations are mechanized through two wheel tractors (2WT) (Table 3-3. Status of farm mechanization (%)). Around 60 percent of agricultural land is irrigated by over 1 million small diesel -powered pump-sets (FAO 2013). Spraying and broadcaster and threshing operations are also widespread. Gaps exist, however, in mechanization of seed establishment, crop protection, irrigation (particularly high efficiency irrigation technologies) and harvesting operations. These operations can easily be mechanized through attachments to existing tractors (FAO 2019). Mechanization of harvesting through combine harvesters is expensive and its cost is justified in large scale grain farming where economies of scale can be achieved. Whereas, while technically and financially cost effective, mechanization of crop establishment and harvesting through attachments did not scale up for multiple reasons.

Among them, the government policy, which follows dual objectives that are to increase farm mechanization as well as support the local manufacturing sector, was the main factor. To achieve the first objective, the policy facilitates mechanization through provision of subsidies and loans and elimination of trade barriers and tax exemptions for machinery. To achieve the second objective, the policy imposes trade barriers for imports of spare parts (e.g. 40-50% import taxes). The policy was successful in local manufacturing of tools such as threshers, sprayers and broadcasters due to their simpler designs to replicate and availability of required materials locally and at affordable costs (CYMMIT 2019, FAO 2019).

However, local manufacturers lacked skills, knowledge and technology to design and produce more sophisticated seeder and reaper attachments of required accuracy and costs (CYMMIT 2012). Moreover, past policies and programs were primarily “technical’ with limited focus on raising farmers awareness on agricultural machineries; developing operational and maintenance skills and knowledge; and marketing aspects. Operation of seeders, for instance, is knowledge intensive and requires extensive training. However, farmers and service providers were provided with short term on the job training. Similarly, repair and maintenance skills were not adequately covered.

Complete mechanization of farming operations would facilitate diversification by increasing cropping intensity as well as increasing paddy productivity, which would be critical for releasing paddy

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Land preparation</td>
<td>80%</td>
<td>98%</td>
</tr>
<tr>
<td>Crop establishment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transplanting/seed</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Broadcasting</td>
<td>1%</td>
<td>n.a</td>
</tr>
<tr>
<td>Crop care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprayer</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>Broadcaster</td>
<td>95%</td>
<td>n.a</td>
</tr>
<tr>
<td>Water pump</td>
<td>85%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Weeding</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Harvesting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutting</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Threshing</td>
<td>75%</td>
<td>80%</td>
</tr>
<tr>
<td>Cleaning</td>
<td>5%</td>
<td>18%</td>
</tr>
<tr>
<td>Combine harvesting</td>
<td>&lt;1%</td>
<td>15%</td>
</tr>
<tr>
<td>Drying</td>
<td>&lt;1%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Source: Masylkanova, 2020

Figure 3-5. Access to Agricultural Machinery and Diversity Index

Source: Hoque and Ahmed, 2020
lands (FAO 2019). In Boro season, for instance, direct planters, which does not require removal of paddy straws, would reduce planting time almost by 15 days. In kharif season, multipurpose seeders and reapers would decrease land preparation, seeding and harvesting timespan whereby allowing production of two kharif crops of shorter duration and additional crops in Boro or spring seasons. Evidence also suggests access to agricultural machineries helps marginal and small farmers in terms of diversification (Figure 3-5.).

Furthermore, there is also scope for expansion of mechanization for crop establishment, harvesting and post-harvest operations in horticulture crops. In potato, for instance, planting and harvesting are currently largely manual. Mechanization of post-harvest operations for most of horticulture crops is also limited.

- **Fertilizer and Pesticides**

Farmers have very good access to fertilizers at affordable prices and over 95 percent of farmers use them. However, unbalanced use and overuse of fertilizers is widespread due to combination of a lack of incentive for efficient uses, a lack of knowledge and the reliance on traders’ recommendation on fertilizer dosages (Gautam and Faruqee, 2016). Integrated pest management is rarely practiced at present. Excessive use of fertilizer is common in all crops and fruits (PRAN 2019). For example, PRAN, one of the largest food processing and export companies in the country, outsources production of mung bean, tomato, mango, cassava, chili, banana, and pineapple through contract farming arrangements. In its contracts, the company introduced GAP and integrated pest management practices. While the rejection rate of produce reduced considerably since adoption of GAP, it is still around 10 percent and primarily due to excessive use of chemicals followed by poor post-harvest management practices and adulteration with poor quality crops (ibid).

Overall, fertilizer use has increased steadily over the past three decades. From 2003 to 2016, fertilizer consumption jumped from 160 to 289 kg per hectare of arable land. This compares with a South Asia average of 160 kg in 2016 (166 kg for India and 144kg for Pakistan). Significant subsidies dedicated to fertilizer use explain these high consumption rates. The strong focus of past policies on nitrogenous fertilizers led to an imbalance in the use of nitrogen relative to other nutrients. Subsidies were increased for potassium and phosphorous macronutrients in recent years to address concerns about resource degradation resulting from an overuse of nitrogen. Evidence suggests that almost half of the farmers are overusing fertilizer with apparently no additional output. Conversely, the overuse of fertilizer could have negative environmental, health and even farm productivity consequences through resource degradation (Gautam and Faruqee, 2016).

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21 Data.worldbank.org
• Seeds

There is a substantial shortage in supply of quality seeds for all crops. The total demand for seeds for all crops is 932,250 tons, but, the formal seeds sector supplies only 20 percent. Remaining share is covered by farmers’ own seeds (88%) and smuggled seeds from India (12%) (BPC, 2018; USAD 2014; BRAC, 2019; and LTS, 2019). Supply gaps for formal seeds vary from crop to crop. For example, current supply of potato seeds is 60 tons against estimated demand of 300,000 tons (BRAC, 2019). For most of the crops, the seed deficits are not caused by limited production capacity but rather dissemination constraints. In potato seed supply chain, for instance, current basic infrastructure (road, electricity) and logistics system do not allow timely dissemination of seeds (Box 3).

Contrarily, horticulture seed supply is controlled in response to actual demands mainly due to farmers’ limited access to finance and insurance products, extension, and markets (LTS, 2019).

At present, both public and private sectors are active in the seed industry. Public seed sector’s focus is on notified crops, whereas, private sector covers above 90 percent of hybrid seeds of two notified crops (paddy and maize) and improved and hybrid varieties of vegetables (54%), pulses and legumes (USAID, 2014). As of 2013, there were around 200 seed companies with 17,000 registered and 50,000 mobile seed vendors with market value of over US$125 million. Most of these companies enjoy good access to international seed technologies through partnership with major international seed companies and seed exports/imports. However, only two companies -BRAC and Lal Teer Seed (LTS) - have complete seed value chains from research and breeding to extension. Private companies formed the Bangladesh Seed Association (BSA) through which they collaborate with the government on seed policy and regulations.

Current regulations are largely favorable for the private sector’s participation in the seed industry. These include regulations that: (i) permit marketing of seeds for non-notified crops as truthfully labelled seed and (ii) require basic compliance with the Bangladeshi quality standards and phytosanitary requirements to import seeds (USAID, 2014). At the same time, the private seed sector is prohibited from breeding and producing seeds for notified crops except paddy (Gautam and Faruqee, 2016; USAID, 2014). Another issue is the lack of a seed quality control mechanism. At present, seed quality is expected to be maintained through market competition. However, the seed market is supplied also with low quality seeds at lower prices whereby increasing farmers’ mistrust toward certified seeds (BRAC, 2019; LTS, 2019).

Box 3. Potato seed supply

Private sector plays an important role in potato seed value chain from research and breeding to distribution and extension. Current national demand for potato seeds is around 300,000 tons, while 60 tons of seeds are supplied. Private seed companies have sufficient production capacity to meet demand. However, seed storage and dissemination are constrained by inadequate electricity supply, ineffective logistics services and weak transport infrastructure. BRAC, which is the lead potato seed company in the country, rents 20 out of total 72 cold storage units in the country to spread the risk of storage losses due to electricity blackouts. Moreover, potato seeds require pre-heating and fanning prior to release from storage. Under Bangladesh’s climate conditions, the timeframe between the release and seedling is 72 hours. However, existing road conditions and lack of refrigerated trucks make maintaining this timeframe difficult. According to BRAC, under current conditions, serving remote districts in the south and east is impossible. Source: BRAC 2019
Based on the above, removing the regulation preventing private sector actors from breeding and producing seeds for notified crops, increasing public, private coordination on quality seed supply for notified crops, and increasing market transparency regarding the quality and effectiveness of seeds in the market are some of the measures that could contribute to improving the access and use of quality seeds.

**Production & Post-production:**

Overall, the production node of the value chain is faced with low yields (except for paddy rice and a few other products), while enjoying good connections with the market via a thriving network of traders.²²

Many factors contribute to these productivity challenges. As seen from the analysis of the Research & Development and Input Supply nodes of the chain, farmers tend to have limited access to certain key inputs (e.g. seeds, labor) or to make improper use of them (e.g. overuse of fertilizer). Extension services are inadequate to support widespread adoption of good agricultural practices.

The limited size of farms also prevents cost efficiencies from economies of scale. Farm incomes are very low (average $2.9/day) making investment in modernization and innovation difficult.²³ Formal aggregation mechanisms, such as cooperatives, as well as informal ones play a limited role in Bangladesh, which – when compared with other countries – creates additional challenges of reach for extension services, pooling resources for access to finance and infrastructure, as well as aggregation of products for marketing, with associated higher logistics costs and disconnection from end buyers.

The field mission did however observe instances of farmers coalescing to create some economies of scale, for example:

- Maize growing farmers in neighboring villages gained advantage by sharing their experiences and creating critical mass market-informed farmers to enable emergence of a competitive market to buy their output;
- A number of farmers on adjoining fields established nurseries to raise vegetable seedlings; this critical mass attracted buyers from all over the country. Interestingly, there appears to be little cooperation and exchange of ideas between farmers, but perhaps it created the competition to improve each other’s offerings; and
- PRAN organizes large numbers of farmers to supply them with specific raw material for their processing.

As described in the analysis of the Distribution and Marketing node of the value chain below, farmers are however well connected to markets thanks to a very active network of traders competing to source products and thereby offering competitive prices to farmers (Gautam and Faruqee, 2016). The scarcity of well-established off-takers, either processors²⁴, formal distributors²⁵ or exporters, limits however

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²² Farming models are described in greater detail in sections 1 and 2 of this report.
²³ A notable exception has been the rapid expansion in ponds for aquaculture.
²⁴ See analysis of the Processing node of the agri-food value chain below.
²⁵ See analysis of the Distribution and Marketing node of the agri-food value chain below.
knowledge transfers and limits the use of higher quality standards in the market with associated better agricultural practices on-farm and in return premia for higher quality products for farmers.

**Processing and value addition:**

While the food processing industry is still in its infancy in Bangladesh, it is starting to expand to meet local demand. Typical of a country’s agriculture that is in transition, adding value to agricultural products will become increasingly important. Currently, most food processing is targeted at the local market with some exports to neighboring countries and diaspora in the Middle East. The production of processed food products has started to grow in recent years and thus, the growth of processed food products has increased faster than the index of general industrial production (Figure 3-6.). As seen when analyzing the production node of the agri-food value chain, the number of agri-food processors remains however limited, which in turn does not provide formal off-take opportunities for farmers and which contributes to the limited focus on higher product standards along the value chain.

Indeed, the agri-food business sector in Bangladesh is dominated by micro and small businesses. Majority of agri-food enterprises engage 2 to 5 persons and about one-third of these enterprises just create jobs for one person. Only 13 thousand, out of half a million agri-food manufacturing enterprises, create jobs for more than 10 persons. Manufacturing enterprises among agri-food businesses are relatively larger in size (both in terms of employment and fixed capital) and generate more jobs compared to service enterprises among the agri-food sector (Figure 3-7). Over 85 percent of enterprises in the agri-food sector have fixed capital less than BDT500 thousands, which is less than US$ 6,000. Besides, most of the enterprises in the agri-food sector are retail businesses and over half of agri-food manufacturing enterprises are household-based enterprises.

