

# **Agricultural Research Priority : Vision- 2030 and beyond**

**Sub-Sector: Food Availability and Consumption, Post Harvest Losses, Agro-Processing Technology, Food Safety and Human Nutrition**

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## List of Contents

	Page No
Abbreviations and Acronyms	3
Executive Summary	4
1. Introduction	6
2. Food Availability and Consumption	7
3. Post Harvest Losses	14
4. Ago Processing Technology	17
5. Food Safety	23
6. Human Nutrition	28
7. The Trends	34
8. Research Priority for Improved Nutrition	37
9. Concluding Remarks	43
Attachment I : ToR of the Team Leader	44
Attachment II : Composition of Sub-Sectoral Team	46
References	47-48

### Abbreviations and Acronyms

- BNNC Bangladesh National Nutrition Council
- BSCIC Bangladesh Small and Cottage industries Corporation
- BSTI Bangladesh Standard and Testing Institute
- BUET Bangladesh University of Engineering and Technology
- CAB Consumers Association of Bangladesh
- CIDD Control of Iodine Deficiency Disorders
- DGHS Directorate General of Health Services
- FAO Food and Agriculture Organisation
- GAIN Global Alliance for Improved Nutrition
- GoB Government of Bangladesh
- HKI Helen Keller International
- IDD Iodine Deficiency Disorders
- IFST Institute of Food Science and Technology
- INFS Institute of Nutrition and Food Science
- IPHN Institute of Public Health Nutrition
- MI Micronutrient Initiative
- MoFDM Ministry of Food and Disaster Management
- MoHFW Ministry of Health and Family Welfare
- MoI Ministry of Industries
- MTR Mid-Term Review
- NNP National Nutrition Programme
- NSP National Salt Policy
- SIP Salt Iodization Plant
- TGR Total Goiter Rate
- UIE Urinary Iodine Excretion
- UNICEF United Nations Children’s Fund
- USI Universal Salt Iodization
- USAID United States Agency for International Development
- WB World Bank

- WFP World Food Programme

## **Executive Summary**

*Bangladesh Agricultural Research Council (BARC) and 10 agricultural research institutes carry out research in the varied fields of agriculture in a coordinated framework called Bangladesh National Agricultural Research System (NARS). In the backdrop of the recent emerging issues like global warming, high food price, widespread hunger, food insecurity and malnutrition in the developing countries, breakthrough of improved agricultural technologies and continuous decreasing availability of land for agriculture, BARC undertook to develop the NARS Vision 2030. BARC conceived of 12 sub-sectors of functional areas in the new NARS Vision of which Food Availability and Consumption, Post-Harvest Losses, Agro-processing Technology, Food Safety and Human Nutrition consist one of the 12 sub-sectoral study areas. This report is an outcome of the study on this specific sub-sectoral study area. The briefs on the individual components of the study areas are given below.*

### **1. Food Availability and Consumption**

*1.1 During the last one and a half decade from 1994-95 to 2008-09, rice production in the country has steadily increased from 16.83 to 34.22 MnT, though wheat production declined from 1.25 to 0.958 MnT. Except pulse, all other major food crops like potato, oilseeds, vegetables, fruits, and also animal products like fish, meat, milk and eggs also increased during the period, though not at sufficient levels to meet the domestic needs fully.*

*1.2 These increases in domestic production together with import of food commodities led to per capita increase in food intake by 6.9 percent. Interestingly, though the total food intake increased, but the intake of cereals shows a slow decreasing trend by 9.5 percent, with increased intake of non-cereal food items, particularly meat, egg, potato, fruits and vegetables. Necessary research support has been suggested for further improvement of this positive trend towards more dietary diversification by 2015 and ultimate intake of balanced diet by 2030.*

### **2. Post-Harvest Losses**

*2.1 Post harvest loss of food commodities remains as a neglected area for a long time. As a result, the post harvest loss of four commodities in 2005-06 amounts to 6.27 MnT. At the same prevailing rates in 2008-09, this loss became 8.86 MnT. Continuity of the negligence to this loss will be increasing the figure proportionally to the accumulated increased quantity of production of these commodities, resulting in to a colossal national loss in the year 2015 and beyond.*

*2.2 The situation demands immediate measures for development of appropriate implements and technology for harvesting, and prevention of the causes of post-harvest losses through adopting proper post-harvest handling methods.*

### **3. Agro-Processing**

*3.1 Agro-processing is considered as an appropriate intervention for reduction of post-harvest loss, improvement of fair price for the producers, generating employment, extension of shelf-life of the commodities for consumption and contributing to nutritional well being.*

3.2 Recent interest of the entrepreneurs in the country led to increase in contribution of this sector to GDP by more than 22.14% among the share of all manufacturing industries. One unique opportunity of agro-processing is that about 8.0 million non-resident Bangladeshis serving in foreign countries have created great "ethnic" demand for Bangladeshi agro-processed commodities in those countries.

3.3 The government policy and financial support, introduction of new technologies (like roasting, extrusion, spray drying) in a wider scale like those in India, Philippines and Thailand, media promotion and individual enthusiasm are likely to attract a large pool of Bangladeshi agro-business entrepreneurs in this area to boost up the overall activities of the sub-sector to meet the growing internal and external demands and ensure fair price of agricultural commodities produced by the farmers.

#### **4. Food Safety**

4.1 A huge number of food items available in the market are not up to the BSTD standards. The BSTD also till now could introduce standards of only about 50 food commodities. Many of the existing standards are not in compliance, rather uncontrolled hazardous chemicals, additives and preservatives are being used widespread for early ripening and preservation.

4.2 The practices are serious threats to human health and increasing the proportion of non-communicable diseases. The issue is a serious concern and discussed frequently both in printed and electronic media. Besides the immediate measures, a medium and a long term plan for improving the situation is a need of the day.

#### **5. Human Nutrition**

5.1 As per UNICEF model, nutrition has three immediate determinants of which food is one, other two being care and medical services, particularly for the vulnerable sections of population like pregnant/lactating women, children and adolescent girls. The study deals mostly the food aspects of nutrition together with the related issues.

5.2 Malnutrition in Bangladesh is a public health problem and it can be classified in to macronutrient (protein-energy) malnutrition and micronutrient (vitamins-minerals) malnutrition. The studies reveal that the underweight (weight-for-age lower than -2SD) rate of children in Bangladesh has decreased from 68% in 1990 to 46% in 2005 (i.e. at an annual rate of 1.4 percentage points). If the target of 34% has to be achieved (MDG # 1, target#2: reducing child underweight by half by 2015), the reduction rate shall have to be 1.2 percentage points per year. Bangladesh is likely to achieve this goal if some more concerted efforts are given at the policy as well as programme levels.

5.2 In terms of stunting (height-for-age lower than -2SD), the picture is a little brighter, in that the rate of decrease between 1990 and 2005 was 1.37% and the target rate to reduce it by half in 2015 is 1.0% per year.

5.3 The ratio of undernourished women (measured by BMI) to overnourished one was 53:7 in 1996 and very alarmingly it has turned to 32:17 in 2005, meaning coexistence of undernutrition and overnutrition (the so-called "double-burden" of malnutrition) in the same country and same community. This sort of overnutrition scenario leads to a number of chronic non-communicable diseases (NCDs) like diabetes, hypertension, heart disease and even some form of cancer. Double burden of malnutrition is becoming an ever increasing concern in the developing countries including Bangladesh. It is estimated that by 2030, more people will die from the NCDs than from the long known common infectious, communicable diseases.

*5.4 In order to address the gigantic and multi-dimensional problem of malnutrition, BARC may come forward to work in collaboration with other relevant agencies to help accomplish a number of national level studies included in the list of priority research studies under section 8.*

## **1. Introduction**

### **1.1 Background**

The Bangladesh National Agricultural Research System (NARS) composed of the Bangladesh Agricultural Research Council (BARC) and 10 agricultural research institutes carry out research in the varied fields of agriculture in order to fulfill its obligation to serve the country, the population at large including the producers, the processors, the consumers and the processors of agricultural commodities. To do so effectively, particularly in a situation of increasing population and decreasing land area under cultivation, the system has to be engaged ceaselessly to transform scientific principles into cost-effective and useful means of production and processing. For the purpose, about a decade earlier, NARS undertook a Vision 2020 incorporating the priority issues for agricultural research in the country.

In the mean time, there has been the emergence of lot of issues like global warming, high food price, widespread hunger, food insecurity and malnutrition in the developing countries and breakthrough of improved agricultural technologies. These necessitated undertaking the NARS Vision 2030 and beyond. For the purpose, BARC conceived of 12 sub-sectors of functional areas with specific TORs to prepare equal number of sub-sectoral study documents with necessary backward information and priority research areas. These sub-sectoral documents would be consolidated into a comprehensive NARS Vision 2030 document for the guidance of the research institutes.

### **1.2 Scope and Methodology of the Study**

The scope of this sub-sectoral study report is limited to 'Food Availability and Consumption, Post Harvest and Agro-Processing Technology, Food Safety and Human Nutrition' conceived as one of those 12 sub-sectoral areas to cover the Vision. The report has been prepared in compliance with the ToR provided by BARC for the Team Leader (Attachment I) and taking inputs from secondary materials,

field level workshops organized by BARC, in consultation with the sub-sectoral Team Members (Attachment II) and his personal experience and insight.

## **2. FOOD AVAILABILITY AND CONSUMPTION**

### **2. 1 Domestic Food Production**

Bangladesh is the biggest deltaic land in the world composed of mostly the alluvial soil eroded from the Himalayan region through the mighty rivers and having an area of 147,570 square kilometer. The country has a tropical climate and is divided in to 30 ecological zones. The total land area is 8.6 million hectare with a cropping intensity of about 179%. About two-thirds of the cultivable land is used for production of rice, the principal staple. Together with wheat the second staple, the two major crops occupy more than 80% of the total cultivable land.

Rice constitutes over 94 percent of food grain production. It contributes about three-fourths of total per capita calorie and protein intake of the people in the country (Hossain, 2004). Rice production during the last one and a half decade from 1994-95 has steadily increased from 16.83 million tons to 34.22 million tons respectively. Though rice production continues to increase, but wheat production is showing a declining trend. Wheat production also increased from 1.25 million tons in 1994-95 to 1.91 million tons in 1998-99. It then started declining and the production has come down to 0.958 million tons in 2008-09.

