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| **Strategies for a paradigm shift in agriculture, aquaculture, animal husbandry and forestry for food security and nutrition in Bangladesh** |
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**Executive Summary**

The overall objectives of the study is to focus on emerging issues and challenges in Bangladesh agriculture in the context of the national objective of ensuring food security and adequate nutrition standards over the next decades.

Contribution of Agriculture to GDP Growth and Poverty Reduction

The agricultural GDP grew with an average growth rate of about 3.7% p.a., during 1997 to 2013. Agriculture being an important engine of growth of the economy, government has invested in this sector to develop it for the alleviation of poverty and achievement of food security and the generation of employment opportunities for the huge population of the country are both directly linked to the development of agriculture. The relative shares of crops, livestock and fisheries changed little over the years. The agriculture of Bangladesh is dominated by crops which now account for 68% of total agricultural GDP. We have decomposed changes in aggregate GDP into main components and found that contribution of agriculture in overall GDP growth was 2% during the period 1999-2014 while the leading role in overall growth was played by industry (2.6%). The contribution of the service sector to overall growth was at a smaller rate.

Bangladesh experienced substantial poverty reduction during the last 15 years. During this period, the average annual rate of poverty reduction was 1.4%. It was found that GDP growth had a higher impact on poverty in Bangladesh than other south Asian counties. Regression analysis showed that there is negative relationship between poverty rates and GDP per worker from agriculture and non-agriculture. As GDP per worker increased poverty rate reduced. The estimated coefficient for agricultural GDP per worker is significantly higher than that for non-agriculture GDP. The coefficient of agriculture GDP per worker is -0.39 and is highly significant at the 1% level. It implies that, other things remaining the same, for 1 percent increase of income of agriculture GDP per worker would reduce poverty by 0.39 percent.

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# Analysis of the shifting paradigm in agriculture and food security: *Productivity status of sector*: Over the last 30 years, rice production tripled from approximately 10 million metric tons in the mid-1970s to almost 34 million tons in 2014/15. Such productivity improvement came through the cultivation of high-yielding varieties under irrigation with use of chemical fertilizers. It enabled Bangladesh to increase food availability to meet the demands of a rapidly growing population.

# Total factor productivity (TFP) of rice was analyzed for the period 2004 and 2014 using a panel data from large sample of rice farmers from 64 districts of Bangladesh. It was found that the TFP of modern Aus and Aman rice increased by 2.3% and 19.6%, respectively while the TFP modern boro declined by 16.8% but remained positive and the TFP of total rice increased by 1.9% during 2004-2014. During 2004-2014, rice output produced per man-day labour use increased while it declined for fertilizer.

We have estimated farm specific mean technical efficiency of the sample boro rice farmers of 64 districts in 2004 and 2014 . The mean efficiency of the boro rice growers was 68% in 2004 and it increased to 80% in 2014. It implies that 12% more rice output could be produced in 2014 compared to using same level of inputs used in 2004. It shows that there is a considerable improvement of the mean technical efficiency of the sample farmers over the last decade. The main driver of reducing inefficiency in rice production was the human capital of the farmer, i.e, education, training and experience of the farmers.

The non-crop agricultural sectors performed better than the crop sector during the SFYP period. In 2013-14, the growth rate for fisheries, forestry, livestock and crop subsectors were 6.19%, 5.05%, 2.83% and 1.91% respectively. Within the agriculture sector, the share of the livestock sub-sector has increased relative to crop, fisheries and forestry. The livestock share of agricultural income increased from 7.6% in 1973–74 to 12.9% in 1998–99 and is projected to increase to 19.9% in 2020.

During 2001/02–2011/12, livestock output grew at 4.0% against the crop output growth of 4.1% (at 1995-96 constant prices). Milk production in the country increased from 1.29 million tones in 1987–88 to 3.5 million tonnes in 2011-12. During the same period production of meat and eggs also sharply increased. It was found that that there is an increasing trend in TFP of milk production for Cross Breed Cows and Local Cows over the past two decades.

## During the period 2003-4 to 2013-14 total fisheries production in Bangladesh sharply increased from about 20 lakh MT to 35 lakh MT. The major contribution to such a large increase came from changes in three sources – inland fisheries (capture), inland fisheries (culture) and marine fisheries. In 2003-04, shares of inland capture, culture and marine fisheries were 38%, 39% and 24%, respectively. During 2003-14, the share of inland culture fisheries to the country’s total fish production sharply increased to 56%, while the share of inland capture fisheries declined to 22% and marines fisheries also declined to 12%. Also, flood plain fisheries production and case and pen culture also had an increasing trend and contributed positively towards increasing the country’s total fisheries production. The trend of pond production over the last two decades has been increasing. There is increasing trend in brackish water shrimp and golda production which could further enhanced through use intensive improved technology. Around 70 to 80% of shrimp produced are exported each year. Marine fisheries provide a livelihood to about 0.51 million fisher folk. Improvement in landing and industrialization of the sub-sector will improve the livelihood of this population. Bangladesh has a coast line of about 714 km and an Exclusive Economic Zone (EEZ) of 164,000 Km2, of which 44% is continental shelf. It offers great potential for marine fisheries production. Ban on hilsha catch during breeding period increased its production considerably over the years. The fishing ban should be continued in the next decades for sustainable reproduction of hilsa and increase of jatka as well as hilsa production.

**The drivers of paradigm shift in agriculture for the next decades: *Driver 1: Soil fertility and fertilizer use:*** Increase in food production and attaining self-sufficiency in Bangladesh requires sustainable growth of the agricultural sector in order to supply adequate food for its increasing population. Bangladesh has a wide variety and complexity of soils. Balanced fertilization is the key to enhancing crop productivity and maintenance of good soil health. It evident from different studies that severe leaching of N and K are going on in the country’s soil system causing low productivity of soils and decline in crop yields. Apart from the natural factors, a major reason is unbalanced use of fertilizer. Awareness-raising for balanced fertilizer application and popularization of more efficient fertilizer application techniques, can help preserve soil quality, raise output, lower costs of production. food production of this country can be increased through expansion of HYVs and balanced use of fertilizer. Timely supply and availability of fertilizer should receive top priority to increase crop production in Bangladesh over next decades.

As part of government policy to promote balanced use of different fertilizers by reducing use of urea and increasing use of non-urea fertilizers, the Government in the past drastically reduced prices of non-urea fertilizers (TSP, MP and DAP) while the price of urea was raised. In line with the Government policy, urea use decreased while TSP and MoP use increased since 2012-13. Although government is trying to promote balanced use of fertilizers for crop production through implementation of fertilizer policy and New Agricultural Extension Policy still there exists high extent of imbalance fertilizer use at the farmers level. There is knowledge gap of the farmers on the recommended fertilizer dose. Promoting balanced fertilizer use could be an important tool for improving agricultural productivity in the next decades.

**Driver 2: Irrigation:** Expansion of minor irrigation through groundwater using DTWs and STWs was the vital component of the GoB’s strategy to facilitate irrigation for agricultural development. Agricultural growth in the country has been largely due to the expansion of minor irrigation with private sector investment. There was increasing trend of irrigation growth in Bangladesh from 1982 to 2014. A regression analysis showed that the degree of acceleration in irrigation was stimulated by the market privatization of minor irrigation equipment.

Rice production accounts for 93% of the total Consumptive Water Use (CWU) and 90% of the total irrigation CWU in Bangladesh. Boro rice accounts for almost all the irrigation CWU of rice. The total irrigation water demand (CWU) for Boro rice production in Bangladesh was 11.8 Billion m3 in 2000 with 265 mm per ha CWU. Water demand has increased by 40% to 16.5 Billion m3in 2010 (Amarsinghe. *et al*, 2014).We have estimated irrigation CWU demand in 2030 and 2050 by using the irrigation CWU per hectare of 2010 level. We have projected that water demand for Boro rice in 2030 will be 17.23 Billion M3 after this period it will stabilize and would remain at 17.23 Billion M3 in 2041 of which 13 Billion M3 would come from ground water.

Groundwater is the source for more than 75% of the irrigated area in Bangladesh (BBS, 2011). It contributed to about 13 Billion m3 of irrigation CWU in 2010. A large part of this CWU is from natural recharge and the balance is from return flows of surface water irrigation. Already we have caused much stress on ground water level. In order to reduce ground water use we need to increase water use efficiency in crop production and enhance utilization of surface water irrigation. Given the falling groundwater tables and water quality issues in Bangladesh, it will be extremely difficult to exploit groundwater resources. Without an increase in water productivity (WP), it will be difficult to meet future water demand in 2030 and 2041.

**Driver 3: HYV Seeds, fingerlings, chicks, breeds and feeds**: During the 1990s to 2000s the seed market has been liberalized with the New Seed Policy 1993, Seed Amendment Acts 1997 and 2005, and the Seed Rules 1998 and opened market for participation and rise of private enterprises in seed production, import, and distribution. In Bangladesh the national requirement for quality seeds of all crops is estimated to be 9,32,250 metric tons. The performance of the seed supply system through quality seed replacement rate (SRR) against national requirement up to 2013-14 was 25% of which about 80 percent seed is being fulfilled through the informal seed system of farmers’ own saved seeds. Agricultural growth is dependent on a very wide-scale switch to HYV seed, but seed quality in general remains a major problem. Various related investments are needed to enhance provision of quality seeds in adequate quantities. Some of the non-government organizations and the private sector have started to enter the seed sector with positive impacts on availability, although quality still remains a vexing issue in some cases.

## Agricultural growth is dependent on a very wide-scale switch to HYV seed, but seed quality in general remains a major problem. Various related investments are needed to enhance provision of quality seeds in adequate quantities. Some of the non-government organizations and the private sector have started to enter the seed sector with positive impacts on availability, although quality still remains a vexing issue in some cases. Further private-public partnerships for seed, marketing, and extension need to be promoted in the next decades of perspective planning period (2030-41).

Bangladesh has a total of 882 fish hatcheries of which 92 are government and 790 are private across the country. A total of 489,331 kg spawn has been produced from private and Government hatcheries in the year 2014, There is gap in the supply of quality fingerling against requirement. Paradigm shift in aquaculture in the next decades would require a boost in production and supply of quality fish seeds and fingerlings.

Livestock production of Bangladesh could have a paradigm shift in the next decades through enhancing sustainable supply of quality chicks, breeds, feeds, vaccines and veterinary medicines. The production of day-old-chicks (DOCs) is currently lower than the total demand and therefore the chicks are priced higher. Out of 4.9 million milking cows, 4.2 million are local breed and 0.7 million are crossed breed. There is tremendous scope of improving dairy productivity in the next decades through enhancing supply HYV cross breed cows. The acute shortage of feeds and fodder is one of the single most important obstacles to livestock development in Bangladesh. Recently, there are 74 feed manufacturing and marketing company in the country, whereas 35-40 feed industries are in large size and producing poultry and fish feeds but the amount cannot satisfy the needs of the growing poultry farms. Bangladesh produces only 2.73 million tons of commercial animal feeds most of which is used for commercial poultry production against a total poultry feed requirement of 5.94 million tons  meeting only 46% of the need. As a result there is enough scope for increasing growth of livestock feed industry.

## Driver 4: Agricultural credit: Agricultural credit, as an input, plays an important role in driving the agriculture of Bangladesh towards a sustainable level. Food security, employment generation and poverty alleviation are closely linked with the development of the agriculture sector. There was an increasing trend in disbursement of agricultural credit during 2005-2016. While demand for credit is increasing with the advent of new technologies and high value crops, the supply side has remained less vibrant. According to data of the Bangladesh Bank, around 25 percent total disbursement of rural credit is delivered by the public sector. The remaining 75% has been delivered by micro-finance institutions (MFIs). The demand for credit is much more than that met by non-institutional sources.

**Driver 5: Technology generation and adoption:** The options for improving agricultural productivity in the next decades are promoting balanced use of land and water resource, improving soil fertility, varietal development, improved technology and mechanization. Technological breakthrough is needed for development improved varieties of rice, wheat, maize, vegetables, spices and fruits. The new HYV varieties should be resilient of diseases and climate change. Supports are needed for development of agricultural research and extension for appropriate technology generation and dissemination for the next decades. The Sixth and Seventh FYP prioritized the importance of research and extension for agricultural intensification, diversification and resilience to climate change.

There could be paradigm shift in production of livestock and fisheries in the country through generation of appropriate technology and technological breakthrough in the context of climate change. Emphasis should be given on improving genetic resources of livestock and fisheries, improved livestock rearing and aquaculture practices and disease control. Research on conservation of native genetic resources should be emphasized.

## Driver 6: Agro-processing, value chains and exports: The size of food processing sector is worth US $2.2 billion and grew on an average at 7.7 percent per annum between FY2004/05 and FY2014/15. The food processing sector is thus growing rapidly with prospects for continued growth as Bangladesh’s GDP continues to grow. Bangladesh exports over $700 million worth of processed food and beverages, of which over 60 percent are shrimp and fish products. Export of fresh fruits and vegetables from Bangladesh significantly increased in the past decade. Frozen foods are the second largest export sector of the economy. It is estimated that Bangladesh could earn more than $1,800 million per year in 2034 from the export of fresh and processed foods. The export potential of fruit and vegetables is about 160 thousand metric tons and potatoes would be around 200 thousand metric tons.

## Projections of food demand and supply in 2030 and 2041

With growing population, planning for future food production to meet food security challenges would require projections of future supply and demand for foods. Using ARIMA models we have projected demand and supply of major food items for the periods 2030 and 2041. Food consumption in Bangladesh has diversified over time. Cereals still provide a major part of the calorie intake, but their share in total calorie consumption has decreased from 92% in 1990 to 89%by 2010. Projections show that it will further decrease to 87% by 2030 and 86% by 2050. The contribution to calorie intake from potato, vegetables, animal and fish products gradually increased during 1990 to 2010 and will continue to increase up to 2030 and 2041.

It was projected that Bangladesh’s total demand for rice will be 37.5 million metric tons in 2030 and 39.4 million metric ton (MMT) in 2041. The total demand of potato, pulses, vegetable and fruits in 2030 will be 12.3, 1.2, 7.0 and 3.2 MMT, respectively. The projected demand for these food items in 2041 will be 12.8, 1.2, and 7.3 MMT, respectively. The total demand for meat, egg, milk and fish in 2030 will be 3.2, 2.0, 0.4, 4.9 and 4.2 MMT, respectively. The total demand for these animal products in 2041 will further rise to 2.1, 1.1, 6.0 and 4.8 MMT, respectively.

Total cereal supply (including rice, wheat and maize) will be 43.2 MMT by 2030 and 45.3 MMT by 2041. Total cereal production will be enhanced by 14% by 2030 than the 2013 level and it will be further enhanced by 15% compared to 2013 level by 2041.

Projections show that areas of non-cereal crops, specifically, potato, pulses, vegetables and fruits will expand gradually from 2013 level and will continue up to 2041 as a result of partly substituting land for more remunerative crops. Supply of total animal products will also be enhanced from domestic production to 8.8 MMT by 2030 from 2013 level of 7.00 MMT and further rise to 9.83 MMT by 2041. The individual animal product items like meat, egg, milk and fish will also increase.

## Projection of surplus and deficit of food supply

The projections show that Bangladesh will have a surplus rice production of 1.2 MMT and surplus maize production of 1.8 MMT by 2030. On the other hand, the country will have deficits of productions of wheat, potato, pulses, vegetables, meat, egg and fresh water fish amounting 2.6, 0.5, 0.8, 0.7, 1.0, 0.1 and 0.7 MMT. Bangladesh will have a surplus production of rice, maize, potato, vegetable and fruit by 2041 and have deficit production of wheat, pulses, meat, egg, milk and fresh water fish.

## Analysis of food security status and safety nets

**Availability of food**: Per capita rice production has increased substantially over the level at the time of independence. Wheat production is showing a declining trend in recent years. Production of vegetables and fruits also increased, but at a slow rate. Spectacular success has been achieved in the production of potato. It has increased significantly from 2.90 million tons in 2001-02 to 8.30 million tons in 2013-14. Per capita availability of cereals (rice and wheat) has been found to increase from 374 gm/day in 1994-95 to 647 gm/day in 2010-11. Sharp increase in per capita availability of potato and vegetables is observed during the last 15 years, while the per capita availability of pulses and oilseeds has remained stagnant or declined. Availability of meat, milk and egg has also increased

**Access to food:** Since 2005 nine million people have been lifted out of extreme poverty. This development helped to achieve the poverty reduction target of MDG1 by 2015. The decline in poverty has been accompanied by an overall improvement of people’s purchasing power, which strengthened their ability to access basic foods. The drop in poverty rates has arguably been the most powerful driver as it allows more people to access and afford better diets. The decline in poverty has been accompanied by an overall improvement of people’s purchasing power, which strengthened their ability to access basic foods.

Almost 30 percent of the households do not own any land and another 30 percent own only up to half an acre. Such tiny landownership is insufficient to meet the food needs of four to five-member households. A large proportion of marginal farmers go to market to access food as their own production is inadequate to meet the household needs. The income growth per year has accelerated since 1990, reaching 7.0 percent in recent years. Bangladesh has also achieved remarkable progress in population control. But, the income is highly unequally distributed and the disparity has been growing. As a result nearly one-fourth of the people still live below the poverty line, with inadequate income to access food from the market.

The periodic floods, cyclones and disasters that have affected the country in 2004, 2007, 2010 and 2017 have impacted progress on the food and nutrition situation. The hike in food prices after the food crisis in 2007 and 2017 had a negative impact on the real wages and access to food.

## Utilization of food and nutrition security

The acceleration in economic and agricultural growth has made a positive impact on the diversity of food intake away from the rice dominant diet. Over the period, the per capita consumption of rice and wheat has been declining, while the consumption of vegetables, fruits and fish and meat has been growing.

Approximately 9 million Bangladeshi children between six months and five years of age suffer from under-nutrition, with 41 percent of children stunted, 36 percent of children underweight, and 16 percent wasted. Bangladesh has made significant progress in reducing under-nutrition for the children. The nutritional status of women shows a better trend. Malnutrition is also severe in the country. More than 90 percent of rural Bangladeshis are not getting enough vitamins A and have iron deficiency.

## Safety net programmes

Despite the gains achieved by Bangladesh in augmenting availability of staple food, a safety net programme is essential to insulate the poverty stricken population from chronic as well as temporary food insecurity that results from natural shocks.  A number of food safety net programmes are in operation in Bangladesh. The present government has given high priority to the safety nets for ensuring food security. Currently nearly 2.2 percent of the GDP are allocated for safety nets and social protection. The evaluation of the programmes however revealed several limitations; a) large overheads due to operation of a large number of small programmes by different ministries often with the same objectives, b) improper targeting of beneficiary households, and c) leakages in implementation.

# Identification of challenges of shifting paradigm in agriculture

The major challenges identified were (i) degradation of natural recourses, Scarcity of surface water for irrigation, Groundwater level decline, Arsenic pollution Drainage congestion, water logging, Low water-use efficiency and productivity and Degradation of forest resources in protected areas, (ii) Climate change, (iii) Constraints of supply of inputs: Inadequate availability of quality seeds to the farmers, (iv) Constraints of agricultural extension and veterinary services, (vi) High post harvest losses. (vii) Constraints of market access and value chains: These include - inadequate market infrastructure and poor transpiration facility, inadequateagro-processing and value addition**, i**nadequate capacity of the stakeholders in the supply chain on safe food issue, (viii) Lack of easy credit to smallholders and market intermediaries (ix) Constraints of availability of agriculture labour, (x) Constraints of farm mechanization, (xi) Degradation of forest resources and low productivity of forestry, (xii) malnutrition and food insecurity related vulnerabilities

Synthesis of recent development strategies:

Much Progress has been made during the last decades in Bangladesh in formulation and adapting agricultural policies to the ever changing needs of modernizing agriculture. The governments in the past have been adapted different sets of policy to cater its needs of the government line departments, private sectors and farmers to create an enabling environment for technology dissemination and enhancing agricultural productivity.

The new National Agriculture Policy (NAP) 2013 focused on development of sustainable commercial agriculture and adaptation to climate change. The National Food Policy 2006 (NFP) and the NFP Plan of Action (2008-2015) serve as a basis for identifying and prioritizing the options for investment and interventions for achieving food security in Bangladesh. The perspective plan (2010-21) considered “Achieving food security” and “pursuing environmental friendly development” as broad goals. The *Sixth Five Year Plan*is the first of two mid-term indicative plans aiming to “develop strategies, policies and institutions that allow Bangladesh to accelerate growth and reduce poverty” for the implementation of Vision 2021 adopted by the Government to elevate Bangladesh to a middle income country. The *Seventh Five Year Plan* (SFYP) focused on the need of enhancement of sustainable agricultural production, commercialization, livelihood improvement.

## Strategy of recent food production and food security

The Ministry of Agriculture has prepared a comprehensive agricultural policy and started implementing the policy to address the problems of improving land, water and labour productivity by promoting balanced use of fertilizer, small scale mechanization, quality seed production, irrigation interventions in drought-prone areas, crop diversification, and improving water use efficiency and supply of agricultural inputs.