*Figure 3-6. Index of Industrial Production*

**Distribution & Marketing:**

A main feature of the distribution and marketing node of the value chain is its informality with almost 98% of the flow of agricultural goods transiting via rural wholesale markets, larger wholesale markets around large cities and wet markets and corner shops in cities, with associated challenges of inadequate infrastructure and lack of quality and food safety standards enforcement. Other major challenges, especially for the marketing of perishable products, are improper transportation conditions and reliable access to energy (both of which are described in greater detail in the analysis of Support Services below).

Visits to major wholesale markets in Dhaka and Rangpur and rural wholesale markets in villages in North Bengal highlighted that in general transactions in domestic wet markets were reasonably efficient with many players involved and obvious and relevant roles for each player. The major weakness in the wholesale markets was physical infrastructure and facilities. Drainage, flooring and weather proofing within the markets were poor and access to roads inadequate leading to serious problems with market access and flooding during the monsoon season. Supplies of clean water for washing and freshening of produce were limited or non-existent. Such practices increase food safety risks from microbiological and chemical contaminants. There is considerable scope for improvements to the basic infrastructure of the markets, such improvements would have benefits in terms of improved consumer health, better quality of produce and reductions in losses during distribution and marketing.

Source: Economic Census, 2013. BBS.
As countries move through the transition phase towards urbanization, supermarket retailers take on a bigger role in consolidating and retailing of fresh produce and other food products. Major retailers have the resources not only to improve conditions at the point of sale but also drive improvements upstream encouraging suppliers to invest in better production, harvesting and post-harvesting handling techniques. Supermarket retailers are also more likely to invest in refrigerated transport and temperature-controlled warehouses and distribution centers.

In Bangladesh, supermarket retail is in its infancy accounting for around 1.0 percent of retail sales of fruits and vegetables. Shwapno the biggest player with 37 stores has a 48 percent share of the market for fresh fruits and vegetables sold through supermarkets but this equates to just 0.8 percent of the total market where traditional wet markets still account for 98.4 percent of sales. Shwapno’s revenues from fresh fruits and vegetables were US$117 million and profits US$18.5 million per annum. Shwapno is beginning to develop closer relationships with its growers and to try and encourage adoption of GAP and better management practices but the size of the business is still too small to support major investments within the supply chain.

Other developing countries also took long time to develop modern retail chains, and supermarkets in such countries have invested in standards and management systems to improve quality and safety primary production level and have encouraged and supported farmers to form farmer organizations to invest in better production, handling and transport technologies. Ultimately, urbanization tends to result in increased consumer demand for more convenient ways to source safer food, which leads to a shift from wet markets to more formal retail options like supermarkets. Consumer sensitization campaigns regarding risks related to the consumption of unsafe food can contribute to accelerating this shift.

3.2 Performance and Key Challenges for Support Services

Access to finance:

Despite Bangladesh’s good history in microfinance penetration and financial inclusiveness, farmers’ access to finance is constrained by a number of factors, including the lack of sufficient funds to agriculture sector (BKB, 2019); limitations in existing eligibility criteria, which require land ownership or guarantee from the landlord to use land as collateral (BKB, 2019); high risks in agriculture and consequently high interest rates; and poor diversity in financial products and services on offer that are suitable for small-scale farmers (Anderson et al 2017; BKB, 2019). Access to finance is also limited in aquaculture, almost half of fish farmers, particularly small and marginal farmers, have poor access to finance (Katalyst, 2016).

26 Shwapno annual reports.
In FY18, the Bank of Bangladesh (BB) disbursed – through the state and commercial banks and micro-financing institutions (MFI) - BDT 214 billion (equivalent to $2.5 billion) for agricultural lending (Table 3-4; BB 2019). According to the BKB’s estimates, actual demand for agricultural finance exceeds current supply by 2-3 times. Of the total agriculture portfolio, almost 85 percent was short term loans and 50 percent was for the crop subsector.

Existing financial products are limited to basic seasonal and short-term loans. Financial and technological packages such as crop and weather insurance products were piloted but with limited scaling up. Demand for such products exists especially from the private sector, as in contract farming arrangements (PRAN 2019). Crop insurance programs are currently being promoted by companies such as PRAN (ibid). Farmers, of which 77 percent report being affected by weather-related risks and 53 percent by pest and disease, recognize the importance of risk management products (Anderson et al 2017). But adoption of such products will depend on the project mix. Ward et.al. (2015), which examined farmers’ preferences for weather index insurance and drought-tolerant rice variety, found that farmers are generally unwilling to adopt the drought-tolerant variety independent from insurance largely due to a yield penalty under non-drought conditions. According to the Enabling Business of Agriculture 2019 report, there is a law regulating the operation of warehouse receipts in Bangladesh with the possibility of issuing negotiable warehouse receipts. However, this instrument allowing for the financing of agricultural goods in storage does not appear to be in practical use in the market.

Access to finance challenges also extend to non-farm actors along the agri-food value chain. According to the 2013 Economic Census and Enterprise Survey, about 99 percent of all non-farm enterprises belong to the micro and small enterprises categories. They provided employment to 20.3 million workers in 2013. MSMEs have limited access to formal finance when compared to the average for the South Asia region. The estimated financing gap amounts to about US$2.8 billion according to International Finance Corporation (IFC) calculations.27

Table 3-4. Agricultural lending (BDT billion), FY16-FY18

<table>
<thead>
<tr>
<th></th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crops loan, excluding tea</td>
<td>86.95</td>
<td>100.61</td>
<td>103.37</td>
</tr>
<tr>
<td>Irrigation equipment</td>
<td>2.60</td>
<td>3.01</td>
<td>2.74</td>
</tr>
<tr>
<td>Livestock</td>
<td>26.14</td>
<td>30.57</td>
<td>30.58</td>
</tr>
<tr>
<td>Marketing of agricultural goods</td>
<td>1.09</td>
<td>1.14</td>
<td>1.14</td>
</tr>
<tr>
<td>Fisheries</td>
<td>19.85</td>
<td>24.13</td>
<td>24.64</td>
</tr>
<tr>
<td>Poverty alleviation</td>
<td>15.59</td>
<td>18.85</td>
<td>21.50</td>
</tr>
<tr>
<td>Other agricultural activities</td>
<td>24.24</td>
<td>31.68</td>
<td>29.96</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>176.46</strong></td>
<td><strong>209.99</strong></td>
<td><strong>213.93</strong></td>
</tr>
</tbody>
</table>

Source: Masylkanova, 2020

Storage:

Existing storage infrastructure is mainly government owned. Agriculture storage units are designed for storing dry food grains and horticulture. Government-owned cold storage facilities are dedicated primarily for storing potato seeds (BRAC, 2019). There are few privately owned and managed cold storages for non-seed potato. Capacity of existing storage infrastructure is inadequate (BRAC, 2019; and LTS, 2019). Farm-level warehouses are also limited which causes most farmers to sell their products immediately after

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27 Financing Solutions For Micro, Small And Medium Enterprises In Bangladesh, World Bank, 2019.
harvest. According to a survey by BBS (2018), storage infrastructure is more important for increasing farm incomes than market location for most crops. As results presented in Error! Reference source not found. show, farm-gate prices for almost all reported crops that are not sold immediately after harvest are higher in the range of 14 percent (masur/lentil) and 32 percent (potato). Price fluctuations, largely resulting from inadequate access to market information and storage infrastructure, are a key factor behind low adoption of diversification practices (Miah and Haque 2013).

Private sector operators have established cold chain infrastructure in certain subsectors. For example, the privately-owned Bengal Meat logistics company has invested in a cold chain to transport their produce. The company delivers 2 percent of the meat sold in Dhaka. The private sector has also invested in cold stores for potatoes. Bangladesh has over 390 privately-owned cold stores and they store about 4 million ton of potatoes each year. These stores have low losses and facilitate adequate potatoes supply in the “off-season”.

Dried goods can be stored much more easily, but they still benefit from proper storage structures. Part of the livestock milling industry have put up silos to store locally produced maize. These larger stores allow for proper management and care of the goods in storage with only good quality dry grain entering storage to prevent losses due to rodents and the development of aflatoxins. As maize production increases, there will need to be more stores so it can be kept longer.

**Access to power:**

The country tripled its installed power generation capacity since 2009 (Zhang, 2019). However, as of 2016, 24 percent of the population still did not have access to electricity, which was higher in rural areas at 31 percent. Less than 80 percent of existing power-generation capacity is operational with frequent scheduled blackouts. On average, electrical outages can reach 80 times per month lasting from five hours for firms to 10 hours for households, which is particularly challenging for manufacturing, including food processing. Bangladesh ranked 108th in terms of electricity access amongst 141 countries and 68th in terms of electricity supply quality, according to the 2019 Competitiveness Index of the World Economic Forum. According to the Ease of Doing Business, Bangladesh ranks 176th out of 190 countries for the Getting Electricity indicator with an overall score of 45 and a score of 0 out of 8 in reliability of supply and transparency of the tariff index (versus a South Asia average at 2.7).

Electricity price for agriculture is subsidized, primarily at the expense of industrial and individual users. Current electricity rate for farmers is 25 percent lower than cost of electricity supply itself and it is lower than for individual users and businesses (e.g. US$0.03 per kWh for farmers against US$0.04 for individual consumers and US$0.08 for businesses). Gas-based power is also subsidized for fertilizer producers. Use of solar power in agriculture is limited.

28 Their processing consists mainly of slaughtering the animals and butchering the carcass into different cuts prior to freezing or chilling.
Transport and logistics:

In agriculture, a well-developed transport infrastructure allows for a more efficient flow of market signals, reduces production and marketing costs and losses and improves product quality and marketability. As evidenced by the aftermath of the Jamuna bridge construction, improved connectivity facilitates technology adoption, diversification towards high value crops (both perishable and non-perishable) and intensification in farming (Blankespoor et al 2018). Basic infrastructure is also key for the development of efficient logistics services, which are in turn essential for high value agriculture (Herrera, et.al. 2019). Evidence suggests that access and utilization of transportation for carrying produce are strongly associated with the level of diversification. Particularly, transportation access supports small and medium farmers more than large farmers (Figure 3-8).

In Bangladesh, the basic infrastructure is underdeveloped, poorly maintained and managed. According to the 2019 Competitiveness Index of the World Economic Forum, Bangladesh ranked 117th in terms of road connectivity and 108th in terms of the quality of road infrastructure amongst 141 countries. Transport infrastructure (roads, inland waterways, and railways) have limited intermodal connections and networks and are concentrated near two big cities - Greater Dhaka and Chittagong city. Poorly managed and maintained roads are the main mode of freight transport followed by inland water transport (Table 3-5). Despite abundance, inland water transport remains underdeveloped. Railways handle insignificant freight volumes. In addition to low capacity, existing infrastructure are outdated and intermodal facilities between the three transport modes do not exist. As a result, the country faces heavy congestion, slow movements and unreliable logistics systems, which translate into high transportation and logistics costs.

In agriculture, which is the second largest sector in freight generation, shares of such costs in revenue is highest for perishable horticulture at 48 percent of total revenue (Herrera, et. al., 2019). Of the total cost, inventory carrying costs (storage) count for 30 percent and direct logistics costs for 70 percent of which more than half are transportation costs and remaining indirect costs (formal and informal fees) (ibid). The
most widely used vehicle for transporting agricultural produce between major towns is a 7-ton truck which has an average cost of US$0.095/ton/km. To put these costs into perspective, comparable transport costs in India and Pakistan are US$0.025 and 0.022/ton/km respectively (Herrera, et.al., 2019). In addition to the dwell time for containers at Chittagong port of 4 days for exports and 11 days for imports adds significantly to the logistical costs in Bangladesh costs of exporting and importing agricultural produce. According to the Ease of Doing Business, Bangladesh ranks 176th out of 190 countries for the Trading across Borders indicator with an overall score of 31.8 and all time and cost scores to import and export significantly above those of the South Asia average.

The national logistic system is currently hampered by having nine ministries and more than 20 government agencies that play active roles in setting policies and regulations, planning, operating infrastructure, and providing services. Despite all these bodies, the oversight of the road transport sector is poor. Trucks are overloaded and damage roads and bridges. Lorries frequently have crashes and regulations regarding the qualifications of drivers are poorly enforced resulting in the fact that unqualified drivers can operate big lorries by simply paying a “facilitation fee” to obtain a license.