Contrary to the trend in rice production, pulses and oilseed production steadily declined mainly because of the loss of areas under these crops to Boro rice and other remunerative winter crops (Rahman and Khan). Production of fruits has increased, but at a slow pace from 1.41 million tons in 1994-95 to 3.32 million tons in 2006-07. But the production of vegetables jumped from 1.21 million tons in 1994-95 to 10.322 million tons in 2008-09, according to the Department of Agriculture Extension (DAE). Spectacular success has been achieved in the production of potato. It has made a quantum jump from 1.47 million tons in 1994-95 to 9.237 million tons in 2007-08, though the production dropped to 6.746 million ton in 2008-09. 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 (Table 1)

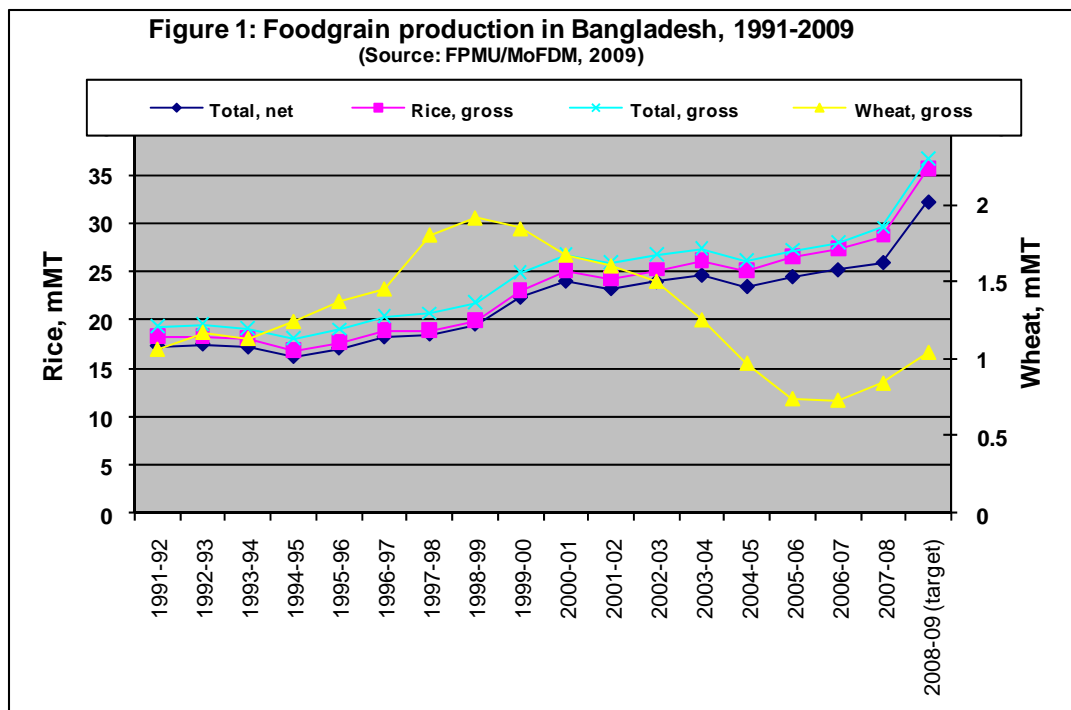
**Table 1: Domestic production (gross) trend of food grains, potato, pulses, oilseeds, vegetables and fruits (1994-95 to 2008-09)**

(000 MT)

Year	Food grain		Potato	Pulses	Oilseeds	Major Vegetables	Major Fruits
	Rice	wheat					
1994-95	16833	1245	1468	535	480	1214	1414
1995-96	17687	1369	1492	524	471	1254	1431
1996-97	18880	1454	1508	525	478	1290	1418
1997-98	18862	1803	1553	518	482	1306	1403
1998-99	19905	1908	2762	499	476	1526	1359
1999-00	23067	1840	2933	394	406	1529	1357
2000-01	25086	1673	3216	366	394	1472	1406
2001-02	24299	1606	2994	341	392	1599	1467
2002-03	25188	1507	3386	349	279	1605	1547
2003-04	26190	1253	3907	333	273	6133	1619
2004-05	25157	976	4856	316	270	7278	3936
2005-06	26530	735	4161	279	268	5952	2963
2006-07	27318	737	5167	259	271	7031	3319
2007-08	31975	956	9237	235	821	8910	-
2008-09	34219	958	6746	584	840	10322	-

Source: BBS, MOFDM (provided by FPMU)

Major Food grain production in Bangladesh from 1991 to 2008-09 is also shown in Figure 1 below:



## 2.2 Import of Rice and Wheat

Import of rice and wheat grains has been taken in to consideration because total availability of food grains includes both domestic production and the import of the commodity. For the sake of convenience, public import and food aid data are taken together for discussion as the volume of food aid now a days is not large compared to GoB and private import. Import of food grains either by the private sector or by the public sector does not follow any pattern or trend (Table 2). It depends on the gaps in production created by flood damage or damage due to other natural disasters (of course, private sector import can be affected, if the Government imported stock is sold in the open market at a subsidized price). The total import (private and public) during 1994-95 and 2008-09, on average, is 2.42 million tons per year, with substantial increase in imports in years following poor harvests due to flood and drought or other natural disasters. Table 2 shows that with gradual increase of private sector import, public sector import of food grains has decreased. Public sector import is expected to level off with further increase of private sector import which is more likely to happen in the future. In the domain of import either by the Government or by the private sector, quality, price and timing of import are important parameters that need to be taken into account in ensuring food security.

The available data indicate no fixed trend in public distribution and domestic procurement of food grains. In some years, both distribution and procurement of food grains increased and in other years, it decreased. This indicates that public distribution and procurement of food grains are guided by the level of domestic production and availability in a given year. The domestic food procurement data gives a signal that the food procurement policy needs to be stream lined, based on production forecast, weather forecast, and in relation to import policy.

**Table 2: Private Import and Public Import of Food Grain (Rice and Wheat) during 1994-05 to 2008- 09.**

000 MT

Year	Private Import (Rice & Wheat)	Public Import + Food Aid (Rice & Wheat)	Total
1994-95	1014	1555	2569
1995-96	85	1584	1669
1996-97	237	730	967
1997-98	1135	798	1933
1998-99	3480	2006	5486
3999-00	1234	869	2103
2000-01	1063	491	1554
2001-02	1289	509	1798
2002-03	2966	254	3220
2003-04	2480	305	2785
2004-05	2982	380	2785
2005-06	2265	297	2562
2006-07	2209	212	2421
2007-08	2916	550	3466
2008-09	2217	796	3013

Source: BBS, MOFDM (provided by FPMU)

### 2.3 Production of Fish, Meat, Milk and Egg

Fish production increased from 1.17 million tons in 1994-95 to 2.70 million tons in 2008-09 (Table 3). The same table shows that meat, milk and egg production has also increased significantly over the one decade from 1994 – 95. But the shortage is

still wide. The current per capita intake of animal protein is less than 2 gm per day against the FAO recommendation of 28 gm per day (Rahman and Khan 2005). Similarly, domestic milk production accounts for only 14% of the minimum requirement (DLS, 1999). Per capita availability of milk is approximately 30 ml per day against the FAO recommendation of 250 ml.

**Table 3: Fish, meat, milk and egg production trend (1994-2005)**

Year	Fish (MnT)	Meat (MnT)	Milk (MnT)	Egg (Milln)
1994-95	1.17	0.48	1.52	2400
1995-96	1.26	0.54	1.57	2830
1996-97	1.36	0.58	1.58	3020
1997-98	1.46	0.62	1.62	3250
1998-99	1.55	0.66	1.66	3510
1999-00	1.66	0.70	1.70	3990
2000-01	1.78	0.75	1.74	4097
2001-02	1.89	0.78	1.78	4424
2002-03	1.99	0.83	1.82	4777
2003-04	2.10	0.91	1.99	4780
2004-05	2.21	1.06	2.14	5625
2005-06	2.32	1.13	2.17	5422
2006-07	2.44	1.03	2.28	5360
2007-08	2.56	1.04	2.65	5653
2008-09	2.70*	1.08	2.28	4696

\* Estimated. Net country availability figure, after deduction of exported quantity would be about 2.62

Source: DoF/GoB 2008, Statistical Year Book on Fisheries in Bangladesh.

It is therefore evident that during nearly one decade and a half (1994/95 - 2008/09), Bangladesh has made a commendable progress in food production. The total net food grain production (rice and wheat together, after 10% deduction from gross production for seed, feed and wastage) increased by 97.02% from 16.09 million MT in 1994/95 to 31.66 million MT in 2008/09, at an average annual rate of 6.93% which surpassed the population growth rate over the same period of time. This together with the imported food grains resulted in increase of the net per capita food grain availability from 364 gm/day in 1994-95 to 637 gm/day in 2008-09 (which is,

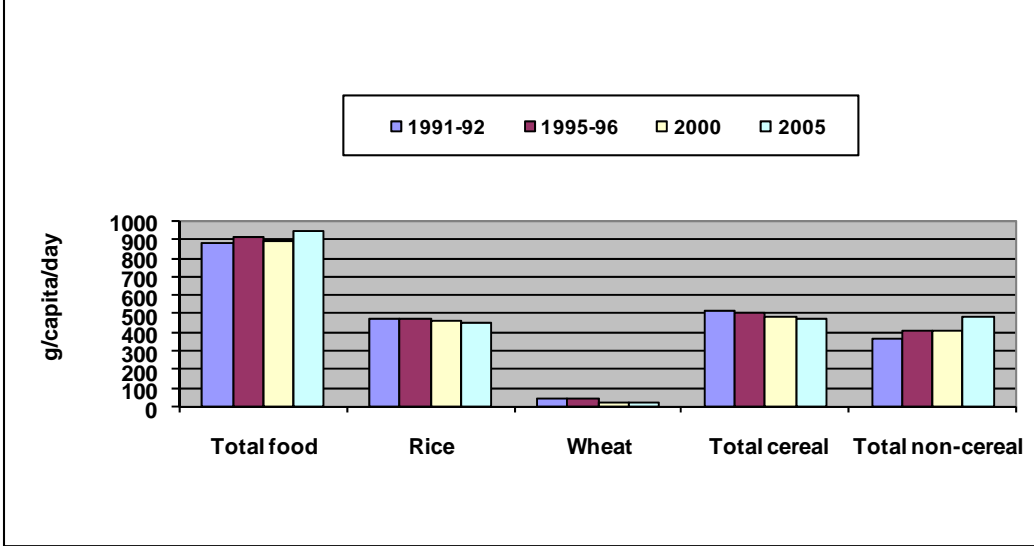
however, far above the nutritionally desirable amount). This total increase (75%) in per capita food (cereal) availability between 1994-95 and 2008/09 are largely attributable to the increase in production that occurred between 2007-08 and 2008-09.

The production of fruits, vegetables and all kinds of animal food e.g. meat, milk and egg, also increased during the last 15 years from 1.17 and 0.48 MnT and 2,400 million in 1994-95 to 1.08 and 2.10 MnT and 4696 Million in 2008-09 respectively. But these increased amounts are still far from meeting per capita per day human needs of 120 gm food of animal origin, 250 gm milk and 106 number of egg, as recommended by WHO/FAO/DAS of GoB. Pulses, once known as the "poor man's meat" as well as oil seeds, known as the most energy-dense food, showed a rather steep fall in growth, though population increased significantly during the period, resulting in drastic reduction of per capita daily consumption.