The Ministry of Fisheries and Livestock also prepared fisheries and livestock policy. The major policies included in the National Livestock Policy are: (1) promotion of smallholder dairy and poultry development; (2) development of goat, buffalo and duck in high potential areas through special projects; (3) institutional reform of DLS and enactment of laws and regulations for quality control of drugs, vaccines, feeds, chicks and breeding materials; (4) privatization of veterinary services of private good nature; and (5) explore all alternatives for producing fodder.

Fisheries Department has developed a strategy and action plan to implement the fisheries policy. The main objectives are: (1) enhancing fisheries resources and production; (2) generating self employment for poverty alleviation of fishers; (3) meeting the demand of animal protein; (4) increase foreign exchange earnings through export of fish and fisheries products; and (5) maintain ecological balance, conserve biodiversity and improve public health.

# Development Strategies for the Perspective Plan (2021-2041)

## 1. Agriculture, rural development and food security

**1.1** **Technology generation and dissemination:** These include –(i) *Enhance research and technology generation: (1) F*or crops, varietals development (short maturing Aus and Aman rice, new HYVs, biotechnology), (2) Promote frontier technology development through enhanced investment in R&D for increasing productivity. This will include activities: (a) Develop new varieties, crops, improving food quality, bio-fortification, nutrition, etc. (b) Enhance agricultural productivity through diversification, sustainable management of natural resources (in flood plain and Chittagong Hill Tract) and inputs. (c) Promote “agro-ecologically suitable”  and “climate-smart” agriculture that are effective to feed the population sustainably in the long term. (d) Supporting transformation of agriculture by building innovative, action-oriented partnerships with different countries. (ii) *Improve research-extension-farmer linkages and extension services.*

## 1.2 Irrigation and water resource development: These include –(i) Surface water augmentation for irrigation development: Develop water reservoirs, recharge of ground water, reduced use of ground water to avoid hazard of arsenic contamination. (ii) Promote water saving technology for improving water use efficiency:It is necessary to promote installation of facilities to reduce distribution losses. (iii) Reduce impact of saline water intrusion in the South and enhance river water flow: The focused priorities for the coastal region

**1.3** **Sustainable supply of quality inputs:** These include –(i)*Enhance availability of quality agricultural inputs*: There is strong demand to improve sustainable supply of improved quality seed, feed, breed, brood and finger ling to enhance agricultural productivity of the country in the next decades. (ii) *Improve and increase sustainability of soil fertility management:*The proposed interventions are to promote fertilizer use efficiency and balanced use of fertilizer to strengthen environmentally sound fertility management practices.

## 1.4 Commercialization, agro-processing and value addition: These include –(i)Improvement of road, market infrastructure and storage facilities, (ii) Capacity building of value chain actors and market promotion (iii) Establishment of export processing zones: Harness opportunities to expand market linkages and agribusiness with establishment of export processing zones. (iv) Improving Food Safety and Quality for Consumer Health and Nutrition: Food analytical laboratories at the central and regional level need to be established to facilitate support to food manufacturers, individuals and the enforcement of laws.

**1.5 Climate resilient sustainable agriculture**: An integrated approach which combines traditional knowledge with innovative strategies needs to be adopted to address current vulnerability while building adaptive capacity to face emerging challenges. Interventions should include: (i) Program to promote adaptive knowledge and technologies among communities/farmers. (ii) Enabling local communities to improve preparedness and participate in effective operation and maintenance of flood protection works, and modeling and or researching the effectiveness of adaptations under extreme climatic events. (iii) Development of salt, drought and flood resistant and heat tolerant crop varieties.

## 1.6 Interventions for development of fisheries: These include –(i) Development of riverine fisheries. Priorities are Community based fisheries management, Establishment of community managed sanctuary, Expansion of cage and pan culture farming, Ensure quality seed and feed, (ii) Development of Beel and floodplain fisheries. Priorities include: Restoration of habitats and establishment of beel nurseries, Expansion of small-scale aquaculture technologies and establishment of co-management approaches. (iii) Development of pond aquaculture. The priority is expansion of aquaculture technologies,

**1.7 Interventions for development of livestock**: These include **–(i)** Improving diagnostic capacity and veterinary clinical services, (ii) Promoting smallholder poultry and dairy development: The priorities are (i) Promoting artificial insemination services (ii) quality feeds and chicks at affordable price, (iii) promoting HYV fodder production, (iv) supply chain development through group marketing, (v) processing and value addition and (vi) community based vaccination program. (vii) dissemination of livestock and poultry technologies and (viii) strengthening training, demonstration and publicity.

## 1.8 Agricultural development of thrust areas: This includes investment for agricultural development of the coastal areas, Haor areas and Hill Tract. Agriculture of these areas are less developed with low productivity.

**1.9 Enhance productivity of forest:** It is necessary to improve productivity of forest and agro-forest. Sustainable afforestation and reforestation of degraded land will contribute to food security by providing fruits and other edible products; energy security by providing fuel wood; livelihood security by employing people in forest plantations; harvesting and trade in forest products; and can protect land from soil erosion and landsides.

**1.10 Improved land management:** It is necessary to prevent encroachment of agricultural and forest lands from expanding urbanization and non-agricultural uses. The priorities include: (i) *Promote Compact Township to reduce substitution of agricultural land for non-agricultural purposes* and (ii) *Improvement of land information, land administration and management:*1.11 Infrastructure development: This includes development rural roads, connectivity, market infrastructure, electricity, communication and transportation system. Construction of flood control and drainage system and polders in the coastal areas.

**7.1.11** **Farm mechanization:** Priorities include- (i) Increasing the availability of agricultural mechanization technology to the farmer. (ii) Develop and promote agricultural machinery that is resource and energy efficient and conserve natural resources. (iii) Applying appropriate machinery and equipment for agricultural production and (iv) Training and education for farmers for using suitable farm machinery.

## 1.12 Infrastructure development: This includes development rural roads, connectivity, market infrastructure, electricity, communication and transportation system. Construction of flood control and drainage system and polders in the coastal areas

## 2. Safety nets for food and nutrition security

## 2.1 Livelihood improvement and food security: The priorities are: (i) Development of programs of alternative income generation and food security to reduce malnutrition of women, children and distressed population. (ii) Development of community based nutrition activities through livelihood approaches (iii) Livelihoods improvement of population of vulnerable and disadvantageous areas of char land, haor, coastal region and Chittagong Hill Tract, (iv) Expand and strengthen programs for supporting women, children, elderly and disable persons, (v) Enhance Investment in Employment and Income Generation Programs with focus on Productive Safety Net program, (vi) Interventions for improvement of public food management: The priorities are: Increase and modernize food storage and handling facilities, especially in disaster prone areas, Strengthen institutional capacities for implementation of safety net program

# Introduction

## 1.1 Background and importance of the sector

Total land area of Bangladesh is about 14.8 million hectares, of which net cropped land is 7.8 million ha. (59%).Agriculture plays a dominant role in the growth and stability of the economy of Bangladesh. More than three quarters of the total population in rural areas derive their livelihood from the agricultural sector. About 48 percent of the labour force is still employed in Agriculture.

During the recent decade, the overall Gross Domestic Product (GDP) of Bangladesh has shown a considerably increasing trend. But the growth in agricultural GDP slightly declined, with an average growth of about 3.4% during 1997 to 2014. Agriculture being an important engine of growth of the economy, there is no other alternative but to develop the agriculture sector for the alleviation of poverty by attaining accelerated economic growth. Since achievement of food security, and generation of employment opportunities of the huge population of the country are directly linked to the development of agriculture, there have been continued efforts by the Government for the overall development of this sector.

There is continuous transformation of Bangladesh’s economy as measured by changes in the sectoral shares of Gross Domestic Product (GDP). This structural change clearly indicates a rapid movement away from an agriculture-dominated economy. Agriculture’s share of GDP declined from 62 percent in 1975 to 19 percent in 2013, but agriculture’s share of total employment has not declined as much. The declining share of agriculture in GDP should not be construed to reflect a diminishing role of agriculture in the overall growth of the economy or in poverty reduction. Notably, the service sector has expanded at a rapid pace at this stage of economic transformation. Much of the growth in the services sector relates to the marketing and processing of agricultural products resulting from rapid commercialization and diversification in agriculture.

Bangladesh will graduate out of LDC status by 2021, aspires to reach upper middle income country status by 2030, and expects to become a developed economy in the 2040s decade, through a process of rapid inclusive growth leading to elimination of poverty.The cornerstone of an inclusive development strategy is a robust strategy of job creation through raising agricultural productivity and employment-intensive export-oriented manufacturing growth. The agriculture sector is dynamic, changing with demand of the people, availability of technology and change of management practices. Thus, it requires regular adjustment with different planning and development programmes. The country has much potential, yet it faces many challenges including vulnerability to climate change. For planning and sustainable development purposes, a diagnostic study of Bangladesh Agriculture is required in order to foster growth of this important sector harmonizing with the management of natural resources and addressing the challenges.

## 1.2 Objectives of the study

In light of past progress and long-term future outlook for the agriculture sector, globally and in the domestic economy, the overall objectives of the study is to focus on emerging issues and challenges in Bangladesh agriculture in the context of the national objective of ensuring food security and adequate nutrition standards over the next decades.

The following specific issues were covered under the study:

* Analyze the shifting paradigm in agriculture and rural development, noting the growing importance of sub-sectors such as agriculture, aquaculture, animal husbandry and forestry;
* Analyze the leading issues likely to impact agricultural development over the next two decades;
* Examine the potential for sustainable growth in agriculture as an important source for nation’s exports.
* How to transform to high-tech modernized commercial agriculture
* Explore Safety-net approaches to handle hunger and vulnerability towards human resource development.
* Evolving approaches to food security and nutrition in the coming decades
* Discussion of effective and inclusive strategies for sustainable agriculture and rural development while ensuring food security and nutrition;
* Suggest strategies and policies for food and nutrition security and safety nets for addressing food insecurity and vulnerability from price and production instability ensuring food security to remove hunger and malnutrition.
* Adaptation and mitigation measures in agriculture under climate change impacts;
* Setting benchmarks, strategies and goals with production targets with a discussion of implementation issues;
* Examine any other issues relevant for sustainable and commercial agricultural sector

## 2. Methodology

The methodology used includes:

* Collection of primary data: We have used BRAC Survey database of randomly selected households in 62 villages of 62 districts, which have so far been surveyed in four rounds (1988, 2000, 2008 and 2014). This helped the generation of longitudinal panel data at household level to serve as the most credible and confident source of statistics. The 2014 data base - generated by BRAC funding - could be construed as the most recent representation of the national situation on any rural indicator.
* Review of relevant policy and planning documents – Seventh Five Year Plan, Sixth Five Year Plan, Agriculture Policy, Livestock and Fisheries Policy, Food Policy, Input Policy, Irrigation and Land Use Policy, etc.
* Collection of secondary information from BBS, DAE, MOA, MOF, etc. and various on-line resources, etc.
* Analysis and synthesis: different econometric models have been used for estimation and a description of underlying models and estimation techniques have been stated in the Annex.
* Report preparation.

**3.** Contribution of Agriculture to GDP Growth and Poverty Reduction

## 3.1 Overview of sectoral growth and contribution of different subsectors

Bangladesh Agriculture plays a dominant role in the growth and stability of the economy. More than three quarters of the total population in rural areas derive their livelihood from this sector. About 48 percent of the labour force is still employed in agriculture.

During the recent decade, overall gross domestic product (GDP) of Bangladesh has shown a considerable upward trend. The agricultural GDP grew with an average growth rate of about 3.4% p.a., during 1997 to 2013. Agriculture being an important engine of growth of the economy, government has invested in this sector to develop it for the alleviation of poverty and achievement of food security, by attaining accelerated economic growth. Since the achievement of food security, and the generation of employment opportunities for the huge population of the country are both directly linked to the development of agriculture, there have been continued efforts by the Government for the overall development of this sector.

Table 3.1 presents the contribution of Bangladesh agriculture to GDP during 1980-2014. There is continuous transformation of Bangladesh’s economy as indicated by changes in the sectoral shares of GDP. This structural change clearly indicates a rapid movement away from an agriculture-dominated economy. Agriculture’s share of GDP declined from 62 percent in 1975 to 16.3 percent in 2016. Notably, the industry and service sectors have expanded at a good pace at this stage of economic transformation. During 1971 to 2014, value addition of the service sector to GDP increased considerably from 34.2% to 56.1% and value addition of the industrial sector to GDP almost doubled from 13.2% to 27.2% (Table 3.2). Much of the growth in the service sector is related to the marketing and processing of agricultural products resulting from rapid commercialization and diversification in agriculture. Although the relative share of agriculture’s GDP to total GDP declined much with the expansion of industry and the service sector, but the size of total contribution of this sector to GDP is increasing at the rate of around 3.4% per annum.. However, agriculture’s share of total employment has not declined as much. The declining share of agriculture in GDP should not be construed to reflect a diminishing role of agriculture in the overall growth of the economy or in poverty reduction. The relative shares of crops, livestock and fisheries changed little over the years. The agriculture of Bangladesh is dominated by crops which now account for 68% of total agricultural GDP.

Table 3.1. Trend of structural transformation of sectoral shares in GDP and growth rate at constant prices.

|  |
| --- |
| **Share (in percent)** |
| **Sector** | **1980-81** | **1985-86** | **1990-91** | **1995-96** | **2000-01** | **2005-06** | **2010-11** | **2011-12** | **2012-13** | **2013-14** |
| Agriculture | 33.07 | 31.15 | 29.23 | 25.68 | 25.03 | 19.01 | 18.01 | 17.38 | 16.78 | 16.33 |
| Industry | 17.31 | 19.13 | 21.04 | 24.87 | 26.20 | 25.40 | 27.38 | 28.08 | 29.00 | 29.61 |
| Service | 49.62 | 49.73 | 49.73 | 49.45 | 48.77 | 55.59 | 54.61 | 54.54 | 54.22 | 54.05 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| **Average growth rate (in percent)** |
| Agriculture | 3.31 | 3.31 | 2.23 | 3.10 | 3.14 | 5.50 | 4.46 | 3.01 | 2.46 | 3.35 |
| Industry | 5.13 | 6.72 | 4.57 | 6.98 | 7.45 | 9.80 | 9.02 | 9.44 | 9.64 | 8.39 |
| Service | 3.55 | 4.10 | 3.28 | 3.96 | 5.53 | 6.60 | 6.22 | 6.58 | 5.51 | 5.83 |

 Source: Bangladesh Economic Review 2014.

Bangladesh agriculture is considered central to growth for two reasons. It has a big share of GDP and it stimulates “structural transformation” - the process whereby resources move from low productivity sectors to higher productivity sectors. There are two possibilities for structural transformation. It can be driven by productivity improvements within the agricultural sector and it can be driven by productivity improvement outside the agriculture sector.

Table 3.2. Value addition from agriculture, industry and service sectors during 1971-2014.

|  |  |  |
| --- | --- | --- |
| Year |  | Value added (% of GDP) |
| Agriculture | Industry | Service |
| Crops | Livestock  | Fisheries | Total |
| 1971-80 | 38.3 | 4.2 | 10.0 | 52.4 | 13.3 | 34.2 |
| 1981-90 | 26.0 | 4.2 | 3.6 | 33.8 | 20.7 | 45.5 |
| 1991-00 | 18.6 | 2.3 | 4.9 | 25.8 | 23.3 | 50.8 |
| 2001-10 | 13.4 | 2.2 | 4.1 | 19.7 | 25 | 55.3 |
| 2011-14 | 11.4 | 1.8 | 3.5 | 16.7 | 27.2 | 56.1 |

## 3.2 Decomposition of the growth process

We have decomposed changes in aggregate GDP into main components: contribution form the sectors, i.e., changes in growth within sectors and intra-sectoral resource shifts or reallocation effect (“structural transformation”) associated with the movement of workers between sectors. The result of decomposition is presented in Table 3.4 and compared with India and China.

The decomposition result showed that agriculture played an important positive role in driving the overall GDP growth of Bangladesh. The contribution of agriculture in overall GDP growth was 2% during the period 1999-2014 while the leading role in overall growth was played by industry (2.6%) (Table 3.3). Bangladesh agriculture grew at a good pace of 3.7% per year from 1999 to 2014, but industry contributed the most to growth, expanding at a spectacular rate of 9% per year. The contribution of the service sector to overall growth was at a smaller rate. The reallocation effect was also at a smaller rate.

Table 3.3 Decomposition of overall growth in output per worker in Bangladesh, India and China

|  |  |  |  |
| --- | --- | --- | --- |
| Country, period | Total | Percentage contribution to growth,Decomposition of within sector effect | Decomposition of intra-sector effect |
| Agriculture | Industry | Service | Reallocation |
| Bangladesh1999–2014 | 6.4(100) | 2.0(31.7%) | 2.6(41.3) | 0.95(15.1) | 0.80(11.9%) |
| India1993-2004 | 4.6 (100) | 0.5(10.9%) | 0.9(19.6%) | 2.0(43.5%) | 1.2(26.1%) |
| China1978-93 | 6.4(100) | 1.2(18.8%) | 2.4(37.5%) | 1.1(17.2%) | 1.7(26.6%) |

Source: Author’ estimation, for India and China**:** Bosworth and Collins (2008)

Both in China and India, agriculture played a positive role but not a leading role in driving overall growth. China’s agricultural sector grew at a very rapid pace, 4.6 percent per year from 1978 to 2004. But it was industry that contributed most to growth, expanding at a spectacular rate of 10 percent per year. Its service sector also grew as rapidly as industry - even slightly faster on average - but because of its smaller share in output, contributed less to aggregate growth. India’s agricultural sector also had a strong but less spectacular 2.5 percent growth rate over the same period.

## 3.3 Contribution of agriculture to poverty reduction

The emerging pattern of growth in poverty reduction in Bangladesh is encouraging. Bangladesh experienced substantial poverty reduction during the last 15 years (Figure 3.1). During this period, the average annual rate of poverty reduction was 1.4%. It was found that GDP growth had a higher impact on poverty in Bangladesh than that of all South Asian countries in the region, although Vietnam, China, and Thailand had a higher GDP growth rates than Bangladesh and had even further reductions in poverty (World Bank, 2008)

 

Figure 3.1 Trend in poverty reduction rate of Bangladesh(1999-2014) Figure 3.2 Trend in agriculture GDP per worker

During 1999-2014, GDP per worker both in agriculture and non-agriculture increased substantially and contributed to poverty reduction in Bangladesh (Fig 3.2-3.3).

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Figure 3.3 Trend in non-agriculture GDP per worker during 1999-2014

It revealed that the there is negative relationships between poverty rates and GDP per worker from agriculture and non-agriculture (Fig 3.4-3.5). This result found was consistent and confirms the findings of a study of Cervantes-Godoy and Dewbre (2010) conducted in 25 countries of Asia and Africa. But, among the two sectors, which has been the most important source of reduction in observed poverty rates? Answering such a question requires, first, quantitative estimates of the statistical relationship between each of the two variables and the poverty rate. We estimated the relationships using a multiple regression analysis to quantify the contribution of growth of GDP per worker from agriculture and non-agriculture to poverty reduction. The estimated coefficients and related statistics are presented Table 3.7.

 

Figure 3.4 Relationship of agriculture GDP and poverty rate Figure 3.5 Relationship of non-agriculture GDP and poverty rate

The regression model explains a high percentage of variation in the dependent variable of poverty rate of Bangladesh as evidenced by high value of R2 (Table 3.4). The regression coefficients for agricultural GDP per worker and non-agricultural GDP per worker are statistically significantly negative as supported by theory and also confirmed by the data plotted in Figures 3.4 and 35. There is an inverse relationship between the poverty rate and productivity growth of GDP per worker from agriculture and non-agriculture. The estimated coefficient for agricultural GDP per worker is significantly higher than that for non-agriculture GDP. The coefficient of agriculture GDP per worker is -0.39 and is highly significant at the 1% level. It implies that, other things remaining the same, for 1 percent increase of income of agriculture GDP per worker would reduce poverty by 0.39 percent. Similar result that that agricultural development is correlated with reductions in poverty is also confirmed by Ligon and Sadoulet (2007), Irz *et al* (2001), Diao *et al* (2008).

Table 3.4 Estimated coefficients of regression analysis of poverty rate and GDP per worker form agriculture and non-agriculture

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | Coefficients | t-value | R2 | F-value |
| Constant | 2.62 | 2.90\*\* | 0.78 | 19.79\* |
| Agriculture GDP per worker | -0.39 | -4.92\*\* |  |  |
| Non-agriculture GDP per worker | -0.11 | -2.26\* |  |  |

\*\* Significant at 1% level and \* significant at 5% level

#

# 4. Analysis of the shifting paradigm in agriculture and food security

## 4.1.Productivity status of sector

## 4.1.1 Productivity status of crops

### Productivity of rice

The production of main staple rice has shown a long term growth trend of 2.8 percent per annum over the period from 1981/82 to 2014/15. During 1997 to 2013, total rice acreage changed little, T. Aman acreage remained almost unchanged, while irrigated Boro acreage substantially increased with the reduction of rain-fed Aus which showed about 6.3 percent annual growth during the same period.