**Packaging:**

Production and post-harvest losses appear to be reasonable—around 7 percent, in the agriculture and rural survey 2018 conducted by BBS (Figure 3-9). Gautam and Faruqee (2016) also demonstrated, with a survey of stakeholders for selected value-chains, that physical postharvest losses are very low (under 5 percent).

Over recent years, the introduction of better packaging has certainly helped reduce losses and maintain product quality, with the example of plastic crates being used along the value chain for perishable fruit. These investment in crates were made by private sector actors because they recognized its benefits.

The use of packaging and labelling remains however limited given the informal nature of the distribution and marketing of food products in the country.

**Standards, Testing & Certification:**

At the present time, development and implementation of standards for primary production is in its infancy in Bangladesh. The majority of farmers have no concept of Good Agricultural Practices (GAP) and keep

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29 IBID
30 On average a truck is involved in one major crash requiring significant repair and several minor crashes a year. The main reason for the crashes is unskilled drivers.
31 IBID
no records at all. The Government and some private sector food processing and supermarket retail businesses are attempting to develop and implement GAP standards with varying degrees of success. The Government is developing BangladeshGAP with a primary goal to export more fruits and vegetables to the EU and other high-value markets. BangladeshGAP is based on a major international standard known as GLOBALGAP. However, experience elsewhere in the world has shown that major retailers in the importing countries tend not to trust locally developed GAP standards. In Kenya the private sector developed KenyaGAP but buyers in the EU and US continued to demand GLOBALGAP as the minimum entry requirement making KenyaGAP redundant for exports to these markets. In Bangladesh, Shwapno is attempting to promote LOCALGAP, part of the GLOBALGAP family. They have had little success as the standard is too complex and expensive for implementation by smallholders in Bangladesh. Building a consensus between public and private actors over the objectives pursued by the creation of quality standards. Similarly, the process to develop a standard setting and management system should involve actors along the agri-food value chain to ensure compatibility with current agricultural systems, while meeting off-taker quality requirements.

PRAN has developed its own GAP standard known as the PRAN Assured Scheme (PAS) and is supporting its network of growers of tomato, mango, turmeric and cassava to implement PAS on a trial basis. If successful the PAS will be rolled out to growers of mug-dhal, peanut, ginger, potato etc. The PAS is currently a company specific standard and there is scope for development of a more generic product that could be used by any grower or buyer in Bangladesh.

As PRAN has its own lab facility, it is able to monitor compliance with GAP and food safety and quality practices. However, outside of contract farming arrangements and export-oriented value chains, monitoring of food safety and quality is difficult as many companies do not have own labs or cannot access lab services. The government, for instance, does not have accredited labs for full range of tests as well as products. There are several accredited private laboratories, but their accreditation is also for limited tests and products.

**Market intelligence:**

Because of the limited market linkages between farmers and domestic end buyers and between local agribusiness firms and export markets, information about domestic and export market requirements in terms of cost, quality and supply is often inaccessible to local agribusiness actors.

3.3 Performance and Key Challenges for Business Climate

**Ease of Business, Competitiveness, and Foreign Direct Investment:**
With a rank of 168 out of 190 countries in 2020 and a score of 45, Bangladesh performs worse than all regional peers except Afghanistan (173rd, score of 44.1). India ranked 63rd (score of 71), Bhutan, 89th (score 66), Nepal, 94th (score of 63.2), Sri Lanka, 99th (score of 61.8), and Pakistan, 108th (score of 61). The country has low scores across all thematic areas except Protecting Minority Investors (72nd): Starting business (131st), Dealing with Construction Permits (135th), Getting Electricity (176th), Registering Property (184th), Getting Credit (119th), Paying Taxes (151st), Trading across Borders (176th), Enforcing Contracts (189th), and Resolving Insolvency (154th). Poor performance on these indicators creates challenges for actors along the value chain, as seen in previous sections of the report with issues of difficult and unreliable access to energy or high time and cost for importing and exporting goods, which is particularly problematic for exports of perishable food items. Bangladesh also ranks 105th out of 141 countries on the World Economic Forum’s 2019 Global Competitiveness Index, far behind India (68th) and Sri Lanka (84th), but ahead of Nepal (108th) and Pakistan (110th).

These overall business climate and broader competitiveness challenges, combined with other factors, contributed to limiting the inflow of foreign direct investments (FDI) to US$ 2.9 billion of net FDI inflow in 2018, which were slightly higher than those of Pakistan over the same period (US$ 2.4 billion) but markedly lower than inflows to India (US$ 42.1 billion).\[^{32}\]

**Regulatory Environment of the Agri-food Sector:**

- **Enabling the Business of Agriculture:**

According to the Enabling the Business of Agriculture (EBA) 2019 report of the World Bank, Bangladesh performs well and above the regional average\[^{33}\] on livestock, plant health and finance. However, in several other areas such as seed, fertilizer, machinery, agriculture trade and water, data shows that Bangladesh lags behind its regional peers. In all areas measured by the EBA report, Bangladesh scores below the global average when compared to the broader sample of 101 countries (Figure 3-10). In Bangladesh, although recent regulatory reform was undertaken for the seed sector (i.e. seed certification), EBA data finds that the private sector participation in the seed market is limited. Agricultural trade regulations in the country do not require burdensome trader-level licensing and membership requirements, and recent reforms to ease agricultural trade by making necessary documentations available online is noteworthy. Yet, the process to obtain mandatory agriculture related documents can take up to 150 hours, in comparison to an average of 45 hours in countries in the region. This increases the cost of doing business in the agriculture sector for the country.

\[^{32}\] Data.worldbank.org
\[^{33}\] The other countries in the region covered by the report are India, Pakistan, Nepal, Sri Lanka and Afghanistan.
Food safety:

As seen in previous sections of the report and in the figure below, food safety challenges have been hurting Bangladesh’s food exports over the past few years. Poor compliance with international food safety and quality standards led to periodic bans and high incidences of alerts for Bangladesh shrimp imports (UNCTAD, 2017). In response to this issue, the government invested in adoption of Better Management Practices (BMP) and good agricultural practices (GAP), raising awareness on international standards and HACCP, and food safety infrastructure (FAO 2016). While considerable improvements were achieved, compliance monitoring and law enforcement remain weak and irregular.

Exports of horticulture products also often suffer setbacks due to poor compliance with international food safety and quality standards. Between 2002 and 2008, the most common reasons for rejecting Bangladeshi agricultural products, food and feed imported into the EU were veterinary drug residues, microbiological contaminants, substandard product composition, and mycotoxins (WB 2014). Similar high rejection rates were reported for products imported into the US, except for aquatic products, which was medium (ibid). Unlike in the aquaculture industry, the food safety and quality issues in the horticulture export industry still remains unchanged (UNCTAD, 2017).

Source: World Bank, 2019
Overall, the enforcement of food safety laws and regulations are considered weak due to: i) Numerous acts, laws, and regulations of various food product categories leading to overlaps and complexity in application and enforcement; and ii) Overlap and lack of coordination among the many ministries and agencies in charge of different aspect of the food quality and standardization control system, with fifteen ministries involved in food safety and quality control and ten ministries involved in food inspection and enforcement.  

**Fiscal policy measures:**

- **Export subsidy**

In an effort to develop exports, Bangladesh has introduced a 20 percent subsidy of the FOB value on certain agricultural produce. However, over the last few years potato exports have declined dramatically, whilst vegetable exports have stagnated (Figs 3.8 & 3.9). Interviews with potato exporters confirmed they were losing money even with the subsidy, whilst vegetable exporters only survived because of the subsidy, indicating persistent cost competitiveness challenges. Overall, the export subsidy has not managed to support sustainable export competitiveness of the targeted agricultural subsectors.

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34 Food and Agricultural Import Regulations and Standards Report, USDA, 2019.
• **Fertilizer subsidy**

About 80 percent of the fertilizer used in Bangladesh is applied to rice crops,\(^{35}\) with very heavy subsidies. Using data provided by the Bangladesh Fertilizer Association (BFA), it was calculated that the average subsidy in 2018/19 on nitrogen, potassium and phosphate fertilizer was 40.7 percent. The BFA data shows that USD 1,669,150 was spent on fertilizer whilst farmers only paid USD 990,210; the balance of USD 678,940 was the subsidy provided by the MoA. This subsidy is a very significant part of the MoA’s annual budget of BDT 22,910 crore\(^{36}\) (US$ 2.7 billion), which means the subsidy is about 25 percent of the total budget.

If these subsidies are applied to the gross margin calculations, then the real margins for field crops are much reduced (Table 3-6). The original aim of subsidizing fertilizer was to reduce the farmer’s production costs to stimulate rice production. This has worked extremely well and now Bangladesh is almost self-sufficient. However, it was calculated that in the 2018/19 season the subsidy came to US$700 million.

Table 3-6. **Projected Gross Margins assuming real cost of fertilizer in Bangladesh**

<table>
<thead>
<tr>
<th></th>
<th>Gross Margins (US$/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subsidised fertiliser</td>
</tr>
<tr>
<td>Maize</td>
<td>412</td>
</tr>
<tr>
<td>Soybean</td>
<td>238</td>
</tr>
<tr>
<td>Rice-boro</td>
<td>(71)</td>
</tr>
<tr>
<td>Rice-aman</td>
<td>114</td>
</tr>
<tr>
<td>Rice-aus</td>
<td>126</td>
</tr>
</tbody>
</table>

*Source* – Sergeant and Graffham, 2020

As seen in section 3.2, subsidies were also focused for many years on nitrogenous fertilizers, which led to an imbalance in the use of nitrogen but was later counterbalanced by an increase in subsidies for potassium and phosphorous macronutrients. Evidence shows that almost half of the farmers overuse fertilizers with no associated increased productivity, while this high consumption of fertilizer raises the risk of negative impacts on the environment, health and even farm productivity through resource degradation (Gautam and Faruqee, 2016).

3.5 **Summary of Key Cross-Sectoral Constraints**

Based on what precedes, challenges for increased diversification of the agriculture sector in Bangladesh span across the agri-food ecosystem, with constraints that are specific to individual nodes of the agri-food value chain, constraints related to some support services and constraints stemming from the country’s

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business climate. When considering diversification and modernization objectives for the sector, these constraints can be organized into three broad categories: i) On-farm productivity constraints; ii) Off-farm value addition and commercialization constraints; and iii) Cross-sectoral enablers.

**On-farm productivity constraints: Supply or “Push” factors**

As seen in sections 1, 2 and 3.1 of the report, Bangladesh is currently not competitive in terms of yields for many products, with the notable exception of paddy rice, when compared to regional peers and world averages. Bridging these productivity gaps will be essential to increase production and on-farm cost competitiveness for these products, as Bangladesh’s agriculture sector seeks to diversify away from rice. Key constraints for increasing productivity for non-paddy rice products are shown in Figure 3-12 and described in greater detail below:

*Figure 3-12. On-farm productivity constraints along the agri-food value chain*

- **Land fragmentation and short land rental tenure**
  
  Land fragmentation limits economies of scale. Land rentals are used to circumvent this challenge. However, typical land rental tenure is limited to three years, which is not conducive to investments in certain crops that requires sizeable upfront investments and generate high returns only after a five to seven-year period, like tree crops. It also limits the intermittent use of cover crops to replenish the soil, as farmers are not sure they will benefit.

- **Lack of access to improved genetic materials**
  
  Research and development from the public and private sectors have been mostly focused on rice paddy over the past few years, with little support to developing varieties adapted to Bangladesh’s agroclimatic conditions for other crops. There is notably a need to remove the regulation preventing private sector

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actors from breeding and producing seeds for notified crops, increasing public, private coordination on quality seed supply for notified crops, and increasing market transparency regarding the quality and effectiveness of seeds in the market as a way to drive greater demand for improved genetic materials from farmers, which should in turn encourage the private sector to invest in this field.

- Limited adoption of good agricultural practices

Good agricultural practices (GAP) are by and large not implemented in Bangladesh. This is notably illustrated by the misuse and overuse of certain inputs like fertilizers. It also contributes to challenges downstream of the value chain by affecting food safety, notably with high levels of pesticides residue in certain subsectors. This challenge is closely connected to the following two constraints, the limited availability of extension advice and the limited use of aggregation models.