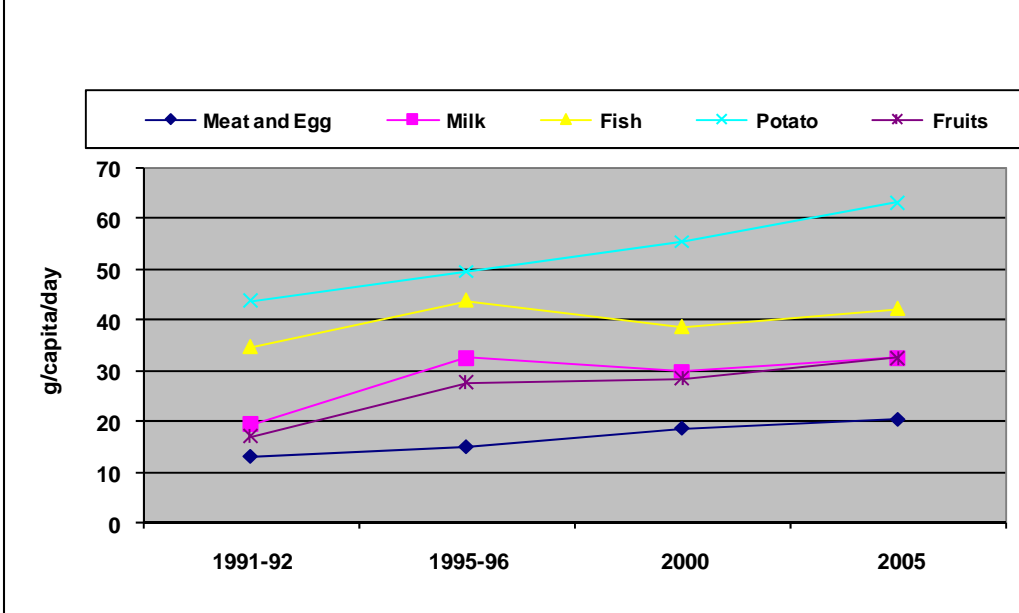
#### **2.4 Food Consumption**

The main staple food of the Bangladeshis is rice, which comprises over 50% by weight and nearly 80% by calorie of the total diet. In terms of intake of wheat, which is the second cereal, comprises only 6-7% of total cereal volume. A close look in to the available data on food intake pattern of the people here from 1991 to 2005 would show that with the increase in food production and an improvement of socio-economic condition of the people during this period, the total per capita food intake in Bangladesh has increased slightly, by 6.9%, but, interestingly, the intake of cereals shows a slow decreasing trend (total by 9.5%, rice by 6.4% and wheat by 52.3%)(Figure 2). The lower intake of cereals is accompanied by increased intakes of non-cereal food items, particularly meat, egg, potato, fruits and vegetables (Figure 3). The data indicate a positive transition towards dietary diversification.

**Fig. 2: Changing food intake pattern in Bangladesh, 1991-2005 (BBSHIES)**



**Fig. 3: Increases in intake of some food items in Bangladesh, 1991-2005 (BBSHIES)**



As a result of this dietary diversification, at a slow pace though it has been, the percent dietary energy supply from cereals to total calorie (DES Cer %) decreased in Bangladesh diet from 79.6% in 1991/92 to 72.9% in 2005, the average annual rate of decrease being 0.45%.

### **3. POST HARVEST LOSSES**

Diversified agro-climatic conditions, ranging from tropical to temperate, afford ample opportunities to grow large number of food grains, fruits and vegetables in Bangladesh. While efforts for production of food grains have been in focus for a long time in order to meet the caloric and other macro nutrient requirements of the people here, increase in production of fruits and vegetables are also being given during the recent years. As a result a galloping increase in production of these commodities is also evident now. Since a large proportion of the population of the country, particularly the children, adolescents, pregnant and lactating mothers are the victims of micronutrient deficiencies, increase in production of fruits and vegetables, the sources of micronutrients, is very relevant. Fruits and vegetables are the foods of the future.

#### **3.1 Current Status of Post Harvest Losses**

Food harvest losses are common in case of almost all agricultural produces. Among the food commodities, proportions of losses in case of grains are comparatively less than those in cases of fruits and vegetables that are more perishable. But since the total quantity of food cereals is much more than any other commodities, the total quantity of post harvest loss is also much more than that of any other crop. Post harvest losses of agricultural commodities, therefore, have all along been a matter of concern for us, particularly of the producers. In subsistence economy like ours, non mechanized harvesting practices and traditional technologies have been in use. Because of these, the extents of post-harvest losses of food commodities are alarming. In order to overcome the food deficiencies, we have been traditionally emphasizing on two lines of actions e.g. (a) reducing future demand by slowing down population growth and (b) augmenting food supplies by increasing production. But perhaps the third and the very important option in our context – reduction of post harvest losses is not given proper considerations.

The three main objectives of applying appropriate post harvest technologies for harvesting crops are:

- to maintain quality (appearance, texture, flavor, nutritive value) of the crops, particularly of fruits and vegetables;
- to protect food safety; and
- to reduce losses between harvest and consumption.

### 3.2 Extent of Post Harvest Losses of Different Crops in Bangladesh

Though there has been appreciable improvement in technologies for production of various crops, but means and implements for harvest of crops remained in primitive stage. The recent trend of shortage of agricultural laborers for reaping crops and their post harvest operations manually and hence escalation of net cost of production has emerged as a threat to the farmers to suffer financially as well as to cause more post harvest losses. To assist the farmers during the season in some specific areas, BRAC came forward to import 10,000 simple mechanical reapers from China (Mondal, 2010). The incidence indicates the immediate need for development of appropriate implements and technology for harvesting.

The following table presents a picture depicting enormous losses of our agricultural commodities and its implications in terms of loss of the quantities of annual losses of individual food commodities in our country

**Table 4: Extent of Post Harvest Losses of Different Food Produces in Bangladesh**

Sl. No.	Food Commodity	Percent of Post Harvest Loss	Quantity of Post Harvest Loss proportionate to the annual production 2005-06 (Million MT)
1.	Cereal grains (rice & wheat)	13.6%	3.71
2.	Fruits	15.0%	0.44
3.	Vegetables	26.0%	1.25
4.	Potatoes	21.0%	0.87
5.	Pulses	14.6%	0.04
6.	Oil seeds	12.3%	0.03

Source: WFP, FPMU of MOFDM/FAO

In order to fill up the food gap in the country, there has not been any spectacular success, except in case of rice. As revealed by the above table, the proportion of loss in case of vegetables tops the list with 26% which implies an annual loss of the

commodity by 1.25 million MT. This is followed by potato with 21% loss to make the quantity 0.87 million MT. Proportion of loss of fruits comes next with 15% to show the quantity of loss as 0.44 million MT. Most of these commodities are available for consumption during their short season of production. Cereal grains (rice and wheat) are also lost at a rate of 13.6% making the total quantity the highest one of 3.71 million MT. The least proportion of loss is 12.3% in case of oil seeds due to which 0.03 million MT is lost. The monetary value of these losses is very high for the economy of the country.

### 3.3 Causes of Post Harvest Losses

There are different causes of the post harvest losses, which vary from commodity to commodity. The table reveals that vegetables and fruits suffer from the highest proportions of losses. The table below shows the principal causes of post harvest losses and poor quality of vegetables and fruits.

**Table 5: Causes of Post-Harvest Losses of Vegetables and Fruits**

Commodity	Group	Varieties	Principal causes of post-harvet losses and poor quality
Vegetables	Root vegetables	Carrots Beets Onions Garlic Sweet potato	1. Mechanical injury 2. Improper caring 3. Sprouting and rooting 4. Water loss (shriveling) 6. Decay
	Leafy vegetables	Lettuce Spinach Cabbage	1. Water loss (witting) 2. Loos of green colour 3. Mechanical injuries 4. Decay
	Flower vegetables	Broccoli Cauliflower Abscission Decay	1.Mechanical injuries 2.Discoloration
	Immature fruits, egg plant,okra	Cucumber Squash	1. Over maturity at harvest 2. Water loss 3. Bruising & injuries 4. Chilling injury 5. Decay
	Mature & all fruits	Tomato Malons Citrus Banana Mangoes Apples	1. Bruising 2. Over ripeness 3. Water loss 4. Compositional changes 5. Decay

### **3.4 Methods for Reduction**

Many of the causes of post-harvest losses may be minimized by adopting proper post-harvest handling methods. These methods include:

- Proper selection of varieties
- Using proper harvesting techniques
- Appropriate drying before storage
- Using appropriate methods of storage including control of atmosphere
- Treatment with approved chemical agents in approved and specified proportions for surface decontamination and preventing decay
- Using waxes and emulsions
- Irradiation

## **4. AGRO-PROCESSING TECHNOLOGY**

Bangladesh is predominantly an agricultural country and agriculture is the single largest and dominant sector for growth and development of its national economy. Though the direct contribution of the sector to the gross domestic product (GDP) of the country shows a gradual descending trend, but till now it accounts for about 20 percent of the GDP and employs about two-thirds of the total work force. Agriculture contributes to growth as a supplier of raw materials to industry as well as a market for industrial products and also contributes substantially to the country/s export-earning. Almost three-fourths of the country's population are living in rural areas and are directly or indirectly linked with agriculture for their livelihood. Any improvement in agriculture will not only help country's economic growth to rise at a faster rate but will also benefit a large segment of the country's population.

But agriculture has yet been in a subsistence level and still far a way for necessary mechanization and use of appropriate technology. As mentioned earlier, in the absence of such a transition, post harvest losses of agricultural commodities, particularly of vegetable, fruits and cereals are at a very high level in the absence of use of appropriate technology for harvesting, storage and processing. Agro-processing is therefore, considered as an appropriate intervention for reduction of post-harvest loss, improvement of fair price for the producers, generating employment, extension of shelf-life of the commodities for consumption and contributing to nutritional well being (EIRI, 2009).

#### **4.1 Status of Agro-based Food Industries**

Agriculture provides the raw materials for various industries including the food-based ones. However, like many other developing countries, food industries constitute the majority ones at the beginning of the industrialization. Bangladesh has more than 700 recognized food industries. The oldest ones are possibly the cereal-based flour mills each one producing 5-150 MT flour per day. Currently there are more than 200 flour mills in the country including about 50 mills in and around Narayanganj producing about 45 % of the total needs of wheat flour in the country. In addition, very recently MOFDM/WFP has established 29 fortified atta mills and the private sector agencies established two fortified blended food factories in poverty-prone areas, mostly to distribute fortified rations to the ultra-poor households. More than 100 cereal-based biscuit and bakery factories constitute the second biggest number of industries, about a dozen of whom produce the fortified high energy and high protein (HEHP) biscuits for the GoB/WFP-sponsored School Feeding programme for providing school snacks to more than a million children regularly. The recent GoB initiative for undertaking a massive National School Feeding Programme with micronutrient fortified HEHP biscuits and safe water to cover 20 million primary school-going children mostly in the economically backward and hard-to-reach areas in order to increase enrollment, decrease drop-out, increase intelligence and attention span of the children, is a long step forward.