Figure 4.1 illustrates the trends of rice production over the past decades. Over the last 30 years, Bangladesh has experienced a "green" revolution in rice production, with a tripling of production from approximately 10 million metric tons in the mid-1970s to almost 34 million tons in 2014/15. It was largely based on the cultivation of high-yielding varieties (HYVs) under irrigation with use of chemical fertilizers This ‘Green Revolution’ has enabled Bangladesh to increase food availability to meet the demands of a rapidly growing population. Fig 4.2 presents trends in rice production in Bangladesh by season. It was found that during 1970-2010 growth in Aus rice production was almost stagnant while both Boro and Aman Rice production had increasing trends.

Figure 4.1: Trends of rice production during 1995-2011 period, source: Islam, 2013

Figure 4.2 Trends of rice production by season during 1995-2011 period, source: Islam, 2013

We have analyzed total factor productivity (TFP) of rice for the period 2004 and 2014 using a panel data from large sample of rice farmers from 64 districts of Bangladesh. It was found that the TFP of modern Aus and Aman rice increased by 2.3% and 19.6%, respectively while the TFP modern boro declined by 16.8% but remained positive and the TFP of total rice increased by 1.9% during 2004-2014 (Table 4.1). The result is found to be consistent with the findings of Alam *et al* (2011) that during the post-policy reform period the TFP of modern rice declined but was positive. Alam *et al* (2011) used a panel data set of BIDS, IRRI and IFPRI of the period 1987, 2000 and 2004 from 64 districts of Bangladesh and estimated TFP of modern rice from farm specific information. It was found from our analysis of input-output information from a the sample farmers that during 2004-2014, rice output produced per man-day labour use increased while it declined for fertilizer (Table 4.2). During this period per ha labour use declined (Fig 4.3) while the fertilizer cost increased considerably (Fig. 4.4).

Table 4.1 Changes in TFP of modern rice production of sample farmers of 64 Districts of Bangladesh by season (2004-14)

|  |  |
| --- | --- |
| Year | Mean TFP |
| Aus | Aman | Boro | All rice |
| 2014 | 113 | 119 | 90 | 108 |
| 2004 | 111 | 100 | 108 | 106 |
| Change (%) | 2.3 | 19.6 | -16.8 | 1.9 |

Table 4.2 Productivity of labour and fertilizer for modern rice production (2004-2008)

|  |  |
| --- | --- |
|  Input used | Rice Output produced (in Kg) |
| MV Aus | MVAman | MV Boro |
| 2014 | 2004 | 2014 | 2004 | 2014 | 2004 |
| Per man-day labour use  | 130.22 | 23.45 | 128.89 | 36.06 | 169.55 | 45.33 |
| Per Tk invested in fertilizer | 0.74 | 2.09 | 0.95 | 2.98 | 0.89 | 1.82 |

Fig. 4.3 Labour use in MV rice (2004-2014) Fig 4.4 Fertilizer cost of MV rice cultivation (2004-14)

We have estimated farm specific mean technical efficiency of the sample boro rice farmers of 64 districts in 2004 and 2014 are illustrated in Figure 4.5. The mean efficiency of the boro rice growers was 68% in 2004 and it increased to 80% in 2014. It implies that 12% more rice output could be produced in 2014 compared to using same level of inputs used in 2004. It shows that there is a considerable improvement of the mean technical efficiency of the sample farmers over the last decade. The main driver of reducing inefficiency in rice production was the human capital of the farmer, i.e, education, training and experience of the farmers.

**Productivity of non-rice crops**

The non-crop agricultural sectors performed better than the crop sector during the SFYP period. In 2013-14, the growth rate for fisheries, forestry, livestock and crop subsectors were 6.19%, 5.05%, 2.83% and 1.91% respectively. Between 2007-08 and 2012-13 period, the area under wheat, maize, oilseeds, spices, potato and vegetables increased, though the area under sugarcane and fruits decreased. It was found that production of all the crops except pulses and banana increased during the SFYP period (Table 4.3). A sharp increasing trend in production was observed for brinjal and edible oilseeds. With the exception of bananas and jackfruit, all the crops maintained an almost steady increasing trend in production since 2009-10.

Table 4.3: Annual change in major non-rice crop production and change in yields

(3 year moving average)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Crops | 2009-10  | 2010-11  | 2011-12  | 2012-13  | 2013-14  |
| Change(%) | Change(%) | Change(%) | Change(%) | Change(%) |
| Production  | Yield  | Production  | Yield  | Production  | Yield  | Production  | Yield  | Production  | Yield  |
| Wheat  | 6.1 | 9.6 | 7.9 | 6.3 | 2.4 | 5.1 | 26.1 | 7.7 | 3.8 | 6.3 |
| Maize  | 21.6 | -0.7 | 14.8 | 0.9 | 27.5 | 5.0 | 14.4 | 4.3 | 4.1 | 4.4 |
| Potato  | 50.5 | 9.3 | 5.0 | 5.5 | -1.5 | 1.8 | 4.8 | 2.0 | 4.0 | 3.3 |
| Pulses  | 12.5 | 3.7 | 3.9 | 0.5 | 4.7 | 3.6 | 10.7 | 0.6 | -40.7 | 9.8 |
| Brinjal  | 1.1 | 0.8 | -0.4 | 1.0 | 3.9 | 2.2 | 4.8 | 3.7 | 20.7 | 10.4 |
| Oilseeds\*  | 11.9 | 2.3 | 5.2 | 1.4 | 2.7 | 4.0 | 5.4 | 0.7 | 16.1 | 3.5 |
| Mango  | 1.7 | 0.0 | 5.5 | 8.9 | 6.3 | 4.5 | 1.3 | 6.3 | 3.7 | -2.9 |
| Banana  | -2.1 | -3.9 | -2.1 | -2.7 | -6.8 | -3.7 | 3.8 | 1.9 | -0.5 | 4.2 |
| Jackfruit  | 3.1 | 2.3 | -4.4 | -2.1 | -3.6 | -1.6 | 3.0 | 1.1 | 5.0 | 7.9 |

Note: \* Includes sesame, rape & mustard, groundnut and soya bean, Source: FPMU 2013, 2014 and 2015

## 4.1.2 Productivity of livestock

During the last three decades a structural transformation has taken place in Bangladesh agriculture. The country has achieved self-sufficiency in food grain production due to an appreciable growth rate in the sector but the share of agriculture in GDP has declined relative to other sectors. Within the agriculture sector, the share of the livestock sub-sector has increased relative to crop, fisheries and forestry. The livestock share of agricultural income increased from 7.6% in 1973–74 to 12.9% in 1998–99 and is projected to increase to 19.9% in 2020. During 1973/74–1989/90, livestock output grew at 5.2% per annum compared to 1.7% for crop output and 2.6% for agricultural output in general (Hossain and Bose 2000, Jabbar, *et al*, 2005). During 2001/02–2011/12, agricultural output grew at 4.2% while livestock output grew at 4.0% against the crop output growth of 4.1% (at 1995-96 constant prices). Milk production in the country increased from 1.29 million tones in 1987–88 to 3.5 million tonnes in 2011-12. However, current national production is inadequate to meet demand. During the same period production of meat and eggs also sharply increased (Fig. 4.6 and 4.7).

During last two decades there was a rapid growth in demand for livestock products due to income and population growth and urbanization. The demand growth for livestock products Bangladesh is expected to continue well into the nest two decades, creating the opportunity for a veritable Livestock Revolution if the increased demand can be met from increased domestic production. Producers may gain through increased income and employment and consumers through access to cheaper livestock products. Evidence from field studies in Bangladesh show that rural poor and landless households typically derive a larger share of their cash income from livestock than do well-off farmers (Jabbar and Islam. 2004).

Figure 4.6 Trend in production of milk and meat Figure 4.7 Trend in production of egg

Dairy and poultry are the most important livestock enterprises produced by smallholder crop–livestock farmers in Bangladesh. Milk production still remains predominantly in the hands of small-scale mixed farms and landless households with 1–2 local cows, who produce70–80%of the milk in the country. Dairy development efforts through cross-breeding, milk collection and processing for urban markets are limited to a number of milk sheds. Beef fattening are getting popularity with rapid spread of such farms across the country. On the other hand, poultry is the most widely-held livestock species among smallholder farmers, especially poor and landless households and can be considered as a tool for poverty reduction. In response to rapidly rising urban demand for poultry meat and eggs, beginning from the early 1990s, a commercial poultry (broiler and layer) sector has emerged using intensive production techniques(exotic and crossbred birds, concentrate feeds and drugs) and with technical and policy support (subsidized credit, local production and import of DOCs, drugs etc). Demand for livestock product will further increase in the coming decades. Achievement of a high growth rate in the livestock sector has the potential to create employment and income generation for a large number of smallholder producers and others involved in dairy and poultry production, processing and marketing, and get them out of poverty. Dairy and poultry generate more regular cash income and their production, processing and marketing generate more employment/unit value added compared to crops (Asaduzzaman 2000; Omore et al. 2002).

Table 4.4 presents productivity of the livestock sub sector during the sixth Five Year Plan. The contribution of the livestock sub-sector to GDP at constant prices was 2.58 percent in FY 2010-11.The estimated contribution to GDP during FY 2011-12 from this sub-sector was 2.50 percent. Though the share of the livestock sub- sector in GDP is small, it makes an immense contribution towards meeting the daily animal protein requirements. A number of initiatives have been taken for livestock development. The most important ones include: production and distribution of vaccine for poultry and livestock, supply of ducklings and chicks at a cheaper price, artificial insemination extension programme for improved breeds, transfer of improved farming technology, prevention and control of anthrax, foot and mouth diseases and avian influenza.

According to the estimate of the Department of Livestock Services, the population of livestock and poultry rose to 52,836,000 thousand and 288,566,000 respectively in 2011-12. Table 4.5 shows the growth of the livestock and poultry population of the country during 2005-12. Table 4.6 shows increasing trends in production of milk, meat and eggs.

Table 4.4 Productivity of livestock subsector during Sixth Five Year Plan, 2009-14

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SFYP output proxy indicators | 2009-10  | 2010-11  | 2011-12  | 2012-13  | 2013-14 |
| GDP from livestock sector as % of agricultural GDP (excluding forest, at constant price 2005-06) | 12.4%  | 14.1%  | 12.2%  | 12.3%  | 14.08%  |
| Total production of Egg (millions) | 5,742.4  | 6078.5  | 7,304  | 7,617  | 10168  |
| Milk (millions MT)  | 2.37  | 2.97  | 3.47  | 5.07  | 6.9  |
| Meat (million MT)  | 1.26  | 1.99  | 2.33  | 3.62  | 4.52  |
| Annual change in artificial insemination | 15.25%  | 7.67%  | 10.11%  | 7.40%  | na  |
| Annual change in number of poultry deaths due to avian flu  | 274%  | 231%  | -75.4%  | -95.1%  | na  |

Source: FPMU 2013, 2014 and 2015 & BER (2014)

Table 4.5 Growth of Livestock and Poultry in Bangladesh. (Number in lakh)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Livestock/ Poultry | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2014-15  |
| Cattle  | 228.0 | 228.7 | 229.0 | 229.76 | 230.51 | 231.21 | 231.95 |  |
| Growth Rate (%)  | - | 0.31 | 0.13 | 0.33 | 0.33 | 0.30 | 0.32 |  |
| Buffalo  | 11.6 | 12.1 | 12.6 | 13.04 | 13.49 | 13.94 | 14.43 |  |
| Growth Rate (%)  | - | 4.13 | 3.97 | 3.37 | 3.34 | 3.23 | 3.40 |  |
| Goat  | 199.4 | 207.5 | 215.6 | 224.01 | 232.75 | 241.49 | 251.16 |  |
| Growth Rate (%)  | - | 3.90 | 3.76 | 3.75 | 3.76 | 3.62 | 3.85 |  |
| Sheep  | 25.7 | 26.8 | 27.8 | 28.77 | 29.77 | 30.02 | 30.82 |  |
| Growth Rate (%)  | - | 4.10 | 3.60 | 3.37 | 3.36 | 0.83 | 2.60 |  |
| **Total livestock**  | **464.7** | **475.1** | **485.0** | **495.58** | **506.52** | **516.66** | **528.36** |  |
| **Growth Rate (%)** | **-** | **2.19** | **2.04** | **2.13** | **2.16** | **1.96** | **2.21** |  |
| Chicken  | 1948.2 | 2068.9 | 2124.7 | 2213.94 | 2280.35 | 2346.86 | 2428.66 |  |
| Growth Rate (%)  | - | 5.83 | 2.63 | 4.03 | 2.91 | 2.83 | 3.37 |  |
| Duck  | 381.7 | 390.8 | 398.4 | 412.34 | 426.77 | 441.20 | 457.00 |  |
| Growth Rate (%)  | - | 2.33 | 1.91 | 3.38 | 3.38 | 3.27 | 3.46 |  |
| **Total Poultry**  | **2329.9** | **2459.7** | **2523.1** | **2626.28** | **2707.12** | **2788.06** | **2885.66** |  |
| **Growth Rate (%)** | **-** | **5.28** | **2.51** | **3.93** | **2.99** | **2.90** | **3.38** |  |

Table 4.6 Trend in production of milk, meat and eggs

|  |  |  |
| --- | --- | --- |
| **Product**  | **Unit**  | **Production**  |
|  |  | 2005-06 | 2006-07 | 2007-08  | 2008-09  | 2009-10  | 2010-11  | 2011-12 |
| Milk  | Lakh tonnes  | 22.7  | 22.8  | 26.50  | 22.86  | 23.65  | 29.47  | 34.63  |
| Meat  | Lakh tonnes  | 11.3  | 10.4  | 10.40  | 10.84  | 12.64  | 19.86  | 23.32  |
| Eggs  | Lakh piece | 54220  | 53690  | 56532  | 46920  | 57424  | 60785  | 73038.9  |

Total factor productivity (TFP) of milk production of both Cross Breed Cow (CBC) and Local Cow (LC) has been estimated and presented in Table 4.7. It was observed that there is an increasing trend in TFP of milk production for CBC and LC.

Table 4.7 Total factor productivity (TFP) of milk production (per cow/day)

|  |  |  |
| --- | --- | --- |
|  | Local cow | Cross breed Cow |
| 1991 | 2002 | 2008 | 1991 | 2002 | 2008 |
| Total output (Tk/cow) | 14.64 | 16.11 | 52.27 | 13.81 | 16.24 | 224.76 |
| Total inputs(Tk/cow) | 14.12 | 13.61 | 32.85 | 10.41 | 10.47 | 71.23 |
| TFP | 1.04 | 1.18 | 1.59 | 1.33 | 1.55 | 3.16 |

Source: author’s estimation

## 4.1.3 Productivity of Fisheries

The country's fisheries resources can be divided into two major categories such as inland fisheries and marine fisheries. Inland fisheries are further classified into two groups, i.e. inland culture and inland capture. Inland fisheries occupy an area of 47.04 lakh ha with an area of 1,18,813 sq.km along with 200 nautical miles. The culture fisheries include ponds, ox-bow lakes and coastal shrimp farms. The flood-plains and the beels, which cover an area of 29.25 lakh ha, offer tremendous scope and potential for augmenting fish production by adopting appropriate aquaculture enhancement techniques**.**

During the period 2003-4 to 2013-14 total fisheries production in Bangladesh sharply increased from about 20 lakh MT to 35 lakh MT (Fig. 4.9). The major contribution to such a large increase came from changes in three sources – inland fisheries (capture), inland fisheries (culture) and marine fisheries. In 2003-04, shares of inland capture, culture and marine fisheries were 38%, 39% and 24%, respectively. During 2003-14, the share of inland culture fisheries to the country’s total fish production sharply increased to 56%, while the share of inland capture fisheries declined to 22% and marines fisheries also declined to 12%. Also, flood plain fisheries production and case and pen culture also had an increasing trend and contributed positively towards increasing the country’s total fisheries production.

Fig. 4.8 Increasing trend in fisheries production of Bangladesh,

 Source: Bangladesh Economic Review, 2015, 2010

Fig. 4.9. Share of different sources of fish production to country’s total production (2002-14)

***Productivity of inland open water fisheries*:** Bangladesh is rich in terms of inland water resources, including 24,000 km of rivers, streams and canals with an estimated area of 480,000 ha, some 114,161 ha of natural depressions or beels, 68,800 ha of reservoir and some 5.5 million ha of floodplains. Rivers and canals roughly cover 5.8% of the total area of the country. Annual flooding during the rainy season inundates up to 60% of the total land surface. Permanent flooded areas represent 6.75% of Bangladesh’s landmass. After China and India, Bangladesh is the third largest country in the world in inland fisheries. But at present the average yield for inland fishery is low and declining by about 2.7 per cent a year. Inland waters comprise numerous rivers, canals, haors, beels, lakes and a vast area of flood plains amounting to about 4.4 million ha (88.45% of total) and produce about 1.6 million MT which was about 41.36% of total fish production.

Beel fishery has taken a new dimension in certain areas, particularly in the greater Mymensingh region, wherein about 45-50% beels have been brought under intensive pangas cultivation giving a production from 10 MT/ha/year to 40MT/ha/year. Similarly, floodplain fisheries have also become a profitable business following the Daudkandi model of community based aquaculture in the floodplain area. However, some initiatives such as community based management of resources, fingerling stocking in open waters, expansion of cage and pen culture in the open water, Jatka- the juveniles of hilsa - protection and sanctuary development in the open water areas have been taken up, although these are not sufficient. One of the major problems faced by the open water fisheries is the leasing system of the Jalmohal which is based on revenue collection only but the production enhancement and biological management has not been considered. As a result, the poor fisherman’s livelihood will not be sustained. Another problem is the open access to the flowing water has restricted the access of the poor fishermen and encouraged the richer. To support the poor fisherman’s livelihood from such water bodies, a licensing system should be introduced for the genuine fishermen. Other problems confronting the development of open water fishery are overfishing, lack of proper implementation of fisheries regulations, lack of awareness development and non participation of the community, conflict of water uses, environmental pollution and habitat degradation.

***Productivity of Hilsa fishery***: Hilsa is our national fish and has the highest contribution to the country’s fish production as a single fish species. During the year 1989-90, hilsa contributed 34.14% of the total capture fisheries whereas during 2015, it contributed around 27.35%. Hilsha productivity in Bangladesh is declining over time. The main causes of declining hilsha productivity are destruction of spawning grounds, higher salinity in the spawning grounds and Jatka (young hilsha) killing in the coastal districts. To ensure its steady growth in production, the Ministry of Fisheries and Livestock adopted several management measures since 2008. These include conservation of jatka through declaring five fish sanctuaries in the major nursery and spawning grounds of river system and protection of berried hilsa catches for 15 days during the peak breeding season are the most important initiatives. The fishing ban was found effective for successful breeding of hilsa. The study of Rahman et al (2015) showed that fishing ban during spawning seasons have significant role in the successful reproduction of hilsa. The fishing ban should be continued in the next decades for sustainable reproduction of hilsa and increase of jatka as well as hilsa production.

### *Productivity of marine fisheries:* Bangladesh has a coast line of about 714 km and an Exclusive Economic Zone (EEZ) of 164,000 Km2, of which 44% is continental shelf. It offers great potential for marine fisheries production. In spite of this high potential, this sub sector contributes only about 21% of the total fish production among which artisanal fisheries contributes 93% and industrial fisheries only 6% of the total marine fish production. Though the Bay of Bengal has about 442 species, only about 20 species are harvested commercially. The trend of marine fishing over the last 15-16 years has been declining.

Data indicated that, as inland sources were being gradually depleted, pressure has been mounting on the remaining marine and estuarine sources. Therefore, marine and estuarine sources are being over exploited, which might lead to diminishing fish resources in these regions in the near future. Indiscriminate and over fishing have already been reported to leading fish resources in the coastal seas to near-exhaustion. Illegal fishing by other countries is also depleting the country’s valuable deep sea resources affecting the fishermen as well. Marine fisheries provide a livelihood to about 0.51 million fisher folk. Improvement in landing and industrialization of the sub-sector will improve the livelihood of this population.

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### *Productivity of cultured fishery*

***Pond culture:*** Fish culture in ponds has been practiced in a total area of about 3.7 lakh ha which is 7.9 % of total inland water. Pond aquaculture is producing about 19.6 lakh MT fish contributing 56% of total inland production in 2013-14. The average productivity of pond fish is 3,430 kg/ha (DOF, 2013). Pond aquaculture is contributing about 866,049 MT representing 41.92% of total inland production (2839 Kg/ha), which is far lower compared with other neighbouring countries.

The trend of pond production over the last two decades has been increasing. Most of the pond production involves poly-culture. Under monoculture of certain species (catfish, tilapia, perch), average production reached up to 3,500-4,000 kg/ha/year. Under the improved poly-culture system, production was found to be doubled. Intensively managed ponds, using improved fingerling, commercial feed and good pond management practices produced up to 10,000 kg/ha/year (NMTPF 2010).There are instances that private farmers in Narshingdi, Trishal and Mymensingh areas have improved poly-culture systems of carp, pangas and tilapia etc. There are records of producing over 40 tons per hectare of pangas under intensive farming with improved supplemental feeds in the Trishal area. In the greater Mymensingh region, most of the aman and boro lands are being converted into ponds for pangas culture. As a result, the total pond area has been increasing. This trend of fish cultivation has already been expanded throughout several districts in the country. The future development of aquaculture depends on the status of existing resources and the potential for bringing more resources under management using aquaculture principles.