- Lack of access to extension advice

Providing timely and relevant information to farmers is made difficult by an inadequate extension system. DAE’s resources and current extension techniques and materials need improvement to meet literacy and farm fragmentation challenges, with around 15 million farms to reach and a very limited use of aggregation models (see below). These outreach difficulties are compounded by the current lack of articulation between extension efforts provided by the public and private sectors and by the limited use of digital technology to provide extension advice.

- Limited use of farmer aggregation models

Both formal (e.g. cooperatives) and informal aggregation mechanisms are not widely used in Bangladesh, which contrasts with many other countries. This creates challenges for the delivery of extension services, accessing finance, developing joint infrastructure, as well as aggregating products for marketing, with additional logistics costs and challenges for off-takers. Some off-takers like PRAN are developing such aggregation mechanisms as a result to secure quality inputs more consistently.

- Inadequate fertilizer subsidy policy

The fertilizer subsidy policy appears to be leading to an overuse of fertilizers, which raises environmental, health and even productivity risks, with land degradation, while bringing no additional output. The policy is also very costly to the state, which suggests that there could be an opportunity to redeploy this support to other public good activities that could better assist increases in productivity for paddy rice as well as other crops in a more sustainable way.

While these on-farm productivity constraints create impediments for serving both domestic and export markets, the limited use of both farmer aggregation models and GAP are particularly problematic to meet the quality standards expected by export markets.

Off-farm value addition and commercialization constraints: Demand or “Pull” factors
Another set of constraints impact the demand for a more diversified production of food products and the signaling of that increased demand to farmers who are currently not switching to higher value crops. Key constraints for increasing off-farm value addition and improving commercialization for non-paddy rice products are shown pictorially in Figure 3-13 and described in greater detail below:

Figure 3-13. Off-farm value addition and commercialization constraints along the agri-food value chain

- **Limited use of farmer aggregation models**
  
  Just as the lack of aggregation channels for farmers constrains their ability to increase productivity, it also further disconnects them from end buyers like food processors and exporters.

- **Limited number of formal off-takers**
  
  Conversely, there is also a dearth of well-established formal off-takers, either food processors, formal distributors like supermarkets, or exporters. This limits knowledge transfers, as well as the use of higher quality standards in the market. Such higher quality standards would typically translate into higher prices to farmers rewarding consistent supply of quality products and incentivize farmers to invest in higher value crop production.

The development of more formal distribution channels for food products itself depends on supply and demand factors. The limited demand from consumers for more convenient, higher quality, and safer food results in the overwhelming majority food retail being done via wet markets as opposed to supermarkets. Domestic food processors and exporters, on their end, are not always able to meet domestic and export market requirements in terms of cost and quality for a number of reasons, some of which are detailed in
this Chapter. Priority constraints perceived by agribusinesses during stakeholder consultations included the limited access to finance, weak food quality and safety standards, poor marketing and logistic infrastructures (such as cool chains, cold storage), costly logistic services, limited use of GAP among farmers, and lack of quality and modern seed varieties, among others.

- **Inadequate and costly transport and marketing infrastructure and services**

As described in section 3.3, transport and logistics infrastructure and services are poor in Bangladesh, which results in higher cost for actors along the agri-food value chain. The marketing infrastructure is also inadequate, with associated heightened food safety risks. Lastly, importing and exporting products is more timely and costly than in most countries, which affects both cost and quality competitiveness of exports in the case of perishable products.

- **Unreliable access to energy**

As shown in international benchmarks, access to electricity is unreliable with repeated outages, which is particularly damaging for food processing, as it damages equipment and requires supplementing the grid with generators. It also creates challenges to maintain cold chain operations along the value chain (e.g. potato seeds).

- **Insufficient upholding of appropriate food safety practices**

Food safety challenges have greatly penalized Bangladesh’s food exports in the recent past. Despite efforts invested in addressing these issues, compliance monitoring and law enforcement remain weak and irregular for exports. On the domestic market, food safety practices are not properly and consistently enforced along mostly informal distribution channels, which creates an unlevel playing field for formal retailers and creates health risks for consumers. The complexity and overlaps of both the legal and regulatory framework, with many acts, laws and regulations, and the control and enforcement system, with many ministries and agencies in charge, contribute to preventing significant improvements in food safety outcomes in the country.

- **Lack of use of product standards**

The definition of domestic product standards needs to be tailored to domestic market conditions in order to protect consumers, while ensuring that value chain actors are able to eventually comply (i.e. need to avoid “gold-plating”). Access to certification services to meet export standards can present challenges for exporters as well.

- **Inadequate export subsidy policy**

The export subsidy policy appears not to be leading to sustainable exports of horticultural products, with exports either decreasing or being maintained only thanks to the subsidies’ support. There could be an opportunity to redeploy this support to other public good activities that could better assist increases in exports by improving the cost as well as the quality competitiveness of the country’s food exports, rather than mitigating the lack of cost competitiveness with a subsidy.
Other cross-sectoral issues: Enablers along the agri-food value chain

Other cross-sectoral constraints impact the competitiveness of the agri-food sector across the board:

- **Constrained access to finance for value chain actors**

  According to BKB’s estimates, agricultural finance demand exceeds current supply by 2-3 times. According to IFC calculations, the financing gap for non-farm MSMEs is also estimated to be very wide at about US$ 2.8 billion.

  On the agri-finance side, financial products are limited to basic seasonal and short-term loans, with a number of constraints preventing greater financial inclusion, such as misaligned eligibility criteria requiring land ownership or guarantee from the landlord to use land as collateral, perception of high risks driving high interest rates, and a limited offer of financial products and services tailored to farmers.

  Many challenges have been identified regarding the financial infrastructure’s ability to achieve market-driven MSME financial inclusion, including the need to: i) Increase the credit bureau’s coverage to include all commercial loans, regardless of value, and use all available data to improve MSME credit information; ii) Expand the collateral registry’s mandate to include moveable collateral for secured lending, beyond current use of only property-based collateral, enact the Secured Transactions Law and create a register; and iii) Improve insolvency and debt resolution solutions.

- **Broader investment climate and competitiveness challenges**

  As shown in the country’s performance according to the Ease of Doing Business and the Global Competitiveness Index, improvements are needed in the country’s overall investment climate. These challenges notably contribute to limit the inflow of foreign direct investments, which would greatly benefit the agri-food sector in terms of knowledge transfers, structuring of domestic value chains and the ability to target and meet export market requirements.

  The production, commercialization and cross-sectoral constraints discussed above identifies how each factor hinders agricultural competitiveness and productivity. The public and private sector have important role to achieve agriculture diversification and modernization. The following chapter delves in specific value chain as demonstration of how the various constraints limit the value generation and distribution.
4 Agricultural Diversification and Modernization: Lessons from Three Selected Value-Chains

Using three value chain ecosystems’ in-depth analysis, the report demonstrates how selected crops – maize, potatoes and mango-products are affected by the constraint discussed above. The analysis focuses on identifying policies, institutions, logistics, and financial bottlenecks—particularly cross-sectoral constraints—that are holding back farmers from diversifying into high-value crops that are shown to have high margins. This presents strategic opportunities to stimulate several products by addressing cross-sectoral constraints including market access models, food safety and standards mechanisms, marketing and distribution infrastructure, and good agricultural practices such as fertilizer usage.

4.1 Selection of Three Value-Chains

The discussion in chapter 2 shows there is potential of productive diversification in Bangladesh with a range of non-paddy crops that can generate greater margins than rice. The discussion in chapter 3 conversely shows that there are multiple cross-sectoral constraints that may be contributing to hindering this diversification process. Indeed, most farmers continue to grow rice and the progress towards diversified agriculture is rather slow. To understand the slow progress towards productive diversification in the country, it requires identifying policies, logistics, and financial bottlenecks that are holding back farmers from moving towards a more diversified production system and prevent integration of farmers to the modern agri-food value chains. This necessitates an in-depth assessment of value chains and markets for selected non-paddy agricultural commodities. For the selection of value-chains, this study looked at what are the agricultural commodities where Bangladesh has competitiveness and comparative advantage against the peers in the region and among the low middle-income countries. The yield advantages and revealed comparative advantages (RCA) for major agricultural commodities are presented in Table A 4 in Annex.

Comparison of yields in Bangladesh versus world average indicates Bangladesh’s on-farm competitiveness for only 8 products. Revealed comparative advantage (RCA) is an indication of export competitiveness, which shows promises for Bangladesh for 9 products. For both indicators, certain distortions may be affecting the results like subsidized inputs boosting on-farm productivity. A low RCA with a high Yield ratio could be indicative of more robust domestic demand for the commodity (relative to competing exporters of this commodity), inability to expand production beyond current production and / or compelling challenges between “farm to port” that reduce global trade competitiveness in spite of high farm competitiveness. On the other hand, a low yield ratio but high RCA could be indicative of policy level factors (e.g. subsidies, SOE dominance etc.) that contribute to global trade competitiveness even while farm productivity is low. Based on these results and other development impact criteria; maize, potato, and mango were chosen for further assessment. These value chains were selected of their relevance to large numbers of farmers as marketing links to fresh markets in the main cities, opportunities for adding value by processing and possible potential for export development.
• **Crops for inclusion in livestock feed** – Bangladesh has a thriving and expanding livestock and fish sector that requires supplementary feed that is being manufactured by local factories based on a mixture of locally grown and imported raw materials. Maize and soya beans were chosen for further investigation because, like rice, they are “field crops” and do not require significant extra management skills. The growing season of maize is also short compared to rice. They also represent good opportunities for import substitution.

• **Annual vegetable crops** – horticultural crops require greater technical and managerial skills to grow and market because they are much more perishable. The investigation concentrated on bottle gourds, tomatoes and potatoes because they represented an opportunity to research several issues such as post-harvest losses, marketing infra-structure, exports, cold storage, packaging. They are mainly produced for the local market, but efforts have been made to export bottle gourds and potatoes. Tomatoes and potatoes are being increasingly grown for processing and potatoes have a much more sophisticated marketing chain using privately owned cold stores.

• **Perennial fruit crops (Mango)** – require a significant upfront investment to establish an orchard (about US$1,000/ha in the case of mangoes). Mangoes were chosen because it is the most widely grown perennial fruit crop in Bangladesh and efforts are being made to develop it for export and processing.

The key objectives of the detail assessment were to:

• Map out the main elements of selected agri-food value-chains and provide a clear understanding of common/cross-cutting bottlenecks (e.g., policies, institutions, logistics, finance)

• Identify markets that demonstrate the best opportunities for growth and have potential for productive diversification in the agriculture sector. Also, identify market-led opportunities for value chain improvements, e.g., post-harvest handling, improved packaging, grading, standards, processing, modern retail.

• Make a series of recommendations to enable more rapid progress towards an increasingly modern and sophisticated agricultural sector.
4.2 Livestock Feed Ingredients-Maize

Overview

Demand for formal livestock feed will continue to be buoyant as a result of the increasing demand for meat, milk and eggs. Sergeant and Graffham (2020) reported that there are about 65,000 to 70,000 number of poultry farms in Bangladesh with a growth rate of about 15 percent annually. In addition, there are around 2 million fishponds/farms and the area of fishponds is increasing by about 6 percent annually. Fish is the dominant protein consumed by the Bangladeshi population (Figure 4-1.) with chicken expected soon to overtake beef consumption in second place. Bangladesh has a growing livestock feed industry with about 85 businesses producing most of the country’s demand for livestock feed. A considerable portion of the cattle feed comes from grazing; the main markets for livestock feed are therefore the inland fish and poultry industries. The main ingredients of livestock feed are 55 to 65 percent carbohydrates, typically maize, and around 25 percent protein, usually soya cake, but rape or mustard cake as well as fish meal can be used.

Source – Sergeant and Graffham, 2020

Trade

Imports of maize, soya beans and soya cake have increased significantly over the last decade. In 2018 about 1.7 million tons of maize, 1.3 million tons of soya beans and 300,000 tons of soya cake were imported; the value of these imports was US$293 million, US$496 million and US$144 million respectively (Figure 4-2.). Currently, the main source of imported maize is Brazil (66 percent in 2018) with smaller amounts coming from India (16 percent) and then Argentina (11 percent). The supply of soya beans and soya cake is dominated by the USA (about 90 percent in 2018) with smaller amounts coming from Brazil and Canada. Virtually all maize and soya cake from soybeans are used by the animal feed industry; the oil is removed from the soya bean before the byproduct (i.e., cake) is used in the feed industry. To encourage the local vegetable oil extraction industry, imports of soya cake incur a 10 percent import duty, whereas soya beans

Source: - UNCOMTRADE mirror data

37 GAIN (Global Agriculture Information Network, produced by FSDA) Report No BG 7002
and maize are imported without any duties. A consortium of four or five livestock millers import boat loads of maize and then distribute it amongst themselves upon arrival. They tend to buy soya cake direct from the vegetable oil extraction companies because it should be cheaper than importing it and paying duty but about 25 to 30 percent of the soya protein is imported directly.