Besides few sugar mills and allied industries, other food processing industries started to grow in the country from early eighties at a very slow pace and contribution of these industries to GDP is rather a recent reality. By 1990, the share of the food industries was only 2.0% in GDP (APO, 1995), though the proportion of food processing industries among all manufacturing industries increased to 22.14% in 1995.

#### **4.2 Importance**

In the past, the small scale food processing industries played very important role in the economic boost up of many developing countries. Taiwan is one of them (Wu, 2004). In our country, with the change of time, the home processing of the staples, particularly rice and wheat, is now almost at the hands of the industrial millers like flour mills and rice mills, who process about 80 percent of our cereals consumer country-wide (Sustain, 1999). New interests have been created in recent Bangladesh to establish food processing industries of new type. These include industries based on processing of vegetables, fruits, new cereal products, dairy and fish processing

(though there is a tendency of going for junk foods). These industries, if properly managed, will accelerate agricultural development by creating backward and forward linkages. Many of these industries show increasing interests in production of varieties of processed foods by application of innovative and alternative technologies. Emphasis is not limited in achieving better understanding to develop new products, but also improving the methods of production, introducing mechanization, improving the quality, shelf-life, safety and packaging as well as marketing of the processed products (Shams-Ud-Din, 2005).

Major new business houses dealing in agro-processed commodities include:

- Agricultural Marketing Co. Ltd. (PRAN Group);
- Ahmed Food Products;
- Javed Food Products Limited;
- Rajshahi Mango Products,
- Nur Food Products;
- A.K. Food Products, Hashem Foods Ltd.;
- Rangamati Food Products;
- Dishan Food Products;
- Ispahani Food Group;
- Ruchi Food group;
- Bombay Food Company;
- Modern Food Company;
- Gonoshasthya Foods Ltd.

The major products of the flour and rice mills and the above mentioned companies include processed wheat flour, rice, jam, jelly, ketchup, squash, juice drinks; mago bar, mango slice, roasted pulses and pickles of different origins like olive, tamarind, complementary food for young children, etc. Some of them even produce and market non-traditional health foods like spirulina, kalojira oil and vegetable-based drinks processed following Ayurveda and Unani systems. About half a million workers, majority being women, are employed by these organizations. Estimated production of these agencies, besides flour and rice, is about 10,000 MT. The enterprises contribute about 2% of the GDP (Haq and Shahjahan 2005).

### 4.3 Opportunities

The following are considered as the opportunities for further promotion of agro-processed food commodities:

- The country has a large population base of 148 million people with increasing per capita average income, in spite of the co-existence of a large section of the people in extreme poverty. The current free market economy has made many processed foods familiar to the affluent class of people. The country aspires to be transformed into a middle income one within next few years. Hence there has already been created a big demand (which is to be further increased soon) for processed foods from cereals, fruits and vegetables of domestic origin, instead of absolute dependence on imported ones.
- The population also provides not only a low cost labor, but also a growing urban middle class with an increasing demand for superior, higher quality and more convenient food commodities. Meeting this demand through domestic production suggests an opportunity for both foreign and domestic investment to develop agro-based industries;
- About 8.0 million non-resident Bangladeshis are serving in foreign countries. They have created great "ethnic" demand for Bangladeshi food commodities. Though currently it is mostly limited in fruits and vegetables, but there is a great opportunity to export processed agro-products also from the country to meet their demands;
- With the introduction of new technologies and cultural practices for production of high yielding and better varieties of Bangladeshi fruits and vegetables. A number of developments would enable Bangladesh to realize the twin potential of meeting domestic demand and expansion of export through agro-processing, packing, cleaning, sorting, grading, packaging, pre-cooling, refrigerated storage.
- Modern roasting, extrusion, spray drying technologies for food processing have been successfully introduced in Bangladesh. With the use of those, Bangladesh has a number of innovative processes to produce value added food commodities like fortified blended foods, fortified and soybean enriched biscuits and fortified atta. Of course these are still confined in various Gov/donor-assisted project areas, and mostly for use by the disadvantaged sections of population. Involvement of the private sector in production and

marketing of these commodities is likely to have good market home and abroad.

- The government policy, financial support, media promotion and individual enthusiasm have created in the country a large pool of Bangladeshi agro-business entrepreneurs. A coherent support to them is likely to boost up the overall activities of the sector.

#### 4.4 Challenges

Grinding grains and blending it with other commodities for convenience of human consumption has a long history. Roller milling system with improved and convenient grain handling started back in 1930. Modern roller mills produce flour of fine texture, after refusing about one-fourth of the grains as wastes. Rice is the main local crop and traditionally it has been the staple for people of Bangladesh. In the past, it was a common practice in the farmer houses that they would process (husk) rice at their home by using the traditional *dheki*. For the sake of convenience and to avoid the drudgery of the rural women, rice milling job was initially taken by the small scale stone meals set up in the rural markets or growth centers. Currently, the major share of rice milling has been taken up by the big rice mills. Wheat, a more nutritious cereal, has also been popular with the people after it was first introduced in this area as a food aid in early sixties. Gradually, it has now become the second major crop after rice. The rural people, particularly the poor section, are accustomed to consume home-made *chapatti* (unlamented flat bread) made of whole-wheat flour, called *atta*, milled in small stone or *chakki* mills. The rich section of the population, particularly in the urban areas, prefers the fine flour, called *maida*, though it is comparatively inferior in food quality. Industrial processing of food almost universally depletes the natural quality food. The following table is presented as an evidence of the changes of composition of processed cereals, rice and wheat, making the processed one nutritionally poor.

**Table : Some Major Elements of Composition of Processed Cereal Products per 100 gm**

Commodity	Some Major Elements of Composition							
	Moisture (gm)	Fibre (gm)	Protein (gm)	Fat (gm)	Iron (mg)	Thiamin (mg)	Riboflavin (mg)	Vit. A (mcg)
<b>Rice</b>								
Rice husked	13.3	6.0	6.8	1.0	3.2	0.21	0.16	0
Rice milled (once)	13.7	2.0	6.6	0.5	3.1	0.06	0.06	0
<b>Wheat</b>								
Atta (100% extraction)	12.3	1.9	12.1	1.7	11.5	0.49	0.29	5.0
Maida (75-74% extraction)	13.3	0.3	11.0	0.9	2.5	0.12	0.07	4.0

Source: INFS/HKI/WFP, 1988, Nutrients Composition of Bangladeshi Foods

From the table it is evident that industrial processing of cereals, and similarly other natural food commodities, depletes bulk of fibres, protein and micronutrients of the natural foods and leave them as wastes. The differences between the compositions of *atta* and *maida* are very distinct. Here comes the importance of food fortification to compensate the losses as well as to enrich foods more in their protein and micronutrient content particularly. UNICEF/WFP/WB/MI have recommended food fortification as an affordable and effective means for controlling vitamin-mineral deficiencies (VMD) to improve the lives of millions of malnourished people. It is also considered that probably no other technology (except fortification) available today that offers as large an opportunity to improve lives and accelerate development at such a low cost and in such a short time. The process has therefore been widely accepted in many countries, rich and poor. Unfortunately, till the recent past only the salt has been the single commodity that is being fortified with iodine. Though the Government of Bangladesh through the Bangladesh National Nutrition Council (BNNC) adopted an NPAN - National Plan of Action on Nutrition 1997-2010 focusing food fortification as an appropriate technology for eradication of micronutrient deficiencies in the country, but its implementation is quite invisible. Only recently, a National Fortification Alliance (NFA) has been formed involving the relevant UN bodies, private sectors, international and national NGOs to expedite the process. The manifestations are the fortified biscuits for the school children, fortified *atta* for the vulnerable sections of population, fortified blended food for the malnourished children and mothers, and fortified edible vegetable oils, most of them await large scale implementation in the country. All these necessitate further research for local production of premix, adoption of Bangladesh Standards in compliance with the

safety levels and in conformity with the Recommended Nutrients Intake (RNI) of the consumer groups.

## **5. FOOD SAFETY**

The consumer expectation is that the supplied food should be nutritious, wholesome, pure and safe. They also expect that food should be plentiful; it should offer wide choices and be of a reasonable value. They put increased emphasis on food safety and expect that foods do not contribute to chronic diseases. Understanding food safety requires understanding of the terms like *safe*, *hazard* and *risk*. *Safe* means that nothing harmful is happened when the consumer consumes the food. In addition, it is also a reality that only exposure to certain toxicants for a considerable period can harm one even after years. Scientists think of food safety in terms of hazards and risks. A *hazard* is the capacity of a thing to cause harm. The probability that a defined harm will occur is the *risk* associated with the hazard. Many times in life we recognize hazards and take actions which reduce risk to an acceptable or improved level. Though in real sense, no food is *absolutely safe* all the times, the goal of food safety is to reduce the size of risks to the lowest reasonable level without severe disruption of the food supply.

### **5.1 Food Hazard Categories**

There are a number of categories of hazards associated with foods. These in brief are as follows (Potter and Hotchkiss):

#### **5.1.1 Biological Hazards**

Biological hazards include bacterial, fungal, viral, and parasitic (protozoa and worms) organisms and/or their toxins. There are many microorganisms which are pathogenic in human beings but relatively few are associated with foods. Those are termed as food-borne pathogens. Diseases caused by these organisms are sometimes incorrectly called food poisonings. There are two types of food-borne disease from microbial pathogens: infections and intoxications. Infections result from ingestion of live pathogenic organisms which multiply within the body and produce disease. Intoxications occur when toxins produced by pathogens are consumed. Intoxications can occur even if no live microorganisms are ingested. This often occurs when foods are stored under conditions which allow the pathogens to grow and produce toxin. Subsequent processing of the food may destroy the microorganisms, but not the

toxin. Production of aflatoxin, a carcinogenic agent produced by the fungus *Aspergillus Flavus* in cereals, especially maize and rice, in bad storage conditions is a glaring example (Quddus 1968). It is estimated that thousands of such cases occur in our country every year. Healthy individuals nearly always recover from these bouts, but an estimated 10,000 or more elderly or very young people with medical problems die each year from food-borne diseases. The number could be reduced if more care is taken in the handling, storage, and preparation of foods (WFP 2004).

### **5.1.2 Nutrition-Related Diseases**

There is a relationship between health and diet and the major objective of eating to maintain or even improve health. Foods, components of foods, or diets which detract from health represent diet hazard. In recent years, knowledge about the connections between diet and health has increased and it has become apparent to many food scientists and nutritionists that food and diet play a role in chronic diseases such as heart disease and cancer. When the incidence of diseases such as cancer and heart disease is compared among human populations with different dietary habits, it becomes clear that certain diets can increase the risk of heart disease and cancer. Compared to other pulses, lethyru has higher protein, carotene and calcium content. But the toxic amino acid in it is the only limiting factor that produces Lethyrisms (Hamid et al, 1986), the fatal disease, in the consumers who take it more frequently. Other diets appear protective. Further, many people over consume foods, and become the victims of the disease called obesity. This amounts to a misuse of foods and is considered a major food-related hazard because it affects large numbers of people. Many organizations, both government and non-government, advocate changes in the diet to promote better health in order to reduce these risks (WFP, 2005).