###

### *Fish culture in the floodplain and paddy field:* An opportunity for increased production in the flood-prone ecosystem is the integration of fish culture with rice farming. The flood-prone areas are seasonally flooded during the monsoon and remain submerged for 4 to 6 months. Community-based management approaches have been successfully used to culture fish in the floodplain. It has been estimated that paddy fields cover an area of about 80 lakh ha of which 28.34 lakh ha are floodplains which remain under water for 4-5 months. Government has taken the initiative to increase fish production from these flood plains through stocking fish fingerlings.

The Department of Fisheries (DoF) along with partner NGOs has taken initiatives to maximize fish production from rice fields and to extend the coverage area. The fish production obtained from the floodplain aquaculture projects in and around the Daudkandi area ranges from 2.5 to 3.0 ton/ha. It is very encouraging for the landowners and farmers to have the additional income from their land within a 4-6 months period, when land is usually left fallow. The farmers on average get a gross return of Tk. 176,385/ha and a net return of Tk 61,077 /ha. Flood plain fish culture is now intensively practiced in the Teesta Basin regions of Rangpur, Kurigram, and Nilphamari districts. If 10% of paddy fields come into this culture system where paddy fields go under water, then about 85 lakh MT more fish will grow annually producing 300 kg fish per ha (DOF 2013).

###

### *Cage and pen culture:* The production achieved through cage culture was encouraging and satisfactory. Cage culture of mono sex tilapia is being practised in Chandpur, Laxmipur Faridpur, Barishal, Mymensingh, Dhaka, Munsigonj, Gopalganj, Narshindi, Chapainawabgonj and other regions of Bangladesh. In 2013 about 6750 MT fish was produced from 6000 cages. Pen culture is also one of the potential means of producing fish from vast water bodies or water channels (DOF 2013). The fish species reared in the pen are carp, tilapia, pangas etc. Pen culture is also becoming popular in and around Dhaka and Narayanganj and expanding every year.

***Productivity of Shrimp culture in the coastal region*:** Among shrimp producing countries, Bangladesh ranks fourth with respect to area under shrimp farming and sixth in volume of production. Among the coastal districts, the highest concentration in shrimp farming occurred in Bagerhat, Khulna, Satkhira and Cox’s Bazar. Again, within these districts the highest numbers of shrimp farms were raised in Shyamnagar, Paikgacha, Rampal and Chakaria Upazilas. By 2012 over 209,456 ha of land were brought under bagda culture. The culture system of bagda varies from traditional extensive to improved extensive. In 2012-13 bagda production in Bangladesh was 57,785 MT. There is increasing trend in brackish water shrimp and golda production which could further enhanced through use intensive improved technology (Fig 4.10-4.11).

Fig 4.10 Trend in brackish water shrimp area and production Fig 4.11 Trend in Golda shrimp area and production

Source: Fisheries Statistical Year Book of Bangladesh, 2013,2014

The shrimp farming system in Bangladesh is mostly traditional extensive type with a low level of productivity per hectare. Overall shrimp production has increased steadily over the last 20 years, but is still much lower than that of the neighbouring countries such as Thailand with 800 kg/ha (Samsak et al. 2006) and India with 600 kg/ha (Vasu, 2006). Golda are cultured in gher, pond and paddy fields covering an area of about 0.63 lakh ha. About additional 0.60 lakh MT fish are produced along with the golda. There is an increasing trend in golda production during 2007-08 to 2012-13. Around 70 to 80% of shrimp produced are exported each year.

Currently the shrimp sector is facing a number of problems. These are: land use conflicts among the various user groups and agencies; social opposition to the environmental effects of large scale bagda monoculture; lack of proper pond engineering design and management; diseases; quality control and post harvest technology; inadequate infrastructure and financial facilities; lack of technical knowledge and skill; lack of resources information and non compliance.

## 4.2 The drivers of paradigm shift in agriculture for the next decades

## 4.2.1. Driver 1: Soil fertility and fertilizer use

Bangladesh has a wide variety and complexity of soils at short distances due to the diverse nature of physiographic conditions, parent materials, land, and hydrology and drainage conditions. Due to intensive cropping to grow more food, continuous changes are taking place in the soil fertility status due to organic matter depletion, nutrient deficiencies, drainage impedance/water logging followed by degradation of soil physical and chemical properties as well as soil salinity/acidity. Most of the soils of the country are depleted and are in urgent need of replenishment with organic matter and fertilizers in order to enhance crop productivity.

Balanced fertilization is the key to enhancing crop productivity and maintenance of good soil health. It evident from different studies that severe leaching of N and K are going on in the country’s soil system causing low productivity of soils and decline in crop yields. Apart from the natural factors, a major reason is unbalanced use of fertilizer. Awareness-raising for balanced fertilizer application and popularization of more efficient fertilizer application techniques, can help preserve soil quality, raise output, lower costs of production.

Increase in food production and attaining self-sufficiency in Bangladesh requires sustainable growth of the agricultural sector in order to supply adequate food for its increasing population. Fertilizer is considered to be one of the main inputs for increasing crop yields and farm profit. But balanced fertilization is the key to efficient fertilizer use for sustainable high yields. Bangladesh has virtually no possibility of increasing its cultivable land area. Therefore, food production of this country can be increased through expansion of HYVs and balanced use of fertilizer. Timely supply and availability of fertilizer should receive top priority to increase crop production in Bangladesh over next decades.

There has been a progressive shift in fertilizer policies in Bangladesh. In 1970s fertilizer was popularized with introduction of heavy subsidy. Later Bangladesh gradually moved towards privatization, deregulation, and a reduction of subsidies, which began in the mid-1980s and continued until the mid 1990s. This was partially reversed following the severe fertilizer crisis in 1995. During the global food price crisis in 2007-08 public sector roles were further strengthened towards market intervention and providing subsidy of fertilizers for achieving self-sufficiency and food security.

Growth in urea fertilizer use was 4.24 during 1984-85 to 2011-12 (Table #). Fig # shows that annual consumption of urea fertilizer had increasing trend during 1981-82 to 2007-08. Thereafter, the growth rate of urea declined. But the growth rate of TSP and MP sharply increased during 2004-12 due to government subsidy on these fertilizers. It promoted towards use of balanced fertilizer (Table 4.8).

As part of government policy to promote balanced use of different fertilizers by reducing use of urea and increasing use of non-urea fertilizers, the Government drastically reduced prices of non-urea fertilizers (TSP, MP and DAP) while the price of urea was raised from 2008-09. The price of urea reached Tk 16/kg in 2013-14, from Tk 6/kg in 2008-09. For non-urea fertilizers prices in 2013-14 were at least one-fifth of the price in 2009-10. Compared to 2009-10, subsidy on urea and non-urea in 2012-13 was raised by nearly 2.44 and 3.38 times respectively. The process of rebalancing subsidy among different fertilizers started from 2007-08. The share of the subsidy to urea was reduced from 89% in 2007-08 to 40% in 2012-13 (FPMU 2014). In line with the Government policy, urea use decreased while TSP and MoP use increased, though use in 2012-13 was marginally lower than that in 2011-12 (Fig 4.12).

Figure 4.12. Fertilizer use by different types in Bangladesh: 1981-82 to 2011-12

Table 4.8 Growth rates (Percentage) of fertilizer consumption over time (1984-85 to 2011-12)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Total Consumption** | **Urea** | **TSP** | **MoP** |
| 1984/85-2011/12 | 4.17 | 4.24 | 1.80 | 7.12 |
| 1984/85-1989/90 | 8.05 | 8.31 | 5.46 | 8.97 |
| 1990/91-1994/95 | 3.65 | 5.57 | -7.69 | 0.59 |
| 1995/96-1999/00 | 1.22 | 0.92 | 2.35 | 1.099 |
| 2000/01-2004/05 | 4.37 | 3.28 | 2.84 | 1.95 |
| 2005/06-2011/12 | 1.35 | 0.70 | 3.44 | 7.54 |

 Source: Bangladesh Economic Review

Although government is trying to promote balanced use of fertilizers for crop production through implementation of fertilizer policy and New Agricultural Extension Policy still there exists high extent of imbalance fertilizer use at the farmers level (Table 4.9). There is knowledge gap of the farmers on the recommended fertilizer dose as well as risk on the increased investment of fertilizer, lack of money to purchase high priced non-urea fertilizers are the some of the reason for not using balanced fertilizers or recommended dose. Promoting balanced fertilizer use could be an important tool for improving agricultural productivity in the next decades.

Table 4.9 Use of fertilizers for rice production in Bangladesh

|  |  |  |  |
| --- | --- | --- | --- |
| Name of Crop (HYV)  | Recommended dose(kg/ha) | Actual dose(kg/ha) | Use gap (%) |
| Urea | TSP | MP | Urea | TSP | MP | Urea | TSP  | MP |
| T. Aus  | 141 | 101 | 69 | 135 | 28 | 17 | 4.26 | 72.28 | 75.36 |
| T. Aman  | 166 | 101 | 69 | 135 | 30 | 24 | 18.67 | 70.30 | 65.22 |
| Boro  | 269 | 131 | 121 | 192 | 47 | 37 | 28.62 | 64.12 | 69.42 |

## 4.2.2 Driver 2: Irrigation

Rice (paddy) is the largest irrigation user with about 86% of the total irrigated area. In Bangladesh, irrigation is accomplished by: i) Major irrigation schemes using canal/gravity irrigation by surface water, ii) Minor irrigation schemes using groundwater from Deep Tube-wells (DTWs), Shallow Tube-wells (STWs), Force Mode Tube-wells (FMTWs) and also surface water using Low-Lift Pumps (LLPs). Irrigation is considered as a necessary precondition to enhancing agricultural production in Bangladesh in the next decades.

Expansion of minor irrigation through groundwater using DTWs and STWs was the vital component of the GoB’s strategy to facilitate irrigation for agricultural development. Irrigation policy in Bangladesh has been evolved in 2-3 stages. The irrigation policy of Bangladesh evolved from operating state owned nationalized irrigation system towards privatization. As a result of a policy shift towards privatization of irrigation equipment, STWs under private ownership played a significant role for irrigation development during the 1980s with a sharp increase in use of STWs. During the Third Five Year Plan (1985-90), continued emphasis on irrigation facilities tremendously increased groundwater irrigation through the use of DTWs, STWs and manually operated HTWs.

Agricultural growth in the country has been largely due to the expansion of minor irrigation with private sector investment. There was increasing trend of irrigation growth in Bangladesh from 1982 to 2014. In 2014, the national irrigation coverage was 6.5 million hectares which is 77.6% of the total cultivable land, where groundwater covered 65.4% and surface water covered 34.6% of the total irrigated area (MoF, 2014).

The following linear trend lines were fitted on the time series data on irrigated areas from 1976 to 2008 to assess the degree of acceleration in irrigation that was stimulated by the market privatization of minor irrigation equipment.

Total irrigated area (000 ha) = 540 + 108 Time variable– 830 Dummy variable + 59 Time\*Dummy, the standard errors of the estimates are: (4.18), (6.68), (3.55) and (3.40) respectively, R2= 0.98

Shallow Tubewell irrigated area (000 ha) = -154 + 87 Time – 612 Dummy + 66 Time\* Dummy, the standard errors of the estimates are: : (-1.52), (5.89), (-3.73) and (4.16) R2=0.99. Where Dummy is a dummy variable to represent the period of privatization that takes a value of 1 for the period 1988 to 2008 when the irrigation market remained fully privatized and a value of 0 for the earlier period when irrigation development was under the control of BADC. The positive and the statistically significant coefficient of the interaction term, Time\*Dummy indicates that there has been significant acceleration in the diffusion of modern irrigation since the change in policy in favor of privatization. The value of the coefficients indicates that the irrigated area accelerated from 108,000 ha per year during the pre-liberalization period to 167,000 ha since liberalization in 1988. In the post-liberalization period, the expansion was entirely due to the use of shallow tube wells. The area irrigated by tube wells increased at a rate of 153,000 ha/year since 1988, which represents a 92 percent expansion of the total irrigated area.

The information obtained from the survey on the ownership of STWs by different groups of farmers is reported in Table 4.10. As noted, only 4.6 percent of the farms owned STWs in 1988, but this grew to 16 percent in 2000, and 22 percent in 2007. Thus, one out of five farmers now own STWs. The data from the survey confirms that the cost of the tube wells has also declined from USD 670 to USD 220 within the last two decades. This decrease is due to the availability of relatively low-cost machines imported from China and the increasing use of second-hand machines. In 2007, almost 90 percent of farmers operating over 2.0 ha owned STWs, compared to only six percent for marginal farms operating up to 0.4 ha. The latter group constitutes 52 percent of farm households in Bangladesh.

Table 4.10. Distribution of ownership of STWs in the landownership scale, 1988, 2000, and 2007

|  |  |  |
| --- | --- | --- |
| Farm size (ha)  | Percent of households with own STWs  | Average replacement cost of STWs (USD per unit)  |
|  | 1988 (n=818)  | 2000 (n=1,083)  | 2007 (n=1,131)  | 1988  | 2000  | 2007 |
| Up to 0.4  | 2.4  | 2.8  | 6.8  | 598  | 278  | 194 |
| 0.4 to 1.00  | 2.1  | 15.6  | 22.7  | 692  | 263  | 191 |
| 1.00 to 2.0  | 3.9  | 36.5  | 60.9  | 560  | 280  | 218 |
| Over 2.0  | 17.2  | 81.4  | 89.7  | 770  | 343  | 273 |
| All farms  | 4.6  | 16.1  | 22.1  | 671  | 302  | 223 |

Source: Hossain (2009)

## Demand for irrigation water

Rice production accounts for 93% of the total Consumptive Water Use (CWU) and 90% of the total irrigation CWU in Bangladesh. Boro rice accounts for almost all the irrigation CWU of rice. Aus and Aman rice have some irrigated area. However, climatic data show that these seasons require hardly any irrigation.

CWU of Boro (598 mm) is 31% and 10% more than the CWU of Aus and Aman rice. Effective rainfall contributes to only 38% of the total CWU of Boro rice. The balance is from irrigation. Boro rice has the highest physical water productivity (WP) (0.56 kg/m3), which is 52% and 84% more than Aman and Aus rice, respectively. The study by Alauddin and Sharma (2013) showed that a large potential still exists for improving rice water productivity in several districts of Bangladesh

The total irrigation water demand (CWU) for Boro rice production in Bangladesh was 11.8 Billion m3 in 2000 with 265 mm per ha CWU. Water demand has increased by 40% to 16.5 Billion m3in 2010 (Amarsinghe. *et al*, 2014).We have estimated irrigation CWU demand in 2030 and 2050 by using the irrigation CWU per hectare of 2010 level. We have projected that water demand for Boro rice in 2030 will be 17.23 Billion M3 after this period it will stabilize and would remain at 17.23 Billion M3 in 2041 of which 13 Billion M3 would come from ground water.

Groundwater is the source for more than 75% of the irrigated area in Bangladesh (BBS, 2011). It contributed to about 13 Billion m3 of irrigation CWU in 2010. A large part of this CWU is from natural recharge and the balance is from return flows of surface water irrigation. Already we have caused much stress on ground water level. In order to reduce ground water use we need to increase water use efficiency in crop production and enhance utilization of surface water irrigation. Besides this, domestic and industrial water demand will also increase. Therefore, a pertinent question is whether there are adequate renewable groundwater resources to meet the increasing demand.

Given the falling groundwater tables and water quality issues in Bangladesh, it will be extremely difficult to exploit groundwater resources. Without an increase in water productivity (WP), it will be difficult to meet future water demand in 2030 and 2041. Alauddin and Sharma(2013) also raised similar concerns about the unsustainable use of groundwater for increasing Boro rice production without sufficiently improving water productivity. Comparison of irrigation CWU and usable groundwater recharge show that a few districts have already passed the sustainable thresholds of groundwater use. These districts include Khulna in the Khulna region, and Bogra and Pabna in the Rajshahi region, where irrigation CWU exceeds the usable ground water recharge. In a few other districts, such as Barisal, Chittagong, Kishoreganj, Kushtia and Rajshahi, groundwater withdrawals for irrigation may exceed the usable recharge (Amarsingheet al 2014).

Two important issues arise from scarcity of availability of irrigation water and rising costs. First, how can water-use efficiency increased to reduce the cost of production of crops, particularly boro rice? Higher water-use efficiency would also reduce energy consumption and lower greenhouse gas emissions, for example, through the adoption of the alternative wetting and drying method. Development of new crop varieties that consume less water can also help reduce boro water needs. Second, how far can surface water be substituted for groundwater, particularly in areas where surface water is more abundant, for example, in the Southwest?

## 4.2.3 Driver 3: HYV Seeds, fingerlings, chicks, breeds and feeds

In Bangladesh the National Agricultural Research (NARS) Institutes, Agricultural Universities, International Research Institutes and some private seed companies act as the source of modern varieties. The formal seed system (commercially oriented seed supply) involves both public and private sector seed enterprises, producing foundation and certified seeds. In the informal system the farmers produce, save and exchange seeds.

The first formal and organized seed system was introduced in Bangladesh with the establishment of the public sector organization providing agricultural input supply and service-named as the Bangladesh Agricultural Development Corporation (BADC) in 1971. The BADC started its journey with the production of a small quantity of 13.8 tons of quality seeds in 1972. During 2014-15 it has increased its capacity to the extent that it could supply a large quantity of 1,44,200 tons of quality seeds of HYVs/MVs/Hybrids of four notified crops (rice, wheat, jute, and seed potato), and eight non-notified crops (maize, barley, kaon, cheena, pulses, oilseeds, spices, and vegetable seeds) . In the post green revolution period (1960-80s) there was heavy subsidization of seed and the public sector role played in the seed market through BADC. During the 1990s to 2000s the seed market has been liberalized with the New Seed Policy 1993, Seed Amendment Acts 1997 and 2005, and the Seed Rules 1998 and opened market for participation and rise of private enterprises in seed production, import, and distribution.

In Bangladesh the national requirement for quality seeds of all crops is estimated to be 9,32,250 metric tons. The performance of the seed supply system through quality seed replacement rate (SRR) against national requirement up to 2013-14 was 25% of which about 80 percent seed is being fulfilled through the informal seed system of farmers’ own saved seeds.

During 2013-2014, the SRR of the quality rice seed of HYVs/MVs/Hybrids has increased to about 43 percent from 25% in 2005-2006 of which a major proportion of seed is being fulfilled through the informal seed system of farmers’ own saved seeds, The contribution of BADC alone is significant i.e. 39% against 10% in 2005-2006. This has made a significant contribution to the increase in the country's rice production to over 33.9 million tons in 2013-14.

The supply of improved seeds from the BADC, DAE and private companies continued decreasing for the consecutive two fiscal years for all the crops except vegetables (Table 4.11).

Ensuring supply of quality seeds and controlling marketing of adulterated seeds was emphasized in the Sixth and Seventh Five Year Plan. Agricultural growth is dependent on a very wide-scale switch to HYV seed, but seed quality in general remains a major problem. Various related investments are needed to enhance provision of quality seeds in adequate quantities. Some of the non-government organizations and the private sector have started to enter the seed sector with positive impacts on availability, although quality still remains a vexing issue in some cases. Further private-public partnerships for seed, marketing, and extension need to be promoted in the next decades of perspective planning period (2030-41).

Table 4.11: Improved seed supply of BADC, DAE and private companies as a percentage of total agricultural requirements of Bangladesh

|  |  |
| --- | --- |
| **Crop**  | Improved seed supply of as a percentage of total agricultural requirements of Bangladesh |
| **2009-10**  | **2010-11**  | **2011-12**  | **2012-13**  | **2013-14** |
| Rice  | 44.5% | 57.9% | 58.8% | 52.4% | 33% |
| Wheat  | 67.0% | 55.1% | 71.5% | 56.5% | 55% |
| Maize  | 84.2% | 100.0% | 95.9% | 74.4% | 28% |
| Potato  | 3.3% | 4.2% | 11.8% | 9.5% | 6% |
| Pulses  | 2.8% | 4.7% | 11.8% | 14.8% | 8% |
| Vegetables  | 32.1% | 32.7% | 19.8% | 20.3% | 76% |
| Edible oilseeds\*  | 4.4% | 8.1% | 11.5% | 13.6% | 5% |

Note: \* Includes sesame, rape & mustard, groundnut and soya bean, Source: FPMU 2013, 2014 and 2015

##

Bangladesh has a total of 882 fish hatcheries of which 92 are government and 790 are private across the country. A total of 489,331 kg spawn has been produced from private and Government hatcheries in the year 2014. Collection of fish seed from natural grounds has decreased to about 2,695 kg in 2014 which was 3,326 kg in 2013. In 2013-14, there are about 55 *P.monodon* (Bagda) hatcheries and 27 *M.rosenbergii* (Golda) hatcheries under operation. About 11,588 million Bagda post larvae (PL) and about 27 million Golda post larvae (PL) have been produced in these hatcheries. There is gap in the supply of quality fingerling against requirement.

