Keynote Paper

Agricultural Transformation in Bangladesh: Extent, Drivers and Implications

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1. INTRODUCTION

Bangladesh agriculture has made remarkable progress in terms of production and diversification towards high value crops and non-crop agriculture over time. All sub-sectors (crop, forestry, animal farming and fisheries) of agriculture have registered substantial growth. Agricultural GDP has increased by 5.6 times since independence. On the other hand, Total GDP has increased by 20.8 times. Per capita income (GNI) has increased by 6.2 times, from 211 dollars to 1,314 dollars. Bangladesh has achieved lower middle income country status in 2015 by the World Bank.

Average growth in agricultural GDP reached 3.5% during the Sixth Five Year Plan (FY2010/11 to FY2014/15), along with exceptional performance during FY2010 and FY2011 (GoB, 2015; p. 289). The achievement of food self-sufficiency is a major milestone for the country. Steady progress with diversification in favour of fish, meat and vegetable production has also contributed to the nutritional improvement. Despite remarkable increase in value of agriculture over the last four decades and particularly during the Sixth FYP, its share has been declining with the expansion of non-agriculture sectors (manufacturing and services) in both urban and rural areas. Share of agriculture to the GDP has declined to 15.6 percent in 2014/15 from 58.4 percent in 1973/74. This transformation is in line with the national economic goal.

Agriculture sector continues to be the largest employing sector in the economy. Number of persons engaged in agriculture, forestry and fisheries has increased from 16.4 million in 1983/84 to 25.7 million in 2010. However, the share of employment in agriculture to the total employment in the country declined to 47.3 percent in 2010 from 51.7 percent in 2002-03. Agriculture sector will play an important role in achieving overall goal of "accelerating growth, empowering citizens" during the Seventh Five Year Plan (FY2015/16 to FY2020/21). Agriculture will be the mainstay for ensuring food and nutrition security, and poverty reduction in the country.

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Broad objective of the study is to analyse the extent and drivers of agricultural transformation in Bangladesh and review the priorities for agriculture sector in the Seventh Five Year Plan. Specific objectives are as follows:

- To analyse the agricultural transformation process, sources of rural livelihood and poverty in Bangladesh;
- To identify the drivers of change in agriculture, income and rural poverty reduction;
- To document the emerging opportunities and challenges for Bangladesh agriculture; and
- To articulate implications of the research findings for development strategies and policies.

Next section (Section 2) analyses transformation in rural economy including changes in rural livelihoods and poverty at the national, district and household level. It has also identified the drivers of change. Emerging opportunities and challenges for agricultural development in Bangladesh are mentioned in Section 3. In light of the ground realities, priorities for agriculture sector and poverty reduction in the seventh plan are reviewed in Section 4. Conclusions are made in the last section (Section 5).

2. TRANSFORMATION IN THE AGRICULTURE SECTOR: NATIONAL, DISTRICT AND HOUSEHOLD LEVEL SCENARIO

2.1 Transformation at the National Level

Agriculture sector has performed remarkably well over the years. Between 1973/74 and 2014/15, agricultural GDP has increased by 5.8 times. Value of agriculture GDP has increased from 5.21 billion dollars to 28.92 billion dollars (Table 1). All sub-sectors of agriculture (crop, livestock, fisheries and forestry) have increased substantially. Crop GDP has increased by 4.4 times, livestock GDP has increased by 5.8 times and forestry GDP has increased by eight times. On the other hand, fisheries GDP has increased by more than six times. During this period, Total GDP has grown by 20.8 times, increased from 8.92 billion dollars to 185.43 billion dollars.

Until the 1980s, share of the crop and horticulture sector to the total Agricultural GDP was slightly less than eighty percent (Figure 1). Forestry contributed about 5.5 percent to the agriculture sector in the early seventies which has gradually increased to about 11 percent in 2014/15. Thanks to the sustained agro-forestry program which has been supported through distribution of saplings, training and agricultural loan support for development of private nurseries in the country. Animal farming particularly poultry, dairy, egg production and animal fattening for meat production has contributed towards many-fold increase in livestock production. Small scale commercial poultry farming has expanded in the periphery of towns and cities. Share of animal farming to the Agricultural GDP has increased from about 7 percent in the seventies to about 11 percent in 2014/15. In the early seventies, fisheries sector contributed about 10 percent which was declining in the seventies and eighties. Since late eighties commercial fish farming started to expand along with new management techniques and new fish breeds developed by scientists. Fisheries sector contributed about 23 percent of the total agricultural

GDP in the recent years. Thus, Bangladesh agriculture has successfully been transformed to a diversified sector in the recent years from mostly crop oriented agriculture in the seventies.

In terms of growth, Bangladesh agriculture performed remarkably well both in the long-term (FY1973/74 to FY2007/08) and in the short term or recent years (FY2008/09 to 2014/15). Total GDP of Bangladesh grew at the rate of 9.72 percent in the recent years against 4.19 percent per annum in the long-term (Table 2). In the recent years, growth in agriculture was 3.71 percent while long-term growth was 2.39 percent. Long-term annual growth in crop, livestock, fisheries and forestry sector was 2.03 percent, 3.26 percent, 3.30 percent and 3.55 percent respectively. On the other hand, annual growth in crop and animal farming GDP in the recent years was 2.67 and 3.71 percent while it was 6.28 percent for fish farming and 5.36 percent in forestry. A comparison of long-term and short-term growth rates of different sub-sectors of agriculture revealed that overall agricultural growth and growth of crop, animal farming and fish farming sub-sector was higher in the recent years. During the Sixth FYP, annual compound rate of growth in GDP from crop and animal farming was 1.68 and 2.78 percent while it was 6.65 percent for fish farming and 5.22 percent for forestry.

Annual growth rates of different sub-sectors of agriculture during the Sixth FYP are provided in Table 3. Annual growth rate in the overall agriculture sector ranged between 1.6 percent in FY2013 and 4.4 percent in FY2014. For crop & horticulture subsector it varied between 0.6 percent (in FY2013) and 3.9 percent (in FY2011). Animal farming experienced annual growth between 2.6 percent (in FY2011) and 3.1 percent (in FY2015). On the other hand, forest and related services had annual growth in the range of 5.0 percent in FY2014 and 6.0 percent in FY2012. Fishing had annual growth between 5.3 percent in FY2012 and 6.5 percent in FY2015.

Crops: Production of food grains and other agricultural commodities have increased by many times. Though there were ups and downs but production of food grains generally experienced an upward trend. Increase in production of food grains was substantial during the last four decades. Total production of foodgrains (rice and wheat) has increased by 3.2 times and average annual production increased from 10.96 million tons in the early seventies to 35.60 million tons in the mid- 2010s (see Table 4). During the same period, total rice production has increased by 3.2 times (from 10.85 to 34.30 million metric tons). Traditionally, Aman rice was the major source of rice in Bangladesh but share of Boro rice to total rice production superseded that of Aman rice since 1998/99. Thus, Bangladesh has experienced a structural shift in its rice production from a largely weather influenced crop to an irrigated crop, which is much more sensitive to the quality of public policy and governance than the vagaries of nature (Deb, 2002). Now, Boro rice contributes about 55 percent to the total foodgarins production against only 18 percent in the early seventies (Figure 2). Wheat production increased from a low base (109 thousand metric tons) until 2000 (1706 thousand metric tons), and then started to decline. In the recent years, wheat production increased to 1302 thousand metric tons.

Despite inter-year fluctuations, production of foodgrains had a sustained growth both in the long-term (FY1969/70 to FY2007/08) and recent years (FY2008/09 to FY2014/15). Long-term annual growth in production of foodgrains was 2.77 percent while it was 1.88 percent in the recent years (Table 4). Long-

term annual compound rate of growth in total rice production was 2.67 percent against 1.66 percent in the recent years. In case of Aman and Boro rice, annual growth in production in the recent years was 1.87 percent and 1.20 percent, respectively. On the other hand, production of Aus rice registered an annual growth of 4.55 percent in the recent years although it had declined annually at the rate of 1.92 percent in the long-term. Wheat production registered an annual growth of 8.87 percent in the recent years. Thus, increased food production in the recent years was possible through increased production of rice in all seasons (Aus, Aman and Boro) and wheat. Slowdown in the growth rate of foodgrains production was linked with market demand and profitability for these commodities as well as for other agricultural commodities.

Maize was not an important crop until the nineties. Maize production increased from about three thousand metric tons in the seventies and eighties to 26 thousand metric tons in the early 2000s. Average maize production has increased to 2216 thousand tons in the recent years (TE2013/14). Increase in maize production was possible due to increased demand for maize for poultry feed and multiple use of maize. Thanks to the new maize hybrids which were marketed mainly through the private companies and NGOs which provide higher profit and scope for growing throughout the year.

Non-Cereal Crops: Production of non-cereal crops has also increased substantially except for sugarcane and jute. Between early seventies and mid-2010s, potato production has increased by 11.8 times (from 827 thousand metric tons to 8,777 thousand metric tons) while vegetable production has increased by 4.2 times (from 803 thousand metric tons to 2,954 thousand metric tons). Spices production has increased by 5.7 times. Tea production has increased by 2.6 times. Total oilseed production in the early seventies was about 274 thousand metric tons which gradually increased to 483 thousand in the mid-eighties and then declined with a fluctuating trend to 333 thousand tons in the late-2000s. In the recent years, oilseeds production has increased to 464 thousand metric tons in mid-2010s. Jute production has declined from 865 thousand bales to 854 thousand bales in the late-2000s. In recent years, jute production has concentrated in some areas and increased to 4.43 million bales. Sugarcane production in the recent years was about two-third of the production in the early seventies. Sugarcane production has declined from 6.9 million metric tons in the early seventies to 4.43 million metric tons in the mid-2010s. Average annual production of pulses was about 259 thousand metric tons in the early seventies which increased until mid-nineties but then declined to 217 thousand metric tons in the late 2000s.Since then gradually increased to 309 thousand metric tons in mid-2010s. Tobacco production has increased in the recent years.

Annual compound rate of growth in production of non-cereal crops is reported in Table 4. Potato production increased by 5.1 percent per annum in the long-term (FY1969/70-FY2007/08) and experienced high annual growth (8.7 percent) in the recent years (FY2008/09-FY2013/14). Vegetable production in the recent years registered 2.5 percent annual growth against 3.3 percent in the in the long-term. Pulses production has increased annually at the rate of 10.6 percent in the recent years. Production of oilseeds increased annually at the rate of 9.2 percent in the recent years. Tea production has increased annually at the rate of 2.4 percent in the long-term and 0.6 percent in the recent years. Bangladesh has experienced consistent decline in area under sugarcane and, thereby, production of sugarcane. Sugarcane

production declined annually at the rate of 0.06 percent in the long-term and 2.5 percent in the recent years. Farmers have shifted from sugarcane to vegetables and fruits in the uplands which provide higher profit.

Livestock: Production of milk, meat and eggs increased substantially. Prior to independence livestock was an integral part of the farming systems but commercial farming for dairy, meat and egg production was limited. Court-yard production was common. Between 1991/92 and 2014/15, milk production has increased to 5.2 times (from 1,352 thousand tons to 6,970 thousand tons), meat production has increased to 12.7 times (from 460 thousand tons to 5,860 thousand tons) (Figure 3). On the other hand, egg production has increased to 7.2 times (from 1,517 million eggs to 10,995 million tons eggs). In the recent years (FY2008/09 to FY2014/15), growth in milk, meat and egg production was 22.9, 32.1 and 15.0 percent respectively. During the Sixth FYP, growth in milk, meat and egg production was 25.7, 32.7 and 16.4 percent respectively.

Rahman, Begum and Alam (2014) analysed the actual headcounts and growth of livestock resources over a period of 60 years period (1949-2008). During this 60 year period, average annual growth in bovine population was 1.0 percent per year and for small ruminants (sheep and goats) it was 5.2 percent. However, the study observed a variable rate of growth between the census periods. High annual growth (7.4 percent) in poultry (fowls and ducks) was observed. The study opined that growth in poultry population was largely due to a combined effect of government's emphasis as well as actions of the non-governmental organisations (e.g., BRAC, Proshika, CARE-Bangladesh) to promote commercial poultry rearing involving mainly women.