### **5.1.3 Chemical Hazards**

Chemical hazards associated with foods can be subdivided into naturally occurring, indirectly added, and directly added. Foods become contaminated with natural and human-derived environmental toxicants, because most foods are grown in the open environment. Lead, in most cases, is one such toxicant. PCBs, dioxin, and other pollutants resulting from human activities are other examples. A nation-wide serious threat is arsenic contamination. The extent of the problem is such that in some

areas, 100 percent of the tube wells (including 15% deep tube wells) used as source of drinking water supply arsenic contaminated water with arsenic level above the Bangladesh standard of acceptable arsenic level (max.50 mcg/L, though WHO guideline is 10 mcg/L). The Department of Public Health Engineering (DPHE) responsible for supply of drinking water, based on findings of the DFID and other donor supported survey (DPHE/DFID, 2006) has categorized the districts in the country into types of arsenic uncontaminated to most contaminated ones. The most affected districts are Chandpur (90%), Munshigonj (83%), Gopalganj (79%), Madaripur (69%), Noakhali (69%), Satkhira (67%), Comilla (65%), Faridpur (65%), Shariatpur (65%), Meherpur (60%) and Bagerhat (60%). The least affected districts are Thakurgaon, Patuakhali, Panchagorh, Nilphamary, Natore, Lalmonirhat and Barguna, where water was found to contain arsenic at levels less than BS of 50 mcg/L (Rahman 2008). The situation indicates for undertaking a comprehensive study how does this situation affects the food chain and human health in the country.

In addition to environmental pollutants, foods become contaminated with trace toxicants which are unintentionally or intentionally added to foods. The use of pesticides to control insects, unwanted plants, or fungi can result in trace residues of the pesticide in the food. Sometimes, components of packaging materials migrate from the package to foods. Oils from processing machinery or other processing aids can leave trace residuals in foods. These substances are sometimes called processing aids and should be regulated for food safety. Traces of drugs which are given to food-producing animals to treat diseases in these animals or make them grow more quickly could, under some circumstances, remain in the food. Traces of antibiotics in milk, shrimp are some examples. These are also considered trace toxicants. As Bangladesh has entered in to the foreign markets through exporting foods, such incidences are coming to our knowledge frequently.

#### **5.1.4 Food Additives Hazards**

Food additives like flavoring ice creams or biscuits, salting fish and meat, of fermenting plant and animal substances, improving the palatability of insipid diets with spices have been in practice globally for long time. Such chemicals have also been in use for uniform ripening and brightening the color of fruits. But these practices are usually kept within the limited level to avoid harms through

introduction and administering the well defined specifications in most of the countries including our neighbors (Akaland, 1997). Unfortunately in an absence of adaptation of such standard specifications and their applications, use of such chemicals in food materials have been in use in the country in widespread and dangerous doses. In order to avoid food chemical hazards, use of these must be thoroughly tested and controlled before use.

#### **5.1.5 Physical Hazards**

Foods may contain physical hazards such a stones, metals, seeds or glass fragments. These materials may also be contaminated during processing and packaging, sometimes intentionally, to become part of foods from the natural environment in which they are grown. Such materials may come from processing machinery, for example. For this reason, food processing operations should have electronic metal detector which screens each package for metals. Foreign objects represent one of the largest categories of complaints by consumers.

All substances within each of the above five categories can be thought of as carrying some degree of health risk. The acceptability of each risk will depend on a number of factors, including the alternatives available, cost, benefit, and size of the actual risk. It is the job of government and industry to ensure that these risks are minimal and acceptable. Eliminating these substances or choosing less risky alternatives is very often possible to reduce the risk. In other cases, the only way to eliminate risks is to ban whole foods.

Risks from processed foods can be reduced through use of good manufacturing practices and careful analysis of the most important steps in processing. This latter approach is often termed "hazard analysis and critical control point" or HACCP.

#### **5.1.6 Microbiological Hazards**

One of the most serious and widespread risks from foods is the occurrence of pathogenic microorganisms. Disease outbreak caused by the occurrence of a deadly type of *E. coli* bacteria caused by undercooked foods in fast-food and common restaurants. Some pathogens such as *Salmonella* spp. are commonly associated with certain foods in their raw form. These pathogens can be carried throughout the processing of the food into the final product. Mishandling is probably the most common problem in many food-borne outbreaks.

Modern animal agriculture, where large numbers of animals are raised in relatively confined areas, intensifies food-borne diseases because the opportunity for one animal to infect the next with a human pathogen is greater. These are few examples of food hazards of this type.

As depicted in the Bangladesh National Food and Nutrition Policy (BNNC, 2007) and the recent National Food Policy (GoB, 2006), the Govt. of Bangladesh is well committed to ensure safe and quality food to its people. The food safety and quality control framework consists of Laws, Regulations & Standards; Administration & Inspection and Laboratory analytical services. The Govt. is also strengthening the Bangladesh Standards and Testing Institution (BSTI) making it responsible for the standardization, testing, metrology, quality control, grading and marking of goods. For the purpose, the BSTI Ordinance, 1985 has been amended (GoB, 2007).

But the actual situation of food quality and safety in the country is grave, because of the fact that uncontrolled hazardous chemicals, additives and preservatives are being used widespread creating serious threat to human health and increasing the proportion of non-communicable diseases. It is a much discussed issue now-a-days, which has been depicted frequently both in printed and electronic media.

The Institute of Public Health (IPH), Dhaka with support from the World Health Organization (WHO), through a study revealed that out of 400 sweetmeat, 250 biscuit, 50 bread and 200 ice cream samples, 96.8%, 24%, , 54% and 59% respectively are adulterated. Another study in 1994 conducted by the Institute of Public Health (IPH) in 1994, also sponsored by WHO, it was found that out of 52 street vended food samples, 100% were contaminated with different types of pathogens. About 50% of all food samples tested by the Institute throughout the last decade, were adulterated or infected. Samples collected through the Sanitary Inspectors from the Municipalities and growth centres also were found to have contamination/infection to the extent of 71%. A recent IPH report also found that at the household level, about 50% iodized salt only did contain iodine at the minimum required specified level of 15 ppm. A number of studies conducted by the professional institutes, Consumers Association of Bangladesh and various others reveal that a good number of different food items available in the market are not up to the standard and that many of them do not have BSTI approval. The agency could introduce till now only about 50 food commodity standards in the country. As a result

the actual situation of food quality and safety in the country is grave, because of the fact that uncontrolled hazardous chemicals, additives and preservatives are being used widespread for early ripening and preservation, creating serious threat to human health and increasing the proportion of non-communicable diseases. It is a much discussed issue now-a-days, which has been depicted frequently both in printed and electronic media (Rahman, S.M. et al 2005).

## **5.2 Major Government Efforts**

Considering the alarming Food safety and quality situation, the Government in the MOFDM with the technical assistance from FAO has undertaken a "Strengthening National Food Safety and Quality System" project to improve the situation. Other Government initiatives include (WFP, 2005):

- Radiation Protection Act, 1987;
- Essential Commodity Act, 1990;
- Fish and Fish Product (Inspection and Quality Control) Rules, 1997
- National Agricultural Policy, 1999;
- Integrated Pest Management Policy, 2002.
- Adoption of 107 different generic, mandatory food standards and some 250 optional standards for different foodstuff so far by BSTI.
- A Multi-Ministerial effort by the Ministry of Agriculture, Ministry of Food and Disaster Management (MOFDM), Ministry of Health and Family Welfare (MOHFW), Ministry of Local Government, Rural Development and Co-operatives (MOLGRDC) and Ministry of Industries- for enforcement of food laws, rules and regulations.

## **6 . HUMAN NUTRITION**

### **6.1 Current Nutrition Situation in Bangladesh**

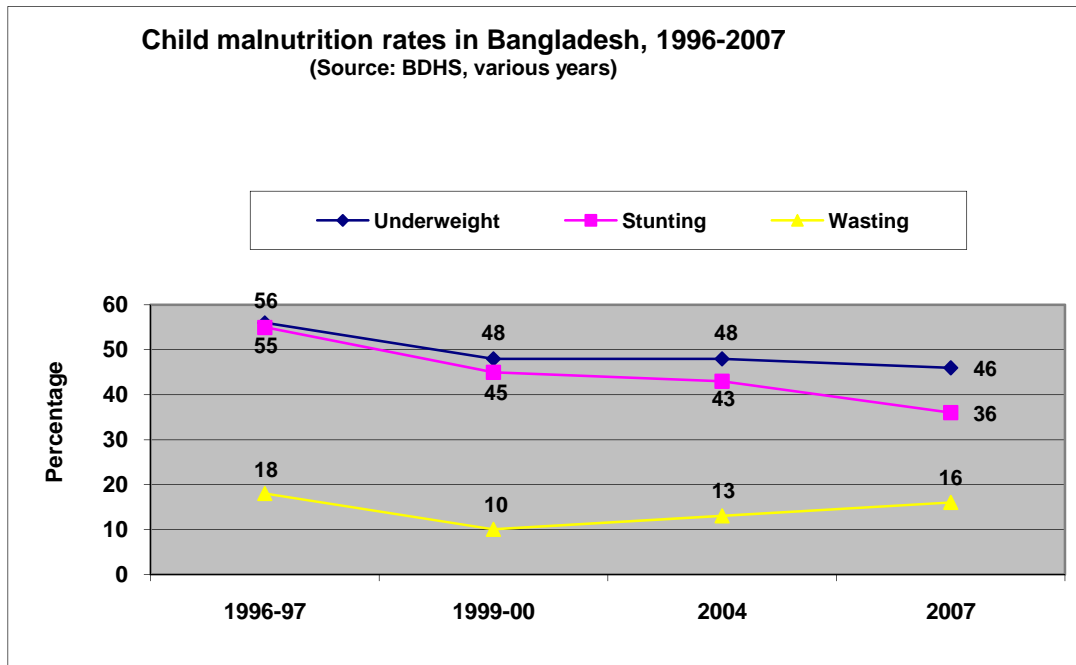
The World Food Summit 1996 (FAO, 1996) has defined food security as a state when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active and healthy life. The summit also defined three conditions of food security namely food availability, access and utilization. Food availability is a function of domestic production, imports and food aids. Of these, domestic production is the most critical one to ensure food availability at both national and household levels. Therefore,

every Government puts lot of emphasis on domestic production of food grains, particularly rice and wheat in order to ensure food security of the population. This has been manifested in the Bangladesh National Poverty Reduction Strategy Programme –PRSP (GoB, 2005 ), wherein food security has been given the top most priority. For this, side by side with domestic food production, great importance has been given to ensure access to adequate and safe food by all people at all times for maintaining an active and healthy life. However, in recent years, the Government is putting additional efforts to increase production of other important food crops as well as fisheries, livestock and horticulture products.