## Paradigm shift in aquaculture in the next decades would require a boost in production and supply of quality fish seeds and fingerlings. The DoF is restoring the natural Breeding habitats of the Halda River to protect natural breeding ground of Indian Major Carps.

## The commercial aquaculture and commercial fish feed production in Bangladesh have been increasing rapidly at the same pace in the past 10 years. Sustainable supply of quality fish feed could be a tool for enhancing fish productivity during the perspective plan period 2030-2041.

Livestock production of Bangladesh could have a paradigm shift in the next decades through enhancing sustainable supply of quality chicks, breeds, feeds, vaccines and veterinary medicines. There are 8 grand parent stock farms are in Bangladesh and supplies about 80% of the total demand of parent stock; the rest 20% is imported. There are 82 parent stock farms and hatcheries are in operation in Bangladesh and producing 55-60 lac **day** old broiler and 5 lac day old layer chicks per week. The production of day-old-chicks (DOCs) is currently lower than the total demand and therefore the chicks are priced higher. Crisis of DOCs and quality feed and instability in poultry sector are the obstacles for the expected growth of the industry. Bangladesh dairy industry is mainly dominated by local breed. Out of 4.9 million milking cows, 4.2 million are local breed and 0.7 million are crossed breed. There is tremendous scope of improving dairy productivity in the next decades through enhancing supply HYV cross breed cows.

The acute shortage of feeds and fodder is one of the single most important obstacles to livestock development in Bangladesh. Feed resources for livestock are primarily derived from crop residues and by‐products such as straw, grass and tree leaves. Supplementary and concentrate feed are provided rarely and inadequately. This has resulted in stunted growth, reproduction and reduced productivity. One of the major problems in the development of the poultry subsector in Bangladesh is the lack of sufficient and appropriate feed. Recently, there are 74 feed manufacturing and marketing company in the country, where as 35-40 feed industries are in large size and producing poultry and fish feeds but the amount cannot satisfy the needs of the growing poultry farms. Bangladesh produces only 2.73 million tons of commercial animal feeds most of which is used for commercial poultry production against a total poultry feed requirement of 5.94 million tons  meeting only 46% of the need. As a result there is enough scope for increasing growth of livestock feed industry.

The manufactured feeds of different feed mills available are not homogeneous in nature and differ in quality. Most of the dairy, poultry and fish farmers are facing the problem of adulterated and inferior quality of commercial feeds. Government intervention is needed for boosting sustainable supply of quality livestock feed in the next decades. Private sector large companies should be encouraged and supported for producing inputs like feed, medicines, vaccines and biological products, genetic stocks and materials for the small and medium size enterprises.

## 4.2.4 Driver 4: Agricultural credit

Agricultural credit, as an input, plays an important role in driving the agriculture of Bangladesh towards a sustainable level. Food security, employment generation and poverty alleviation are closely linked with the development of the agriculture sector. To strengthen the agricultural and rural credit programme, Bangladesh Bank formulated its Agricultural and Rural Credit Policy and Programme. The objective of this policy is to ensure easy access to the agricultural and rural credit facilities by the farmers from the scheduled banks of the country. There was an increasing trend in disbursement of agricultural credit during 2005-2016 (Table 4.12). During the Sixth Five Year plan period, agricultural credit disbursement steadily increased. During the last two fiscal years, disbursement was more than target whereas in other years it was almost close to the targets (Table 2.11). Recovery of agricultural credit increased by 16% to 143.62 billion taka in 2012/13 from 123.6 billion taka in 2011/12 (Bangladesh Bank 2013).

Table 4.12 Year-wise disbursement and recovery of agricultural credit (In crore Taka)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Fiscal year | Target | Disbursement | Recovery | Balance |
| 2005-06 | 5982.21 | 5496.21 | 4164.35 | 15376.79 |
| 2006-07 | 6351.30 | 5292.51 | 4676.00 | 14582.56 |
| 2007-08 | 8308.55 | 8580.66 | 6003.70 | 17822.50 |
| 2008-09 | 9379.23 | 9284.46 | 8377.62 | 19598.15 |
| 2009-10 | 11512.30 | 11116.88 | 10112.75 | 22588 |
| 2010-11 | 12617.40 | 12184.32 | 112148.61 | 25492.13 |
| 2011-12 | 13800.00 | 13132..15 | 12359.00 | 25974.97 |
| 2012-13 | 14130.00 | 14667.49 | 14362.29 | 31057.69 |
| 2013-14 | 14595.00 | 16036.81 | 17046.02 | 34632,82 |
| 2014-15 | 15550.00 | 15978.46 | 15406.96 | 32936.80 |
| 2015-16 | 16400.00 | 17646.39 | 17056.43 | 34477.37 |

Source: Bangladesh Bank

While demand for credit is increasing with the advent of new technologies and high value crops, the supply side has remained less vibrant. The volume of institutional credit is low and the proportion of the public sector in the total volume of institutional credit is even smaller. According to data of the Bangladesh Bank, around 25 percent total disbursement of rural credit is delivered by the public sector. The remaining 75% has been delivered by micro-finance institutions (MFIs) including NGOs and the Grameen Bank. However, the demand for credit is much more than that met by non-institutional sources.

Table 4.13 Agricultural credit disbursement during 2009-14

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
| Credit disbursed (billion taka ) | 111.17  | 212.84  | 131.32  | 146.67  | 160.37 |
| % of target  | 97%  | 97%  | 95%  | 104%  | 110%  |

Specialized banks, like the *Krishi Bank*, are a major source of agricultural credit. Two-thirds of the credit from public sector agencies is from specialized banks. As of July 2015, there were 527 NGOs registered by the Microfinance Regulatory Authority (MRA). The average amount of microcredit received per person from MFI sources has been Tk 7,144 (Planning Commission, 2011). The total amount of credit received per person would be higher as people borrow from multiple sources.

As total demand for credit far outweighs its supply, private moneylenders dominate the credit market. Poor farmers have little choice. In order to increase access to credit of the marginal and small farmers it is necessary to promote more flexible credit products with easy interest rate. Also, besides reducing cost of agricultural credit it is necessary reduce risk of investment in agricultural production through introducing different type of insurance.

## 4.2.4 Driver 5: Technology generation and adoption

Availability of cultivable land will shrink next two decades. So, it will not be possible to increase agricultural production through expansion of cultivable land. The remaining options are promoting balanced use of land and water resource, soil fertility, varietal development, improved technology and mechanization. Technological breakthrough is needed for development improved varieties of rice, wheat, maize, vegetables, spices and fruits. The new HYV varieties should be resilient of diseases and climate change. Supports are needed for development of agricultural research and extension for appropriate technology generation and dissemination for the next two decades.

The government of Bangladesh has given priority to the agricultural sector to boost agricultural production. Increasing the speed and sustaining agricultural growth are priorities for increasing food production and reducing poverty. The future challenge of increasing food production could be met through the introduction of modern biotechnology and an increase in investment in agricultural technology generation and transfer. Table 4.14 presents information on technology generation and innovations in Bangladesh agriculture during 2004-14.

Table 4.14 Technology generation and innovations in Bangladesh agriculture during 2004-14

|  |  |
| --- | --- |
| **Product type**  | **Examples of innovations**  |
| Inputs  |
| Seed  | Rice, hybrid rice and maize, Cultivars for potatoes, vegetables, spices and other crops  |
| Fertilizer  | Biofertilizer from coconut dust, earthworm compost, and green manure  |
| Pesticide  | Pheromones, parasitoids, and phostoxin  |
| Machinery  | Corn shellers, rippers, threshers, straw-bundle cutting machines, and seeders  |
| Large-scale production  |
| Crop-based  | Cultivars for gladiolas, strawberries, longum, grapes, guava, jujube, and durian  |
| Processing  |
| Crop-based  | Rubber rollers, color sorters, and graders for rice processing; and solvent extraction for oil seeds and rice bran  |

The Sixth and Seventh FYP prioritized the importance of research and extension for agricultural intensification, diversification and resilience to climate change. Since 2009-10, the Government of Bangladesh (GoB) agencies developed 23 new rice varieties (Table 2.10). Of these, some important ones are: saline tolerant rice variety BRRI Dhan 61, the world’s first zinc-enriched rice variety BRRI Dhan 62, submergence tolerant BINA Dhan-11 and 12, water logging resistant BINA Dhan-14, BINA Dhan-13, three new stress tolerant rice varieties (BRRI Dhan 55, 56 and 57) and one short duration (BRRI Dhan 58) rice variety. The released varieties are expected to address adverse climatic conditions, particularly in the south and northern regions of the country. For non-rice crops, five new varieties were developed for vegetables, while no new varieties were released for maize and potato in 2013-14 (Table 4.15).

Table 4.15: Technological innovations in varietal development and irrigation coverage

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SFYP output proxy indicators**  | 2009-10  | 2010-11  | 2011-12  | 2012-13  | 2013-14 |
| No. of improved new rice varieties developed by GoB agencies | 5 | 2 | 5 | 3 | 8 |
| No. of new non-rice varieties developed |
| Wheat  | 2 | 0 | 2 | 1 | 2 |
| Maize  | 0 | 0 | 0 | 1 | 0 |
| Potato  | 2 | 2 | 11 | 13 | Na |
| Pulses  | 1 | 5 | 0 | 4 | 2 |
| Vegetables  | 3 | 11 | 7 | 5 | 5 |
| Edible oilseeds\*  | 1 | 7 | 0 | 4 | 4 |
| Fruits  | 10 | 4 | 3 | 4 | 2 |
| % of cropped area under irrigation  | 45.3% | 45.8% | 46.8% | 47.4% | Na |
| Surface water irrigation area as % of total irrigation area | 22.0% | 21.3% | 21.3% | 20.9% | 21% |
| No. of farmers trained on sustainable agriculture practices by DAE (lakh) | 13.34 | 12.78 | 12.77 | 12.83 | Na |

Source: FPMU 2013, 2014 and 2015

There could be paradigm shift in production of livestock and fisheries in the country through technological breakthrough and automation in the context of climate change. Emphasis should be given on improving genetic resources of livestock and fisheries, improved livestock rearing and aquaculture technology, disease control and automation. Research on conservation of native genetic resources should be emphasized.

It is important to mention that a paradigm shift in productivity of Bangladesh agriculture during next two decades would require a technological transformation in agriculture – production, marketing and institutions. Application of technology and automation are going to be key drivers of agricultural productivity as Bangladesh moves into high gear towards becoming a developed country. South Korea is an excellent example of an economy that went through a process of transformation from developing to developed economy, with transforming agriculture in the process. In this regard emphasis should be given on technological back through as well as capacity development of farmers, market actors and concerned institutions.

## 4.2.4 Driver 6: Agro-processing, value chains and exports

The size of food processing sector is worth US $2.2 billion and grew on an average at 7.7 percent per annum between FY2004/05 and FY2011/12 (USDA, 2012).The beverage industry more than doubled during the same period to US dollar 29 million, with an average growth rate exceeding 8%. The food processing sector is thus growing rapidly with prospects for continued growth as Bangladesh’s GDP continues to grow. Bangladesh exports over $700 million worth of processed food and beverages, of which over 60 percent are shrimp and fish products.

About 100 types of fruits and vegetables are exported from Bangladesh to more than 40 countries in the world. Export of fresh fruits and vegetables from Bangladesh significantly increased in the past decade. Table 4.16 presents export growth of fresh fruits and vegetables.

Table 4.16: Export growth of fresh fruits and vegetables

|  |  |  |  |
| --- | --- | --- | --- |
| FiscalYear | Quantity Exported (MT) | Export Value (in Million US$) | Export Growth(%) |
| 2008-09 | 24670 | 50.71 | - |
| 2009-10 | 29370 | 64.21 | (+) 26.62 |
| 2010-11 | 48428 | 109.41 | (+) 70.39 |
| 2011-12 | 59573 | 134.59 | (+) 23.01 |
| 2012-13 | 80660 | 182.23 | (+) 35.39 |

Source: Export Promotion Bureau (EPB) and Hortex Foundation 2013

Table 4.17: Export growth of potato in Bangladesh

|  |  |  |
| --- | --- | --- |
| *Fiscal**Year* | *Quantity exported**(MT)* | *Export value**(million US$)* |
| 2011-12 | 34232 | 8.50 |
| 2012-13 | 41830 | 10.93 |
| 2013-14 (up to July-December 2013) | 10750 | 5.50 |

Source: EPB 2014

Frozen foods is the second largest export sector of the economy. The massive natural resources available in Bangladesh make this sector particularly promising for investors looking to supply in international as well as in domestic markets. Export earning from shrimp and fish export in 2016 was around 348.28 million US$ and 348.28 million US$ in 2015.

There is potentials to transform Bangladesh’s export markets of fresh, frozen horticultural crops and processed food. It is projected that Bangladesh’s export earnings could be around $1,765 million per year from the export of fresh and processed foods in 2034 from base year level export value of 380 million USD (Fig 4.13 and Table 4.18). This would require capacity development of value chain actors, compliance of certification of food quality and safety and improvement of storage and transportation facilities. The export potential of fruit and vegetables is about 160 thousand metric tons and potatoes would be around 200 thousand metric tons. During 2015-2034 total export under business as usual scenario is US $ 14,773 million and under improved scenario is US $21,556 million and additional benefit due to improvement is US $ 6,803 million. Table 4.19 presents top ten vegetables exporters globally. It revealed that similar to Bangladesh’s export value of horticultural crops in 2015 the export value of vegetables of Thailand was 562 million USD in 2004 and within a 10 year period it rose to 1797 million USD in 2014.

Though agriculture is the least automated or digitized there is vast scope for automation (not necessarily in farming) in agricultural processing and value chain integration, according to recent research. A paradigm shift in agro-processing in the next decades could be achieved through automation in agro-processing and value chain integration. As South Korea did in the past.

Figure 4.13: Projection of export of fresh, frozen horticultural crops and processed food

(Million US$) under business as usual and enhanced capacity, Source: Karim and Islam (2014)

Table 4.18 Projection of export of fresh, frozen horticultural crops and processed food

(in Million US$) under business as usual and enhanced capacity scenarios

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Business as usual projection of export (Million US$) | After capacity enhancement projection of export (Million US$) | Incremental benefits due to capacity enhancement (Million US$) | Year | Business as usual projection of export (Million US$) | After capacity enhancement projection of export (Million US$) | Incremental benefits due to capacity enhancement (Million US$) |
| 2015 | 380 | 418 | 38 | 2026 | 796 | 1171 | 374 |
| 2016 | 420 | 482 | 63 | 2027 | 828 | 1234 | 406 |
| 2017 | 459 | 551 | 92 | 2028 | 861 | 1292 | 431 |
| 2018 | 499 | 648 | 150 | 2029 | 896 | 1361 | 466 |
| 2019 | 538 | 711 | 172 | 2030 | 932 | 1444 | 512 |
| 2020 | 578 | 780 | 202 | 2031 | 969 | 1531 | 562 |
| 2021 | 617 | 852 | 235 | 2032 | 1008 | 1612 | 605 |
| 2022 | 657 | 913 | 256 | 2033 | 1048 | 1687 | 639 |
| 2023 | 697 | 975 | 279 | 2034 | 1090 | 1765 | 676 |
| 2024 | 736 | 1038 | 302 | Total | 14773 | 21576 | 6803 |
| 2025 | 766 | 1110 | 345 | GDP% (2013) | 21.7 | 14.9 | 6.9 |

Source: Karim and Islam (2014)

Table 4.19 Top ten vegetables exporters globally (Value in million USD)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | China | Netherlands | Spain | Mexico | USA | Canada | Belgium | France | Thailandd | Italy |
| 2004 | 2,537 | 4,336 | 4,172 | 2,997 | 2,151 | 1,471 | 1,730 | 1,733 | 562 | 1,003 |
| 2005 | 3,052 | 4,258 | 4,308 | 3,122 | 2,421 | 1,714 | 1,829 | 1,812 | 518 | 1,084 |
| 2006 | 3,715 | 5,076 | 4,410 | 3,479 | 2,681 | 1,910 | 1,967 | 1,991 | 673 | 1,211 |
| 2007 | 4,043 | 6,122 | 5,037 | 3,558 | 3,010 | 2,379 | 2,315 | 2,431 | 789 | 1,416 |
| 2008 | 4,222 | 6,630 | 5,528 | 3,869 | 3,468 | 3,039 | 2,508 | 2,452 | 730 | 1,564 |
| 2009 | 4,853 | 5,939 | 5,539 | 3,694 | 3,401 | 3,023 | 2,295 | 2,174 | 858 | 1,438 |
| 2010 | 7,477 | 6,779 | 5,297 | 4,324 | 3,785 | 3,365 | 2,319 | 2,385 | 1,071 | 1,756 |
| 2011 | 8,723 | 7,462 | 5,474 | 4,992 | 3,939 | 3,667 | 2,312 | 2,599 | 1,278 | 1,696 |
| 2012 | 6,906 | 6,981 | 5,591 | 4,969 | 4,045 | 3,169 | 2,335 | 2,381 | 1,371 | 1,583 |
| 2013 | 7,871 | 7,906 | 6,367 | 5,398 | 4,405 | 4,275 | 2,812 | 2,773 | 1,590 | 1,793 |
| 2014 | 8,226 | 7,620 | 6,330 | 5,420 | 4,512 | 4,448 | 2,579 | 2,350 | 1,797 | 1719 |

## 4.3 Projections of food demand and supply in 2030 and 2041

While the on-going efforts of the Government of Bangladesh are contributing towards enhancing agricultural productivity growth and attaining the food security, a quantitative analysis of demand and supply for food is a worthwhile consideration for the perspective plan (2030-2041).With growing population, planning for future food production to meet food security challenges would require projections of future supply and demand for foods. Using ARIMA models we have projected demand and supply of major food items for the periods 2030, 2041 and 2050. In the ARIMA model we have used projected population growth and income growth of Bangladesh for estimation demand for food. The results are discussed below:

Food consumption in Bangladesh has diversified over time. Cereals still provide a major part of the calorie intake, but their share in total calorie consumption has decreased from 92% in 1990 to 89%by 2010. Projections show that it will further decrease to 87% by 2030 and 86% by 2050 (Fig. 4.14). The contribution to calorie intake from potato, vegetables, animal and fish products gradually increased between 1990 to 2010 and will continue to increase up to 2030 and 2050 (Islam 2016).The consumption of animal products (meat, milk, egg and fish) and non-cereals (potato, vegetables and fruits) followed similar increasing trend during 1990 to 2030.Absolute demand for animal products increased from 52.5 kcal/person/day in 1990 to 83.5 kcal/person/day in 2010 and will further increase to 92.8 kcal/person/day in 2030 and to 112.7 kcal/person/day in 2050 (Fig 4.15).

Figure. 4.14. Share of major food items in total calorie intake

## Food demand

Using ARIMA model, we have projected that Bangladesh’s total demand for rice will be 37.5 million metric tons in 2030 and 39.4 million metric ton (MMT) in 2041 (Table 2.35).. The total demand of potato, pulses, vegetable and fruits in 2030 will be 12.3, 1.2, 7.0 and 3.2 MMT, respectively. The projected demand for these food items in 2041 will be 12.8, 1.2, and 7.3 MMT, respectively.

Figure. 4.15. Projection of per capita calorie intake from animal products.

Source: Islam, 2016

The total demand for meat, egg, milk and fish in 2030 will be 3.2, 2.0, 0.4, 4.9 and 4.2 MMT, respectively. The total demand for these animal products in 2041 will further rise to 2.1, 1.1, 6.0 and 4.8 MMT, respectively.

## Food supply

Projections of food supply were estimated considering structural changes in the production characteristics/technology of agriculture over the periods 2030 and 2041. Forecasts of ARIMA models, using Business as usual (BAU) scenery, show that supply of rice will be 38.7 MMT in 2030 and 43.2 MMT in 2041. This projection of rice production in 2030 is closely similar to the projection of Ganesh *et al,* (2013) under BAU scenario. Ganesh et al projected that rice production in 2030 will be 38.8 MMT under BAU scenery. The projection of Amarasinghe *et al* (2014) shows that production of rice in 2030 will be 49 MMT under BAU scenery. However, a contentious point in the projection of Amarasinghe is the area expansion, mainly for Boro rice, Boro rice area will expand from 4.10 million ha in 2010 to 5.7 million ha by 2030. With increasing pressure on land due to urbanization and development and decreasing availability, it is not plausible whether such a horizontal expansion of area is possible.

Amarasinghe’s projection also shows that with the forecasts of yield growth, self-sufficiency of rice is possible even without this area expansion. His estimation shows that even under the pessimistic scenario of lower growth in yield, i.e. along the 75% Lower Limit of Confidence interval (PS scenario), the total rice production of 39 MMT would be more than sufficient to meet the total demand by 2030. But our projections show that expansion of rice area would not be feasible in the long run, beyond 2020 rice area will stabilize (at Aus 1.0 million ha, Aman 5.6 million ha and Boro 4.7 million ha) and remain so up to 2041. This seems more plausible result under the context of increasing population pressure and urbanization on land resources and gradual decline of cultivable land over time in Bangladesh. Moreover, land will shift from rice to high value non-rice crops as a result area of non-rice crop will expand.