**Production and Processing**

Maize in Bangladesh is grown during Boro season (usually displacing some of the rice crop); it has expanded rapidly over the past few years, from around 700,000 MTs in 2009 and it is now estimated to be 3.5 million MTs in 2017 (Figure 4-3.). The rapid expansion is attributed to the attractive prices offered by the livestock feed industry coupled with the poor margins associated with Boro rice. Interviews with farmers also confirmed that despite a tradition or culture of rice production, the higher maize gross margins make it more attractive.

The rapid expansion of maize suggests that the prospects of higher margins outweighed possible benefits of home food security and risk associated with growing a crop which they had less knowledge and expertise. Maize is almost entirely used in the animal feed industry and most of it is grown in clusters near a feed mill that buys it soon after harvest for either immediate use or storage in silos. Despite increasing demand for soya beans and cake, the growth in local production has been less impressive and for the last few years has been static at around 90,000 to 100,000 MTs per year (Figure 4-4.). This is attributed partly to the smaller projected gross margins (Table 2-5) and, according to farmers and DAE officials, also due to agronomic issues. The issues identified included soya varieties that were not well adapted to Bangladesh environment and there is poor nodulation on the roots, which could be associated with not using rhizobium inoculum at planting.

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38 Salam, M., & Kamruzzaman, M. (2016) noted that “Although the cultivation of soybean was found to be profitable, many farmers showed negative attitudes toward its production” Among the reasons for this was “lack of HYV seed availability, lack of technical knowledge and natural calamities”.

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**Distribution and marketing**

The potential market opportunity for increased maize production would be to substitute imports; which based on 2018 data would be 1.7 million MTs. Given that maize is more profitable than Boro rice sold for cash (Table 3-6), it would mean an extra US$ 110 million generated in the rural economy and reduce imports by US$300 million. However, the country would produce about 900,000 MT less rice which would result in increased costs for imported rice. The driver in the maize value-chain are the livestock milling companies; they virtually consume all local production crop and effectively set the market price, which are based on import parity. Currently, groups of milling companies cooperate to import boat loads of maize; world prices are about US$170 to 175 per MT at the port of origin and the logistic costs of shipping to Chittagong is about US$30 per MT. Internal transport and other costs result in a delivered to factory price of about US$ 230 per MT; the equivalent of BDT19.5 per KG. During the field mission, the farmers reported that they received BDT15 per KG (US$176 per MT).

The marketing chain of locally produced maize is relatively straight forward. Farmers deliver to village-based traders who own a warehouse and who are in effect aggregators because they bulk-up the grain from several farmers in their locality. When the village-based trader has aggregated a lorry load (generally between 7 to 15 MT), they negotiate its sale to traders or agents (often referred as beparis) of the milling companies who then transport it to the mills. The animal feed mills have storage silos to carry enough stock to keep the factory operational. The maize marketing chain is relatively simple, as follows:

Farmer → village-based aggregator → large-scale trader → feed-mill processor->Distributor->Clients

Within the value chain, farmers leverage the largest margin share (Figure 4-5.). This is not too surprising as most farmers probably only produce about 1 to 2 tons of maize per season and take more risks than the other actors along the chain.

The quick review of the marketing chain shows that it is competitive and efficient. The barriers for entry to this chain are minimal; obviously a farmer would need some access to land and inputs, the village-based aggregator would require a shed capable of holding up to around 15 MT of product as well as access to short-term finance. On average, about 15 to 20 village-based traders compete to buy maize from farmers in a village. Farmers also inquire price information from various traders to ensure that they are getting a fair price. The agent linking with the factory requires

![Figure 4-5. Build-up of costs along the maize marketing chain (BDT/kg)](source: - Sergeant and Graffham, 2020)
finance and access to lorries to start the business. All transactions are based on cash and there are no structural barriers to set up business at any stage.

**Main Lessons**

The main observations from the assessment of the livestock feed crops value chain include:

- **Local market opportunities and high margins for farmers:** Market opportunities exist to replace imported maize and soya. Attractive gross margins have encouraged farmers to rapidly expand maize production, but some issues need to be addressed before soya production increases.

- **Unlike other many other value-chains, maize has reliable off-takers:** The maize value chain is "driven" by the limited number of feed millers who see local production as a good alternative to imports and have actively established systems for procurement. Domestic maize production could be boosted further, if the feed millers had support to increase their storage capacity.

- **More research and development on maize and soybeans are important:** Agronomic research is needed to seize the market opportunity for soya beans. It would benefit from a comprehensive research program to identify higher yielding varieties, identification of best soils and climates and a better understanding of nitrogen fixing rhizobium. Agronomic research into soya beans should be undertaken in conjunction with vegetable oil processing companies with the aim of producing the crop domestically. Maize production would also benefit from further varietal research especially in an era of climate change.

- **Land fragmentation and short land tenure prevents economies of scale:** In most countries, maize and soya are grown by large-scale farmers using mechanization. So, in the long-term, efforts should be made to gain economies of scale.
4.3 Vegetables-Potato

Overview
Total vegetable production was reported as 3.88 million MT in 2017 and has grown by around 5.5 percent annually over the previous 10 years (Figure 4-12.). This increase in production responded to an increase in demand driven by increase in disposable income and population increase (1 percent annually) (Gautam and Faruquee, 2016). Potato data are recorded separately in Bangladesh; in 2017, the country produced just over 10 million tons, almost doubling over the last 10 years (Figure 4-13.). Much of the increased potato production is derived from yield increases, from 13.3 MT per ha in 2008 to 20.4 MT per ha in 2017.

Trade
There have been considerable efforts at developing export markets, encouraged by a government subsidy of 20 percent of the FOB value and by various projects. The volume of vegetable exports has been more or less constant at around 50,000 MT annually with a CIF value of around US$40 million per year (Figure 4-6. & Error! Reference source not found.). Exports used to be predominantly to the EU but have dramatically reduced to about 2,000 MT per year worth only US$4 million per year. Sales to the EU have been constrained by lack of maintaining sanitary and Phyto-sanitary (SPS) standards (i.e., pesticide residues on some of the products) leading to bans on some product lines. Between 2000 and 2014, around 10 percent of total alerts issued for imports into EU markets was for the Bangladeshi aquatic products and 30 percent of these notifications were on border rejection (UNCTAD, 2016). Potato exports have also fallen dramatically over the last five years. Exporters face serious competition in the export markets both in terms of price and quality, despite the government export subsidy.
Figure 4-6. Vegetables & potato exports, 2009/18 (MT)

Source: UNCOMTRADE mirror data

Figure 4-7. Fruits and Vegetables Trade ($)

Source: UN COMTRADE AND EPB, 2020

Figure 4-8. Potato Exports Destinations, FY2017-18

Source: EPB, 2020

Figure 4-9. Destinations of Vegetables and Fruits Exports (US$): 2017-18

Source: EPB, 2020

Figure 4-10. Imports Sources of Fruits and Vegetables 2018

Source: UN COMTRADE AND EPB, 2020
**Production and Processing**

Bangladesh grows a wide range of vegetables; the most popular being aubergine (*brinjal*) and tomatoes, which have shown very rapid expansion in the last 10 years (Figure 4-11.). More traditional vegetables such as cabbage and cauliflower have also gained popularity. Most of these grow best in the dry and cool rabi season (rabi season runs from October to March and covers the boro rice season) when the temperatures are cooler for better growth and there is less pest and disease infestation. The much higher gross margins for these annual vegetables than for rice make them attractive to some farmers. However, they do require greater management and technical skills and that makes them much riskier and it might deprive them of some of their staple food security. They are highly perishable, and their prices are relatively volatile; so, marketing of such crops can be problematic. However more entrepreneurial farmers who live closer to major markets, they can generate profits by growing vegetables.

**Potatoes are a temperate crop and hence perform well in winter season.** This season is too short for potato crops to reach their yield potential. In most countries with well establish potato industries the crop is allowed to mature over 120 days but in Bangladesh potato can only be grown for 90 days. Additionally, this cool season coincides with the time of the year when sunshine-hours are at their shortest allowing less time for photosynthesis. Together, these climate disadvantages mean that potato yields are well below those attained in the main potato growing countries.\(^{39}\)

**Potatoes tend to be grown in in larger scale by better resourced farmers; the average size of a potato farmers land is 1.76 ha**, of which 1.14 ha is arable. These are still exceedingly small by international standards. Most of the potatoes are sold at harvest time, the rest are put into storage; for a few months at ambient temperatures. It is estimated that about 4 million MT, (ie about 40 percent of the total crop), are stored in over 390 privately owned dedicated cold stores; an essential service required to keep the market supplied throughout the year.

\(^{39}\) In 2018, FAO data gave the average potato yield in Bangladesh as 20.4 ton/ha, India (with its similar daylength and climate to Bangladesh) as 22.6 ton/ha, the UK as 35.9 ton/ha, Australia as 40.0 ton/ha and the USA as 49.8 ton/ha. In [https://ourworldindata.org/grapher/potato-yields](https://ourworldindata.org/grapher/potato-yields)
Distribution and marketing

Vegetables are grown and consumed throughout the country; Dhaka is the largest end market, but other cities are also important. The main vegetable marketing channels are the traditional “wet markets”; even though supermarkets are increasing, but from a very low base. A rapid assessment of these markets shows a competitive chain where vegetables are harvested and transported rapidly throughout the country. The large rural consumption is supplied from local village markets; the farmer often takes the produce to the nearest market where it is often retailed—directly by the farmer or a trader. However, because of the very small average farm and field sizes, a farmer will not produce enough to justify marketing it directly to the wholesalers. Therefore, they rely on market intermediaries to aggregate and transport the vegetables to urban wholesale markets where the consignments are broken down and sold to retailers in traditional kiosks.

Post-harvest losses for fruits and vegetables were found to be reasonable. Gautam and Faruqee (2016) also found that physical postharvest losses were under 5 percent. Good progress has also been made in recent years in adopting improved packaging; the use of plastic crates and trays is now widespread and has contributed to maintaining product quality and reducing losses. However, improvements can and should be made to market infrastructure to improve the flow and their general operation which will improve throughput, waste disposal, protection of the traders, buyers and produce from inclement weather etc. For example, better surfaces and drainage combined with regular cleaning of waste materials would improve sanitation, more roofing, a good water supply and provision of hygienic toilet facilities as well as weighing scales. Overtime, supermarkets will become more important in coming years and it is expected that supermarkets might drive improved quality, but at the moment, they have not established any significant discrete supply chains direct to their retail outlets; they still heavily rely on the existing/traditional marketing channels.
There is also a small market opportunity for vegetables to be sold for processing. Due to lack of data, it is difficult to know accurately the tonnage of vegetables that are being processed because there are many small companies buying vegetables. The main market for processed products is the local market. The Bangladesh Agro-Processors Association (BAPA), which has 282 active members, claims that the value of exports by its members was about US$ 371 million in 2017/18 and main export items are spices (mainly chilies (18,000 MT worth US$ 67 million)) and a range of fruit drinks and juices. The majority of these exports are targeted at the Bangladeshi communities in the Middle East and regional markets with smaller amounts going to Europe and the USA. Though, the exports are small in overall terms, the benefits of achieving export standards do eventually benefit some aspects of local processed food markets. To put the market opportunities into perspective, it was calculated that 93 percent of the vegetables were sold in traditional marketing channels, between 3 and 6 percent were processed, while 1 percent were sold through supermarkets and 1.6 percent were exported (Table 4-1). Exports are declining, whilst sales to supermarkets, processors and through traditional channels are all expanding.