Fisheries: During the time of independence, fish cultivation was limited and most of the fish were caught from the water bodies. Fish production registered substantial increase during the last quarter century and exponential growth during the last five years (Figure 4). Bangladesh obtains fisheries from both inland and marine sources. Currently, major source of production in the country is inland fisheries. Marine fisheries are comprised of industrial and artisanal fisheries. Inland fisheries have two main sources of production: capture and culture. Inland open water (capture) fisheries include harvest from river & estuaries, Sundarban, depression (Beels), Kaptai Lake and flood land. On the other hand, inland close water (culture) fisheries include fish production in ponds, seasonal cultured water body, Ox-bow Lake (Baors) and shrimp farms. Between 1988/89 and 2012/13, total fish production increased by 4.1 times, from 841 thousand metric tons to 3410 thousand metric tons. During this period, inland capture fisheries increased by 2.3 times, from 424 thousand metric tons to 961thousand metric tons. Inland culture fisheries have increased by 10.1 times, from 184 thousand metric tons to 1860 thousand metric tons. Production of marine fisheries has increased by 2.5 times, from 233 thousand metric tons to 589 thousand metric tons. In the late 1980s (FY1989), contribution of inland culture fisheries to the total fish production was 21.8 percent which has increased to 54.5 percent in the recent years (FY2013). Contribution of inland capture fisheries has reduced from 50.4 percent to 28.2 percent. On the other hand, contribution of marine fisheries reduced from 27.7 percent to 17.3 percent. According to the FAO Statistics 2014, Bangladesh ranked 4th in capture fisheries and 5th in world aquaculture production (GoB, 2015; p. 318).

Forestry: Increased demand and remunerative prices for forest products (timber, fruits, etc.) has contributed to the increase in agro-based forestry in the country. Forestry GDP has increased annually at the rate of 5.3 percent during the Sixth FYP against long-term growth of 3.6 percent (Table 2).

Performance in Agricultural Trade: Bangladesh has transformed itself from a aid-dependent nation to a trade dependent nation over the last four decades. Value of both agricultural exports and imports has increased substantially over time.

Export of agricultural commodities: In the early seventies raw jute, tea and leather were main agricultural products for exports. Over time it has changed. During the last two decades (FY1996 to FY2015), value of export of primary and processed agricultural products has tripled, increased from 801 million dollars to 2420 million dollars (Figure 5). During this period, export of frozen foods has increased by 81percent while leather export increased by 88 percent. Export of jute and jute products quadrupled, increased from 220 million dollars to 868.53 million dollars. During the Sixth FYP, export of all agricultural commodities increased by 49 percent, from 1622 million dollars in FY2010 to 2420 million dollars in FY2015.

Import of Agricultural commodities: Bangladesh is a net importer of both rice and wheat even in normal years. It is also a net importer of pulses, edible oils, spices, fruits, sugar, milk and milk products. Prior to 1993, private sector was not allowed to import foodgrains. Only government agencies used to import rice and wheat. Since 1993, the government allowed private sector to import foodgrains. Most of the imports of rice and wheat are done by the private sector in recent years (Figure 6 and Table 5). The import of rice has declined in normal years but increases substantially in years of floods and cyclones. Import of wheat has increased in recent years due to (a) decrease in domestic production (b) substantial reduction in food aid and (c) increase in demand for products made from wheat flour in urban areas. During the last two decades, import of pulses, edible oils, spices, and sugar have been on the rise at a rapid rate to meet the growing demand-supply gap. Value of import of all food items in 2014/15 was about 12 times than that of 1993/94 (Table 6). Total import of food items increased from 408 million dollars to 5.104 billion dollars. Compared to 1993/94, value of total import of food grains (rice and wheat) in 2014/15 was 10.4 times while it was 8.2 times for milk & dairy products, 9.8 times for spices and 14.3 times for pulses. In case of oilseeds, import value was 8.9 times and for edible oil it was 13.1 times than that of 1993/94. On the other hand, total value of sugar import has increased from 13 million dollars to 730 million dollars in 2014/15. Increase in import of sugar is also linked with rise of companies in agro-processing sectors and some of the companies also export processed food items. Liberalized import of food grains helped the country to meet the shortfall in domestic production particularly after the floods in 1998 and 2004. During the Sixth FYP, value of import of all food items has increased by 18 percent, from 4326 million dollars in FY2011 to 5104 million dollars in FY2015.

One important objective of the Sixth Five Year Plan (Sixth FYP) was to achieve self-sufficiency in food grains production. Has Bangladesh achieved self-sufficiency in food grains production? Available evidence suggests that the country has been able to produce enough to meet its domestic requirement. If so, then what explains huge import of food grains? As mentioned earlier, import of foodgrains was

mainly done by the private sector in the recent years. During the last three years, the government has not made any commercial import of rice. Import of rice by private sector was linked with lower import parity price in the international market particularly in India and India's policy towards rice export in the recent years. India is the main source of rice imports for Bangladesh because: (a) it is quicker and cheaper to bring rice from India; (b) it is possible for importers to bring in small quantities of rice by road; and (c) India exports parboiled rice, which is preferred by most Bangladeshis (Deb, Hossain and Jones, 2009).Wheat imports have steadily increased over time, with big jumps in the years following natural disasters. Import of wheat was associated with increased demand for wheat products such as wheat flour (atta), super-refined wheat flour (Maida), granulated wheat (Suji) and bakery products (biscuits, cakes, etc.). Demand for such commodities is likely to increase in the future. Thus, it needs to be recognised that Bangladesh has achieved self-sufficiency in rice production and import of rice was driven by other economic factors than inadequate domestic production.

Why rice price is lower in India than in Bangladesh? An analysis of structure of production costs in India and Bangladesh is reported in Table 7. In India, the cost of production is lower than Bangladesh, mainly due to the lower cost of fertilizer (due to high subsidies), irrigation (high subsidies for electricity used in irrigation) and labour. The cost of production is very low in Punjab and Andhra Pradesh, the states that generate most of the marketable surplus in India. In Punjab, the unit cost of production is about 35 percent lower than for Boro rice in Bangladesh, and 30 percent lower than for Aman rice. In the neighbouring State of West Bengal, the cost of production is comparable to Bangladesh.

The above analysis indicates that Bangladesh will not be able to compete with imports from India (Punjab and Andhra Pradesh) mainly due high cost of irrigation, labour and fertilizers for rice production in Bangladesh. Then, what should be our actions in the Seventh FYP? We must have to reduce cost of human labour through development of labour saving rice production techniques through agronomic research, and promoting farm mechanisation; cost of irrigation can be reduced through promotion of cost effective irrigation techniques such as alternate wet and drying (AWD). Increase in rice productivity through cultivation of recently released better rice cultivars can reduce per unit cost of production.

It may be noted here that rising costs for human labour and labour scarcity is not a case for Bangladesh agriculture only. Many countries have faced it before and have successfully dealt with it. We can learn from their experiences. For example, during the late eighties and early nineties, Thailand's economy was growing at a faster rate. Growth in manufacturing and service sector was increasing labour wage and costs of rice production. Thailand being the world's largest exporter of rice faced a lot of challenge in rice production. Until then, Thailand was cultivating rice using transplanting method. Transplanted rice required a lot of labour (117 man-days per hectare) for rice production. Increase in wage had also put a pressure on per unit cost of rice production and, thereby, export competitiveness. International Rice Research Institute (IRRI) in partnership with national research institutes in Thailand successfully developed direct seeded rice production technique. Direct seeding technique accompanied by mechanical tillage, weeding and harvesting operations have reduced labour requirement for rice production to 64 man-days per hectare.

Win-Win solutions for farmers, farm labours and consumers in Bangladesh can be achieved through three complementary ways. First of all, we have to develop and disseminate labour saving rice production technologies. Secondly, farm mechanisation measures and policies must be inclusive and beneficial towards landless labour, smallholder farmers and youth. Third, we have to facilitate integration of farm and non-farm activities in rural areas through development of better infrastructure, transport, storage, credit and market access which will ensure higher employment and income in rural areas and stable supply of rice and other agricultural commodities at a lower price.

2.2 Transformation at the District Level

Crop: At the district level specialization in crop production was observed. Rice and maize are produced all over the country but specialization has taken place for other crops particularly for cash crops, vegetables and fruits. In the recent years, sugarcane production is concentrated in 14 districts (Natore, Rajshahi, Noagaon, Chapai Nawabgonj, Kustia, Meherpur, Chuadanga, Dinajpur, Thakurgaon, Panchagar, Pabna, Sirajgonj, Jamalpur and Sherpur) which produce more than 70 percent of total production in the country. About 85 percent of the total potato is produced in 14 districts (Rangpur, Munsigonj, Bogra, Rajshahi, Joypurhat, Dinajpur, Thakurgaon, Nilphamari, Noagaon, Comilla, Chandpur, Gaibanda, Panchagar and Narayangonj). More than 90 percent wheat is now produced in 22 districts (Thakurgaon, Rajshahi, Pabna, Natore, Faridpur, Meherpur, Dinajpur, Panchagar, Kustia, Rajbari, Chapai Nawabgonj, Noagaon, Magura, Kurigram, Jhenaidah, Chuadanga, Tangail, Gopalgonj, Madaripur, Brahmanbaria, Nilphamari and Jamalpur). About 70 percent of the total jute is now produced in 16 districts (Faridpur, Jamalpur, Rajbari, Kustia, Pabna, Meherpur, Jessore, Chuadanga, Magura, Madaripur, Tangail, Jhenaidah, Narail, Sirajgonj, Shariatpur and Bogra). Vegetable production is spreaded in more districts. Top 10 vegetable producing districts (Tangail, Mymensingh, Jessore, Jhenaidah, Magura, Narail, Chittagong, CoxsBazar, Kustia, and Meherpur) produce about one third of the total vegetables in the country. In case of fruits, top 10 growing districts (Tangail, Rajshahi, Noagaon, Chapai Nawabgonj, Natore, Kustia, Meherpur, Chuadanga, Khagrachari , Bandarban and Rangamati) grow about 45 percent of the total fruit production. Implication of specialization among districts in terms of production of various crops indicate that we have to reorient our support strategy for input delivery, extension services, marketing institutions and storage facilities accordingly. Reorganization of agricultural support system with differential need for different districts will be an important aspect for Seventh FYP.

Livestock: Production of milk, meat and eggs increased exponentially during the last five years. A recent study (Rahman, Begum and Alam (2014) has shown that livestock resources are relatively evenly distributed across regions with one or two exceptions. For example, the highest per hectare availability of livestock unit is in Chittagong and lowest in Chittagong Hill tracts. All regions experienced increase in the stock of livestock over time but at a variable rate, with highest rate of increase is in Chittagong Hill tracts followed by Rajshahi.

Fisheries: Pond fish has emerged as a major source of fish production in Bangladesh. Within a span of less than two decades, total production of pond fish has increased by 5.5 times (from 267 thousand metric tons in 1994/95 to 1,447 thousand metric tons in 2012/13). Detailed analysis of performance in pond fish production at the national and district level was carried out by (Deb, Faruque, Mandal and Sadat, 2016). Performance was measured in terms of growth in pond area and production of pond fish, and share of pond fish to the total fish production during 2001/02-2012/13. The study revealed regional concentration in pond fish production in some districts located in the northern (Panchagarh, Thakurgaon, Dinajpur, Jaypurhat, Bogra and Sirajganj), western (Nawabganj, Rajshahi), south-west (Jhenaidah, Magura, Narail, Jessore), south (Patuakhali and Jhalokathi) and eastern (Brahmanbaria, Comilla, Noakhali, Feni and Chittagong) part of the country. Pond fish production has association with area under fish cultivation, human capital engaged in fish production, fish production technology, access to market and per capita income of the district.

2.3 Drivers of Change at the National and District Level

Several factors have contributed towards agricultural transformation in Bangladesh. These include rapid technological change and more options for farmers created through agricultural research, increased market opportunity, higher level of profit and income. Farmers' aspirations and positive attitude towards change were ably supported through policies, public investment in agriculture and delivery of essential inputs. Development and diffusion of improved crop varieties with useful traits and higher yield and profitability, expansion and better management of irrigation through innovative ways such as introduction of prepaid cards in the Barind region for use of DTWs, effective input (seed and fertilizer) delivery, expanded credit facility for agriculture sector, policy reform and investment in agriculture. Access to input and output markets through better road networks in the country and to the international market through trade policy reform (reduction of tariff rates for inputs and cash incentive for export of vegetables and fisheries products) also contributed towards increase in domestic production and increased availability of food items to the consumers.

Development and Release of New Varieties, Hybrids and Breeds: Bangladesh has released more than 550 modern varieties of 74 different crops developed by the National Agricultural Research Systems in partnership with international agricultural research organizations. These include 92 varieties for rice, 37 varieties for wheat, 25 varieties for maize, 44 varieties for jute, 22 varieties for tomato, 61 varieties for potato and 43 varieties for sugarcane. More than 70 improved varieties were released during last six years (2009 to 2014). Adoption of these improved varieties and hybrids by replacing low-yielding traditional varieties have contributed to increase in yield, reduction in per unit cost of production and increased profitability in farming. Thus, real price of agricultural products declined over time without hampering production incentives for the farmers. Bangladesh released 92 modern varieties of rice and approved another 52 hybrids for cultivation during the Boro season. Currently, more than 95 percent of potato area is under HYVs, all maize area is under hybrids, almost all area under vegetables are under hybrids and HYVs, more than 95 percent area under Boro rice is under HYVs and hybrids while three-

fourth of the area under Aman rice is under HYVs. Improved cultivars were complemented with better crop husbandry practices, efficient utilization of fertilizer and irrigation, and pest management methods. Modern varieties and other inputs, production technologies and knowledge were disseminated to the farmers' field through extension services and other public and private agencies. Fish production has also benefited from supply of quality fingerlings and improved varieties of Tilapia and other fish species. New methods of rearing better quality poultry birds and improved breeds of cattle for both milk and meat production have expanded throughout the country. Livestock production was also supported by the NGOs and private sector companies.