Compared to 2013 level, wheat production will increase by 0.6 million ton by 2030 from 2013 level and 0.3 million ton by 2041 from 2030 level as result of slight expansion of area and yield. Similarly, compared to 2013 level, maize production will increase by 0.7 million by 2030 and will further increase by 0.3 million ton in 2041. Beyond 2041 maize area and yield will stabilize at 0.4 million ha and 7.5 ton/ha. Total cereal supply (including rice, wheat and maize) will be 43.2 MMT by 2030 and 45.3 MMT by 2041. Total cereal production will be enhanced by 14% by 2030 than the 2013 level and it will be further enhanced by 15% compared to 2013 level by 2041.

Projections show that areas of non-cereal crops, specifically, potato, pulses, vegetables and fruits will expand gradually from 2013 level and will continue up to 2041 as a result of partly substituting land for more remunerative crops and partly due to increasing cropping intensity. Per ha yield of potato, pulses and vegetable will increase to 20.5 ton, 1.3 ton and 8.5 ton by 2030 from 18.1 ton, 1.2 ton and 8.0 ton of 2013 level, respectively. As a result, production of potato, pulses, vegetables and fruits will also be enhanced and reach to 11.8, 0.4, 6.4 and 3.6, respectively, by 2030. Fruits production will increase by 2030 because of area expansion. Production of potato and vegetables will further rise to 12.8 MMT, and 7.3 MMT respectively by 2041. Beyond 2030 pulses area will stabilize and its production also does so at 0.4 million tons. But fruits production will slightly increase to 3.3 MMT by 2041 as a result of increasing yield of this perennial crop.

Supply of total animal products will also be enhanced from domestic production to 8.8 MMT by 2030 from 2013 level of 7.00 MMT and further rise to 9.83 MMT by 2041. The individual animal product items like meat, egg, milk and fish will also increase to 0.9, 0.4, 4.3, and 3.2 MMT by 2030, respectively. The supply of these products will rise to 1.1, 0.43, 4.8 and 3.5 MMT in 2041, respectively.

## Projection of surplus and deficit of food supply

Bangladesh is self-sufficient in rice now. Rice production was 5% less than the demand in 2005 and in 2000, but there was a surplus of 5% in 2010. The projections show that Bangladesh will have a surplus rice production of 1.2 MMT and surplus maize production of 1.8 MMT by 2030. On the other hand, the country will have deficits of productions of wheat, potato, pulses, vegetables, meat, egg and fresh water fish amounting 2.6, 0.5, 0.8, 0.7, 1.0, 0.1 and 0.7 MMT. Bangladesh will have a surplus production of rice, maize, potato, vegetable and fruit by 2041 amounting 3.8, 1.5, 2.4, 0.1 and 0.2 MMT, respectively. It will have deficit production of wheat, pulses, meat, egg, milk and fresh water fish (Table 4.20).

The policy implication of the above projections is that Bangladesh could export some amount of rice and import wheat and some other non-cereal food. Alternatively, it could reduce rice production and enhance diversified productions of non-cereal food items to reduce deficit by 2030 and 2050.

## 4.4 Analysis of food security status and safety nets

Bangladesh has made good progress since 1992 in reducing income poverty based on the national poverty line. The country was able to lower the overall incidence of poverty from 58.8 percent in 1991‐92 to about 48.9 percent in 2000, with an annual rate of decrease of 1.8% about the percentage point per year. It further declined to 40% in 2005 with a decreasing rate of 3.9% about the percentage point per annum and further to 31.5% in 2010 (Fig. 5.1). The most recent estimates (Household Income Expenditure Survey– HIES, 2010) indicate that still 31.5% of the population has absolute poverty and are undernourished who fail to meet minimum level of caloric consumption needs of 2122 KCal/person/day and 17.6% of the total population are hard core poor who are unable to consume 1805 Kcal/person/day.

Table 4.20. Projections of demand and supply of food by 2030 and 2041 (Based on estimates of ARIMA model (Quantity in million ton)

| Year | Rice | Wheat | Maize | Potato | Pulses | Vegetable | Fruits | Meat | Egg | Milk | Fresh water fish |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Food Demand** |
| 2030 | 37.5 | 4.2 | 1.1 | 12.3 | 1.2 | 7.0 | 3.2 | 1.9 | 0.5 | 4.2 | 3.9 |
| 2041 | 39.4 | 4.5 | 1.4 | 12.8 | 1.2 | 7.3 | 3.3 | 2.1 | 1.1 | 6.0 | 4.8 |
| **Food Supply** |
| 2030 | 38.7 | 1.6 | 2.9 | 11.8 | 0.37 | 6.4 | 3.6 | 0.9 | 0.4 | 4.3 | 3.2 |
| 2041 | 43.2 | 1.9 | 2.9 | 15.2 | 0.39 | 7.4 | 3.5 | 1.1 | 0.43 | 4.8 | 3.5 |
| **Surplus(+)/deficit(-)** |
| 2030 | 1.2 | -2.6 | 1.8 | -0.5 | -0.8 | -0.7 | 0.4 | -1.0 | -0.1 | 0.1 | -0.7 |
| 2041 | 3.8 | -2.6 | 1.5 | 2.4 | -0.81 | 0.1 | 0.2 | -1 | -.67 | -1.2 | -1.3 |

Source: Author’s estimation

Food security worsens with inter‐year shortfall in food grain production caused by climatic variations and natural disaster such as floods, tidal surge and insect and pest attacks. Variations in food intake also exist between regions of the country, between adults and children and between men and women at the household level.

## 4.4.1 Availability of food

In view of repeated experience of severe hunger and famine, food security in Bangladesh has long been synonymous with achieving self-sufficiency in the staple food rice. The Bangladesh economy has made remarkable progress in tripling rice production from 11 million tonnes in 1971 to 34 million tonnes in 2015 for its 160 million people. Per capita rice production has increased substantially over the level at the time of independence.

Wheat production is showing a declining trend in recent years. Its production decreased from 1.6 million tons in 2001-02 to 1.20 million tons in 2013-14. Production of vegetables and fruits has increased, but at a slow pace from 1.59 million tons and 1.47 million tons in 2001-02 to 4.1 million tons and 3.7 million tons in 2013-14 respectively. Spectacular success has been achieved in the production of potato. It has increased significantly from 2.90 million tons in 2001-02 to 8.30 million tons in 2013-14 (Table 4.21). Production of non-cereals such as pulses, oilseeds, vegetables and fruits, which are the chief sources of protein, mineral and vitamin, still remains far below the actual requirements, making it difficult to provide balanced diet for all. The production of pulses and oilseeds has picked up in recent years due to favourable prices, some progress in the development of higher yielding varieties, and identification of favourable agro-ecological niche. The dependence of Bangladesh on the world market for the availability of pulses, edible oil and sugar and milk has been growing, along with wheat.

Table 4.21: Trend in domestic production of food crops: 2001-02 to 2010-11 period (Million MT)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Food grain | Potato  | Pulses  | Oilseeds  | Vegetables  | Fruits  |
| Rice  | Wheat |
| 2001-02  | 24.30  | 1.61  | 2.90  | 0.35  | 0.39  | 1.59  | 1.47  |
| 2013-14 | 33.4  | 1.20  | 8.30  | 0.30 | 0.84  | 4.1  | 3.7  |

Commercial import of wheat has however increased despite growth in domestic production till the 1990s, mainly due to the discontinuation of food aid and stagnation of domestic production after a rapid growth in the 1980s. The import has recently exceeded three million tonnes. It appears that even if Bangladesh achieves self-sufficiency in rice production or becomes a rice exporting country, the import of wheat will continue.

Fresh water fish production in the country increased from 1.89 million tons in 2001-02 to 2.6 million tons in 2013-14. Meat, milk and egg production has also increased significantly over the last ten years and reduced the deficit of demand and supply. But there is still shortage of meat.

## Per capita availability

Per capita availability of cereals (rice and wheat) has been found to increase from 374 gm/day in 1994-95 to 647 gm/day in 2010-11. Sharp increase in per capita availability of potato and vegetables is observed during the last 15 years, while the per capita availability of pulses and oilseeds has remained stagnant or declined. Availability of meat, milk and egg has also increased. Per capita availability of fish increased from 27 gm in 1994-95 to 53 gm in 2010-11, while those of meat and milk increased from 11 gm and 35 gm in 1994-95 to 35 gm and 55 gm, respectively in 2010-11.

## 4.4.2 Access to food

Poverty of Bangladesh has decreased significantly since 1992. Bangladesh’s commitment to social protection and safety-net programs has led to a sustained decline in poverty. Since 2005 alone, nine million people have been lifted out of extreme poverty. This development helped to achieve the poverty reduction target of MDG1 by 2015.

The decline in poverty has been accompanied by an overall improvement of people’s purchasing power, which strengthened their ability to access basic foods. The drop in poverty rates has arguably been the most powerful driver as it allows more people to access and afford better diets. The major achievements in term of food access are: i) Per capita income has been increased more than two folds in the last 10 years; ii) Employment generation has increased through public and private sector programmes; iii) Number of extreme poor reduced from 44 million in 2000 to 26 million in 2010.

The share of households that do not spend enough to meet their basic needs almost halved over the past two decades, from 56.6 percent in 1990 to 31.5 percent today. Improvements are even more pronounced when applying a lower expenditure threshold. In addition, targeted interventions such as homestead gardening, social protection schemes and nutrition education programmes have facilitated or directly promoted access to a larger variety of foods, and strengthened awareness of the importance of dietary diversity. Regardless of wealth quintiles in the society, malnutrition is pervasive and is present in all sections of the society.

Almost 60 percent of the rural households are engaged in farming. The farming household can access their food from self-production and/or trading the surplus with other foods available in the local market.  But the landownership is unequally distributed, and so is the access to food from self-production. Almost 30 percent of the households do not own any land and another 30 percent own only up to half an acre. Such tiny landownership is insufficient to meet the food needs of four to five-member households.  A tenancy market is in operation, which provides access to land to landless and marginal landowners for farming. A large proportion of marginal farmers go to market to access food as their own production is inadequate to meet the household needs.

The results of BIHS data (2011-12) indicated that in 2011–12, 36.8% households in the Government’s Feed the Future (FTF) zone and 35.3 percent of households in the rural national sample were food energy-deficient (below 2,122 kcal/person/day) who could not afford an adequate diet. Furthermore, 17.5 percent of the households in the FTF zone and 16.5 percent of the households in entire rural Bangladesh were below the lower food energy threshold of 1,805 kcal/person/day and, therefore, remained severely food energy-deficient. The income growth per year has accelerated since 1990, reaching 7.0 percent in recent years. Bangladesh has also achieved remarkable progress in population control. But, the income is highly unequally distributed and the disparity has been growing. As a result nearly one-fourth of the people still live below the poverty line, with inadequate income to access food from the market.

An indicator often used to assess the capacity of the poor to access food from the market is the level and trend in real wages.  This indicator shows that since the mid-1990s there has been a favourable trend in the income of the households who depend on selling labour in the market, such as agricultural wage labourers, transport operators and construction workers. The Land Reform in 1984 stipulated a minimum wage equivalent to 3.5 kg of rice at the prevalent market price. The rice equivalent wage had increased from about three kg in 1990 to nearly 8 kg in 2015. The only low income group who have not been able to increase their real income are industrial labourers, particularly the unskilled workers in the garment industry.

One-third of households in the country are affected by food insecurity with significant inequalities in access to food due to gender and age-related issues and great regional disparities. Food insecurity and under-nutrition are generally worse in rural areas and urban slums. The most food-insecure regions are in river flood plains in north-east part, cyclone-prone areas in the southern coastal belt and the southeastern part of Bangladesh.

The periodic floods, cyclones and disasters that have affected the country in 2004, 2007, 2010 and 2017 have impacted progress on the food and nutrition situation. The hike in food prices after the food crisis in 2007 and 2017 had a negative impact on the real wages and access to food.  Sharp increase in food grain prices significantly lowers the real income of poor households who spend over half of their income on staple food. At the same time the instability in producer prices increases risks and uncertainty, and discourages the subsistence farmer to invest in agriculture. The volatility in food prices remains an issue for achieving seasonal and temporal stability in food security.

## 4.4.3 Utilization of food and nutrition security

The acceleration in economic and agricultural growth has made a positive impact on the diversity of food intake away from the rice dominant diet. Over the period, the per capita consumption of rice and wheat has been declining, while the consumption of vegetables, fruits and fish and meat has been growing (Table 5.4).  For rural areas the consumption of rice has declined from 175 kg per person per year in 2000 to 161 kg in 2010, a decline of about 1.4 kg per year. For urban areas, the consumption of rice and wheat together has declined from 144 kg per person per year in 2000 to 140 kg in 2010, a decline 1.5 kg per year. During 2000 to 2010, the consumption of meat and egg has increased by one-third for rural areas and by 35% in urban areas. However, the level of consumption of other food items, hardly meets the requirement for balance diet as specified by the National Nutrition Council and FAO. Table 4.22 shows that the average level of consumption has reached the adequacy level for rice and vegetable, and about to be reached for fruits and fish, but serious deficiency persists for food such as pulses, oil, and livestock products.

Table 4.22 Consumption of different food items (gm/person/day)

|  |  |  |  |
| --- | --- | --- | --- |
| Food item | Normal for balanced nutrition | Rural area | Urban area |
| 1984 | 2000 | 2005 | 2010 | 1984 | 2000 | 2005 | 2010 |
| Rice | 500 | 421 | 479 | 477 | 442 | 351 | 377 | 389 | 343 |
| Wheat | 100 | 65 | 24 | 12 | 38 | 79 | 17 | 28 | 51 |
| Vegetable | 225 | 140 | 196 | 218 | 221 | 179 | 196 | 228 | 241 |
| Pulses | 30 | 26 | 15 | 13 | 13 | 22 | 19 | 19 | 17 |
| Fruits | 50 | 17 | 26 | 33 | 43 | 21 | 27 | 33 | 50 |
| Fish | 45 | 29 | 38 | 40 | 46 | 39 | 41 | 50 | 60 |
| Meat & egg | 34 | 10 | 15 | 18 | 20 | 22 | 31 | 31 | 42 |
| Milk | 50 | 22 | 29 | 31 | 32 | 34 | 33 | 37 | 39 |
| Total | 934 | 741 | 899 | 986 | 1005 | 761 | 841 | 999 | 983 |

Source: Household Income and Expenditure Survey, BBS, various years and Bangladesh National Nutrition Council

The average numbers also mark serious inequality in the distribution of consumption across the income scale. While the richer sections of the society are being able to gradually reduce their cereal intake and diversify their diet, the poor still have an unmet demand for rice.  A recent IFPRI study shows that nearly 20 percent of the population is still calorie deficient and the gender disparity in calorie intake still persists. A quarter of the households has to go without a meal a day or to reduce the intake of food a number of days during a month.

Approximately 9 million Bangladeshi children between six months and five years of age suffer from under-nutrition, with 41 percent of children stunted, 36 percent of children underweight, and 16 percent wasted. Bangladesh has made significant progress in reducing under-nutrition for the children (Figure 4.16). There was good decline in the prevalence of underweight children from 60 percent in 1990 to 36 percent in 2011, and is on track for achieving the target set by the Millennium Development Goals (MDGs) this decline is likely to be related to the reductions in poverty and fertility and improving health services and enrolment in education over the same time frame.. However, progress in reducing stunting, the indicator of chronic malnutrition, shows a less encouraging picture. The level is still about 41 percent, much higher than countries in sub-Saharan Africa. Over 2007 to 2011, the stunting declined by only two per cent points. Stunting affects the cognitive ability and the immunity of the children from diseases. The prevalence of wasting, an indicator of current nutritional status, remains at an alarming level of 15 to 17 percent, with very little improvement over time (Fig 4.17).

 

Fig. 4.16 **Trends in Children Nutritional Status Fig. 4.17 Prevalence of Undernourishment (%)**

Low birth weight among Bangladeshi infants is among the highest in the world, ranging between 20 and 22 percent. The nutritional status of women shows a better trend. The proportion of women with chronic energy deficiency has declined from 52 percent in 1997 to 25 percent in 2011. But The hidden hunger, the insufficiency of vitamin A, iron and zinc in the diet that causes major diseases such diarrhoea and anaemia and poor eye sight is still a major health problem.

Despite tremendous accomplishments in the past, in 2009 nearly half of the Under-5 children were underweight (nearly 8.0 million children). Given the current trend it is unlikely that Bangladesh will reach the MDG (Millennium Development Goals) target of reducing prevalence of the underweight in children by 2015. Based on data from 1990 to 2009, the number of underweight children reduced at the annual rate of 1.0 per cent. To reach MDG target, the number of the underweight children has to reduce at the annual rate of 2.0 per cent from 2009 and onwards.

The underweight rates were more pronounced in rural areas compared to urban areas (BDHS 2007 & HFSNA 2009). By 2005, 40 per cent of the population (60 million) were not obtaining the minimum level of dietary energy of 2122 Kcal. In terms of minimum energy consumption Rajshahi and Barisal divisions are relatively worse off compared to other divisions (HIES 2005, HFSNA 2009). Malnutrition is also severe in the country. More than 90 percent of rural Bangladeshis are not getting enough vitamins A and iron deficiency— which can cause anaemia and the risk of death in childbirth—is also very high, especially for women of reproductive age (BIHS, 2011-2012).

## 4.4.4 Safety net programmes

 Bangladesh is often at the mercy of natural calamities such as floods, droughts and cyclones. Riverine Bangladesh also witnesses frequent land erosion causing thousands of people to lose their land every year. Despite the gains achieved by Bangladesh in augmenting availability of staple food, a safety net programme is essential to insulate the poverty stricken population from chronic as well as temporary food insecurity that results from external shocks.  A number of food safety net programmes are in operation in Bangladesh, each with its own specific objectives and target population.  These include test relief, Vulnerable Group Feeding, Vulnerable Group Development, Food for Work, Employment Guarantee Scheme, etc. A number of social protection programmes such as vulnerable group feeding, allowance for destitute women, and old age pensions have also been introduced to support food security of the extremely needy people.

The present government has given high priority to the safety nets for ensuring food security. Currently nearly 2.2 percent of the GDP are allocated for safety nets and social protection. The evaluation of the programmes however revealed several limitations; a) large overheads due to operation of a large number of small programmes by different ministries often with the same objectives, b) improper targeting of beneficiary households, and c) leakages in implementation.

## 4.5 Food security implications in the long term planning

Around 90 per cent of the rural population of Bangladesh is directly involved in agriculture and around 43.6 per cent of the total labour force is engaged in agricultural activities. For increasing food production and attaining food sufficiency a sustainable growth of the agricultural sector is required. However, it would be a great challenge to attain food security while maintaining sustainable agriculture practices. Moreover, decreasing arable agricultural land, together with increasing population and changing climatic conditions, make this challenge more formidable in the coming decades.

The recent global food price inflation illustrates the critical importance of ensuring food security for a large number of poor people of the country. Past progress in rice production suggests that Bangladesh has the capacity to achieve food security through domestic production. The emphasis on productivity improvements will be particularly helpful in reconciling food security objectives with farmer incentives. In case of food production, climate change adaptation strategy in the agriculture sector needs to be prioritized to address the global food insecurity susceptibility due to climate change.

# 5.0 Identification of challenges of shifting paradigm in agriculture

##  5.1 Degradation of natural recourses

One important obstacle that Bangladesh agriculture will face in the next two decades is degradation of its natural resources. The growing population of Bangladesh places stress on decreasing agricultural lands and a waning supply of natural resources. Cropped land is declining at the rate of about 1% per year. On average, Bangladesh is losing good quality agricultural land by approximately 80,000 ha annually due to urbanization and building of new infrastructure. In addition, regular degradation is occurring due to soil erosion, river erosion, soil fertility decline, depletion of soil organic matter, water logging, soil salinity, pan formation, acidification and deforestation (Fig 5.1). In the last three decades,170,000 ha area of agriculture land has been affected by increased salinity. Soil fertility is declining in Bangladesh due to imbalanced use of fertilizer, intensification of crop cultivation without appropriate techniques for sustainable natural resources management.

Fig 5.1. Degradation of Agricultural Land in Bangladesh, Source:. Karim, et al, 2001 and Karim 2009

Water erosion accounts for about 40 percent of land degradation due to washing away of topsoil and depositing sand on the croplands from upstream. Riverbank erosion and siltation are chronic concerns for Bangladesh. About 1,200 kilometres of riverbank are eroding and more than 5,000 kilometres river banks face erosion-related problems in the country. Water erosion accounts for about 40 percent of land degradation due to washing away of topsoil and depositing sand on the croplands from upstream. Riverbank erosion and siltation are chronic concerns for Bangladesh. About 1,200 kilometres of riverbank are eroding and more than 5,000 kilometres river banks face erosion-related problems in the country. The river bank erosion is expected to increase further with the rise of water flow in the rivers due to global temperature rise and increased ice melting in the Himalayas. The charlands are frequently subject to erosion. Active floodplains, i.e. charlands and adjoining bank lines, account for about six percent of total land area of the country and support four percent of the total population.