Table 4-1. Estimated size of different vegetable market segments (ton)

<table>
<thead>
<tr>
<th>Market Segment</th>
<th>Metric Ton (MT)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total production</td>
<td>Commercially traded</td>
</tr>
<tr>
<td>Total Production</td>
<td>3,880,000</td>
<td>100</td>
</tr>
<tr>
<td>Post farm losses</td>
<td>776,000</td>
<td>20</td>
</tr>
<tr>
<td>Commerically traded</td>
<td>3,104,000</td>
<td></td>
</tr>
<tr>
<td>Exported</td>
<td>51,000</td>
<td>1.6</td>
</tr>
<tr>
<td>Processed</td>
<td>136,460</td>
<td>4.4</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>31,060</td>
<td>1.0</td>
</tr>
<tr>
<td>Sold on the fresh market</td>
<td>2,885,480</td>
<td>93</td>
</tr>
</tbody>
</table>

Source: Sergeant and Graffham, 2020

The existing limited scale of vegetable processing is almost entirely focused on the local market or some regional sales across land borders to neighboring countries. It is estimated that between 100,000 to 200,000 MT per year of vegetables are processed which is about 2.5 to 5.0 percent of total vegetable production. There is also a nascent potato food processing industry making crisps and to a lesser extent, French fries. It is estimated that it utilizes about 60,000 tons/year and the output is sold in the local market. In addition, there are some old factories that manufacture potato flakes for use in the preparation of starch, but these only operate in years when market prices are low and have very limited capacity.

**Main Lessons**

The main observations from the assessment of the vegetables (potato) subsector include:

- **Domestic market opportunity:** As discussed in chapter 2, the domestic demands for fruits and vegetables are growing with rising incomes and urbanization. An FAO estimate suggest that the

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40 The Bangladesh Agro-Processors Association (BAPA) claims to have 282 active members, some of which are buying vegetables.
41 Mainly in India, Nepal, and Bhutan.
daily consumption of vegetables and fruit in Bangladesh is 112 and 14 grams per capita respectively\(^42\) which is well below the WHO recommended diet of 400gram per day. Therefore, the local fresh and processed markets offer much more potential and should be the focus of support to the vegetable industry.

- **Limited number of formal off-takers in fruits and vegetables value-chain.** The food processing industry is still small, but indications are that it is growing as the buying power on the local consumers increases.

- **Inadequate and ineffective export subsidy policy:** Vegetable and potato exports are very small and show no signs of increasing; in fact, potato exports are declining rapidly. Air freight exports have had a difficult time attaining required food safety standards and being competitive. Currently, there is a 20 percent subsidy on the FOB value for exports, but this is not stimulating exports. The strategy to promote vegetable exports needs a major reevaluation.

- **Inadequate marketing infrastructure:** The potato and vegetable marketing chains are very competitive with many buyers competing with each other at each stage. Farmers and market intermediaries are in regular contact to help establish market prices. This results in efficient transactions. However, it was noted that the logistics and operations of the markets could be improved by investments in market infrastructure.

- **Expanding logistics support services capacity:** Private sector initiatives have driven much of the diversification of cropping, investments in processing and storage, as well as improved marketing and packaging. As the private sector invests further in processing and marketing, it is important that they are supported because they not only provide secure markets for the farmers but can be used to deliver extension messages and drive improved food safety and quality standards.

- **Improving food safety and standards capacity:** There is considerable interest among both public and private sector stakeholders in establishing improved standards and traceability; the private sector should be encouraged to take this forward but with a focus on meeting domestic food safety and quality requirements.

- **Opportunity for incentivizing retail market:** Currently, the supermarkets pay VAT on fresh produce whereas traditional markets do not; this needs to be re-evaluated and used as an incentive to stimulate improved standards.

\(^{42}\) [http://www.fao.org/3/ag126e/AG126E05.htm](http://www.fao.org/3/ag126e/AG126E05.htm)
4.4 Fruits-Mango

Overview
Bangladesh grows a wide range of fruits, including mango, jackfruit, blackberry, pineapple banana, litchi, lemon, guava, custard apple, and many more. Many of these fruits mature in the summer months of June, July and August and are very important for the nutrition of the population; they counter-balance many of the vegetables that are nutritionally important in the winter months. However, Bangladesh imports significant quantities of citrus fruits (mainly oranges and some mandarin) and apples; the majority being imported from China and South Africa.

Trade
Bangladesh is currently the 8th largest mango producer in the world but fresh mango exports are negligible and have declined from a peak of 800 MTs in 2016 to 100 MTs in 2019. Khirshapati variety (popular name Himsagar) is the most popular high-value variety accounting for 25 percent of volume produced. For processing, Guti and Sahawina varieties are most favored due to lower demand for these fruits on the fresh market. The domestic fresh market dominates and drives mango production; about 91 percent of Bangladesh’s commercially traded output is sold on the fresh market. Fresh high-grade mango (Khirshapati, Fozli, Lengra & Guti varieties) farm-gate price in 2019 was US$0.29-0.44/kg (BDT 25-38/kg) in Rajshahi. Rangpur produces Hadiwhanga a high-value variety of mango with a later season (Jul-Aug), the farm-gate price for mango in Rangpur in 2019 was US$0.74-0.88/kg (BDT 63-75/kg).

Bangladesh has been much more successful developing exports of processed mango products than exports of fresh produce. In 2018, Bangladeshi companies exported US$12.3 million of processed mango products to 63 countries; the number of destinations and value of processed product has increased. According to BAPA, the major destinations for processed mango products were India (64 percent), Saudi Arabia (13 percent) and Nepal (7 percent). Processed products have many advantages over fresh fruits. All processed products are stable at ambient temperatures with long shelf-life. Production is carried out by larger well-resourced businesses that can demonstrate compliance with international standards for food safety, quality, packaging and religious requirements.

Production and Processing
Mango is a popular fruit and it has emerging importance for processing as well as some efforts to develop exports. Mango clusters are mainly located in the northern parts of the country and there is considerable trade in fresh mangoes to most other parts of the country as well as a small but expanding processing market. In the 2018 season, mango was grown on 167,760 ha, yielding 1,161,685 MT of fruit which gives a national average yield of 6.9 MT per ha. The planted area has doubled in the last 10 years as some farmers have moved away from rice cultivation and mango output is increasing by 4 percent per annum since 2010. Even though national average yields might be low, the yield potential for modern varieties such as “Amropali” is 20 MT per ha, if the farmers follow good agronomic practices. However, production records for farms in Rajshahi District indicate an average of 5 MT per ha for 7-20 years old trees and around 3 MT per ha for trees ranging from 50-100 years old; but many of these orchards have been poorly managed with a low planting density. There are believed to be significant areas of older less productive trees although hard data is lacking. Orchard sizes are small ranging from 0.5-3.0 ha in size. Most mango farmers have not adopted good agricultural practices, lack knowledge of commercial production, and have limited managerial capacity. These factors are responsible for the inability of farmers to get closer to the potential yield.

It is estimated that 9 percent of the country’s mango crop is used in processing, i.e. about 107,000 MT. The biggest mango buyer for processing is PRAN which purchased 76,900 MT of mango for processing (valued at US$16.2 million). The other 30,100 MT were bought by a range of smaller processors. In 2019 the farm-gate price (i.e., paid to farmer) ranged from US$0.18 (15BDT)/kg to US$0.28 (24BDT)/kg; these prices were lower than paid for mangoes traded on the fresh market because they were of lower quality from the less popular varieties. In 2018 the market for processed mango products (e.g., juice, drink, pickle, chutney and fruit bars) was US$28.6 million (excludes mango products made from imported concentrates). PRAN accounts 65 percent of the market share, while Akij accounts 20 percent share. And the remaining 15 percent is accounted for by numerous smaller processors. Processed mango products are increasingly popular in Bangladesh; according to BAPA, the purchase of mango for processing grew 89 percent between 2012-2018.

Within Bangladesh, there is a growing concern among consumers that locally grown fresh fruits might contain pesticides, illegal ripening agents, and illegal preservatives such as formaldehyde. Before 2015 there was evidence of poor practices within the system, but Government initiatives and improved regulation and enforcement have significantly reduced the food safety risks. Because of these safety concerns, some processing companies are now prohibiting the use of certain ripening products that are permitted by DAE in the fruit that they procure; a good example of private sector standards being higher than the Government’s legal minima. In June 2019, BSTI tested 265 samples of mangoes and other seasonal fruits from wholesalers and dealers and found no evidence of the presence of formaldehyde. These are good examples of Government improving food safety and quality along the food supply chains.

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44 Annual Reports, Ministry of Agriculture.
45 Based on key informant interviews.
46 Often farmers will take the best fruit and sell into the fresh market and keep the lesser quality, damaged and smaller fruit for selling to processors.
**Distribution and marketing**

A fruit farmer has various options for marketing, e.g., sell in the local market or direct to a bepari (trader) who either buy post-harvest or while the fruit are on the trees and harvest themselves. Some bepari’s offer 2-3 years contracts to farmers. Mango intended for the domestic fresh markets is mostly sold in open markets in the main production areas and consolidated by traders who move the fruit to the major urban centers such as Dhaka, Chittagong, Sylhet, etc. The mango value chain for the domestic fresh and processing markets is well organized and efficient. Although many stakeholders complain of post-harvest losses there is little evidence. A USAID study in 2010 reported losses for growers in Rajshahi District of 3-4 percent due mainly to poor harvesting techniques. Losses downstream from the farm were mainly due to unsuitable forms of transport, poor packaging and storage facilities lacking means of controlling temperature and humidity. Post-harvest losses were falling in 2010 due to the rapid uptake of plastic crates for handling in place of woven baskets and jute sacks for high-value products such as mango. In 2019, plastic crates had completely replaced traditional packaging for post-harvest handling of mango in Rajshahi and Natore Districts.

The bepari’s normally pay cash on receipt; deductions are made for rejects, sales commission, and rental of storage to give the final price. The bepari’s have partners working in the main city markets to monitor commission sales by the wholesalers. The wholesalers charge 8 percent commission on sales and usually pay within 2 days of sale via B-Cash47.

**Mango processors encourage the improvement in good agricultural practices among farmers.** The largest buyer of mangos for processing is PRAN Foods Ltd. It tends to buy cheaper fruit such as less popular varieties as well as lower quality, i.e., with skin blemishes or overripe but still suitable for pulp extraction. In Rajshahi and Natore Districts, they employ 53 beparis; each one supports about 150 growers who are subdivided into smaller groups of around 25. The Bepari is paid a commission as well as a retainer. PRAN’s bepari’s have a wider role as they are expected to provide growers with advice on good agricultural practices and company specifications including quality and safety requirements. When the fruit is delivered to the factory, all crates are labelled with the growers’ name as well as the weight for payment. In the event of a quality or food safety problem the ultimate trace is back to a group of 15-25 growers via unique reference code. Corrective actions normally involve providing refresher training to the offending grower group focusing on the issue(s) that caused the problem.

**Fresh mango is a seasonal product in Bangladesh** with the season running from April (green mango) and May-August (ripe fruit) each year. To make optimal use of processing facilities companies such as PRAN require a year-round supply of mango pulp. This is achieved by buying an entire years’ supply of fruit during the season. Fresh fruit is washed and then crushed to extract the pulp. The extracted pulp is heat sterilized and then packed into food-grade drums under aseptic conditions. Drums of pulp are frozen and stored at minus 20°C in bulk freezers until required for processing. The utilization of the pulping section has been extended by using the same extraction and thermal processing line for pulping of tomatoes (December-February).

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47 An electronic payment system using mobile phone
Bangladesh’s mango production is being held back by its reliance on very old orchards with outdated varieties and unpruned trees. Replanting of orchards is both costly and the farmer losses income for the first 4 or 5 years until the trees start to produce economic yields. Sergeant and Graffham estimated that the average cost to establish a new orchard would be just over US$1,000 per ha; most of the expense is incurred in the first year in the purchase of trees. However, cost-benefit analysis shows that the net cost of establishment would be recovered in year that the orchard was in full production. But in order to achieve these high margins, it would require a high level of management with good technical skills. In order to encourage the modernization of tree crops, grants or loans with deferred repayment periods and perhaps subsidized interest rates could be given to farmers to compensate for lack of earnings in the first few years.