Better access to Technology Related Information: Farmers received better access to technology related information through face to face interaction with extension personnel, agricultural information centres, call centres and knowledge intensive technologies (leaf colour chart, IPM, pollination for Kakrol).

Effective Delivery of Agricultural Inputs: Improved seeds, fertilizer and irrigation are three essential inputs for crop production. Bangladesh has been able to ensure delivery of improved seeds, fertilizer and irrigation. Public agencies like Bangladesh Agricultural Development Corporation (BADC) have increased production and supply of improved crop varieties and hybrids. Private sector is vibrant in supply of HYV and hybrid seeds.

The government has successfully ensured supply of fertilizers. Availability of fertilizer was a problem in the early 1990s and agricultural production for many crops was negatively affected because of lack of fertilizer availability on time. Fertilizer subsidies were reintroduced in 1996, following acute fertilizer crisis in the domestic market during the 1995 Boro season. The government virtually overtook the wholesale distribution from the private sector and started operating a buffer stock in order to stabilize fertilizer prices. The government has introduced heavy subsidy to non-urea fertilizers such as TSP and MP in 2009 to ensure more balanced use of chemical fertilizers, vitally needed to maintain soil fertility (Hossain and Deb, 2010). It has promoted use of balanced fertilizers and increased crop productivity.

The technological progress has been supported by both public and private investments for irrigation, flood control and drainage. The irrigated area has expanded rapidly since late 1980s especially under private investment by numerous farmers in minor irrigation system (diesel operated Low Lift Pumps (LLPs) and shallow tubewells (STWs)) which now account for over 70 percent of total irrigated area. Expansion of irrigation facilities were complemented with the emergence of a water market that provides irrigation service to adjoining plots in the command area, as a result of which the small and marginal farmers who cannot afford to invest in irrigation equipment can now have access to irrigation for cultivation of irrigated Boro rice in the dry season (Hossain and Deb, 2010).

Rapid Actions against Contagious Diseases such as culling of bird to curtail bird flu, vaccination of day old chicks contributed towards rapid growth in poultry production. Release of fish fingerlings into open water bodies and distribution of brood stock to the private hatcheries contributed towards increased fish production. There have been a number of positive changes that are expected to improve fish marketing environment in the country. These positive drivers for fisheries sector include: (i) the shift from

subsistence to commercial fish farming, (ii) emergence of super-markets, and (iii) a changing social attitude towards fish marketing, as it is increasingly considered as a less dishonourable job as was thought in the past (Alam, Palash, Mian and Dey, 2012).

Trade policy reform: The government had also implemented trade policy reforms in case of other inputs such as seed, import of fertilizers and irrigation equipment. The seed market in Bangladesh has dual structure in which major crops such as rice, wheat, jute, potato and sugarcane are classified as notified crops. For these crops variety development, evaluation, maintenance, multiplication, quality control and distribution are done by different public agencies. The private sector's role in the seed business has been restricted to the distribution of non-notified crops, mainly brand name hybrid vegetable seed. In 1999, the government allowed the private sector to import seeds of hybrid rice. During the last one and a half decade, some leading NGOs have been obtaining breeder seeds directly from Bangladesh Rice Research Institute (BRRI) so that they can produce the foundation and certified seeds of rice for distribution. As a result, the marketing of seeds of high-yielding varieties of rice has substantially increased. Private sector has been allowed to import fertilizer from the international market since the mid- eighties. In case of import of diesel engines, import duties were reduced and procedures were simplified. These were accompanied by withdrawal of restrictions on standardization of minor irrigation equipment, especially for shallow tube-wells and low lift pumps. These policy changes led to huge import of diesel engines from China, Taiwan and other low cost exporting countries and massive private investment in minor irrigation system, which now account for over 70 percent of total irrigated area in the country.

Financial inclusion through expanded credit facilities and policy support: Agriculture credit disbursement increased significantly during the Sixth FYP. Annual disbursement of agricultural credit has increased from Taka 6.786 billion in 1982/83 to 85.807 billion in 2007/08. In 2013/14, it has reached to Taka 160.368 billion in 2013/14. Several policy initiatives undertaken by the Bangladesh bank has contributed towards financial inclusion in the agriculture sector particularly during the Sixth FYP. These are: (i) mandatory minimum 25% agricultural lending target for all banks, (ii) government interest subsidy on loans for specified higher value exotic crops and spices, (iii) Banks with inadequate rural branch presence can lend through local micro-finance institutes (MFIs), (iv) credit needs of tenant farmers supported by lending through BRAC, (v) Bank accounts for farmers available at nominal deposits; 10 million accounts opened so far.

Public, private and international investment in agriculture: Public investment in agriculture was substantial which has also stimulated private investment in the country. Public investment also facilitated to harness the potential from investment made by international community through the international agricultural research institutes.

*Profitability and Comparative Advantage in Crop Production***:** Rashid and Deb (2016) has analysed the recent trends (FY2010 to FY20113) in productivity, profitability and comparative advantage in cultivation of 17 major crops grown in Bangladesh using household survey data collected from 503 sample farms located in 12 villages under 11 districts in Bangladesh. These included five cereal crops (Aus rice, Aman rice and Boro rice, Wheat and Maize), Jute, Potato, Lentil, Groundnut and eight

vegetables (Ash gourd, Bitter gourd, Pointed gourd, Brinjal, Cucumber, Cabbage, Cauliflower, Okra). It has showed that cultivation of these crops was profitable at the farm level. Productivity (per hectare yield) of these crops in FY2013, compared to FY2010, increased between 5.6 percent (Aus rice) and 37.3 percent (Groundnut). Per unit cost of production in real terms (USD/ton) reduced for Boro rice, wheat, lentil, potato and maize slightly decreased but it has increased for groundnut during the last four years (FY2010-FY2013). During this period, average per hectare net return (financial profitability) in production of different crops ranged between USD 162 (for Aus Rice) to USD 3,985 (for Brinjal). Per hectare net return from wheat and maize was higher than rice grown in any season (Aus, Aman and Boro). Net return was higher from cultivation of vegetables but there was fluctuation in prices. The study added that Bangladesh has comparative advantage in production of Aus rice, Aman rice, Boro rice, wheat, maize, lentil and groundnut at import parity price implying that increased domestic production of these crops can reduce import of these crops. On the other hand, Bangladesh has comparative advantage for production of jute, potato, and vegetables (Ash gourd, Bitter gourd, Pointed gourd, Brinjal, Cucumber, Cabbage, Cauliflower and Okra) at export parity prices indicating that these crops can be grown not only for domestic consumption but also for export to the international market.

2.4 Transformation at the Household Level: Insights from Panel Data 2010/11-2014/15

Changes in cropping pattern: Cropping pattern among the rural households was mainly rice dominated in the rainy season (Figure 7). There was not much change over the last five years. In the post-rainy season, there was increased production of vegetables, oilseeds, pulses and other high value crops (Figure 8). More than 60 percent of the total cropped area in the post rainy season was now under cultivation of non-rice crops among the VDSA Panel households in 2014/15.

Sources of Rural Livelihoods: Household Incomes were computed for all farm and non-farm sources for all VDSA panel households for the last five years. Farm income sources include crop, livestock, fish and farm labour. Non-farm income sources include service, business, non-farm labour, caste occupation, remittances and rental income. Between FY2010/11 and FY2014/15, average per-capita income increased by 38 percent (from USD 325 to USD 448) (Figure 9). Income sources have diversified. Increased dependence on non-farm sector as sources of livelihood amongst the VDSA Panel households was observed. Increase in income among the VDSA Panel households was associated with expansion of irrigation facility, adoption of modern varieties, accumulation of agricultural and non-agricultural capital, access to agricultural credit, market access through better roads and infrastructure, educational attainment, and expansion of rural non-farm economy (Table 8). Migration within country and outside country has also played an important role for increase in household income.

Agriculture continues to play an important role and contributing more than 40% average income of all rural households and more than 80% for farm households. Wide variation exists in per capita income across villages. Per capita income increased rapidly in the villages which has experienced technological

change, better market access and accumulation of new income generating assets expansion of non-farm sectors (Deb, Bantilan, Pramanik and Khan, 2015).

Poverty among Rural Households: The Sixth Plan sought to reduce head-count poverty from 31.5 percent in 2010 to 22.5 percent by 2015. Unfortunately, the last Household Income and Expenditure Survey (HIES) was done in 2010. Since there is no survey based evidence on what has happened to poverty since 2010, projections are made in the Seventh FYP based on relationship between GDP growth and poverty reduction during the two most recent years for which HIES data are available: 2005-2010. This aggregative elasticity of poverty reduction with respect to GDP assumes unchanged consumption-GDP relationship and unchanged income distribution (GoB, 2015, p. 8). The projected decline made by the Planning Commission in poverty is shown in Table 9. The incidence of poverty and extreme poverty both exhibit considerable reduction, with faster progress in the reduction of extreme poor. The incidence of poverty falls to below 25 percent while that of extreme poverty declines to below 13 percent. In other words, during the Sixth FYP average annual reduction in poverty was approximately 1.4 percentage points while it was about 1.0 percentage point for extreme poverty.

To answer the question, "What has happened to rural poverty reduction?", we have analysed the VDSA Panel Household Survey data collected from 500 households located in 12 villages of 11 districts in Bangladesh during FY2011 to FY 2015. The study villages are located in different agro ecological zones (favourable, drought prone, flood prone) and socio-economic condition. Therefore, we shall be able to get pretty good insights from this analysis particularly about rate of poverty reduction in rural areas and factors associated with poverty reduction in rural areas. These would also allow us about identifying intervention strategies and action points for poverty reduction in the future. However, these are not nationally representative samples; therefore, we should not use the estimates to tell about the extent of poverty in the country.

We have used the Head Count Ratio to measure the extent of poverty among sample households. FAO norm based calorie intake method was used for calculation of poverty line. Poverty Line represents cost of balanced food basket that provides 2,110 calorie per person per day plus provision for non-food basic needs on the assumption that 70 per cent of the poverty threshold level income is spent on food. Extent of poverty among sample households decreased from 41.4 percent in FY2010/11 to 27.6 percent in FY2014/15 (Figure 10). Average annual reduction in poverty among VDSA Panel Households was 3.45 percentage points. Rapid reduction in poverty among the sample households were linked with increased per capita income along with low food inflation and especially with lower rice price during the Sixth FYP. Relationship between per capita income growth, increase in rice price and rate of poverty reduction among VDSA Panel Households is depicted in Figure 11. Poverty reduction rate was higher in FY2014/15 even though income growth was relatively lower than that of other years. It was possible mainly because of more than 20 percent decrease in rice price compared to the previous year. Therefore, Seventh FYP must have to prioritise actions towards keeping lower level of food prices in general and rice prices in particular.

Employment and Wages in Rural Areas

Labour force has expanded in the country over the years. Number of persons engaged in agriculture, forestry and fisheries has increased from 16.4 million in 1983/84 to 25.7 million in 2010. Share of employment in agriculture to the total employment in the country declined from 51.7 percent in 2002-03 to 47.3 percent in 2010. Absorption capacity of the agriculture sector for increasing labour force has weakened with decline in per capita land availability. But, employment opportunities have expanded in non-farm enterprises. High mobility of rural population away from farming to nonfarm activities was observed in recent years. About three-fifth of the VDSA households were employed in non-farm activities and about 60 percent of the income of the households was from nonfarm sources. Real wages for agricultural and non-agricultural labourers increased continuously over the last three decades but it grew rapidly during the last 10 years. Daily real wage of agricultural workers has increased from Taka 19.58 in the early eighties (1983-84) to Taka 72.23 in 2003. It has further increased from Taka 135.67 in 2008 to Taka 262.93 in 2014. Daily real wage of agricultural labour increased from 3.51 kg in 1990/91 to 5.77 kg in 2002/03. Then, it declined to 4.96 kg in 2007/08 during the time of price hike (Shahabuddin and Deb, 2011). Real wage was about 8 to 10 kg rice in the recent years (Talukder et al. 2015).

How did farmers respond to the rising wages in agriculture?