On the other hand, as per UNICEF model, nutrition has three immediate determinants of which food is one, other two being care and medical services, particularly for the vulnerable sections of population like pregnant/lactating women, children and adolescent girls. The article deals mostly the food aspects of nutrition together with the related issues.

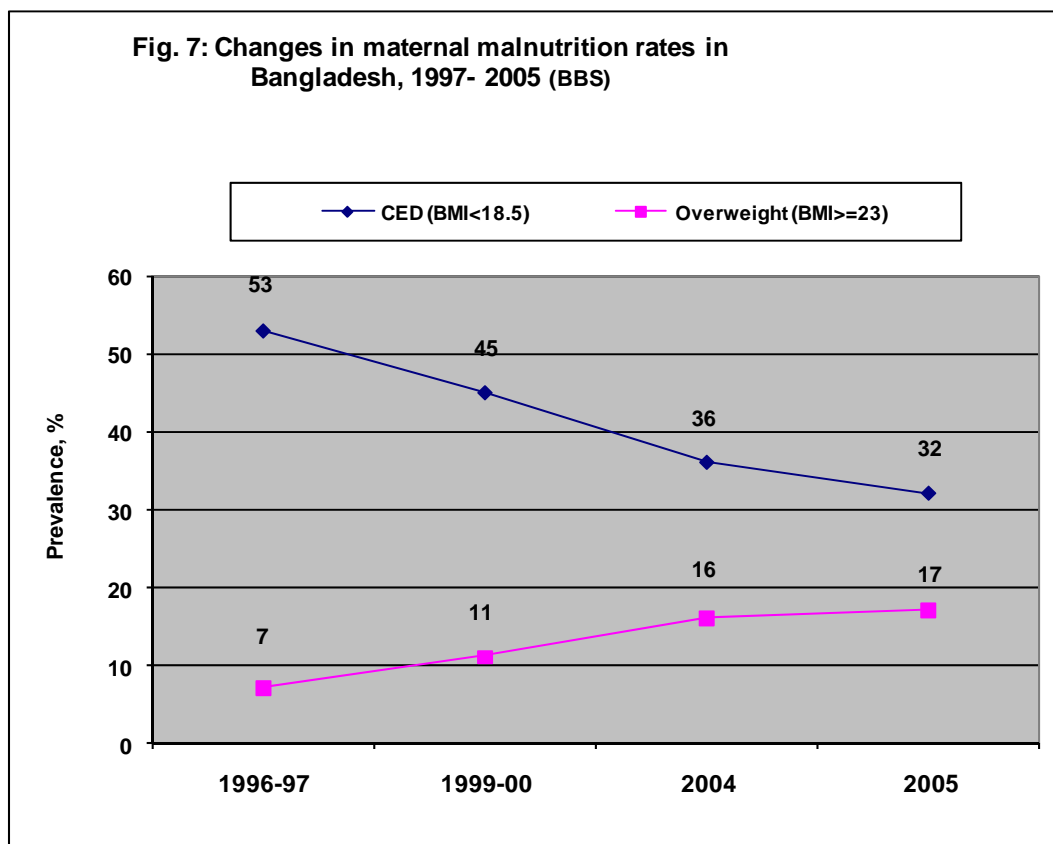
#### **6.1.1 Macronutrient malnutrition**

Macronutrient malnutrition arises due to deficiencies of the macronutrients (calories and protein). This is together known as protein-energy malnutrition (PEM). Malnutrition rates in children under 5 years of age (strong indicators of national development) have shown a decreasing trend between 1990 and 2005 (Yusuf and Quddus). For example, prevalence of both underweight (weight for age lower than -2SD of the reference median) and stunting (height for age lower than -2SD of the reference median) has decreased (Figure 6), although wasting (low weight for height) did not show much trend of improvement. The underweight rate has decreased from 68% in 1990 to 46% in 2005 (i.e. at an annual rate of 1.4 percentage points). If the target of 34% has to be achieved (MDG # 1, target#2: reducing child underweight by half by 2015), then the reduction rate shall have to be 1.2 percentage points per year. Bangladesh is likely to achieve this goal if some more concerted efforts are given at the policy as well as programme levels. In terms of stunting, the picture is a little brighter, in that the rate of decrease between 1990 and 2005 was 1.37% and the target rate to reduce it by half is 1.0% per year.



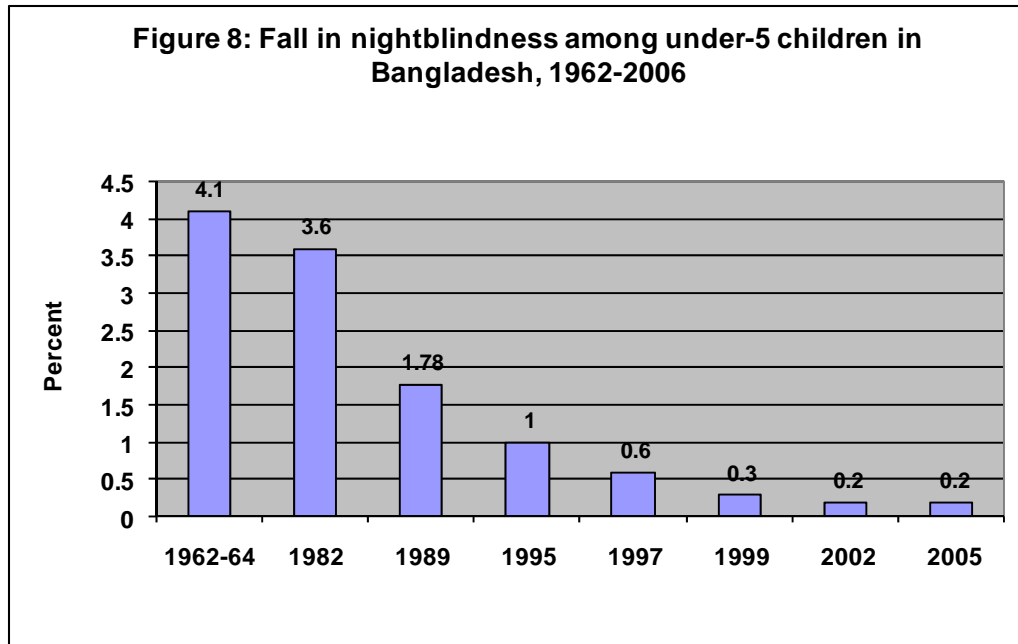
Maternal undernutrition rate, measured by proportion of women who have Body Mass Index (BMI, weight in kg divided by height in meters squared)  $<18.5 \text{ kg/m}^2$ , has also decreased in Bangladesh during the last decade, from 53% in 1996/97 to 32% in 2005. While this is a good indication of nutritional improvement in the mothers in the context of the fact that malnutrition in a child's life begins with the mother, a more concerning observation is that the prevalence of overweight (BMI  $\geq 23 \text{ kg/m}^2$ ) among Bangladeshi women is also increasing, at an alarming rate. It has increased by 10 percentage points in just 10 years between 1996/97 and 2005 (Figure 7). As a result, what the ratio of undernourished to overnourished was 53:7 in 1996/97 has become 32:17 in 2005, meaning coexistence of undernutrition and overnutrition (the so-called "double-burden" of malnutrition) in the same country, in the same community and also in many cases in the same household.

Overweight and obesity are again indicators of poor nutrition and lifestyle, in the sense that some people are eating more calories than they need and they do not have enough physical activities to burn out the excess. It seems that their number is increasing. Overnutrition leads to a number of chronic non-communicable diseases (NCDs) like diabetes, hypertension, heart disease and even some form of cancer. Double burden of malnutrition is becoming an ever increasing concern in the developing countries all over the world. It is estimated that by 2030, more people will die from the NCDs than from the long known common infectious, communicable diseases.

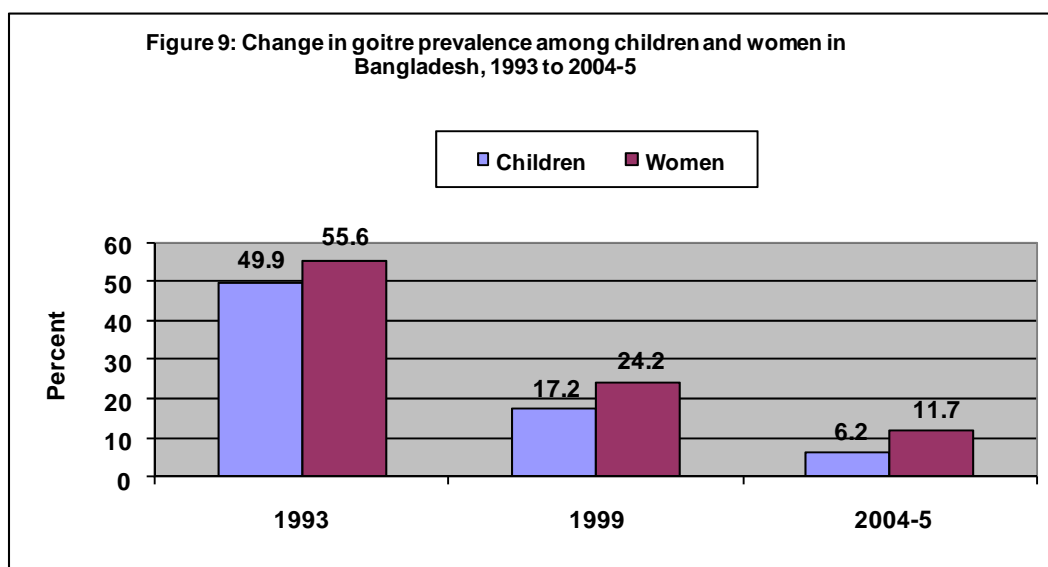


### 6.1.2 Micronutrient malnutrition

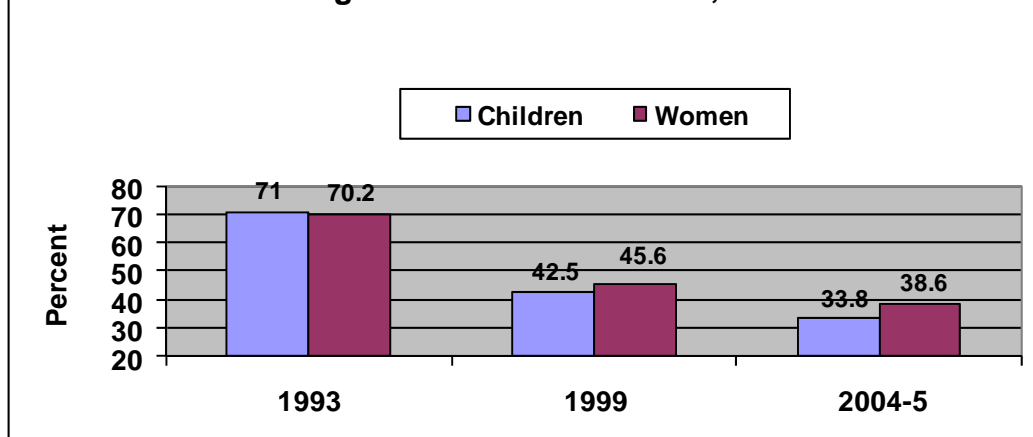
Bangladesh has also achieved some success in bringing down some of the most common micronutrient malnutrition problems, namely vitamin A deficiency night blindness and iodine deficiency disorders. Night blindness which was prevalent among under 6 year old children to the extent of 4.1% in 1962-64 is now almost non-existent (Figure 8). More recent data from Helen Keller International studies show the prevalence to be below 0.1% in 2006. The main actions behind this success has been a blend of vitamin A supplementation in the form of Vitamin A Capsule (VAC) distribution along with the EPI (Extended Programme for Immunization) and also the observance of the regular annual vitamin A week, and the food based strategy in the form of wide scale home gardening.