***Scarcity of surface water for irrigation:*** Expansion of surface water irrigation by LLP has stagnated in recent years, largely due to reduction of trans-boundary stream flows, shrinkage of wetlands and siltation of river resulting reduction of base flow to the river and increased salinity. As the lowest riparian of all the 57 trans boundary rivers, Bangladesh carries huge sediment load through its river system. According BWDB it is ranging to the tune of 1.0 to 1.4 billion ton per year. This resulted in a serious deadlock in the available flow during the dry season. Capital dredging in water resource management is vital in the context of revitalization of the river systems and ecological balance.

***Groundwater level decline:*** Over the last decade irrigated area has significantly increased owing to the rapid expansion of Shallow Tube Wells (STWs). It has already resulted in a continued decline of water tables during the peak dry months and in the .north-west region of the country the situation became already alarming.

***Arsenic pollution:*** It has been reported that arsenic contamination of the tubewells, especially STWs and Hand Tubewells (HTWs), have occurred due to over exploitation of groundwater. Within 59 districts of the country where about 1.44 million tubewells have been affected and people are exposed to arsenic toxicity. [[1]](#footnote-1)

***Drainage congestion and water logging:*** Because of low-lying topography the country is inundated during monsoon season each year and vast area remains under water logging condition even after recession of flood. So, drainage is equally important like irrigation; because the benefits out of drainage are: (i) potential increase in cropped area, (ii) higher yield from transplanted Aman rice through early planting, (iii) more control over crop calendars and patterns through control of water regime. But, little attention has so far been paid to the importance of field drainage to intensify crop production and increase yields.

***Low water-use efficiency and productivity:*** Irrigated agriculture of the country is impeded by low water use efficiency and low water productivity i.e. production of crop in kg per cubic meter of applied water. The irrigation water efficiency in STW command areas is below 60% and the water productivity is equally low at about 0.3 kg/cubic meter of water (NMTPF, 2010). This situation has been created by faulty design of equipment, improper matching of pump and prime mover, improper operation and maintenance (O&M) of pump sets, water losses in conveyance and distribution at field level, etc.

Cost of irrigation is one of the vital factors considered for profitable agriculture. Around 90% of the minor irrigation equipments are operated by diesel fuel and the rest are electrically driven prime movers. Cost of irrigation using electrically operated pumping sets are 30 – 35% lower than those using diesel engines. But, major disadvantage is the load shedding, especially during the dry season when demand for irrigation is in the peak.

***Degradation of forest resources in protected areas:*** Forest area amounts to about 11% of the total land area, but barely half of that is actual tree covered. High degradation of forested land is occurring in Bangladesh, largely due to population encroachment and crop/horticultural farming, jhum farming; illegal logging practices are also to blame (particularly in the CHT). In addition, the output of forests in Bangladesh is one of the lowest in the world. Productivity is low due poor management practices, low initial survival, incompatible species composition, low soil efficiency, top soil loss, etc. FAO reported in 1988 that Bangladesh accounted annual losses of about 38,000 hectares of forest between 1980 and 1988. A large tract of forest land is denuded in the north-east and Chittagong hill tract regions..

## 5.2 Climate change

Bangladesh is currently ranked as the most climate-vulnerable country in the world. Some of the adverse impact of climate change that the Bangladesh agriculture likely to face in the next decades are increasing trend in flood, drought, intrusion of saline water, drying up of wetlands due to decrease of up stream flow and intensification of irrigation, resulting in severe degradation of ecosystems during the dry season. Extreme flood frequency has increased in recent years. The locations most threatened by climate change and natural disasters are charlands, coastal areas, haor areas, flood plain and drought zones of Bangladesh.

According to SRDI produced soil salinity data shows that a large area has become salt affected over 27 years and more than 170,000 ha has been affected in the 11 coastal districts (Table 9.8). The situation has been further aggravated since 2000. This is a very severe threat which affects productivity and livelihoods in the area. Finally, high salinity in groundwater is known to threaten drinking water wells in the coastal zone, particularly at shallow depths, and limit the possibility for groundwater irrigation for crop production.

Climate change will diminish rainfall in the dry season and will increase winter and pre-monsoon temperatures significantly, causing more frequent and more severe droughts in Bangladesh. Some part of the Northern region and some part of the hill region will experience moderate drought during the Rabi and Pre-Kharif season (November to February) by 2030.

The agriculture sector of Bangladesh is very vulnerable to climate change. According to NAPA, temperature rise and drought will affect crops, livestock and fishery of North West region, Sea level rise and salinity intrusion will affect agriculture of coastal areas, flood will affect agriculture of the North East and Central regions and charlands, drainage congestion will affect agriculture of the coastal region, storm surge will affect marine fishing.

Climate change has several after effects on water resources which are: water scarcity, reduction in fisheries production, poverty, lack of potable water, sanitation and hygiene problems, conflict among users and environmental hazards etc. The most important challenge for agriculture in the country is to develop technologies e.g. crop varieties, production packages etc. to escape from the on-set of natural hazards like cyclones, tidal surges, water and soil salinity, floods and climatic changes risks.

Due to its position in the delta, the Southern region is the most affected by environmental risks, including climate change, and has the lowest records of agricultural development. The current agricultural land use in the South consists of transplanted Aman rice, irrigated Boro rice, agroforestry, livestock and fisheries (eg: shrimps), but their productivity constrained by the predominance of traditional technologies. Nevertheless, the region has very good bio-physical resource base and diversified opportunities for integrated crop, fish and livestock farming. Greater R & D thrust wouldbe required for this unfavourable eco-system with a view to boost up agricultural and rural development and food security.

## 5.3 Supply of inputs

## *Inadequate availability of quality seeds to the farmers:* The first and foremost challenge in the seed sector of Bangladesh is how to make available sufficient quantity of quality seeds to the farmers. The seed replacement rate of quality seed against national requirement was 12.61% in 2005-2006 which has increased to 25% in 2014-2015. For improving total crop production, seed replacement rate must be enhanced in the next two decades and the private sector has to be encouraged to play a major role in this endeavour.

## 5.4 Agricultural extension and veterinary services

The National Mainstream Extension Approach of DAE, DLS and DOF does not have adequate capacity to cope with the emerging challenges in each sector. Equally, research scientists are only slowly adjusting the research agenda to meet the needs of farmers and producers. A technological break through will be needed to coop with the challenges of climate change and boost agricultural productivity in the next two decades (2021 – 2041). This would require strengthening NARS and extension organizations for generation of climate smart technology and dissemination.

Bangladesh is highly vulnerable to infectious animal diseases, with a shortage of quality community based animal health care services, diagnostic facilities and veterinary surgeons, causing serious impediment to livestock production. The quality and quantity of vaccine, medicine and veterinary service delivered by the DLS are inadequate, and the private sector is also not stepping in to fill the void.

Recently there are many emerging diseases for fisheries and shrimp. The current capacity of DOF to address this problem is inadequate due to shortage of skill manpower and diagnostic facilities. Addressing this problem would not only benefit livelihoods of fisher folk, but would increase the exportability of Bangladeshi fishery products.

## 5.5 Post harvest losses

There is huge post harvest loss of around 20% in rice and 30% in vegetables and fruits. There is substantial scope to increase agricultural production by reducing post-harvest losses, by increasing the shelf life of perishable commodities and by adding value through agro-processing of agricultural commodities into finished or semi-finished products, packaging in appropriate containers, proper storage and exports.

## The estimated total fish production of the country is around 35.5 lakh MT of which 0.89 lakh MT go to waste every year considering 2.5% penalty factor of fish wastage due to inadequate fish processing units, modern and hygienic landing centers, transportation facilities in remote areas, inadequacy in ice plants, improper handling, etc. Recently a number of challenges have been identified by some studies for fish marketing and these are lack of modern infrastructure at lending site and markets, lack of cold storage facilities, lack of refrigerated transportation facilities, unhygienic post harvest handling and exploitation of middle men (Rahman *et al*., 2013, Ali *et al.,* 2014, Alam *et al*., 2012, Rahman *et a*l.,2009, Al-Hasan *et al*., 2014).

## 5.6 Market access and value chains

*Inadequate market infrastructure and poor transpiration facility*: Rising income, urbanization, liberalized trade, advancing technology-all are driving the demand for high value fresh and processed agricultural products. This development demand quality and timely delivery of products to the consumers, posing special challenge to the smallholders. The performance of marketing is often hampered by poor transports and inadequate market infrastructure, pushing up transaction cost and price volatility. Improved market infrastructure can reduce the cost of food and uncertainty of supply and improving the food security of poor and nonpoor households (World Bank, 2008), Although there has been substantial expansion of road communication over the past years, existing roads, railways and waterways, particularly in rural areas, are insufficient which pose negative impact on the growth of perishable high value products. Besides road network, attention should be given to improve waterways by re-excavation of rivers and canals. The rail transport facilities fall far short of requirement and need to be expanded and improved for transporting agricultural products at a cheaper rate.

The farmers of char lands and remote areas are suffering with inadequate transports with small number of petty traders. The marginal and small farmers are often facing problem of marketing their products and are not getting fair price due to existence of trade syndicates. Government initiatives and supports will be required to develop service for enhancing market access for small producers and farmers’ groups. Besides, sustainable development is needed for growth centres, rural markets, women market centres and UP complex.

*Inadequate* **agro-processing *and value addition***: The possibility of processing agricultural products to value added items signifies sizeable potential for the development of the agricultural sector in Bangladesh. Processing of perishable products can also play an important role in reducing wastage of food. Adequate focus on the agro-processing sector to strengthen the links between agriculture and industry will be of critical importance in coming decades. (Gosh, 2014). Although there has been a significant expansion of agro-processing industries, but still there is gap between requirement and supply, more support is needed for further expansion. More agro-processing zones may be developed in different regions with government initiative.

There are also traditional food processing activities at household level where participation of women is high. Such traditional fruits and vegetable processing are suffering from inadequate capital and food quality problem. From a strategic point of view, where possible, policies should be directed at increasing the capacity of traditional actors.

Agri-business and agro-processing activities are extremely limited, which severely impedes the country’s post-production potential. Value addition and supply chain investments including processing, packaging, storage and transportation at the local and national levels are a priority. In addition, efforts need to be made to ensure that products abide by certain quality attributes. Several issues including policy environment, such as product standardization, food safety, sanitary and phyto-sanitary measures need greater investment to increase the quality of produce and potentially the volume of exports.

In Bangladesh, small, medium, and even large farmers are vulnerable to the exercise and influence of market power by rural traders, wholesalers, retailers, and processors. The petty traders are poorly rewarded for their efforts and the risks they take in an environment of inadequate quality control, gross returns as well as increasing product wastage. Formation of farmers’ groups is one possible way to create better market linkages and ensure fairer competition in prices and curb exploitation of middlemen.

*Inadequate capacity of the stakeholders in the supply chain on safe food issue:*Bangladesh faces significant problems with food contamination through poor handling practices, and deliberate adulteration for purpose of fraud (extension of shelf life, passing off cheaper ingredients as expensive ones, etc). The findings of National Food Safety Laboratory revealed the presence of high residues of banned pesticides and chemical preservatives in fresh produce in Dhaka markets (Robson, 2014). Not only does this impact the health of the population, but it also affects the exportability of Bangladeshi agricultural produce. The challenge is how to create a satisfactory food control system backed by inspections and improved practices among food producers and handlers, as well as building awareness of consumers. As food products move through every stage of the supply chain, it is crucial to extend training to all stakeholders in the supply chain in order to ensure quality and safety of food along the way “from the field to the table”.

***Lack of easy credit to smallholders and market intermediaries***: Credit play an important role in agricultural development and it is believed that expansion of credit programs will have beneficial effect on agricultural production and income of small farmers and traders. It is also key to poverty alleviation, livelihood diversification and increasing the business skill of small farmers and traders. A study showed positive relationship between institutional credit and agricultural production and therefore suggested expansion of agricultural credit disbursement particularly to small farmers (Khondker, 2013). It is also found that timely sanction and hassle free advance is more preferred by the farmers than the lower interest rate. Although in FY2014/15 about Tk.160 billion credit was disbursed to the farmers through different banks, no credit reportedly disbursed to the poor traders in the supply chain of agricultural products (Bangladesh Bank, 2016). Therefore, it is the challenge of government to extend more timely and hassle free credit to the poor farmers as well as poor traders in the supply chain.

## 5.7 Availability of agriculture labour

The share of the agricultural sector in informal economic activity in Bangladesh is very high (Sixth Five Year Plan, 2011). The contribution of labour in the agricultural sector is decreasing over the years (Figure 5.2). The participation rate of the labour force in the agricultural sector changed over the decades. Household panel data of BRAC collected from 62 villages of Bangladesh showed that adult male participation in agriculture has sharply declined from 83% in 1988 to 56% in 2000, a decrease of 27%; this has however, increased to some extent to a level of 65% in 2008. Participation of women in agriculture on the other hand remained almost the same in 1988 and 2000 (59% and 58% respectively); but compared to 2000, in 2008 women’s participation has increased by about 8%. Findings indicated that decrease in agricultural activities by adult males was due to less involvement in crop cultivation in recent years. About 79% of adult males were engaged in crop cultivation in 1988 which has dropped to only about 42% in the year 2000; however, there had been some increase in male participation in crop cultivation in 2008 (53%).

This transformation of agricultural labour is found to be due to productive and well paid jobs available mainly in the organized manufacturing and services sector. As a result, scarcity of agricultural labour during peak season is increasing. The government made a commitment to reduce the percentage of the labour force engaged in the agricultural sector to 30 percent by 2021. Based upon historical trends, the labour force engaged in agriculture has decreased to 47.3 percent in 2010 from 51.3 percent in 1999-2000. If this trend continues, the contribution of labour in agriculture might decrease to 39.55 percent by 2021, which is higher by about 10 percent than the target of the government.

In Bangladesh, being a traditional Muslim society, women’s participation in economic activities in general and in agriculture in particular has remained low. But recent Labour Force Surveys conducted by the Bangladesh Bureau of Statistics show rapidly increasing participation of women in economic activities. The progress is attributed to poverty, empowerment of women by NGOs, and migration of male family members from agriculture to non-farm occupations. With the absence of males, women’s role is changing from unpaid family workers to farm managers.



Figure 5.2: Labour employed in agriculture sector

Source: Various Issues of Labour Force Survey, Bangladesh Bureau of Statistics

## 5.8 Farm mechanization

Modernization in the Bangladesh agricultural sector is going on with the increased use of machineries like power tillers, irrigation equipment, threshers, drum seeders, maize shellers, rice milling machines, improved storage, cool-chain and transportation, etc. Farm machinery, such as weeders, threshers, winnowers, centrifugal pumps etc. are developed and manufactured locally with locally available materials. Manually operated weeders and sprayers are used widely. A few hundred pedal and power operated winnowers are also being used in the country (Roy and Singh, 2008). It was found that farm mechanization promoted commercial farming and helped in reducing post-harvest losses. Post-harvest loss in agriculture amounts to over US$ 4,000 million a year. Proper grading, packing, pre-cooling, refrigerated storage and transportation can reduce these losses and maintain the quality. Mechanization in the country is associated with some inherent drawbacks like fragmented land, poor buying capacity of farmers, lack of quality machines for farm operation, inadequate knowledge of the users about machines and insufficient awareness of building activities. For the modernization of the agricultural sector, support is needed in skill development of researchers, capacity building of manufacturers, formulation of agricultural mechanization policies, support to the formation of farmers groups, review and rationalization of current tariff rates and expansion of credit facilities for farm mechanization.

## 5.10 Degradation of forest resources and low productivity of forestry

Deforestation is a cause of land degradation when the steeply and sloping land is cleared or has shallow or easily erodible soils such as in Chittagong hill districts and when clearance is followed by shifting cultivation “Jhum” in the hill districts. Encroachment of forest land due to population 20 pressure and crop/horticultural farming is also regarded as a major cause for deforestation. FAO reported in 1988 that Bangladesh accounted annual losses of about 38,000 hectares of forest between 1980 and 1988. A large tract of forest land is denuded in the north-east and Chittagong hill tract regions. Absence of participatory co-management practices has been identified as the principal cause of degradation.

The output of forests in Bangladesh is one of the lowest in the world. Even within the country the yield of forests managed by Forest Department is less than village forests. Apart from illicit felling, the productivity is low due poor management practices, low initial survival, incompatible species composition, low soil efficiency, etc. The other problems in low productivity call for immediate addressing appropriate management practices including improving the nursery techniques, selection of site specific species, using quality planting materials, controlling pests and diseases, applying appropriate silviculture practices, etc.

## 5.11 Malnutrition, stunted growth and food insecurity vulnerabilities

Despite its transformation from a country of chronic food shortages to one of food self-sufficiency, Bangladesh still faces food-security challenges. Almost 40 percent of people in rural Bangladesh live on less than $1.25 per day and 60 percent of that income is spent on food. In rural Bangladesh, 66 percent of the labor force makes their living in farming, and the vast majority of the farmers (81 percent) farm less than one and a half acres (Bangladesh Integrated Household Survey (2011-12)

Bangladesh has a population of approximately 165 million and is growing at a rate of 1.6%. The Bangladesh economy faces much pressure to feed increased numbers of people. Despite poverty reduction over the last two decades, absolute number are still high. About 50 million people, or 31.5% of total population, are still poor, with one‐fourth caught in hard‐core or extreme poverty. Regional and gender-based differences are also a grave concern, as are time-bound vulnerabilities caused by fluctuations in weather throughout the year. Certain section of people also tend to suffer more from poverty, malnutrition and food insecurity, including women, children, elderly, the disabled and remote rural dwellers.

6. Synthesis of recent development strategies

## 6.1 Review of relevant policy and planning documents

Much Progress has been made during the last decades in Bangladesh in formulation and adapting agricultural policies to the ever changing needs of modernizing agriculture. The governments in the past have been adapted different sets of policy to cater its needs of the government line departments, private sectors and farmers to create an enabling environment for technology dissemination and enhancing agricultural productivity.

The new National Agriculture Policy (NAP) 2013, focuses on development of sustainable and profitable agricultural production; development and dissemination of new technologies; crop diversification, commercialization; adaptation to climate change.

There has been a progressive shift in fertilizer policies in Bangladesh towards privatization, deregulation, and a reduction of subsidies, which began in the mid- 1980s and continued until mid 1990s. This was revised following the severe fertilizer crisis in 1995. During global food price crisis in 2007-08 public sector roles were further strengthened towards market intervention and providing much subsidy on TSP and MP fertilizers for promoting balanced use of fertilizers and enhancing productivity and food security.

The national seed policy aims at balanced growth of both public and private sector seed production and distribution system. Bangladesh has been successful in switching over to high-yielding varieties (HYV) for rice production, the source of its impressive agricultural growth.

The National Food Policy 2006 (NFP) and the NFP Plan of Action (2008-2015) serve as a basis for identifying and prioritizing the options for investment and interventions for achieving food security in Bangladesh. The NFP provided strategic guidance for addressing the key challenges Bangladesh faces in achieving food security in all its dimensions, including public food supply and management. The Plan of Action of the NFP (2008-2015) translated the provisions of the NFP into 26 areas of interventions and priority actions, providing a comprehensive framework for identifying investment and priorities for policy actions required to achieve food security.

The perspective plan (2010-21) considered “Achieving food security” and “pursuing environmental friendly development” as broad goals. This would be achieved through successive five year plans- The *Sixth Five Year Plan and Seventh Five Year Plan*. Priority was given for crop intensification in the coastal zone. The plan identified interventions for improvement of local and export markets, packaging materials, cool chains, storage facilities at rural level, modern testing facilities and capacity development for SPS compliance and competitiveness.

The *Sixth Five Year Plan*is the first of two mid-term indicative plans aiming to “develop strategies, policies and institutions that allow Bangladesh to accelerate growth and reduce poverty” for the implementation of Vision 2021 adopted by the Government to elevate Bangladesh to a middle income country. The plan provided strategy, framework and guidelines for reducing regional disparities, developing human capacity, managing land constraints, using natural resources, increasing agricultural productivity, household income and employment and ensuring food security and adaptation to climate change. It considered “Ensuring food security” as a key strategy emphasizing agro-processing and non-farm economic activities in the backward regions. Some important strategies adopted in Sixth Five Year Plan crop sector:

* Sustainable achievement of self-sufficiency in the production of rice.
* Diversification of agricultural crops.
* Crop intensification in the coastal zone, Sylhet region and the char areas in the northern poverty stricken region.
* Growing high profit non-rice crops in Rabi season
* Motivate farmers to use balanced fertilizers and organic fertilizer to enhance soil fertility.
* R&D for technology development for stress tolerant varieties (salt, submergence and drought tolerance for rice as well as heat tolerance for wheat).