Farmers have dealt with the rising wages in agriculture through replacement of human and bullock labours for some operations such as tillage, harvesting and threshing, and thus reduced use of human labour for production of major crops on a per hectare basis, For example, in the late eighties (1988) for production of HYV rice in a hectare of land would require 104 man-days which has reduced to 52 man-days in FY2013/14 (Table 10). During the same period, per hectare labour use reduced in production of wheat (from 69 to 35 man-days), jute (from 104 to 74 man-days), pulses (from 41 to 26 man-days), oilseeds (from 59 to 33 man-days), sugarcane (from 135 to 77 man-days) and potato (from 116 to 84 man-days). In addition, farmers are also using weedicide to control weeds. Spread of education and expansion of information through extension services, print and electronic media has also facilitated promotion of labour saving and knowledge intensive technologies and crop husbandry practices.

2.5 Impacts of Change

Marketing Margin—Farmer's Share to the Consumers Taka: The marketing margin (the difference between what consumers pay and what farmers' receive) is a good indicator about farmer's share to the consumers Taka. It varies across agricultural commodities and also includes costs of marketing. A review of marketing studies revealed that vegetable farmers received 51.1 percent of the price paid by the consumers in Dhaka while Paikers received 20.1 percent, Aratdars received 1.9 percent and Retailers got 26.5 percent of the payment made by the consumers of summer vegetables (Deb and Bairagi, 2014).

Alam, Palash, Mian and Dey (2012) studied the overall fish marketing system of Bangladesh with particular emphasis to the extent of value addition during the process of marketing of rohu, catla, pangas, tilapia, hilsha and shrimp. Farmers' share of the consumers prices for different fishes seem to be reasonable except for hilsha fish. Farmers received 67%, 72% and 76% share of the consumer's Taka for

major carp-pangas-tilapia, shrimp (overseas value chain) and shrimp(domestic value chain) respectively. However, for hilsha, the major share (46%) of consumer Taka goes to Mahajon, and fishermen receive only 31%.

Food Consumption and Nutrition: Increased domestic production and liberalized import of foods has increased per capita availability as well as consumption of food items. Household Income and Expenditure Surveys (HIES) conducted by the Bangladesh Bureau of Statistics in various years revealed that per capita daily intake of foodgrains has decreased from 509 grams in 1991-92 to 442 grams in 2010. During the same period, per capita daily consumption of vegetables has increased by 19 grams (Figure 12). Meat consumption was doubled (increased from 12.8 grams to 25.8 grams). Milk consumption increased by 75 percent (from 19.1 grams to 33.7 grams). On the other hand, fish consumption has increased by 15 grams (from 34.5 grams to 49.5 grams). In 2010, fruits consumption was about 2.5 times than that of early nineties (increased from 16.9 grams to 44.7 grams). Consumption of edible oils was doubled (increased from 10.1 grams to 20.5 grams). Per capita consumption of poor and well-off increased both in rural and urban areas. Though per capita consumption has increased but there are significant differences in food consumption between the poor and well-off households. According to the Poverty Monitoring Surveys, poor households consumed about 25 percent less food in term of quantity and about 20 percent less in terms of calories, compared to the well-off households at the national level. Hence, economic access to food by all, particularly for the poor people of the country is indeed a major concern. Another pertinent concern is stability in food consumption particularly during rapid increase in price and during the time of natural disaster.

Trends in Hunger Index: The Global Hunger Index (GHI) is a comprehensive measure to track hunger globally and by country and region (IFPRI, 2015). International Food Policy Research Institute (IFPRI) calculates the GHI each year. *Hunger* is usually understood to refer to the distress associated with lack of food. The Food and Agriculture Organization of the United Nations (FAO) defines food deprivation, or undernourishment, as the consumption of fewer than about 1,800 kilocalories a day—the minimum that most people require to live a healthy and productive life. In the IFPRI GHI Report, "*hunger*" refers to the index based on the four component indicators. Taken together, the component indicators (undernourishment, child stunting, child wasting, and child mortality) reflect deficiencies in calories as well as in micronutrients. Thus, the GHI reflects both aspects of hunger (food deprivation and malnutrition). *Malnutrition* refers more broadly to both under-nutrition (problems of deficiencies) and over-nutrition (problems of unbalanced diets, which include consuming too many calories in relation to energy requirements, with or without low intake of micronutrient-rich foods).The GHI ranks countries on a 100-point scale. Zero is the best score (no hunger), and 100 is the worst, although neither of these extremes is reached in practice.

Hunger index in Bangladesh has consistently declined from 52.2 in 1990 to 31.0 in 2005 and then to 27.3 in 2015 (Table 11). During the last 10 years reduction in hunger condition was 3.7 points. It implies that in the early nineties one out of two persons was in the "hunger" condition. On the other hand, one out of four persons was in "hunger" condition in the 2015. This is a significant achievement. However,

we have to do a lot more for eradicating hunger from the country and ensuring food security for all in all times.

Factors Affecting Food Security: National and household level food security in Bangladesh is affected by a number of factors including the performance of the agriculture sector, especially the incidence of natural disasters such as floods, droughts and cyclones, flow of remittances and trade policies pursued by trading partner countries. Both availability and consumption of food items increases during the normal and good production years. On the other hand, natural disasters directly affect household food security status by undermining their asset base and, indirectly, through a loss of employment opportunities, an increase in health expenditure and also an increase in necessary food expenditure (WFP, 2010). International remittances received by Bangladesh have reduced the incidence and severity of poverty in the country by 6 percentage point (Adams, 2005). Non-Government Organizations (NGOs) in Bangladesh have contributed towards achieving household food security through increasing food availability, providing economic access to food, enhancing food utilization and stability over time. Liberal export policies along with low prices in the international markets have helped to enhance its food security situation particularly during the time of floods in 1998 (Dorosh et al. 2003). However, high and volatile prices in the international market accompanied by restrictive and unpredictable export policies of the major exporting countries in the late 2000s had adverse impact on the food security situation in Bangladesh.

3. EMERGING OPPORTUNITIES AND CHALLENGES

3.1 Opportunities

There are multiple opportunities for increasing agricultural production, enhancing food security situation and eradicating hunger during the Seventh FYP. These include:

Promotion of nutritious crop cultivars and production technologies for higher yield, resilience and better nutrition: In the recent years, Bangladesh has released a number of crop varieties tolerant to salinity, drought and submergence. Expansion of nutritious rice varieties (BRRI dhan62, BRRI dhan 64 and BRRI dhan72) can contribute towards nutrition security. Research on Vitamin A rich 'Golden Rice' is in the final stage which can solve the problem of vitamin A deficiency related problems particularly for mothers, pregnant women and children. Introduction of System of Rice Intensification (SRI) has also the potential for reduction in cost and increase in yield. Special efforts should be made to promote SRI technology. Promotion of salt-tolerant rice varieties (BR 23, BRRI Dhan 41, BRRI 47) and submergence tolerance varieties (Swarna Sub2) will enhance resilience against vagaries of nature.

Water management and improved crop husbandry practices: Efficiency of water used for irrigation is low in Bangladesh. Scientists have already proved that adoption of alternate wet and dry (AWD) irrigation technology for Boro rice cultivation can save 25 percent irrigation water and also save energy (electricity, diesel) without reducing the yield level. Therefore, special efforts should be made to promote AWD instead of current practice of constant irrigation with standing water in the field.

Integrated soil fertility management program: Promotion of adequate and balanced fertilizer use can contribute towards achieving high yield goals and increase production substantially (Karim 2008). Newly approved organic fertilizers provide a good opportunity for soil fertility improvement but quality control would be a challenge.

Input delivery for livestock and fisheries sector through private sector: Development of a vibrant private sector over the last three decades for delivering inputs for fish farming and animal farming is strength for non-crop farming in the country. Government should encourage private investment in livestock sector but quality assurance of day old chicks, drugs, vaccines, feeds, and breeding materials through legal and regulatory framework is necessary for sustainable development of the livestock sector (Rahman, Begum and Alam, 2014).

Boosting agricultural trade and addressing technical barriers to trade: Cash incentive had positive contribution to the export of frozen shrimp/prawn, frozen fish and vegetables (Deb and Bairagi, 2014). It had also contributed to the income of shrimp farmers, fish farmers and vegetable farmers. Cash incentive had positive impact on labour employment particularly for labour engaged in production and processing of exported shrimp, and production of fish and vegetables. Bangladesh has been facing the challenge of ensuring safe food and compliance to sanitary and phyto-sanitary (SPS) rules. On these grounds, the country is facing the technical barriers to trade (TBT) for export promotion of some agricultural commodities like vegetables and fruits, and frozen foods for which Bangladesh has comparative advantage. Establishment of the South Asian Regional Standards Organization (SARSO), a specialized body of SAARC, has created new opportunity to develop SAARC standards on the products which are important for Bangladesh's trade. Therefore, SARSO will be able to help Bangladesh to address technical barriers to trade and facilitate flow of goods and services from Bangladesh in the region and to the global market.

Innovative means to reduce risks: Minimizing risk in agricultural production is possible through introduction of effective measures such as insurance in case of any loss occurred due factors which are beyond their control such as floods and cyclones. Price risk can be reduced and farmers share to the consumers Taka can be increased through enhanced market linkage and development of cold storage facilities in the private sector through right kind of policies and regulations.

Converting wastes into wealth: There are several examples of new inventions which have turned wastes into wealth. For example, use of sugarcane bagasse for making of bricks delivered good results. Converting rice husks to rice briskets contributed towards reduction in environmental pollution and solved the fuel problem of rural households. Promoting rice bran oil technology will be good for health and environment. Shrimp and other fish wastes can be converted into fish feed and animal feed. Maize straws can be processed as animal feed. Promotion of vermicomposting will enhance soil fertility. Promotion of biogas for fuel in a large scale would contribute towards energy security. New jobs can be created for the rural youth through such kind of economic activities.

Strengthening ICT based agricultural research and extension service: Adequate support for agricultural research and extension service would be required to achieve higher production. To this end, training and research supports for frontier rice science particularly for bio-technology and hybrid should get priority. Training of extension workers particularly for agricultural officers and assistant officers working at the Upazila and Block level are essential. Use of ICT and electronic media for dissemination of agricultural technologies should be promoted further.

Nurturing young minds for creative ideas and new technologies: Nurturing talented youth population would be the key for steering economic growth in the country. A group of Bangladesh students have utilised sugarcane bagasse (fiber) to make affordable, durable and environment friendly housing material (bricks) for the rural population of Bangladesh. This innovation brought home glory as runners up in the Global Social Entrepreneurship Competition (GSEC) 2014. We can organize such completion on an annual basis and fund for agro-foundation can be used for this.

Designing Social Safety Net Programs: Increased production alone would not be sufficient to ensure food security for the lower income group. Therefore, expansion of safety net programs for poor and vulnerable groups would be necessary. Effective implementation of employment generation schemes during lean season will be beneficial. Based on a nationwide representative household survey for 2009.10 (mid-2009 to mid-2010), Osmani (2014) concluded that the existing system is reasonably progressive in the incidence of benefits but its coverage is limited. The total amount of benefit is not even one per cent of the consumption expenditure of an average rural household. Even for the extreme poor households among the beneficiaries, the contribution of safety net to household consumption was only about 4 per cent and for the moderate poor just 3.4 per cent. Taking the rural population as a whole, the extreme poor households received only 2.2 per cent of their household consumption from safety net programs and moderate poor households received only 1.5 per cent.

Collaboration with SAARC Countries: Ensuring food security is also a challenge for other South Asian countries. Strengthened collaboration for agricultural development among SAARC will benefit Bangladesh. Areas for such cooperation include agricultural research and technology development, technology exchange including exchange of germplasm, variety and breed, crop and animal husbandry practices; capacity building through development of human resources and development of regional facilities to ensure food quality and food safety; regional programmes to control transboundary pests and animal diseases; harmonization of policies and acts (such as protection of plant variety, bio safety protocols, biodiversity and indigenous knowledge); establishment and functioning of the SAARC Food Bank and participation in WTO negotiations in agriculture (Deb, 2006).

3.2 Challenges

Bangladesh has made remarkable achievements during the Sixth FYP period. The goal of "accelerating growth, empowering people" will require attainment of targets for poverty reduction and sustained growth in agriculture sector in the Seventh FYP. To this end, there are number of challenges to be faced.