**Main Lessons**
The main observations from the mango value chain include:

- **Adequate local market access but limited international market:** Production and processing of mango is expanding with the majority of sales going to the domestic market. Despite considerable donor support, Bangladesh has had very little success in exporting fresh mangoes, especially when compared to India and Pakistan. There is some potential for further growth of the export market for processed products, but this opportunity will be small compared with the local fresh market.
- **Land fragmentation and low yields:** Production is characterized by small farm sizes, with relatively low yields that are well below commercial expectations;
- **Limited adoption of good agricultural practices.** The main reasons for low yields appear to be old age of the trees, lack of knowledge and application of good agricultural practices; in fact, the management of many of the orchards was very poor. There are significant areas of old trees (>40 years of age) that give poor yields and are too large for implementation of proper pruning and crop protection strategies.
- **Access to improved genetic materials.** The mango sector would benefit from re-planting with new trees, larger sized orchards, adoption of good agricultural practices. The mango industry would benefit if farmers were better informed about improved production and management techniques. Improved information transfer techniques are required to get information on better practices down to farm level.
- **Inadequate fertilizer and pesticides policy.** There is a perception that there is excessive use of pesticides on mangoes; this could be due to the fact that there have been more tests on mangoes, but undoubtedly there is a poor understanding of what farmers spray against; some to the insects on the trees are in fact beneficial and should be encouraged;
5 Moving Forward: Priority Areas of Action

5.1 Recap of Key Challenges

Analysis and discussions in Chapter 2 highlighted market opportunities and potential for productive diversification of the agri-food sector in Bangladesh. With rising incomes, increasing urbanization, and changing diets, the demands for high-value food products are gradually growing and thus, new market opportunities are emerging for a more diversified agri-food sector. Also, agro-climatic conditions and agricultural production systems that are required for agricultural diversification exist in the country. However, the current regime of staple-focused agricultural policies and support is not well positioned to unlock the diversification potential of the sector. The current level of direct (through public expenditures) and indirect (through policies) support for agriculture in Bangladesh is substantial, but the bulk of this support is delivered in a manner that emphasizes paddy rice production and incentivizes overuse of resources. Moreover, modernization of the agri-food value-chain, which is currently largely informal, is important to materialize the untapped potential for increased diversification of the agri-food sector. Therefore, realigning agricultural policies and support is important to promote productive diversification and modernization of the sector.

Discussions in Chapters 3 and 4 have identified constraints and challenges for increased diversification and modernization of the agri-food sector in Bangladesh across the agri-food ecosystem under broad categories: i) On-farm productivity constraints; ii) Off-farm value addition and commercialization constraints; and iii) Cross-sectoral enablers. Major productivity constraints that have been identified and discussed in preceding sections include land fragmentation and informality in land rental markets, limited access to quality seeds for non-paddy crops, limited knowledge and adoption of GAP reflected in imbalanced use and overuse of inputs, and limited use of farmer aggregation models, which constrains the delivery of extension services, accessing finance, and linking with markets. Similarly, some key constraints that prevent off-farm value addition and commercialization in the agri-food sector have been identified and discussed in previous sections. Such constraints include limited number of formal off-takers, inadequate and costly marketing infrastructure and logistic services, inadequate upholding of appropriate food safety practices and product quality standards, and poorly designed export subsidy policy. These productivity, value addition, and commercialization related constraints are exacerbated by other cross-sectoral issues such as access to finance and overall investment climate and competitiveness challenges.

The section below discusses recommendations to increase private investment along the agri-food value chain and promote greater diversification and modernization of the agri-food sector in Bangladesh.
5.2 Proposed Areas of Action

5.2.1 Recommendations for Greater On-farm Productivity

- **Support greater land agglomeration and promote greater formalization of land rental markets with associated longer rental tenures**

For modernization to be successful, it is essential that Bangladesh agriculture achieves economies of scale. However, land fragmentation limits such economies of scale and a well-functioning land market including land rental markets can help to circumvent this challenge. While sales markets of land are functioning well and property rights are clearly defined, the land rental markets remain largely informal and land leasing agreements are short-term in nature. This prevents medium and long-term investments in the land by the renting farmers as tenure security for rented land is limited. This also constrains the ability of these farmers to use land as collateral for financing. Therefore, further review of the agricultural land rental market is important to identify existing market failures that are preventing more prevalent longer-term rentals of agricultural land and to offer private solutions, if possible, in line with the MFD framework, to correct these market failures.

- **Encourage and promote aggregation models to bring economies of scale in operations**

Aggregation models such as productive partnership, contract farming, or producer group, among others need to be encouraged to facilitate the delivery of extension services and improve farmer’s ability to access finance, develop joint infrastructure, lower marketing logistics costs and better connect with large buyers and off-takers. While public extension services can encourage and promote such aggregation models for efficient inputs and service delivery to farmers, the private sector can also lead the organization of such models for improving good agricultural practices, traceability, economies of scale, among others. An assessment needs to be done to determine some of the essential parameters for greater uptake of aggregation models in close concertation with the private sector, in line with the MFD framework. Supporting the development by the private sector of online platforms to connect producers with off-takers or directly with consumers would also contribute to overcoming market linkage challenges.

- **Remove regulatory barriers to private sector participation in seed market and increase the use of quality standards for seeds in the market**

There is a need for reform to remove the regulation preventing private sector actors from breeding and producing seeds for notified crops. There is also a need to increase public, private coordination on quality seed supply for notified crops, and increase market transparency regarding the quality and effectiveness of seeds in the market as a way to drive greater demand for improved genetic materials from farmers, which should in turn encourage the private sector to invest in this field. Both the proposed regulatory change and the improvement in the seeds markets would ideally be developed in close partnership between the public sector and seed producers, importers and distributors from the private sector to ensure targeted market outcomes, again in line with the MFD framework.
- **Develop and adopt good agricultural practices**

Local good agricultural practices (GAP) standards should be developed and adopted through public-private collaboration to address the misuse and overuse of certain inputs like fertilizer and pesticides along with other food safety concerns (see recommendation on food quality standards). Subsequently, GAP should be the key area of focus for both public and private extension service delivery to farmers.

- **Improve access to extension advice through innovations and use of digital technologies**

Improvements to current extension services are needed to get information on new techniques and innovations down to farm level in a usable form. Improved support for DAE extension staff is notably required with regards to updating agricultural knowledge, training curriculum, techniques for training, and the use of new technologies. The introduction of ICTs for extension service delivery is critical to overcome limited resources and to reach most farmers, particularly hard-to-reach farmers in remote areas, which would call for partnerships with private sector actors to enable digital extension service solutions. More public-private collaboration is also important to maximize efficiency of use of available resources, including support to private operators who routinely provide extension advice to farmers, like input suppliers, but who also need to be trained themselves. Increasing public-private coordination in the provision of extension advice would also help facilitate quicker dissemination and demonstration of innovations and technologies developed by the national agricultural research system (NARS).

- **Realign and repurpose of fertilizer subsidy policy**

As discussed above, the current regime of fertilizer subsidy policy appears to be leading to an overuse and unbalanced use of fertilizer, and the policy is also very costly to the state. Thus, there could be an opportunity to redeploy this support to other public good activities that could better assist increases in productivity for paddy rice as well as other crops in a more sustainable way. To rationalize the current fertilizer subsidy in terms of the long-term sustainability of the agricultural sector, a phased approach can be followed to reform the policy on fertilizer subsidy and increase direct support to farmers to improve efficiency of the public support for agriculture and to incentivize farmers in taking market-driven production decision. As a part of the input subsidy rationalization process, a pilot on inputs e-voucher system could be considered to shift production to non-paddy crops, with broader scale adoption being dependent on pilot results.
5.2.2 Recommendations for Greater Off-farm Value Addition and Better Commercialization of Food Products

- **Improving marketing infrastructure and logistics services**

As described in section 3.3, marketing and logistics infrastructure and services are poor and inadequate in Bangladesh, which results in higher cost for actors along the agri-food value chain. The development of marketing infrastructure and logistics services for agriculture supply-chains should be led by the private sector, while policies and incentives could be implemented to support private businesses that are interested to take business opportunities in the development of marketing infrastructure. A public-private partnership (PPP) framework for agricultural marketing infrastructure (such as regional market hubs, cold storages, warehouses, cool chains including railway cool chain) would contribute to giving private sector greater policy certainty and government support for market infrastructure development.

Adoption of a regulatory framework for vehicles and driver standards, who are engaged in the transportation of agricultural commodities, is important to reduce bad practices such as overloading of vehicles. This framework should also seek to reduce unnecessary roadblocks and other logistical impediments for food transportation.

- **Reliable access to energy**

Access to reliable and cost-competitive sources of energy are needed for food processing and cold chain operations along the value chain (e.g. potato seeds). Promotion of renewable energy (e.g. solar energy) along with energy efficient climate-smart agriculture technologies could contribute to a sustainable and modernized agri-food sector alongside other public and private sector efforts to improve access to energy in the country.

- **Improve the food safety regulatory and oversight system and support adoption by the private sector of appropriate food safety practices**

Food safety challenges have greatly penalized Bangladesh’s food markets in the recent past. Despite efforts invested in addressing these issues, compliance monitoring and law enforcement remain weak and irregular. The complexity and overlaps of both the legal and regulatory framework, with many acts, laws and regulations, and the control and enforcement system, with many ministries and agencies in charge, contribute to preventing significant improvements in food safety outcomes in the country. Substantial efforts in streamlining both the legal and regulatory framework for food safety, as well as the control and enforcement system appear needed, ideally in close coordination with the private sector.

Private actors along the agri-food value chain will also need support in complying with food safety rules, once they are clarified.
• **Promote improved quality standards in the market**

There is a need to support the private sector in coming together to develop industry-wide harmonized commercial standards, that comply with minimum legal food safety standards, for both primary production and food processing. Such a private sector-led approach has proved successful in other parts of the world, examples include the UK Red Tractor Standards and British Retail Consortium (BRC) Food Standards. Success would be derived from the public sector supporting the harmonization process, and for the public and private sectors to work together to ensure close linkages and harmony between regulatory requirements and the private standards. The definition of domestic product standards needs to be tailored to domestic market conditions, making sure to protect consumers, while ensuring that value chain actors will be able to eventually comply (i.e. need to avoid “gold-plating”). Different, more stringent standards would probably be needed for export industries.

• **Promote more formal distribution channels**

To promote the development of more formal off-takers such as food processors and supermarkets, the public sector could support increased demand for higher quality and safer food via consumer awareness and sensitization campaigns about the importance and food safety and nutrition. Better enforcement of food safety standards would also encourage more formal distribution channels or encourage informal channels to formalize. Addressing access to finance issues for agribusinesses and aggregation challenges would also help the expansion of food processing alongside improvements in the quality and cost of energy supply and of marketing and logistics infrastructure and services.

• **Repurposing export subsidy policy**

The current export subsidy provision of 20 percent of FOB value does not appear to have led to sustainable competitiveness of horticulture exports. As such, a more in-depth cost-benefit assessment is needed to see how the subsidy could be modified and / or repurposed, especially to help address pre-export competitiveness challenges.

• **Promote public-private dialogue platforms by subsector**

The implementation of most of the recommendations listed above will require close coordination between the public and the private sectors. Platforms and other systems of coordination between private sector actors themselves (such as industry associations, interprofessional bodies) and between the public and the private sectors will need to be supported to ensure this much needed joint work toward unlocking some of the sector’s key constraints.
5.2.3 Recommendations for Other Cross-Sectoral Issues

- **Facilitate access to finance for value chain actors**

Access to finance, particularly access to formal credit, remains a key challenge for agribusinesses and farmers in Bangladesh. Interventions to improve access to finance for agri-food value chain actors could be wide-ranging, from the opportunity to further develop innovative tools like warehouse receipt financing for post-harvest financing to addressing broader issues like strengthening the secured transactions regime or supporting the use of rental land as collateral. Detailed solution areas have been proposed by a recent World Bank report on MSME finance for instance. As for most proposed solution areas coordination among key stakeholders, notably value chain actors and financial institutions, would be needed to implement actionable solutions.