The *Seventh Five Year Plan* (SFYP) focused on the need of enhancement of sustainable agricultural production, commercialization, livelihood improvement. It emphasized post harvest transformation, value chain development and improvement of marketing of agricultural products in Bangladesh through:

* Encouraging wider women participation in homestead based agricultural production, post

harvest management, agro-food processing, and marketing.

* Creating opportunity for agricultural product processing and establishing agro-based

industry

* Strengthening agricultural market management system and improving transport,storage and processing facilities; and
* Promoting the effective use of ICT in agriculture.

The development strategies included in the plan were:(i) creating opportunities for Sustainable Agriculture and Green Growth through capacity building of farmers, extension providers, dealers, distributors, entrepreneurs, agribusiness people, trainers and researchers, (ii) introduction and popularization of Good Agricultural Practices (GAP) for safety, quality and creating market opportunities (iii) post harvest management, (iv) value chain development, (v) promotion of easy agricultural credit.

The Country Investment Plan (CIP 2011)- A road map towards investment in agriculture food security and nutrition provided a coherent set of 12strategic priority investment programmes under three components of food security: access, availability and utilization.

The Master Plan for agricultural Development of the Southern Region of Bangladesh provided a road map for the integrated development of Bangladesh’s coastal region focusing on increasing agricultural productivity and sustainable food security. It also designed investment plan for development of market linkage of the small farmers and value chain improvement of high value crops.

The Bangladesh Delta Plan considered intervention for development of market infrastructure, agro-processing, storage facilities development and value chain development of high value crops.

The Sustainable Agricultural Development Strategiesfor the Chittagong Hill Tractswere developed considering some concerns over environmental degradation and food insecurity in the region and identified priorities: i) enhancing productivity, conservation and diversification, ii) more sustainable Jum, iii) upscaling technology and sustainable input supply, iv) market/value chain development, v) food security and nutrition.

## 6.2 Strategy of recent food production and food security

Ensuring food security for the poor is a fundamental strategic goal of the Government. The Ministry of Agriculture (MoA) has prepared a comprehensive agricultural policy in 2004 and started implementing the policy to address the problems of improving land, water and labour productivity by promoting balanced use of fertilizer, small scale mechanization, quality seed production, irrigation interventions in drought-prone areas, crop diversification, and improving water use efficiency and supply of agricultural inputs.

Policy developments and programmes of the Ministry of Agriculture (MoA) is underway and needs for further action. Under subprogramme 1.1 related to enhancing knowledge generation, CIP 2014 (2012/13) includes seven completed, 31 ongoing and seven pipeline projects with total financing at 192.9 million USD or 1.61% of total financed CIP. Of the 181.1 million USD for completed and ongoing projects, 137.2 million USD (76%) are financed by GoB and 43.9 million by DPs. Under sub-programme 1.2, related to improvement of agricultural extension service, there are 11 completed, 24 ongoing and four pipeline projects, amounting to 243.9 million USD. Of the total budget of 202.3 million USD for completed and ongoing projects, 146.7 million USD i.e. 73% are financed by GoB and the rest 27% by DPs. This sub-programme accounts for 2.03% of total CIP budget. Sub-programme 1.3, which mainly focuses on research and extension for climate adaption, includes 11 ongoing and seven pipeline projects worth 366.9 million USD. DPs finance 170.9 million USD or 61% of the total 279.7 million USD of ongoing projects.

The Government budget for the research institutes under NARS increased by 15%, up from 4.5 billion taka in 2012/13 to 5.2 billion taka in 2013/14, although its share in the National Budget remained unchanged at 0.23%, reflected in lower budget allocated to BRRI, but higher for other institutes. The SFYP focused on farming system research in different agro-ecological zones; and building linkage between research and extension.

The National Agriculture Policy 2013 identified different strategies for research and development in the areas of planning and financing of research, technology transfer, ICT in agriculture, improve agriculture extension services and public private partnership.

## Livestock and fisheries development

The Ministry of Fisheries and Livestock also prepared fisheries and livestock policy. The major policies included in the National Livestock Policy are: (1) promotion of smallholder dairy and poultry development; (2) development of goat, buffalo and duck in high potential areas through special projects; (3) institutional reform of DLS and enactment of laws and regulations for quality control of drugs, vaccines, feeds, chicks and breeding materials; (4) privatization of veterinary services of private good nature; and (5) explore all alternatives for producing fodder. In addition to routine activities of providing extension services, animal health service, supply of inputs, artificial insemination, and feed analysis, DLS implemented programs/projects on production of vaccine, smallholder livestock development, artificial insemination and embryo transfer, breed up gradation, modernization of Central Cattle Breeding Station and Dairy Farm, establishing regional duck breeding farm with hatchery, and training program for small scale dairy.

National Fisheries Policy was formulated in 1998, with the objectives: (1) enhancing fisheries resources and production; (2) generating self employment for poverty alleviation of fishers; (3) meeting the demand of animal protein; (4) increase foreign exchange earnings through export of fish and fisheries products; and (5) maintain ecological balance, conserve biodiversity and improve public health. Fisheries Department has developed a strategy and action plan to implement the 1998 fisheries policy, taking into account the likely changes to occur over the next 10 years. The policies are being implemented through a range of revenue and development projects. Revenue projects include extension services to farmers, Fish Act implementation and Jatka protection. As many as 12 development projects supported by different donors were implemented, covering aquaculture development, Brood Bank establishment, resource development and management, supporting coastal fishing community, fish inspection and quality control and development of Shrimp Seed Certification.

**Strategies**

* Closed water fisheries production.
* Increasing fresh water golda shrimp production in coastal areas.
* Cage culture in flood plains
* Supply of inputs and promotion of technical knowledge among the educated youth for culture of pond and other closed water bodies.
* Adoption and implementation of the concept of fishermen cooperatives in government-owned water bodies.

The Ministry has formulated a National Food Security Policy that includes access to and utilization of food, coordination, food policy analysis, short and long-run forecast of domestic and world supply and trade. In order to achieve these objectives it implemented “National Food Policy Capacity Strengthening Program”. Achieving the MDG targets within the next decade will require Bangladesh to develop and implement more effective strategies. Accelerating per capita income growth and pursuing targeted safety net programmes are needed for the expansion of household food intake. A comprehensive programme to address hunger would include interventions:

* Promoting food security by sustaining growth of domestic food production and implementing a liberalized regime for food imports
* Designing and implementing interventions to promote food security
* Supporting safety nets for protection against natural disasters
* Promoting change in food habits for increasing nutritional intake of vulnerable
* Promoting partnership among the Government, private sector and NGOs

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# 7. Development Strategies for the Perspective Plan (2021-2041)

Bangladesh economy is transforming towards a middle income country (MIC) and would further transform to high income country (HIC) in the next 25 years. Agriculture should be linked with the process to play a greater role towards poverty reduction and food security for advanced society. Still majority of the population of Bangladesh depends on agriculture for their livelihoods. It revealed from our analysis that growth in agriculture played greater role for poverty reduction than the non-agriculture sector. Like South Korea we need to design strategies for expected positive transformation in agriculture through technological breakthrough, mechanization as well as institutional capacity development for farm production, marketing, agro-processing and value addition. The economy would demand more high value nutritious food and less cereals and it is expected that the agriculture will be transformed towards sustainable high value commercial agriculture with conservation of natural resources and would accelerate towards agro-processing, value chain development and industrialization. The goal is to transform agriculture with enhanced productivity to meet need of the society as MIC and HIC for food and nutrition security. Considering these, we have designed following development strategies for the Perspective Plan (2021-2041):

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## 7.1 Agriculture, rural development and food security

## 7.1.1 Irrigation and water resource development

**7.1.1.1 *Surface water augmentation for irrigation developmen****:*Develop water reservoirs, recharge of ground water, reduced use of ground water to avoid hazard of arsenic contamination. Key priority investment includes: (1) the development of small scale surface irrigation in the southern part of the country. Thus require new infrastructure and capacity building; (2) partially reduce reliance on deep tube well irrigation in the northern part of the country, reduce costs and mitigate the risk of arsenic contamination; (3) rehabilitate dikes and embankments particularly affected by previous cyclones to protect vulnerable households and production base against sea intrusion in the extreme south, with effective community-based operation and maintenance of infrastructure (4) improved drainage and saline intrusion control in the coastal region and (5) Flood control and management in the Haor area.

**7.1.1.2 *Promote water saving technology for improving water use efficiency:***It is necessary to promote installation of facilities to reduce distribution losses. Priorities include: (i) reduce water losses in existing schemes through improved water management through capacity building of water management organizations, development of water saving crop production technology. Improvement of distribution system is very important to ensure efficient use of irrigation water in light texture soil situation like Teesta Basine Region, where water use efficiency is 28% - 30%. In this context programs should be taken up for construction of buried pipe distribution system with all DTWs and LLPs above 1.00 cusec discharge capacity. And for STWs and LLPs below 1.00 cusec capacity hosepipe should be used to minimize water losses and increase water use efficiency.

**7.1.1.3 *Reduce impact of saline water intrusion in the South and enhance river water flow*:** The focused priorities for the coastal region include: rehabilitation of polders and their management; tidal river management; enhanced surface water irrigation; and improved brackish water resource management practices.

## 7.1.2 Commercialization, agro-processing and value addition

Though agriculture is the least automated or digitized there is vast scope for automation (not necessarily in farming) in agricultural processing and value chain integration, according to recent research. Following interventions are needed:

***Improvement of infrastructure:*** A number of **priority investments** have been identified that could form the programme, including (i) Construction and *adequate maintenance* of rural roads to facilitate marketing of products and access to services in particular in remote areas. (ii) Construction or rehabilitation of rural markets including the supply of potable water, drainage, and storage facilities. (iii) Improvement and rehabilitation of wholesale markets in major cities; (iv) Private storage facilities to reduce losses and increase value added.

***Capacity building of value chain actors and market promotion:*** A number of **priority investments** have been identified that could form the programme, including (i) Capacity building for group marketing at community level in the form of marketing groups, service cooperatives whose capacities should be developed and training provided; (ii) Capacity development of farmers and market intermediaries through training in food quality and safety regulations and requirements, good agricultural practices so as to comply with market requirements; (iii) Improved post-harvest management, value chain analysis and facilitation (iv) Promote agro-processing. (v) Facilitate coordinated, market-based action, harnessing the productive capacity of agriculture to promote food security, and environmental sustainability.

***Establishment of agrot processing zones:*** Harness opportunities to expand market linkages and agribusiness with establishment of agro processing zones. This will create a big transformation in agriculture and enhance value addition, reduce post harvest loss and accelerate GDP growth

***Improving Food Safety and Quality for Consumer Health and Nutrition:*** Food analytical laboratories at the central and regional level need to be established to facilitate support to food manufacturers, individuals and the enforcement of laws. There is no reliable surveillance data on food borne illnesses, impeding the understanding of the extent of disease burden and health and nutritional implications. An effective surveillance of food borne illnesses would therefore be necessary. These would include among others, strengthening capacity of the existing institutions, strengthening consumer protection and improving insufficient food safety activities.

* + 1. **Climate resilient sustainable agriculture**

Bangladesh, due to its geo-physical position and socio-economic context, is highly prone to regular natural hazards and the impacts of climate change. Riverine *char* lands, coastal region and haor areas are considered as hotspots for climatic hazards. An integrated approach which combines traditional knowledge with innovative strategies needs to be adopted to address current vulnerability while building adaptive capacity to face emerging challenges. The process involves four inter-related strategies: promotion of climate-resilient livelihood strategies, disaster risk reduction strategies, capacity development for local civil society, and advocacy and social mobilization with particular focus on gender. Interventions should include: (i) Program to promote adaptive knowledge and technologies among communities/farmers. (ii) Enabling local communities to improve preparedness and participate in effective operation and maintenance of flood protection works, and modelling/researching the effectiveness of adaptations under extreme climatic events. (iii) Development of salt, drought and flood resistant and heat tolerant crop varieties.

## 7.1.4 Interventions for development of fisheries

Fisheries and aquaculture is important livelihood for the people of different regions of Bangladesh. The opportunity of development fisheries productions are discussed by habitats as follows:

## Development of riverine fisheries

***Community based fisheries management*:** Large area of public water bodies exist in the country with low productivity. The community based fisheries management by involving Community Based Organizations (CBOs) and NGOs is a good option for efficient management of public water bodies. The local administration should arrange for distribution of public water bodies among the real fishers and their capacity to improved productivity need to be enhanced by training.

***Establishment of community managed sanctuary*:** Establishment and maintenance of fish sanctuaries is one of the key instruments to maintain the sources of fish fingerlings and to conserve aquatic diversity. To enhance productivity of riverine ecosystem as well as to conserve biodiversity, wetland sanctuary may be actively considered in feasible locations of Bangladesh. The river, canals and khals in Teesta region are almost silted-up. Government should take up re-excavation program of all the water bodies and in all main courses of rivers and canals delineating potential locations of sanctuaries.

***Expansion of cage and pan culture farming***: In riverine eco-system cage and pan farming may be introduced by involving local beneficiaries. Teesta barrage water distribution canals, coastal regions and haor regions, Kaptai lake may be considered for cage farming, whereas secondary and tertiary canals could be used for pan farming. To reduce the poverty level of the poor fish farmers/fishers of different regions through creating employment opportunities, expansion of area-specific cage and pan farming in feasible water areas is to be prioritized.

***Ensure quality seed and feed***: For sustainable aquaculture expansion in the country, seed (spawn/ fry/fingerling) and feeds are the most important production inputs. But now-a-days quality seed and feeds become more crucial for sustaining the aquaculture production. Government interventions are needed to address this issue.

## Development of Beel and floodplain fisheries

***Restoration of habitats and establishment of beel nurseries*:** Due to expansion of cropped area fish habitat has severely been destroyed. During lean period the Teesta river bad displayed lot of sand and silt with a narrow water cannel. Until the water flow in Teesta is increased through mutual inter-governmental agreement and dredging of it is done in the downstream, it would not be possible to sustain any fish habitat. Therefore, the priority need is to obtain more water from upper riparian countries by water diplomacy.

***Expansion of small-scale aquaculture technologies*:** In the recent past years small-scale floodplain aquaculture is popularizing at community level. Small-scale aquaculture in potential areas may be actively considered as one of the important adaptation measures of climate change impacts. It could be an alternative option of increasing open-water productivity.

***Establishment of co-management approaches*:** The Government of Bangladesh is accentuating to ensure co-management approaches of the potential *beel* and floodplain fisheries to explore its due potentials. Through strengthening CBOs, co-management approaches may be established for ensuring biological production system in *beel* and floodplain fisheries.

##  Development of pond aquaculture

***Expansion of aquaculture technologies*:** Considering the agro-ecological context, government in collaboration with development agencies and partners is emphasizing for the expansion of drought resistant and short-cycle species in ponds and seasonal water-bodies. To ensure food security in the poverty-prone Teesta Basin area, coastal region and Haor regions, expansion of pond aquaculture could be one of the important alternatives.

## 7.1.5 Interventions for development of livestock

Increased livestock production will depend ultimately on the adoption of appropriate technologies, improved support services, market access and infrastructural development. Following interventions are needed to explore the potentials of the region for developing the livestock sub-sector.

## Improving diagnostic capacity and veterinary clinical service

At present disease diagnostic of capabilities of Department of Livestock services (DLS) is limited and are constrained by lack of skilled manpower and modern analytical facilities. Therefore, support would be required to improve diagnostic capacity and veterinary clinical services of DLS. Promotion of Community Health Worker approaches is required to address the lack of professionals.

## Promoting smallholder poultry and dairy development:

Promoting small holder poultry and dairy development is important for agricultural diversification, poverty reduction food security and employment generation. It needs supports for (i) quality feeds and chicks at affordable price, (ii) promoting HYV fodder production, (iii) supply chain development through group marketing, (iv) processing and value addition and (v) community based vaccination program. (vi) dissemination of livestock and poultry technologies and (vii) strengthening training, demonstration and publicity.

## 7.1.6 Agricultural development of thrust areas

This includes investment for agricultural development of the coastal areas, Haor areas and Hill Tract. Agriculture of these areas are less developed with low productivity due to slow dissemination of improved technology, poor market infrastructure and value chains, high population density and incidence of high poverty.

## 7.1.7 Infrastructure development

This includes development rural roads, connectivity, market infrastructure, electricity, communication and transportation system. Construction of flood control and drainage system and polders in the coastal areas.

## 7.2 Safety nets for food and nutrition security

## 7.2.1 Livelihood improvement and food security

**Development of programs of alternative income generation and food security**, reduce malnutrition of women, children and distressed population and enhance social protection.

***Development of community based nutrition activities through livelihood approaches*:** home gardening, poultry raising and other community level nutrition-based agricultural activities need to be included as a food based nutrition approach and also complemented by integrated horticultural development, fish ponds, behaviour change communication and other activities. This strategy will include linking agriculture and food based nutrition to other nutrition efforts, including health. The proposed programme would aim to restore a process to assist the rural communities, based on their local conditions and priorities, to undertake these activities through a livelihood approach aimed to build local capacities and provide technical and financial support in and where required.

***Livelihoods improvement of population of vulnerable and disadvantageous areas of char land, haor, coastal region and CHT***: All of the *chars* regions are not easily accessible and people are beset with many problems and suffering. Despite appalling conditions, a large number of families, due to abject poverty and lack of alternatives, are often forced to relocate to such lands struggling with precarious weather and adverse living conditions. People living in Char lands particularly struggle with floods and river erosion. As the families are often hard to reach through mainstream anti-poverty programmes, it drastically reduces opportunities to promote social and economic development within these communities. In consequence, achievement of the millennium development goals (MDGs), accelerated economic growth and nationwide poverty reduction policies of the Government are hindered. Pioneering work by the government Char Livelihood Project and Char Development and Settlement Project may be mainstreamed and up scaled by covering more geographical areas and increasing the number of beneficiaries. Special extension program need to be promoted to harness the potentials of charlands without depleting soil fertility and process of land formation. Keeping these objectives in mind a coordinated extension program with national and regional NGOs and Public extension service is required with increasing availability of seeds of newly released modern varieties along with skill development of the farming community through training. There are also a few programmes targeted towards the ethnic communities of the Chittagong Hill Tract region which also need to be scaled up in terms of reaching the relatively inaccessible areas.

***Expand and strengthen programs for supporting women, children, elderly and disable persons:*** The NSSS would require to strengthen the transformation towards a life cycle system by consolidation of programmes into a smaller number of priority schemes. The five core life cycle programmes suggested by NSSS are (i) Programme for Children: child grant, school stipend, school meals, immunization, (ii) Programmes for the Working Age: education and training, workfare for the unemployed poor, sickness, maternity and accidental insurance/ allowance, (iii) Comprehensive Pension Scheme for Elderly: old age allowance, universal pension scheme to be funded through employer and employee contribution of both public and private sectors, (iv) Programmes for People with Disabilities: disability benefit for working age population including women, (v) Special Programmes for the Freedom Fighters: to support the freedom fighters and their families under the consolidated freedom fighter benefit programmes..The food based programmes can be made nutrition-sensitive through distribution of micronutrient-fortified rice and wheat. For improving child nutrition and school attendance of children, school feeding has proved to be an effective programme which can be scaled up to a significant extent.

***Enhance Investment in Employment and Income Generation Programs with focus on Productive Safety Net programs*:**There are as many as 8 workfare schemes of which the two largest programmes are Employment Generation Programme for Poorest (EGPP) and Food for Work Programme (FWP). The two missing areas of social security for working age group are the unemployment insurance promramme and the injured workers’ insurance scheme. The lack of any social insurance is more pronounced in the informal sector which accounts for 87.5 percent of all employment (NSSS 2015). These aspects need to be paid due attention in reforming the present social security system.

## Interventions for improvement of public food management

This includes investment on development of public food storage and safety net programs for the vulnerable population of the country:

***Increase and modernize food storage and handling facilities, especially in disaster prone areas:*** The frequency of occurrence of environmental shocks likely to increase during the Second Perspective Plan period. One priority intervention is to build modern storage facilities that are better equipped to adapt to the climate change impacts and resist disaster shocks, repair and rehabilitation of existing warehouses and improving ambient environment of stocks to maintain quality and increase shelf life in the coastal region and Haor areas. Some progress has been made with respect to building of public storage facility development. Efforts are under way to develop household level storage facilities through use of mini silos on which some piloting has been done. Scaling up of such facilities is a priority area of intervention.

***Strengthen institutional capacities for implementation of safety net program:*** Capacities should be strengthened to develop a multi-year strategy to improve the targeting performance of SSNs, streamline and coordinate these safety net programmes. Attempts should also be made to improve synergies between safety net programmes (food or cash for work) with productive infrastructure such as irrigation, rural transport and markets. Targeting effectiveness needs to be improved to ensure that the benefits of the programmes reach the poorest and the food insecure groups of people. These efforts need to be strengthened with particular focus on agriculture-related risks and disasters. Making food available to the disaster-affected people is contingent upon two factors: availability of requisite food stocks in the local supply depots and adequate transport infrastructure through which food can be channelled to the intended beneficiaries. A successful implementation of emergency distribution programmes calls for effective interagency/inter-ministerial cooperation and coordination**.**

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