First of all, maintaining balance between interests of producers and consumers to provide adequate incentives for the numerous small agri-producers and ensure food security of low income group, hard-core poor by keeping agricultural prices at affordable level. Low food inflation particularly maintaining low rice price with adequate profit through increased competitiveness with the global markets including India will largely define the outcomes. **Second** challenge is (also linked with the first) dealing with rising wages, labour scarcity and high costs for irrigation in agriculture. Rising wages have contributed to the income of labour households and contributed towards rapid poverty reduction in the rural areas. At the same time, high costs for labour in rice production made Bangladeshi rice farmers uncompetitive to the Indian farmers. Irrigation costs are high in Bangladesh due to high dependence on diesel operated irrigation system and lack of low cost power sources (e.g., solar and electricity operated pumps), low adoption of efficient irrigation techniques such as alternate wet and drying (AWD) in rice production and micro irrigation (drip and sprinkler) technologies for production of other crops. **Third**, supporting specialization process of districts and regions in production of high value agricultural commodities (potato, vegetables, fruits, fish, shrimp, animal farming) and reduction of price risks. **Fourth**, maintaining soil fertility due to overexploitation of soil nutrient, and inadequate use of organic fertilizers. **Fifth,** address the challenge of climate change through promotion of salinity, drought and submergence tolerant crop cultivars. **Sixth,** ensure safe and nutritious food through maintaining good agricultural production practices and promotion of pest resistant varieties such as Bt Eggplant, and nutritionally rich rice varieties (zinc-rich rice varieties BRRI dhan62, BRRI dhan 64and BRRI dhan72, vitamin A rich "Golden Rice"). **Seventh**, increase export of agricultural commodities to the global market.

4. PRIORITIES AND TARGETS FOR AGRICULTURE IN THE SEVENTH FYP: A REVIEW

To take advantage of the emerging opportunities and also to meet the challenges, a number of priorities must have to be addressed in the Seventh FYP. These priorities are listed below in five categories: (i) for boosting agricultural production, (ii) for reduction in production and price risk, (iii) for enhancing food safety and standards, (iv) for rapid reduction in poverty, enhancing food and nutrition security, and (v) for boosting agricultural exports.

Priority Actions	Critical Need/ Importance	Addressed in the Seventh FYP
For boosting agricultural production		
Productivity enhancement through promotion of newly released crop cultivars	High	Yes
Increase investment for agricultural research and technology exchange	High	Yes
Dealing with labour scarcity and enhance competiveness in rice production through reduction in per unit cost of production particularly for fertilizer, labour and irrigation	Very High	Not explicit
Ensure availability of quality seed, fingerlings, animal breeds and poultry	Very High	Yes
Farm mechanization	High	Yes
Feeds and fodder management	High	Yes
Expansion of credit facilities	High	Yes
Strengthening of ICT-based extension services	High	Yes
Reorientation of agricultural support system to promote revealed specialization of districts in crop, fish farming and animal farming	Very High	No
For reduction in production and price risk		
Technology based weather prediction and forecasting	Very High	Yes
Introduction of crop insurance	Medium	Not Explicit
Promotion of newly released drought, submergence and salinity tolerant crop varieties	High	Yes
For value addition, enhancing food safety and standards		
Promote agro-processing	High	Yes
Diversification towards high value crops	High	Yes
Better market linkage and storage facilities for highly perishable commodities	High	Yes
For rapid reduction in poverty, enhancing food and nutrition security and inclusion of women		
Reduction in real prices of agricultural commodities	High	Not explicit
Increase profitability in crop, fish and animal farming	High	Yes
Mainstreaming women in agriculture	High	Yes
Expansion of social safety net programs	High	Yes
For boosting agricultural exports		
Addressing technical barriers to trade	High	Not explicit
Compliance to safety standards in food production and marketing	High	Yes
Linking famers to the global market through reorientation of Cash Incentive (export subsidy) scheme	High	No

5. CONCLUDING REMARKS

Bangladesh has made remarkable progress in agricultural development and structural transformation has taken place over the years. Production of various agricultural commodities (crops, livestock, fisheries and agro-forestry) has increased and diversified. During the Sixth Five Year Plan period, agriculture sector performed well in terms of agricultural production, addressing the challenges of floods and natural calamities, diversification towards high value crops and non-crop agriculture. Specialization among districts in production of various crops, vegetables, pond fish production, poultry and dairy production was observed. Increased rural credit for farm and non-farm sectors and separate credit program for the tenant farmers with opening Bank Accounts for more than 10 million farmers contributed towards financial inclusion of the rural households. More than 70 new varieties and hybrids of different crops were developed and released along with new breeds for poultry during last six years. In FY2015, compared to FY2010, value of exports of agricultural commodities has increased by 49 percent. During the same period, import of agricultural commodities has also increased by 18 percent. Rural economy has diversified and increased dependence on rural non-farm sector for livelihoods was observed. Based on major sources of income and employment, two types of households, farm and nonfarm, have emerged in rural areas. Farm households depend on agriculture for more than 80 percent of the total income. Along with expansion of rural non-farm economy part-time farming has expanded. Part-time farming is going to increase further in the coming years due low per capita availability of land. Increased production and import of agricultural commodities accompanied by targeted distribution of food under social safety net programs increased per capita availability and consumption of food items by both poor and non-poor households. However, inequality exists between poor and non-poor in consumption of nutritious food items such fruits, vegetables, milk, meat and fish items.

In spite of the remarkable achievements made over the years and particularly during the Sixth FYP, further increase in agricultural production and ensuring food security (physical availability and economic access to food) would continue to be a major challenge for Bangladesh in the coming years particularly due to shrinking resource base, adverse impact of climate change on agriculture sector and overall economy. Future growth in production of agricultural commodities (such as crop, livestock and fish) will depend on agricultural productivity growth. To achieve this, we must have technological breakthrough in agriculture particularly for shifting the yield frontier and development of climate smart (resilient to drought, submergence and salinity tolerant) crops and production technology. In addition, longer-term weather forecasting ahead of the cropping season and agro-advisory services in accordance of the predicted weather will essential.

Integrated development of rural farm and non-farm economy will be the key for prosperity, poverty reduction and economic viability of rural households. Recently developed crop suitability maps by the Bangladesh Agricultural Research Council (BARC) along with revealed comparative advantage (specialization) of districts for production of various crops, vegetables, fruits, fish, milk, meat and egg production should be the basis for targeting, resource allocation and project formulation at the district and upazila level.

Bangladesh must have to rely on its national capacity (available with public institutes, private companies and NGO sector) and strengthen its partnership with international agricultural research centres for achieving the targets to set for food security and agricultural development in the Seventh Plan. To safeguard the food security of poor and low income households, scope and extent of safety net programs should be increased including effective implementation of employment generation schemes. Collaboration with other South Asian countries particularly for effectively tacking trans-boundary pests and diseases (bird flu, avian influenza) and ensuring food safety standard would be needed. Effective functioning of the SAARC Food Bank would be beneficial to reduce the food security risks at the time of disasters. Bangladesh has already achieved the status of lower middle income country status in 2014. We do strongly believe that our leaders supported by professionals, workers and entrepreneurs will be able to translate our dream for a hunger free country by the end of Seventh FYP. Then we will be able to happily celebrate the Golden Jubilee Year of Independent Bangladesh in 2021.

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Table 1: Trends in sectoral composition of the Bangladesh economy, 1973-74 to 2014-15

(Current GDP in Million USD)

Sectors	1973-74	1980-81	1990-91	2000-01	2010-11	2011-12	2012-13	2013-14	2014-15P
Agriculture	5207 (58.4)	5830 (41.0)	8425 (36.0)	11796 (21.9)	21631 (16.8)	21581 (16.2)	23239 (16.3)	26541 (16.1)	28916 (15.6)
Industry	914 (10.2)	2395 (16.8)	3682 (15.7)	12193 (22.6)	32229 (25.1)	33764 (25.3)	39460 (27.6)	45488 (27.6)	51884 (28.0)
Service	2798 (31.4)	6008 (42.2)	11279 (48.2)	27309 (50.6)	68260 (53.1)	70905 (53.2)	80083 (56.1)	92729 (56.3)	104626 (56.4)
Total GDP	8919 (100.0)	14233 (100.0)	23385 (100.0)	53984 (100.0)	128678 (100.0)	133401 (100.0)	142783 (100.0)	164758 (100.0)	185426 (100.0)

Note: Values in the parenthesis indicating percentage and P indicates Provisional.

Source: Bangladesh Bureau of Statistics

Table 2: Annual Compound Rate of Growth of Real GDP (2005-06 constant pieces) of Different Sub-Sectors of Bangladesh Agriculture, 1973/74 to 2014/15

(Percent per annum)

Sectors	1973/74-2007/08	2008/09-2014/15	2010/11-2014/15
Agriculture (A+B)	2.39	3.58	3.06
A. Crop and Forestry	2.33	3.51	2.98
i) Crops & horticulture	2.03	3.10	2.25
ii) Animal Farming	3.26	2.69	2.79
iii) Forest and related services	3.55	5.36	5.33
B. Fishing	3.30	5.79	6.19
Total GDP	4.19	6.12	6.31

Source: Author's calculation, based on data from Bangladesh Bureau of Statistics.

Table 3: Growth Performance of Agriculture Sub-Sectors during Sixth Five Year Plan: FY2011 to FY2015

Particulars	FY2009	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015
Rate of growth (%)							
Agriculture (A+B)	3.14	6.61	3.92	2.40	1.59	4.37	3.04
A. Agriculture and Forestry	4.10	5.56	5.09	2.46	1.47	3.81	2.07
i) Crops & horticulture	2.83	7.57	3.85	1.75	0.59	3.78	1.30
ii) Animal farming	2.35	2.51	2.59	2.68	2.74	2.83	3.10
iii) Forest and related services	5.54	5.34	5.56	5.96	5.04	5.01	5.10
B. Fishing	4.94	4.6	6.69	5.32	6.18	6.36	6.41
Total GDP	5.26	6.04	6.46	6.52	6.01	6.06	6.51
Percent of GDP (%)							
Agriculture (A+B)	20.49	20.30	18.00	17.38	16.77	16.50	15.96
A. Agriculture and Forestry	15.91	15.81	14.27	13.70	13.09	12.81	12.27
i) Crops & horticulture	11.43	11.42	10.50	10.01	9.49	9.28	8.83
ii) Animal farming	2.73	2.65	1.98	1.90	1.84	1.78	1.73
iii) Forest and related services	1.75	1.73	1.79	1.78	1.76	1.74	1.72
B. Fishing	4.58	4.49	3.73	3.68	3.68	3.69	3.69

Source: BBS (2014) Bangladesh National Accounts Statistics: Sources and Methods (Revised estimates from 1995-96 to 2013-14 with base year 2005-06) and GDP of Bangladesh 2014-15(P) download from BBS website in January 2016.

Table 4.Trends in the Average Annual Production of Major Crops: 1969/70 –2014/15

Period	Production (in '000' tons)				Growth Rate (%)		
	1969/70 – 1971/72	1999/00-2001/02	2006/07-2008/09	2012/13-2014/15*	1969/70-2007/08	2008/09-2014/15*	2010/11 – 2014/15*
Cereal Crops							
Total Foodgrains (Rice and Wheat)	10961	25857	29999	35602	2.77	1.88	1.10
Total Rice	10852	24151	29189	34300	2.67	1.66	0.83
Aus Rice	2722	1819	1638	2271	-1.92	4.55	1.74
Aman Rice	6186	10760	10705	13037	1.57	1.87	0.79
Boro Rice	1944	11571	16845	18992	6.48	1.20	0.74
Wheat	109	1706	810	1302	6.47	8.87	9.68
Maize	3	26	992	2216	14.30	24.99	15.96
Non-Cereal Crops							
Sugarcane	6901	6718	5329	4434	-0.06	-2.48	-1.92
Potato	827	3048	5694	8777	5.11	8.65	3.94
Vegetables	803	1560	2664	2954	3.26	2.53	NA
Jute (in Bales)	6193	797	856	5439	-6.90	46.13	57.89
Cotton	10	29	22	31	2.53	9.57	14.01
Tobacco	38	37	40	79	-0.47	15.12	1.47
Total pulses	265	364	217	309	1.41	10.64	14.24
Moong	14	35	19	25	3.72	7.79	8.16
Masur	54	123	83	93	3.55	5.02	19.80
Total oilseeds	257	328	333	464	1.18	9.21	6.77
Rape & Mustard	125	240	215	294	2.35	6.42	6.72
Spices	338	407	1323	1826	2.59	9.33	5.36
Tea	24	50	59	64	2.36	0.60	2.11

Note: * indicates average for 2012/13 and 2013/14 for maize and non-cereal crops and 2012/13 for vegetables.

Source: Author's calculation, based on data collected from Bangladesh Bureau of Statistics and MoA for Maize.