Another positive change in micronutrient malnutrition in the country is the reduction of goiter prevalence among children and women through the Universal Salt Iodization (USI) programme initiated in 1994/95. The total goiter prevalence (TGR) among children, men and women together decreased from 47.1% in 1993 to 8.8% in 2004/05, with an astounding annual declining rate of 3.48% (Figure 9). However, we still have a prevalence of physiological iodine deficiency (measured as urinary iodine excretion - UIE <100 µg/L) to the extent of around 36% (Figure 10).

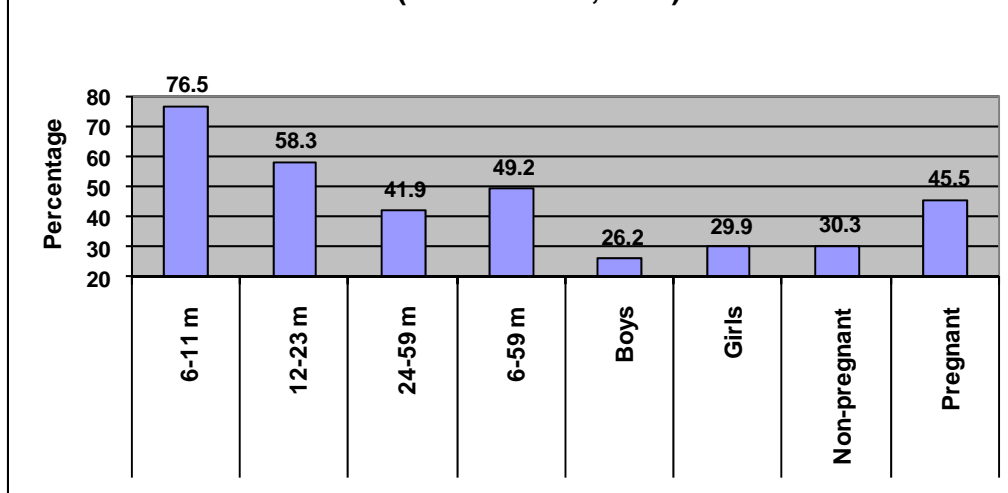


**Figure 10: Fall in iodine deficiency (UIE<100 ug/L) in schoolaged children and women, 1993 -2004/5**



In contrast to night blindness and goiter, not much improvement has occurred in anaemia situation (GoB, 2007) among the Bangladeshi population, despite several interventions (iron syrup, iron-folate tablet) since the last 4 decades. The current situation, shown in Figure 11, is as alarming as ever. Infants, young children, adolescent girls and pregnant women are the worst affected population groups. The main reason for this high prevalence of anaemia in Bangladeshi population is the intake of too little animal products which contain the more bioavailable form of iron (the heme-iron, also called the “first class” dietary iron). Some plant foods are rich in iron, but plant iron is present in inorganic form, which is non-heme iron and less available for absorption from the gut. Therefore, until and unless the overall economic condition of the country improves and the people have the access to animal foods, particularly meat and egg, achievement of a sustainable anaemia-free nation would remain a far cry.

**Figure 11: Anaemia prevalence in Bangladesh, 2001-03 (BBS/UNICEF, 2004)**



All out efforts need to be taken to fight the anemia problem, both food based and supplement based. Micronutrient Powder (MNP) or Sprinkles (enriched with iron powder along with other micronutrients to make it better absorbable and effective) as a home-fortification strategy, atta fortification for vulnerable section of the population and biscuit fortification with essential vitamins and minerals for more than a million primary school going children now launched in Bangladesh brings us hope towards a positive change in malnutrition scenario.

## **6.2 Government Initiatives**

As manifestations of its commitment to arrest the gigantic and multi-sectoral problem of malnutrition, the Government of Bangladesh has undertaken the following major initiatives:

- Formulated the Bangladesh National Food and Nutrition Policy, 1997 (which needs updating now)
- Formulated the National Plan of Action on Nutrition (NPAN), 2007
- Introduced the National Nutrition Programme (NNP) with a community-based approach which by this time covered about one-third of the upazilas in the country
- Adopted the National Food Policy 2006, making it gender-sensitive and pro-poor
- Formulated the National Strategy for Anaemia Prevention and Control in Bangladesh 2007
- Formation of National Fortification Alliance (NFA) and promotion of fortification of food commodities like atta, biscuits, blended food for addressing micronutrient deficiencies and improvement of learning capacity.
- Adoption of National Salt Policy (NSP), 2005

## **7. The Trends**

### **7.1 Food Availability and Consumption**

- Gross production of rice during the last one and a half decade from 1994-95 has steadily increased from 16.83 million tons to 34.22 million tons respectively, showing a trend of annual increase by 13.56 %. If this trend can be continued, in spite of the fact that availability of land for crop production is gradually decreasing, by the year 2015, the target MDG year, the country will be able to produce sufficient quantity of rice making it clearly food surplus and by the year 2030 it will turn in to a big rice exporting country.

- On the other hand wheat production is showing a declining trend from 1.25 million tons in 1994-95 to 0.958 million tons in 2008-09, showing an annual decline in production by 1.56%. If the trend continues like this, in the year 2015, its annual production will decline to 0.90 MnT and by the year 2029-30 the yield will be only 0.69 MnT.
- Contrary to the trend in rice production, pulses and oilseed production steadily declined from 1994-95 till 2006-07 to about a half, though during the last two years (2007-08 & 2008-09), a reverse trend is evident. During this time, pulse production regained the production figure in 1994-95 and oil seed production almost doubled the production figure of 1994-95.
- Production of vegetables jumped from 1.21 million tons in 1994-95 to 10.322 million tons in 2008-09. Spectacular success has been achieved in the production of potato. It has made a quantum jump from 1.47 million tons in 1994-95 to 9.237 million tons in 2007-08.
- Continuation of the trends of increasing annual production of the four commodities mentioned above will make the country more than surplus by the year 2015.
- During the last 15 years, the total per capita food intake in Bangladesh has increased slightly, by 6.9%, but, interestingly, the intake of cereals shows a slow decreasing trend (total by 9.5%). The lower intake of cereals is accompanied by increased intakes of non-cereal food items, particularly meat, egg, potato, fruits and vegetables. The data indicate a positive transition towards dietary diversification. Continuation of the trend will lead the country towards more dietary diversification and closer to a balanced diet by the year 2015.

## **7.2 Post Harvest Loss**

Post harvest loss of food commodities remains as a neglected area for long time. As a result, due to this the post arvest loss of four commodities in 2005-06 amounts to 6.27 MT. At the same prevailing rates in 2008-09, this loss becomes 8.86 MnT. Continuity of the negligence to this loss will be increasing the figure proportionally to the accumulated increased figure of production of these commodities, resulting in to a colossal national loss in the year 2015 and beyond.

### **7.3 Agro-processing**

Agro-processing, currently contributing 2% of the GDP is an important area for promotion for the development of the country. During the recent years, more than a dozen of entrepreneurs have come forward to engage themselves in this business and have introduced modern machineries for agro-processing.

Existence of millions of non-resident Bangladeshis in various developed and developing countries around the world has created an ethnic demand of Bangladeshi processed foods in those countries. Proper attention to the sub-Sector is likely to increase the contribution to the GDP to a double figure digit to the GDP by 2015 and increase it significantly by 2030

### **7.4 Food Safety**

Various studies and survey reports reveal that a good number of different food items available in the market are not up to the standard and that many of them do not have BSTI approval. The agency could introduce till now only about 50 food commodity standards in the country. Many of these are not in compliance, rather uncontrolled hazardous chemicals, additives and preservatives are being used widespread for early ripening and preservation, creating serious threat to human health and increasing the proportion of non-communicable diseases. It is a much discussed issue now-a-days, which has been depicted frequently both in printed and electronic media. Besides the immediate measures, a medium and a long term plan for improving the situation is a need of the day.

### **7.5 Human Nutrition**

- The underweight rate of children in Bangladesh has decreased from 68% in 1990 to 46% in 2005 (i.e. at an annual rate of 1.4 percentage points). If the target of 34% has to be achieved (MDG # 1, target#2: reducing child underweight by half by 2015), then the reduction rate shall have to be 1.2 percentage points per year. Bangladesh is likely to achieve this goal if some more concerted efforts are given at the policy as well as programme levels. In terms of stunting, the picture is a little brighter, in that the rate of decrease between 1990 and 2005 was 1.37% and the target rate to reduce it by half is 1.0% per year.
- The ratio of undernourished women (measured by BMI) to overnourished one was 53:7 in 1996 and very alarmingly it has turned to 32:17 in 2005,

meaning coexistence of undernutrition and overnutrition (the so-called “double-burden” of malnutrition) in the same country and same community. This sort of overnutrition scenario leads to a number of chronic non-communicable diseases (NCDs) like diabetes, hypertension, heart disease and even some form of cancer. Double burden of malnutrition is becoming an ever increasing concern in the developing countries including Bangladesh. It is estimated that by 2030, more people will die from the NCDs than from the long known common infectious, communicable diseases.

## **8. RESEARCH PRIORITIES FOR IMPROVED NUTRITION**

Based on the situation analysis, current status, emerging problem areas and trends under various sub-sectors of the study, the following research priorities are recommended, putting them under individual sub-sectorsd.