- **Broader investment climate and competitiveness challenges**

As shown in the country’s performance according to the Ease of Doing Business and the Global Competitiveness Index, improvements are needed in the country’s overall investment climate. These challenges notably contribute to limit the inflow of foreign direct investments, which would greatly benefit the agri-food sector in terms of knowledge transfers, structuring of domestic value chains and the ability to target and meet export market requirements.
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Annexes

Table A.1. Pattern of Crop Diversification in Bangladesh and across Divisions between 2014 and 2018

<table>
<thead>
<tr>
<th>Geographic Unit</th>
<th>Simpson Index 2014</th>
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<th>Simpson Index 2018</th>
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<td>0.43</td>
<td>0.75</td>
<td>0.46</td>
<td>0.73</td>
</tr>
<tr>
<td>Barisal Division</td>
<td>0.23</td>
<td>0.88</td>
<td>0.34</td>
<td>0.81</td>
</tr>
<tr>
<td>Chattogram Division</td>
<td>0.31</td>
<td>0.83</td>
<td>0.37</td>
<td>0.79</td>
</tr>
<tr>
<td>Dhaka Division</td>
<td>0.56</td>
<td>0.65</td>
<td>0.62</td>
<td>0.60</td>
</tr>
<tr>
<td>Khulna Division</td>
<td>0.50</td>
<td>0.69</td>
<td>0.53</td>
<td>0.67</td>
</tr>
<tr>
<td>Mymensingh Division</td>
<td>0.21</td>
<td>0.89</td>
<td>0.24</td>
<td>0.87</td>
</tr>
<tr>
<td>Rajshahi Division</td>
<td>0.55</td>
<td>0.66</td>
<td>0.58</td>
<td>0.64</td>
</tr>
<tr>
<td>Rangpur Division</td>
<td>0.46</td>
<td>0.73</td>
<td>0.48</td>
<td>0.71</td>
</tr>
<tr>
<td>Sylhet Division</td>
<td>0.16</td>
<td>0.92</td>
<td>0.18</td>
<td>0.90</td>
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### Table A.2. Commodity balance ('000 metric ton), 2000-2017

<table>
<thead>
<tr>
<th>Commodity</th>
<th>2000</th>
<th>2005</th>
<th>2010</th>
<th>2013</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cereals</strong></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Domestic supply quantity</td>
<td>28,620</td>
<td>31,168</td>
<td>34,399</td>
<td>35,891</td>
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</tr>
<tr>
<td>Export Quantity</td>
<td>1</td>
<td>7</td>
<td>12</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Import Quantity</td>
<td>2,483</td>
<td>2,953</td>
<td>4,606</td>
<td>3,606</td>
<td></td>
</tr>
<tr>
<td><strong>Fruits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic supply quantity</td>
<td>1,476</td>
<td>3,081</td>
<td>4,248</td>
<td>4,021</td>
<td>4,845</td>
</tr>
<tr>
<td>Export Quantity</td>
<td>11</td>
<td>14</td>
<td>26</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Import Quantity</td>
<td>116</td>
<td>90</td>
<td>355</td>
<td>348</td>
<td>403</td>
</tr>
<tr>
<td><strong>Oil crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic supply quantity</td>
<td>1,144</td>
<td>803</td>
<td>907</td>
<td>706</td>
<td>1,051</td>
</tr>
<tr>
<td>Export Quantity</td>
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<td>5</td>
<td>18</td>
<td>29</td>
<td>10</td>
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<tr>
<td>Import Quantity</td>
<td>736</td>
<td>385</td>
<td>447</td>
<td>185</td>
<td>1,023</td>
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<tr>
<td><strong>Pulses</strong></td>
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<td></td>
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</tr>
<tr>
<td>Domestic supply quantity</td>
<td>561</td>
<td>663</td>
<td>1,005</td>
<td>1,072</td>
<td>1,230</td>
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<tr>
<td>Export Quantity</td>
<td>-</td>
<td></td>
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<td>0</td>
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</tr>
<tr>
<td>Import Quantity</td>
<td>178</td>
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<td>785</td>
<td>804</td>
<td>848</td>
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<tr>
<td><strong>Spices</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic supply quantity</td>
<td>257</td>
<td>357</td>
<td>396</td>
<td>430</td>
<td>499</td>
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<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Import Quantity</td>
<td>30</td>
<td>37</td>
<td>86</td>
<td>114</td>
<td>106</td>
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<tr>
<td><strong>Vegetable oil</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic supply quantity</td>
<td>1,109</td>
<td>1,276</td>
<td>1,618</td>
<td>1,818</td>
<td>2,145</td>
</tr>
<tr>
<td>Export Quantity</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Import Quantity</td>
<td>1,114</td>
<td>1,215</td>
<td>1,337</td>
<td>1,672</td>
<td>2,383</td>
</tr>
<tr>
<td><strong>Vegetables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic supply quantity</td>
<td>1,835</td>
<td>2,635</td>
<td>4,265</td>
<td>4,654</td>
<td>6,082</td>
</tr>
<tr>
<td>Export Quantity</td>
<td>7</td>
<td>31</td>
<td>8</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Import Quantity</td>
<td>40</td>
<td>99</td>
<td>584</td>
<td>471</td>
<td>274</td>
</tr>
<tr>
<td><strong>Fish</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic supply quantity</td>
<td>1,623</td>
<td>2,158</td>
<td>3,002</td>
<td>3,063</td>
<td>3,951</td>
</tr>
<tr>
<td>Export Quantity</td>
<td>41</td>
<td>64</td>
<td>103</td>
<td>107</td>
<td>78</td>
</tr>
<tr>
<td>Import Quantity</td>
<td>3</td>
<td>7</td>
<td>70</td>
<td>45</td>
<td>150</td>
</tr>
<tr>
<td><strong>Milk</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic supply quantity</td>
<td>2,451</td>
<td>3,167</td>
<td>3,985</td>
<td>4,283</td>
<td>3,585</td>
</tr>
<tr>
<td>Export Quantity</td>
<td>1</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Import Quantity</td>
<td>314</td>
<td>552</td>
<td>587</td>
<td>752</td>
<td>3</td>
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</table>

Source: FAOSTAT
Table A 3. Regression Results: What are the correlates for crop diversification in Bangladesh?

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number of Crop Categories Grown</th>
<th>Std. Err.</th>
<th>Simpson Index of Crop Diversification</th>
<th>Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of Head</td>
<td>0.001</td>
<td>[0.001]</td>
<td>0.0</td>
<td>[0.000]</td>
</tr>
<tr>
<td>Marital Status: Currently married (Base: Never Married)</td>
<td>0.052</td>
<td>[0.055]</td>
<td>0.030**</td>
<td>[0.014]</td>
</tr>
<tr>
<td>Marital Status: Divorced/Widowed (Base: Never Married)</td>
<td>0.072</td>
<td>[0.078]</td>
<td>0.027</td>
<td>[0.020]</td>
</tr>
<tr>
<td>Head is Male</td>
<td>0.162***</td>
<td>[0.045]</td>
<td>0.037***</td>
<td>[0.011]</td>
</tr>
<tr>
<td>Number of Adult Males in HH (Age 15 to 60)</td>
<td>0.029**</td>
<td>[0.012]</td>
<td>0.0</td>
<td>[0.003]</td>
</tr>
<tr>
<td>Number of Adult Females in HH (Age 15 to 60)</td>
<td>0.006</td>
<td>[0.016]</td>
<td>0.004</td>
<td>[0.004]</td>
</tr>
<tr>
<td>Household Size</td>
<td>0.019**</td>
<td>[0.008]</td>
<td>0.003</td>
<td>[0.002]</td>
</tr>
<tr>
<td>Education: Primary (Base is No Schooling)</td>
<td>0.029</td>
<td>[0.119]</td>
<td>0.019</td>
<td>[0.026]</td>
</tr>
<tr>
<td>Education: High School (Base is No Schooling)</td>
<td>0.032</td>
<td>[0.120]</td>
<td>0.017</td>
<td>[0.026]</td>
</tr>
<tr>
<td>Education: Secondary and Above (Base is No Schooling)</td>
<td>-0.025</td>
<td>[0.121]</td>
<td>0.01</td>
<td>[0.026]</td>
</tr>
<tr>
<td>Live in own house</td>
<td>0.066*</td>
<td>[0.036]</td>
<td>-0.001</td>
<td>[0.010]</td>
</tr>
<tr>
<td>Own Livestock</td>
<td>0.03</td>
<td>[0.028]</td>
<td>-0.020***</td>
<td>[0.006]</td>
</tr>
<tr>
<td>Have Foreign Remittance Income</td>
<td>0.109***</td>
<td>[0.041]</td>
<td>0.002</td>
<td>[0.009]</td>
</tr>
<tr>
<td>Receive Social Transfer</td>
<td>0.038</td>
<td>[0.027]</td>
<td>0.006</td>
<td>[0.007]</td>
</tr>
<tr>
<td>Have Labor Income from Non-farm Activity</td>
<td>-0.156***</td>
<td>[0.033]</td>
<td>-0.024***</td>
<td>[0.008]</td>
</tr>
<tr>
<td>Primary Labor Market Income Source is Non-Agr Activity</td>
<td>-0.118***</td>
<td>[0.034]</td>
<td>-0.023***</td>
<td>[0.009]</td>
</tr>
<tr>
<td>Have Income from Non-farm Enterprise</td>
<td>0.021</td>
<td>[0.025]</td>
<td>-0.001</td>
<td>[0.006]</td>
</tr>
<tr>
<td>Non-Agr. Asset score (Based on PCA*)</td>
<td>-0.011</td>
<td>[0.008]</td>
<td>-0.004*</td>
<td>[0.002]</td>
</tr>
<tr>
<td>Agricultural Asset Score (Based on PCA*)</td>
<td>0.084***</td>
<td>[0.008]</td>
<td>0.011***</td>
<td>[0.001]</td>
</tr>
<tr>
<td>Total Cultivated Land</td>
<td>0.002**</td>
<td>[0.001]</td>
<td>-0.001***</td>
<td>[0.000]</td>
</tr>
<tr>
<td>Sale Agr. Produce in the Market</td>
<td>0.250***</td>
<td>[0.030]</td>
<td>0.071***</td>
<td>[0.007]</td>
</tr>
<tr>
<td>Have Access and Utilize to Irrigation</td>
<td>0.032</td>
<td>[0.034]</td>
<td>0.004</td>
<td>[0.008]</td>
</tr>
<tr>
<td>Access to Machine rental Market</td>
<td>0.199***</td>
<td>[0.036]</td>
<td>0.016*</td>
<td>[0.009]</td>
</tr>
<tr>
<td>Utilized Hired Labor</td>
<td>0.269***</td>
<td>[0.027]</td>
<td>0.044***</td>
<td>[0.006]</td>
</tr>
<tr>
<td>Transport Usage for Carrying Produce</td>
<td>0.321***</td>
<td>[0.029]</td>
<td>0.045***</td>
<td>[0.006]</td>
</tr>
<tr>
<td>Subscribed to Agricultural Loan or Insurance</td>
<td>0.334***</td>
<td>[0.082]</td>
<td>0.055**</td>
<td>[0.022]</td>
</tr>
<tr>
<td>Constant</td>
<td>0.919***</td>
<td>[0.178]</td>
<td>0.076*</td>
<td>[0.039]</td>
</tr>
<tr>
<td>District Fixed Effect</td>
<td>YES</td>
<td></td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Number of Observations</td>
<td>14086</td>
<td></td>
<td>14086</td>
<td></td>
</tr>
<tr>
<td>adj. R-square</td>
<td>0.311</td>
<td></td>
<td>0.277</td>
<td></td>
</tr>
<tr>
<td>F Stats</td>
<td>30.86</td>
<td>0.00</td>
<td>19.9</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Note: Std errors are in brackets. All standard errors are clustered at the Primary Sampling Unit (PSU) level. Significance level can be read as *p<0.05, ** p<0.01, *** p<0.001

Notes: 1) Two other variables (roof materials and types of toilet are used as control variables, but results are not significant and are not reported.

- PCA stands for principal component analysis
### Table A 4. Yield Advantage and Revealed Comparative Advantage of Bangladesh Agricultural Commodities

<table>
<thead>
<tr>
<th>Bangladesh yield/World average yield</th>
<th>Revealed Comparative Advantage (RCA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.67</td>
<td>1.63</td>
</tr>
<tr>
<td><strong>Coconuts</strong></td>
<td><strong>Spices</strong></td>
</tr>
<tr>
<td>487.96</td>
<td>10.52</td>
</tr>
</tbody>
</table>

Source: Authors’ own calculations using FAOSTAT database.