Table 5. Import of Foodgrains in Bangladesh:1990/91-2014/15

(000 m. tons)

Fiscal Year	Food Aid Arrival			GoB Commercial			Private Commercial			Total National Imports		
	Rice	Wheat	Total	Rice	Wheat	Total	Rice	Wheat	Total	Rice	Wheat	Total
1990/91	11	1530	1541	0	37	37	0	0	0	11	1566	1577
1991/92	39	1374	1414	0	150	150	0	0	0	39	1524	1564
1992/93	20	716	736	0	93	93	0	355	355	20	1165	1185
1993/94	0	654	654	0	0	0	74	238	312	74	892	966
1994/95	0	935	935	230	390	620	584	430	1014	814	1755	2569
1995/96	1	743	743	490	351	841	650	200	850	1141	1293	2434
1996/97	10	608	618	9	103	112	15	222	237	34	934	967
1997/98	0	549	549	92	156	249	993	142	1135	1085	848	1933
1998/99	60	1174	1235	348	429	777	2660	820	3480	3068	2424	5491
1999/00	5	865	870	0	0	0	428	806	1234	433	1671	2104
2000/01*	33	459	492	0	0	0	529	534	1063	562	993	1555
2001/02*	9	502	511	0	0	0	118	1162	1280	127	1664	1791
2002/03*	4	250	254	0	0	0	1553	1414	2966	1557	1664	3221
2003/04*	4	285	289	0	29	29	797	1684	2480	801	1997	2798
2004/05*	27	263	290	72	30	101	1196	1786	2983	1294	2079	3374
2005/06	34	160	194	0	103	103	498	1767	2265	532	2030	2562
2006/07	13	109	122	12	79	90	695	1514	2209	721	1700	2420
2007/08	77	162	239	616	272	888	1431	1138	2569	2124	1572	3696
2008/09	35	87	122	396	295	691	187	2031	2218	618	2413	3031
2009/10	3.6	56	60	47	444	490	36.6	2863	2899	87	3362	3449
2010/11	6.2	158	164	1264	776	2040	290.5	2818	3109	1561	3752	5313
2011/12	9	46	55	455	540	995	59	1181	1240	523	1767	2290
2012/13	1	130	131	2	338	340	25	1393	1419	29	1862	1890
2013/14	3	73	76	0	853	853	372	1765	2137	375	2691	3065
2014/15	0	10	10	0	324	324	1490	3450	4940	1490	3784	5274

Note: *including Food Aid wheat receipts for Direct Distribution by World Vision

Source: Bangladesh Food Situation Report (various Issues), FPMU, Ministry of Food.

Table 6: Trends in Imports of agricultural Commodities by Bangladesh, 1993/94-2014/15

In million US$

Food Items	1993/94	1996/ 97	2001/ 02	2006/ 07	2010/11	2011/ 12	2012/13	2013/14	2014/15
Rice	10	28	15	179	835	277	30	345	554
Wheat	141	156	171	402	1085	602	697	1081	1011
Total Foodgrains (Rice and Wheat)	151	184	186	581	1920	879	727	1426	1565
Milk &Dairy Products	37	53	59	83	162	221	214	255	304
Spices	22	10	13	76	126	137	118	181	216
Oilseeds	40	62	72	107	103	180	242	483	354
Edible Oil	117	216	251	583	1068	1650	1399	1612	1535
Pulses (all sorts)	28	54	88	196	291	242	422	424	401
Sugar	13	49	24	295	656	1187	732	822	730
Total Food Imports	408	628	692	1920	4326	4495	3855	5203	5104

Source: Economic Trends (various issues), Bangladesh Bank; converted to US dollar by applying annual average exchange rates.

Table 7: Cost of production of paddy in India and Bangladesh: 2011/12

(USD/ha)

Items	Punjab, India (2010-11)	Andhra Pradesh, India (2011/12)	West Bengal, India (2011/12)	Aman HYV, Bangladesh (2010/11)	Boro HYV, Bangladesh (2011/12)
Seed	27.1	30.5	29.7	26.0	22.8
Fertilizer	61.0	89.5	65.4	84.0	124.6
Manure	5.3	19.2	17.5	16.0	49.8
Pesticides	48.9	31.7	14.4	24.0	11.8
Irrigation	31.1	19.6	40.8	28.0	151.4
Machine rental	27.1	30.5	29.7	95.0	159.0
Animal labour	2.4	11.7	44.1	Nil	Nil
Human labour	224.7	447.7	499.5	320	371.68
Total cost	427.5	680.3	741.2	593.0	891.1
Yield (t/ha)	4.27	5.56	3.91	4.12	5.78
Unit cost ($/ton)	100.1	122.4	189.6	143.9	154.2
Price ($/ton)	228.60	228.60	228.60	230.00	230.00

Source: Authors calculation for Bangladesh, using VDSA Panel Household Survey data. For India, CACP Report, Report On Price Policy For Kharif Crops Of 2014-15 Season (Annexure).

Table 8: Changes in economic indicators among VDSA Panel Households: FY2010/11 to FY2014/15

Particulars	FY2010/11	FY2011/12	FY2012/13	FY2013/14	FY2014/15
Resource Endowments & Human Capital					
Land owned (Acres)	0.46	0.47	0.45	0.46	0.46
Irrigated land (Acres)	0.43	0.44	0.42	0.42	0.42
MV Adoption Rate (%)	73.78	71.99	74.66	74.75	75.12
Household size (Person)	5.40	5.30	5.30	5.30	5.30
Dependency Ratio	0.79	0.76	2.11	2.29	2.28
Agricultural worker (Person)	0.74	0.72	0.68	0.67	0.68
Non-agricultural worker (Person)	1.04	1.04	1.07	1.10	1.11
Total worker (Person)	1.78	1.77	1.75	1.77	1.78
Average education of worker (Years)	7.43	7.19	7.02	7.21	7.25
Assets Ownership and Liabilities and Income					
Per-capita Agricultural capital (USD)	3343	3637	4193	4772	5930
Per-capita Non-agricultural capital (USD)	648	689	834	982	1042
Per-capita Total capital (USD)	3991	4327	5027	5754	6792
Total loan (USD)	322	329	311	303	370
Per Capita Income (USD)	325	384	414	445	448
Farm Income (%)	49.65	49.94	45.63	50.70	39.25
Non-farm Income (%)	50.35	50.06	54.37	49.10	60.74
Poverty Line (Per Capita, USD)	224	214	220	243	235

Source: Author's calculation, VDSA Panel Household Survey Database.

Table 9: Projected Reduction in Poverty during the Sixth Plan Period (%)

Year	Poor (Head Count Poverty with Upper Poverty Line (%))	Extreme Poor (Head Count with Lower Poverty Line (%))
2010	31.5	17.6
2011	29.9	16.5
2012	28.4	15.4
2013	27.2	14.6
2014	26.0	13.7
2015	24.8	12.9

Source: GoB (2015) Seventh FYP, Final Draft (11 Nov 2015). Table 1.4 and Table 2.6

Table 10: Trends in per hectare labour use (days) in crop production, 1988 to 2013

Crop	1988	2004	2007	2010	2011	2012	2013
Rice TVs	72	40	55	54	57	52	36
Rice MVs	104	62	60	55	56	58	52
Wheat	69	50	30	43	39	29	35
Jute	104	82	70	97	83	70	74
Pluses	41	19	20	39	49	27	26
Oilseeds	59	28	28	51	24	36	33
Potato	116	83	115	64	71	76	84
Sugarcane	135	103	85	147	122	111	77

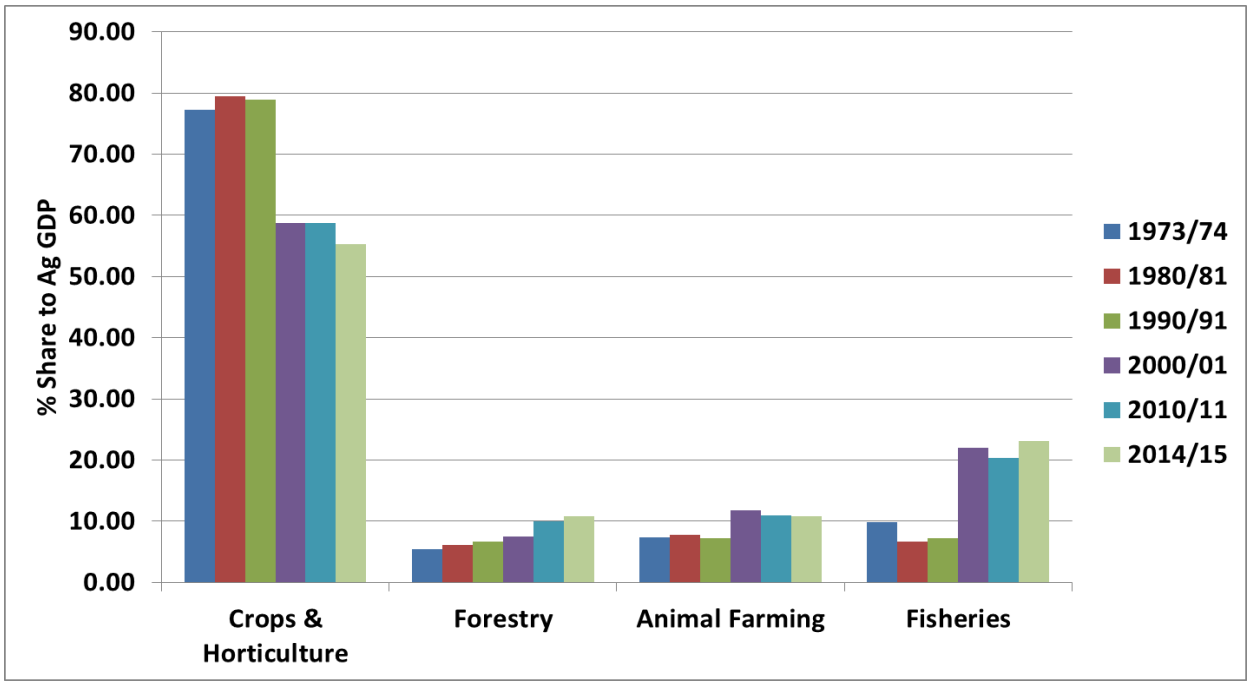
Source: VDSA Household Survey Database.

Table 11: Trends in Hunger Index in Bangladesh: 1990 to 2015.

Year	1990	1995	2000	2005	2015
Hunger Index	52.2	50.3	38.5	31.0	27.3

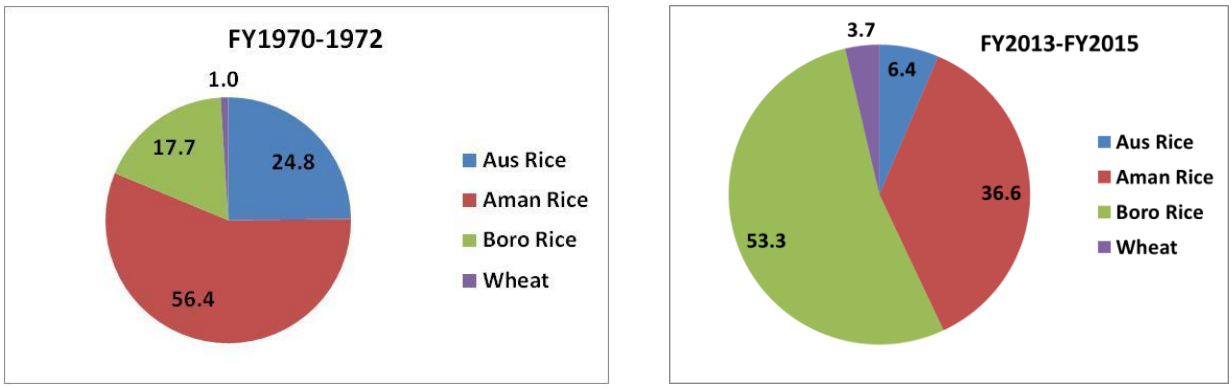
Source: 2014 Global Hunger Index (http://ghi.ifpri.org/countries/BGD/), accessed on 13 January 2016.

Figure 1: Composition of agriculture GDP (% share) : 1973/74 to 2014/15



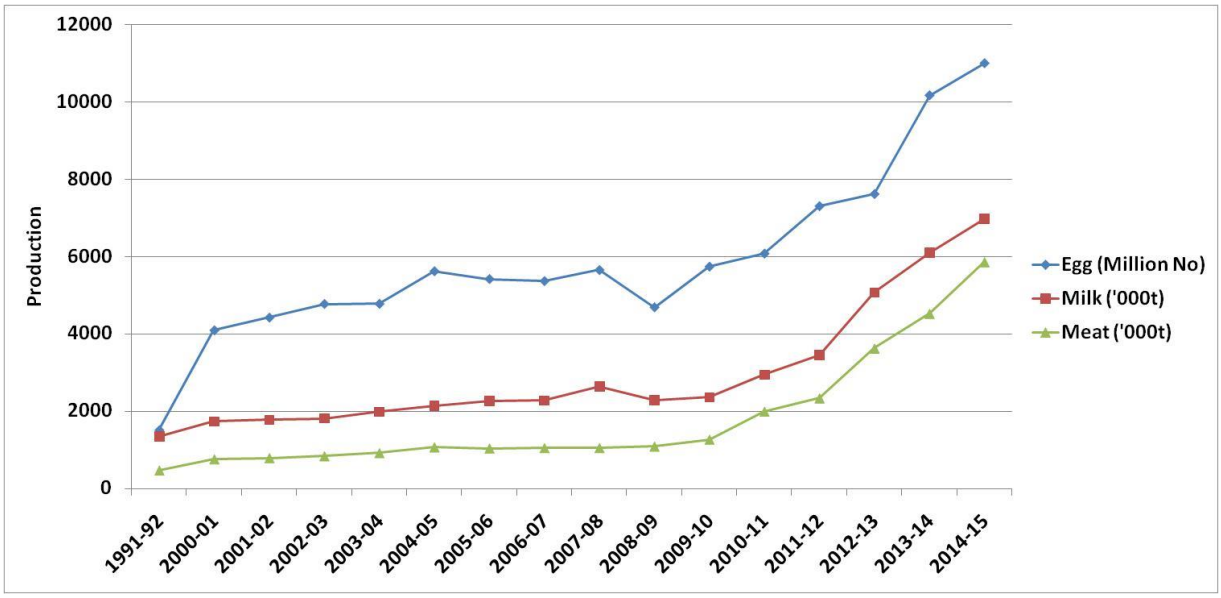
Source: Bangladesh Bureau of Statistics.