### **8.1 Food Production and Consumption**

Satisfactory progress in production of cereal crops has been achieved, making available per capita cereal availability of about 637 gm/day, which is far above nutritionally desirable amount. Efforts should continue to go further to avoid any gap even due to natural calamities. But production of fruits, vegetables and all kinds of animal food (meat, egg, milk and fish) are far behind to meet nutritional requirements. Pulses, once known as the “poor man’s meat” as well as oil seeds, known as the most energy-dense food, showed a rather steep fall in growth. Agricultural production system should therefore be reoriented to ensure the nation a balanced diet and to develop a talented and healthy new generation through undertaking innovative efforts as have been taken in a number of developing countries. Keeping this in view, the followings are suggested as the priority research needs in this area:

Research/Problem Area	Magnitude (% of the total area/ coverage)	Severity /importance of resolving the problem (1-3)	Expected beneficiaries of solving problem (%)	Priority ranking (High/ Medium/ Low)
1. Integrated farming of improved crops, livestock, fisheries and bio-fuel for Improved Nutrition and Livelihood: Operational Guidelines (e.g. for the "Ekti Bari- Ekti Khamar" type of projects)	100	1	75%	High
2. Appropriate land use planning ensuring adequate opportunities for production of required amount of fish, livestock, milk and leguminous crops (soybean, improved mustard, mung, etc)	100	1	100	High
3. Re-orientation of agricultural extension system giving focus on both production, nutrition education and consumption of nutritious foods considering better health and nutrition as the 'objective of development' (an operational research).	100	1	75	High
4. Diversification and intensification of agriculture production system giving emphasis on, popularizing medicinal plants, protein-rich (e.g. soybean) and micronutrient-rich (e.g. broccoli, colored sweet potato, colored cabbage, etc) by using biotechnology .	75	2	80	Med
5. Development, piloting and extension of further high yielding varieties of oil seeds for minimizing the gap of edible oil	75	2	66	Med
6. Development of appropriate tissue culture for year-round production of various fruits, vegetables, oil crops (e.g. improved coconut in Taiwan, Philippines and Sri Lanka)	75	2	75	Med
7. Adopting strategies for breeding of local fishes in	66	2	67	med

natural water areas and ensuring free access of the fishermen community and common people for fishing and increasing consumption				
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## 8.2 Post-Harvest Loss

In order to overcome the food deficiencies, we have been traditionally emphasizing on two lines of actions e.g. (a) reducing future demand by slowing down population growth and (b) augmenting food supplies by increasing production. But perhaps the third and the very important option in our context is the reduction of colossal post harvest losses that this poor country should not afford. The following study areas are suggested keeping in consideration of this reality:

Research/Problem Area	Magnitude (% of the total area/coverage)	Severity /importance of resolving the problem (1-3)	Expected beneficiaries of solving problem (%)	Priority ranking (High/ Medium/ Low)
8. Undertaking a strategic action-research plan to innovate various appropriate technologies and put them in practice to drastically minimize the post harvest losses	100	1	80	High
9. Identification of traditional wisdom-based practices for rodents and insects control devices to protect crops from post harvest losses.	75	2	80	Med

## 8.3 Agro-Processing

Agro-processing is considered as an appropriate intervention for reduction of post-harvest loss, improvement of fair price for the producers, generating employment, promoting export, extension of shelf-life of the commodities for consumption and contributing to nutritional well being. The following research priorities are suggested:

Research/Problem Area	Magnitude (% of the total area/ coverage)	Severity /importance of resolving the problem (1-3)	Expected beneficiaries of solving problem (%)	Priority ranking (High/ Medium/ Low)
20. An Action-research and extension initiative for dev. Of low-cost technology and expansion of agro-processing (in line with those in India, Thailand, Malaysia, Indonesia, Philippines, who have made commendable advancement in agro-processing technologies) to produce convenient foods (e.g. pasta for manufacturing various food items, various flakes for breakfast cereals, noodles of various types).	100	1	80	High
20. Innovation of improved marketing, packaging and other value chain development system for processed agro-products particularly in countries with large number of non-resident Bangladeshis.	100	1	80	High
12. Processing, fortification and preservation of milk foods, fortified biscuits for school feeding and fortified atta and blended foods for vulnerable sections of the population (e.g. pregnant/lactating women, adol. Girls and young children)	80	2	75	Med

#### 8.4 Food Safety and Quality, Hazards and Risk

Article 15 (a) of the Constitution of the People's Republic of Bangladesh clearly mentions that the fundamental responsibility of the state is to secure its citizens the basic necessities of life including adequate food and nutrition. All efforts have to be taken to make this state responsibility a reality. The existing food safety and quality control framework consists of Laws, Regulations & Standards; Administration & Inspection and Laboratory analytical services. The Bangladesh Standards and Testing Institution (BSTI) is responsible for the standardization, testing, metrology, quality

control, grading and marking of goods. Keeping the framework of the amended BSTI Ordinance, 1985, the following research priorities are suggested:

Research/Problem Area	Magnitude (% of the total area/ coverage)	Severity /importance of resolving the problem (1-3)	Expected beneficiaries of solving problem (%)	Priority ranking (High/ Medium/ Low)
13. Establishment of an easily accessible and low cost Centre of Excellence in support of BSTI for checking the food quality and safety by the manufacturers, distributors and the consumers;	100	1	80	High
14. Development and adoption of appropriate and adequate number of standards on food and additives and ensure their compliance	100	1	100	High
15. Updating the current Pure Food Law and rules including clear provision of fortification and higher level penalty for violators	100	1	100	High
16. Study on arsenic contamination in water and soil, and its affect on the food chain and human health				

### 8.5 Human Nutrition

Food and nutrition security is a multi-sectoral and multi-ministerial issue. Hence a pre-requisite for overall improvement of the situation is to develop an integrated policy and action plan through bringing together all the diverse players/stakeholders and making them accountable to contribute their bits to the overall challenge. The current nutrition and food security situation in the country is far from a satisfactory one. The data on these issues from different sources like BBS, INFS, IPH and others are quite anomalous. Hence, a national level comprehensive and coordinated effort from all relevant stakeholders is needed to make a visible positive change. The following research areas are suggested keeping those in consideration:

Research/Problem Area	Magnitude (% of the total area/ coverage)	Severity /importance of resolving the problem (1-3)	Expected beneficiaries of solving problem (%)	Priority ranking (High/ Medium/ Low)
16. Updating the National Nutrition Policy and the National Plan of Action on Nutrition (NPAN) 1997, keeping in conformity with the National Food Policy, the National Agriculture Policy and the National Health Policy.	100	1	80	High
17. A national level multi-agency sponsored in-depth nutrition survey (cover all agro-ecological zones) focusing, among others, on determining nutrition related standards like (i) the national average daily dietary energy and Recommended Nutrients Intake (RNI), (ii) the physical activity levels of population of varying professional occupations, (iii) the means of achieving the prescribed level of balanced diet basket and (iv) the factors underlying the household consumption of different nutrients. (It would also help remove the anomalies in food intake data provided by BBS, INFS, IPHN and other sources)	80	1	100	High
18. Planning a low cost balanced, nutritious and safe diet (with multiple options) for the vulnerable section of the population	80	1	80	High
19. A multi-agency study on assessment of local manufacture of vitamin –mineral premixes (as food supplement) and adopting their Bangladesh Standards	80	1	90	High
20. Comprehensive analysis of				

different Bangladeshi food crops for determining their nutritional values.				
21. A nation-wide advocacy and extension education programme including nutrition, dietary diversification, food quality and preservation	75	2	67	Med
22. Development of a complimentary food for infant and young children using locally produced food commodities	66	2	60	Med

## 9. CONCLUDING REMARKS

- 9.1 The Government of Bangladesh (GoB) is committed to address the food and nutrition security problems of the country and has already formulated a number of relevant policies including the National Food Policy 2006, which is one of the most comprehensive, pro-poor, gender-sensitive equitable documents.
- 9.2 Other policies including the National Nutrition Policy, National Health Policy, National Education Policy are also in a process of adoption or updating. Formulation of a Joint Plan of Action for Improved Nutrition, allocating the relevant roles to be played by multi-agencies with an effective and Independent Joint Monitoring Group is likely to ensure coordinated efforts to generate visible results.
- 9.3 BARC with its priority research agenda is expected to be an active player in the above mentioned approach for improved nutrition. The initiative is also expected to unmask the myth that BARC deals mostly in quantitative production aspect of agriculture, but it is also pro-active in qualitative as well as relevant consumption aspects of food for nutritional well being of the population.

**ToR of the Team Leader**

1. The Team Leader will consult and review the all or as required number of relevant documents related to agriculture and rural development. These are, but not limited to, the followings:
  - 1.1 Bangladesh Planning Commission Reports on Five Year Plans, Annual budgetary documents, etc;
  - 1.2 National Agriculture Policy;
  - 1.3 Poverty Reduction Strategic Papers (PRSP) of GoB;
  - 1.4 World Bank documents on revitalizing agriculture and related others ;
  - 1.5 Agriculture Sector Review/Actionable Policy Briefs of FAO;
  - 1.6 Reports of the DFID, DANIDA and others on the performance of Agriculture Sector in Bangladsh;
  - 1.7 National Food Policy;
  - 1.8 National Land Use Policy;
  - 1.9 National Livestock Policu;
  - 1.10 National Fisheries Policy;
  - 1.11 National Forestry Policy;
  - 1.12 BARC Vision document – 2020 and strategic plan of 1996;
  - 1.13 Land, soil and management of natural resources;
  - 1.14 Reports on Food Security, Quality and Safety;
  - 1.15 MDG assessment reports;
  - 1.16 Master Plan and Animal Reports of the ARIs;
  - 1.17 Websites of relevant agencies  
(Major Relevant Sources are BARC Library; BARC P&E Division Concerned institutes, websites of the concerned Ministries/ Organizations).
2. Collection and collation of the information stated under Sl.No. 1 above, work out the sectoral country situation/issues e.g.
  - 2.1 Rice
  - 2.2 Cereals other than rice, sugarcane and jute
  - 2,3 Horticulture crops (e.g. potato, fruits, vegetables, spices including flowers)
  - 2.4 Pulses and oilseeds
  - 2.5 Soil and fertility management
  - 2.6 Forestry
  - 2.7 Livestock
  - 2.8 Fisheries
  - 2.9 Agriculture mechanization and water management
  - 2.10 ICT in Agriculture
  - 2.11 Agricultural economics, marketing and supply chain development
  - 2.12 Food availability and consumption, Post harvest losses, Agro-processing technology, Food safety and Human Nutrition

- 3 Sub-sectoral studies are expected to be ***in-depth and detailed in nature. This is to cover all components, trends in production, demand supply and gap, opportunities, problems and constraints, required technological interventions and their analysis in the context of the country. By the process, to determine the priority needs of the concerned sector/area by the year 2030 and beyond;***
- 4 Population dynamics, reduction in land resource base and degradation, issues pertaining to climate change and sea level rise(SLR), economics of commodity and non-commodity related activities, income growth rate, etc – all these are to be taken in to account in formulating the research priority;
- 5 Undertake the related tasks as may be deemed necessary or evolved while performing this assignment;
- 6 Draft report from the Team is to be presented in the workshops to be organized by the P & E Division of BARC at a suitable date
- 7 Final Draft Reports, after incorporating comments/opinions obtained from the workshop, field consultation sessions, different agencies/individuals to be submitted **within 2 (two) months from the date of assignment** to the MD (P&E) of the BARC, Dhaka.

**Composition of Sub-Sectoral Team**

<b>Sl. No.</b>	<b>Composition of Sub-Sectoral Team</b>	<b>Remarks</b>
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