Figure 2: Annual foodgrain production and crop-wise contribution: TE1972 vs TE2015



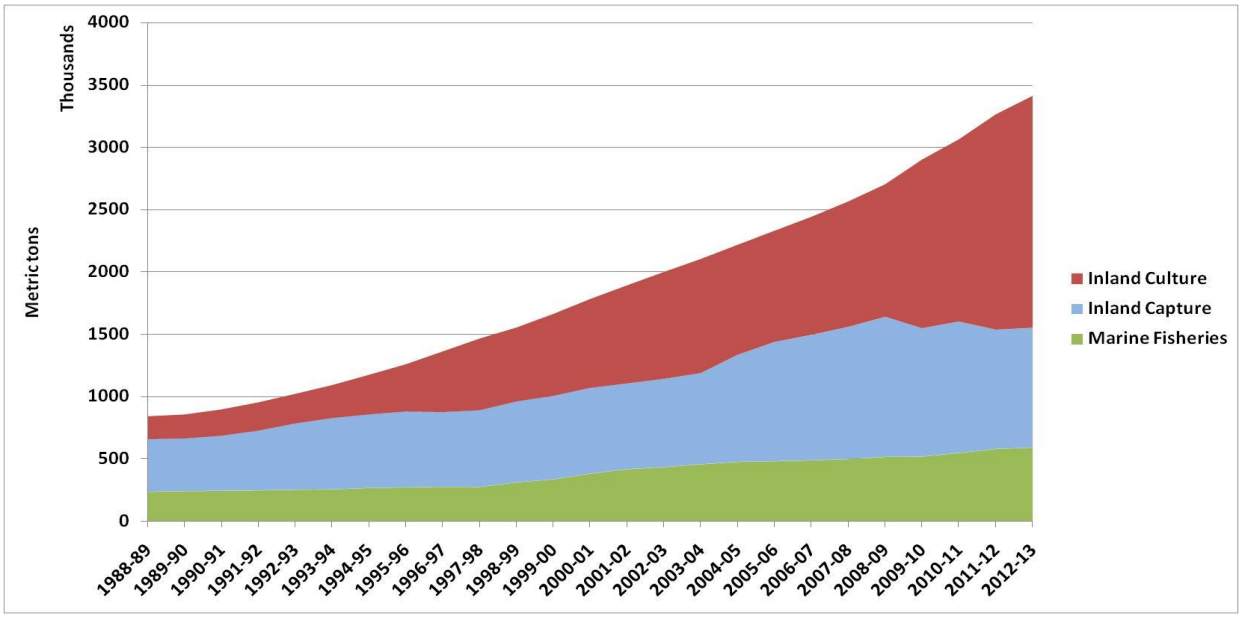
Source: Author's calculation, based on data from the Bangladesh Bureau of Statistics (BBS).

Figure 3: Annual Production of Milk, Meat and Eggs in Bangladesh: 1991-92 to 2014/15



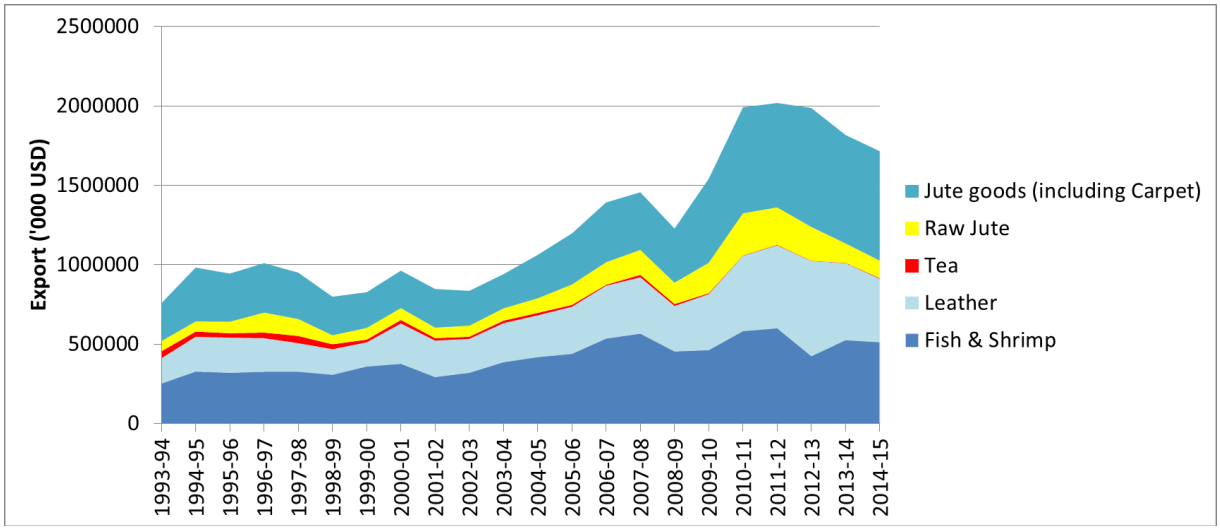
Source: Bangladesh Economic Review (various years).

Figure 4: Annual Fish Production (metric ton)in Bangladesh from 1988/89 to 2012/13



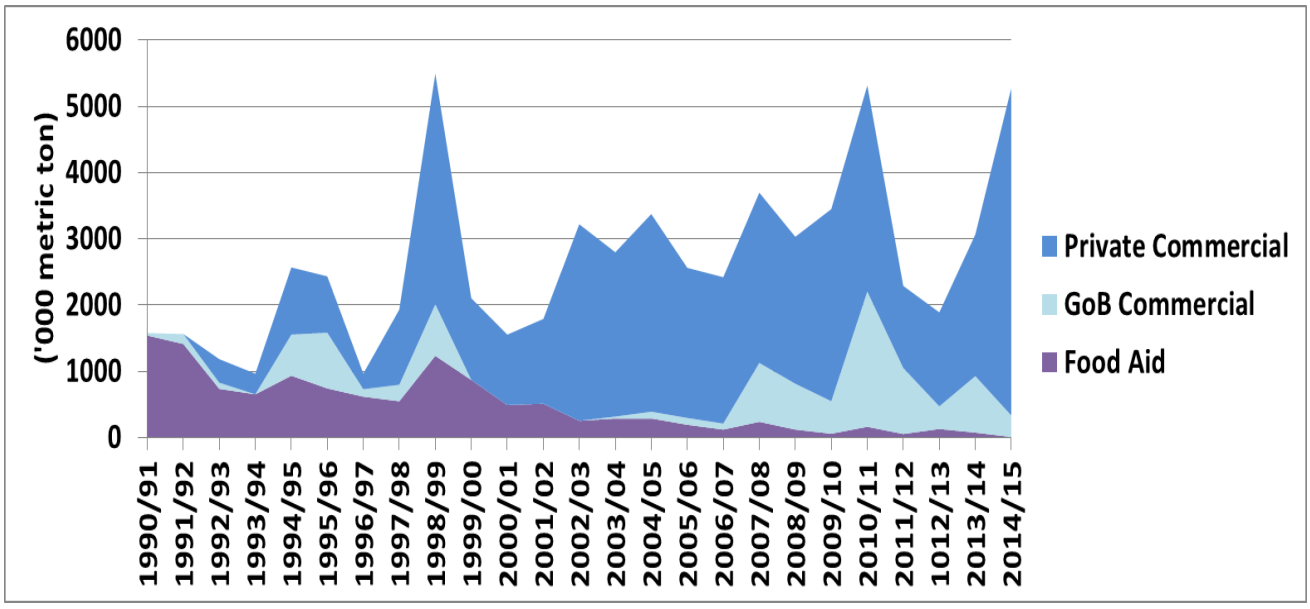
Source: Department of Fisheries, Bangladesh.

Figure 5: Trends in export of selected agricultural commodities by Bangladesh, 1993/94 to 2014/15



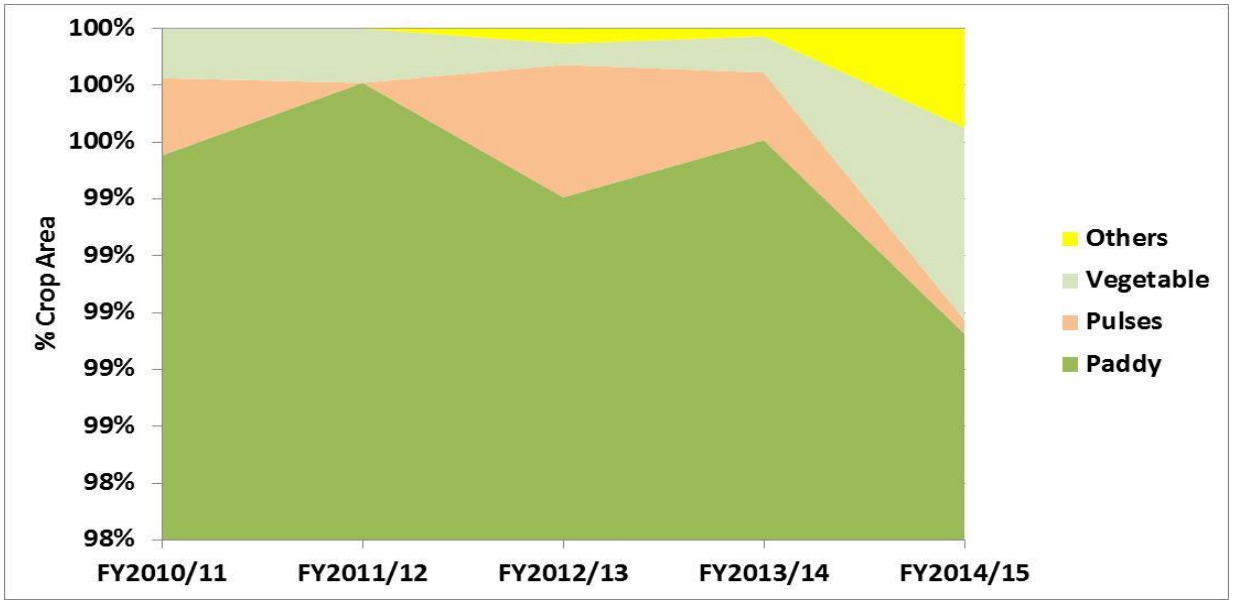
Source: Bangladesh Bank.

Figure 6: Trends in Import of Food Grains (thousand metric tons) by Bangladesh: 1990/91 to 2014/15



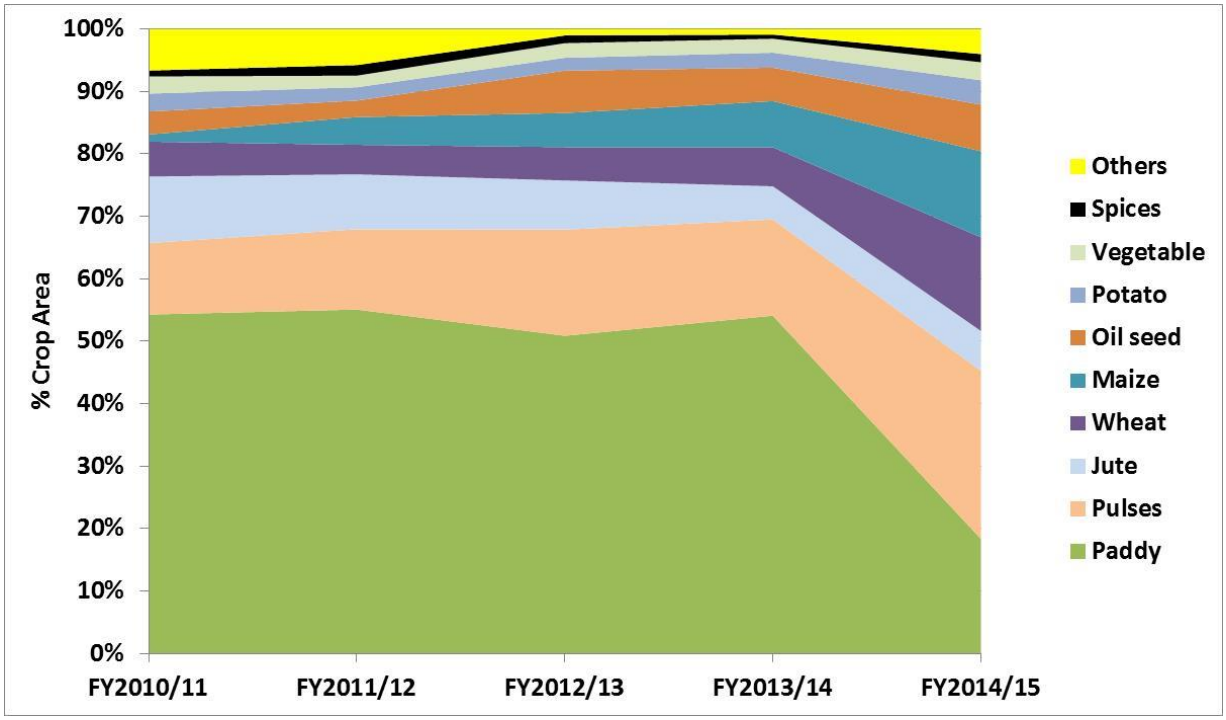
Source: Prepared by the Author, based on data collected from the Directorate of Food.

Figure 7: Trends in cropping pattern in rainy (Aman) season among VDSA Panel Households: FY2010/11 to FY2014/15



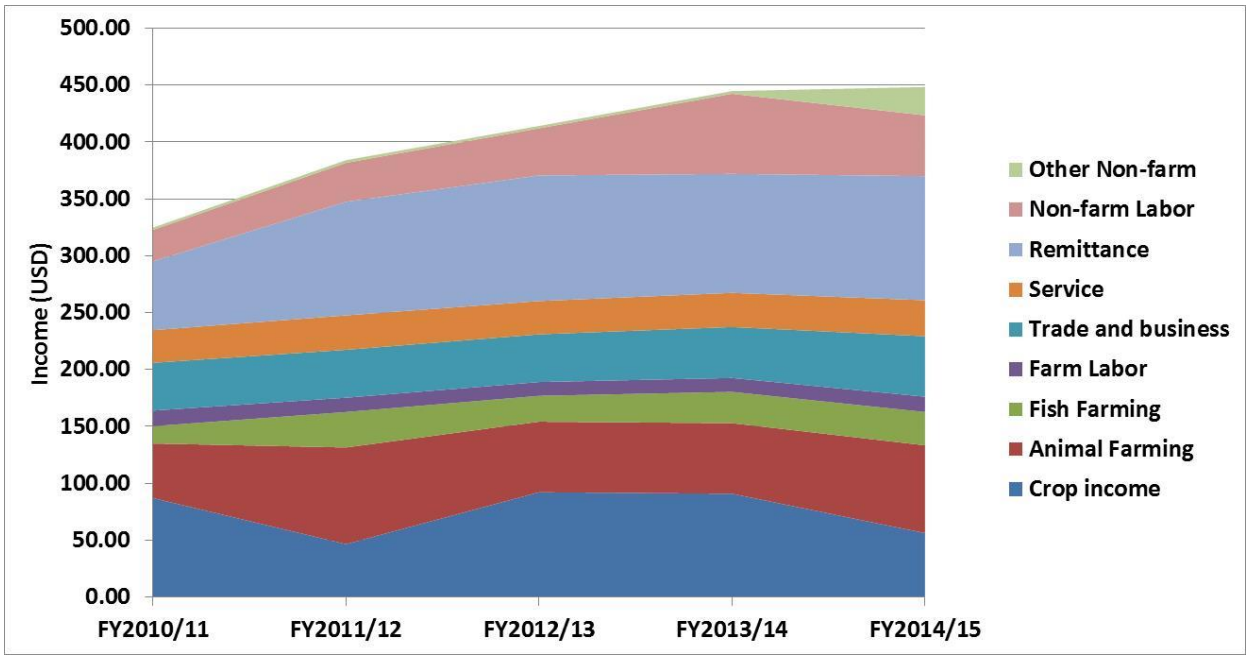
Source: Author's calculation, based on VDSA Panel Household Survey Data.

Figure 8: Trends in cropping pattern in post-rainy (Rabi and Aus season among VDSA Panel Households: FY2010/11 to FY2014/15



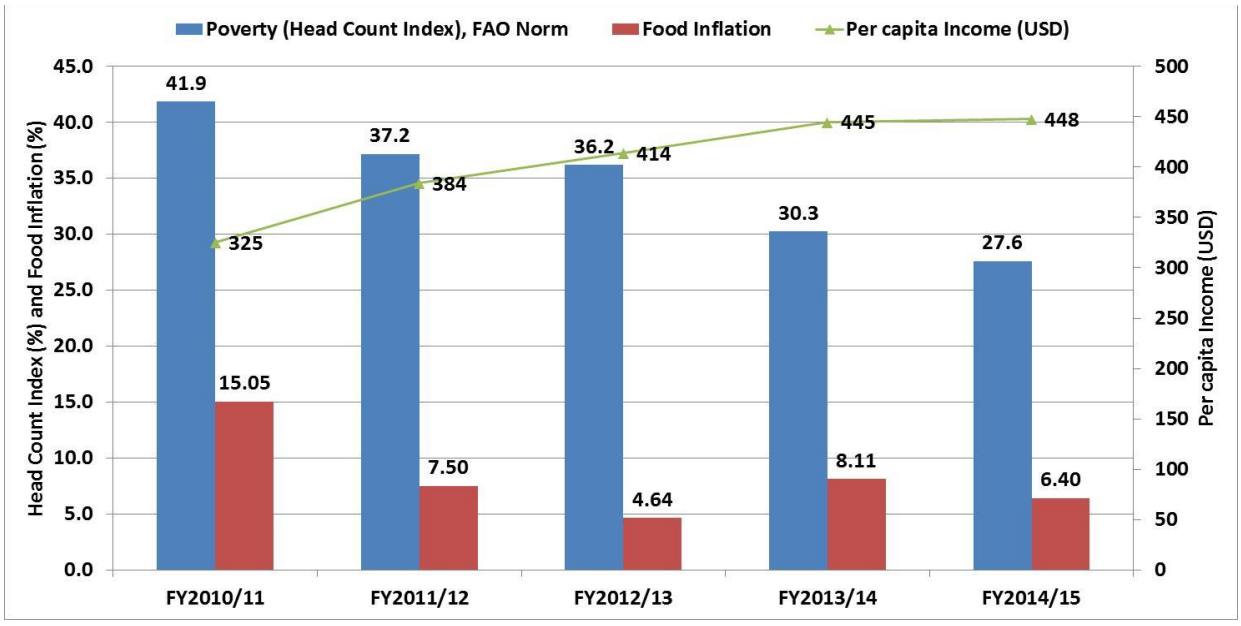
Source: Author's calculation, based on VDSA Panel Household Survey Data.

Figure 9: Trends in per capita income among VDSA Panel Households, by source: FY2010/11 to FY2014/15



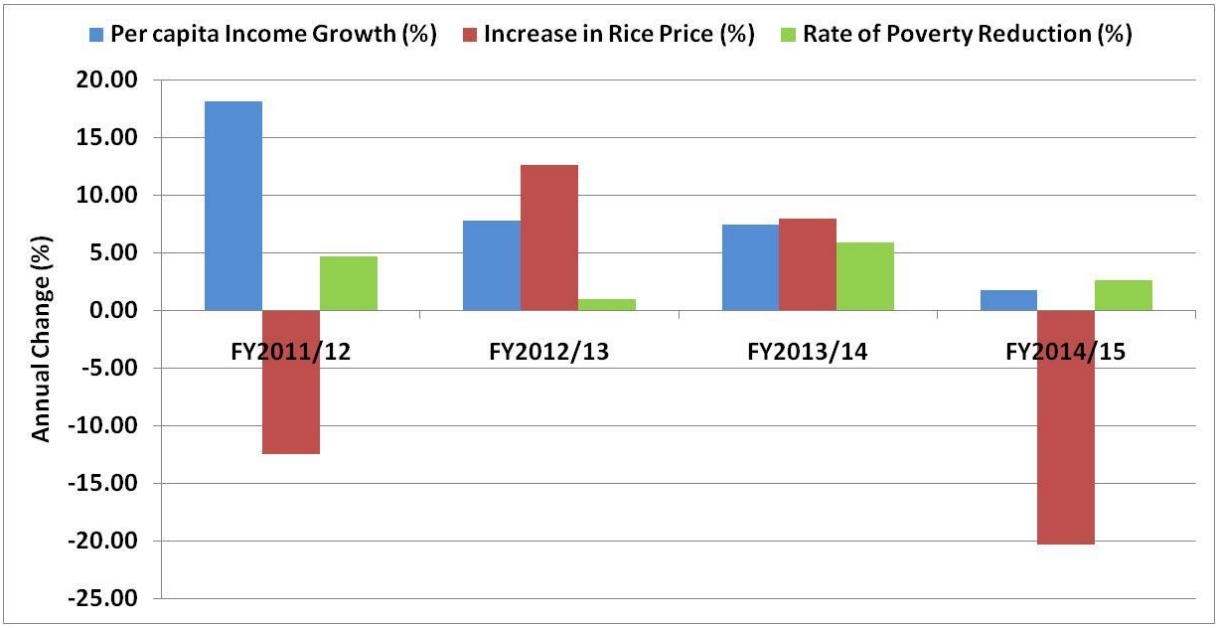
Source: Author's calculation, based on VDSA Panel Household Survey Data.

Figure 10: Trends in per capita income, food inflation and poverty among VDSA panel households: FY2010/11 to FY2014/15



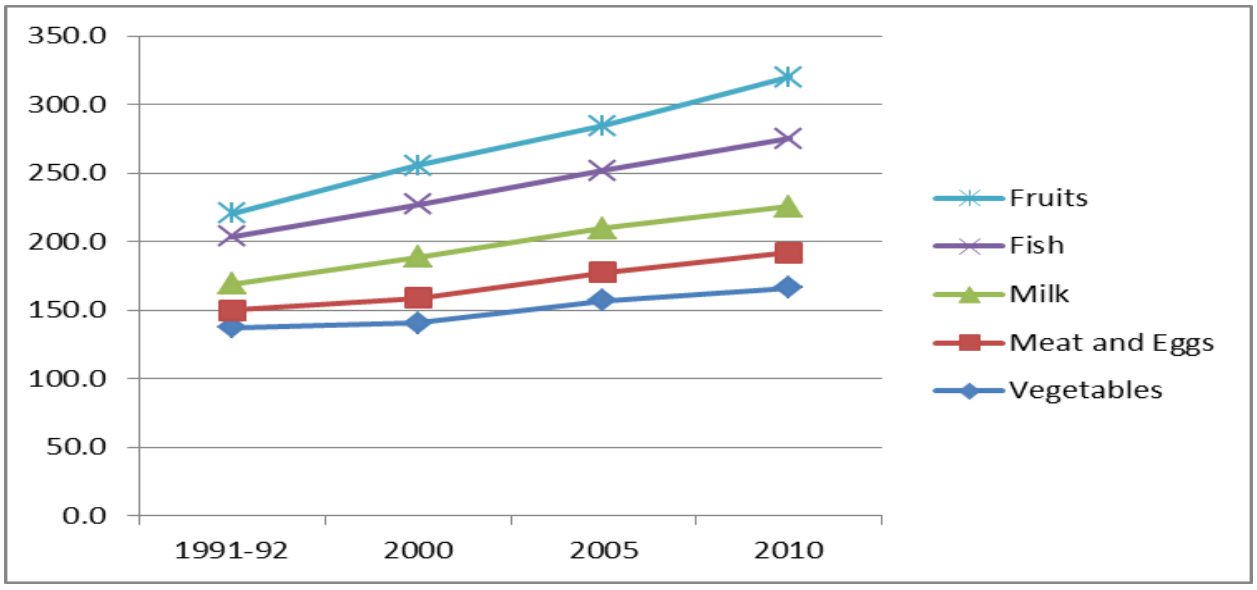
Source: Author's calculation, based on VDSA Panel Household Survey Data.

Figure 11: Relationship between growth in rural income, rice price increase and rate of poverty reduction among VDSA panel households in Bangladesh, FY2010/11 t0 FY2014/15



Source: Author's calculation, based on VDSA Panel Household Survey Data..

Figure 12: Per capita daily in intake of some food items (grams) in Bangladesh, 1991-2010



Source: Household Income and Expenditure Survey (HIES) , Bangladesh Bureau of Statistics (BBS).