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Transformation for Sustainable and Nutrition Sensitive Food Systems in Bangladesh

Md. Jamal Hossain[1], Rahana Akther[2] & Farjana Simi[3]
[1]Principal Scientific Officer, [2.]Director, & [3.] Senior Scientific Officer, Bangladesh Institute of Research and Training on Applied Nutrition
Corresponding Author Email: jamal9597@gmail.com

Abstract
Bangladesh is a South Asian country that ranks 94th in the world in terms of area but 8th in the world in terms of population. It is a nation of over 173 (2023) million people and one of the most densely populated countries in the world with 1,333 (2024) people living per square kilometer.Significant progress in poverty reduction, supported by sustained economic growth, improved access to food and enabled Bangladesh to reach lower middle income country status in 2015. The Bangladesh National Food and Nutrition Security Policy (NFNSP) 2020 includes a nutrition-sensitive approach toachieve Food and Nutrition Security by 2030.Nutrient-sensitive agriculture (NSA) offers a promising avenue for addressing malnutrition.Despite substantial fluctuations, the prevalence of undernutrition (PoU) declined to 13% in 2019, as reflected by the food security experience of food insecurity, largely due to nutrition-sensitive drivers and pro-poor economic growth within a broad enabling environment of agriculture. (FIES). Changing climate and lack of proper food distribution channel is major barrier for Sustainable and Nutrition Sensitive Food Systems in Bangladesh.In order to keep the food system viable, natural disaster resilient technologies must be developed so that damage can be avoided.Problems faced by rural people in achieving household food security included insufficient land for agriculture, lack of money or capital or necessary funds, inadequate training facilities, lack of knowledge on various aspects of improved agricultural enterprises and inadequate credit facilities.Based on this significant decline, accelerated efforts through comprehensive nutrition sensitive policies can help meet national nutrition goals and pave the way for sustainable food systems.

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I. Background:

Bangladesh, with an area of 147,570km^2 and a population of about173 million (2023), is located in between the Himalaya's and the Bay of Bengal at 23°41′5.96"N latitude and 90° 21′ 22.79"E. longitude and 6maltitude.It has a gentle sloping land from the north to the south, meeting the Bay of Bengal at the southern end (Karim, 2011**).** Climate change due to global warming has already or is likely to accelerate the ill effects on coastal agriculture that includetropical cyclones, saline water intrusion, storm, drought, erratic rainfall, high temperature, coastal erosion and floods. Global warming is potentially harmful for crop production. In different parts of Bangladesh, problems are associated with too much water during monsoon leading to floods, too little water during the dry season leading to droughts, wrong timing of water leading to water loggings and wrong quality of water leading to salinity intrusion. The average temperature has already increased by about 1°C in May and 0.5°Cin November during 1985-1998and saline water has intruded about 100km or more inland from the Bay of Bengal b**y**the coastal rivers during the dry season (CCC, 2009**).** The average monsoon maximumand minimum temperatures show an increasing trend annually at the rateof 0.05°C and 0.03°C respectively (Miah, 2010). The rate of sea level riseduringthe last 22 years from 1977 to 1998 appeared to be 4.0 mm/year at Hiron Point, 6.0 m m / year at Char Change and 7.0 mm/year at Cox's Bazar, and these are many times higher than the mean rate of global sea level rise over the last 100 years (SMRC, 2003).While global disruptions have clearly impacted food availability and affordability, Bangladesh is also particularly vulnerable to the impacts of natural disasters,

Agro ecological zones of Bangladesh: Bangladesh has diversity in soil quality, climate and land cover, creating 30 agro-ecological zones and three physiographic zones. The latter is divided into (I) floodplains, (II) terraces and (III) hills, each with distinct soil characteristics.The country's arable land is spread across highland and medium highland areas (71%) and various low land categories (29%) (Ahmed, Saint-Geours&Gitau, 2021). In addition to these geographical variations, water availability plays a vital role in crop production. Water availability differs across each of the physiographic zones. Bangladesh has a humid and warm climate, experiences seasonal variation and receives high amounts of rainfall, averaging around 2,200

millimeters per year (The World Bank, 2021d). As a result, the agricultural land use across Bangladesh is highly dynamic, and flood levels and durations influence farmer's decisions regarding cropping patterns (Ahmed, Saint-Geours&Gitau, 2021). Regional differences influence agricultural production due to variation in farming practices, irrigation cover and differences in climate and physiography. As a result, Bangladesh's land cover has been classified into 30 agro ecological zones (DoE & CEGIS, 2023).

Food intake pattern of Bangladesh: The dietary habits of Bangladeshis have changed significantly over the past years as their protein- and vitamin-based food intake has increased significantly, with official data showing that heavy reliance on carbohydrates has decreased significantly over the past 17 years and their consumption of healthy foods is increasing.Just 17 years ago, each Bangladeshi consumed only 57.7 grams of meat and fish per day, which almost doubled in 2022, as per the Household Income and Expenditure Survey (HIES) 2022 report of the Bangladesh Bureau of Statistics (BBS) that was recently unveiled.

Meat and fish consumption has been increasing year-on-year significantly as the per capita intake of the primary protein sources of the human body swelled to 79.1gm in 2010 and 88gm in 2017. According to the HIES 2022 report, per capita meat and fish consumption has boosted to 201.9 grams. Similarly, each of the population's intakes of fruit has nearly tripled to 95.4 grams per day in 2022. Seventeen years ago in 2005, per capita fruit consumption was only 32.5 grams, as shown by the HIES report.Another major source of necessary vitamins for the human body, vegetable consumption, has also increased by 28.6 per cent to 201.9 grams per day in 2022. The vegetable intake was only 157 grams per capita per day in 2005, the HIES 2005 report showed.

The food habit for protein and vitamin consumption has also shown a massive change as each Bangladeshi eats 12.7 grams of eggs per day in 2002. Some 17 years ago in 2005, they only ate 5.2 grams of eggs per day, as per BBS data.The per-head milk and milk product consumption has also slightly increased in Bangladesh over the years. In 2005, the milk and milk product consumption was recorded at 32.4 gm, which increased to 33.7 gm in 2010.However, its consumption declined to 27.3 gm per day in 2016. The protein and vitamin-rich milk and milk product have again increased to 34.1gm per day, the latest HIES data showed.On the other hand, the carbohydrate intake in the daily meal has declined significantly over the years where healthy foods like protein and vitamins have replaced it.Once in 2005, the per capita rice consumption per day was 439.6 grams, which fell to 416 grams in 2010, 367.2 grams in 2016, and plunged to 328.9 grams in 2022, as per the BBS's HIES survey.Meanwhile, wheat intake is rising in Bangladesh as different types of processed, prepared, or ready food are now available in the market where flour is the main ingredient.Each Bangladeshi person once in 2005 consumed 12gm of wheat which has now increased to 22.9 gm per day, as per the BBS survey. Another protein source, the pulses intake by each Bangladeshi has also increased to 17.1 gm per head per day in 2022 from that 14.2gm in 2005, BBS data showed.Meanwhile, Bangladeshis are still far behind the international standard of nutritious food intake level. As per the World Health Organization (WHO), an adult shall consume at least 400 g (i.e., five portions) of fruit and vegetables per day, excluding potatoes, sweet potatoes, cassava, and other starchy roots.

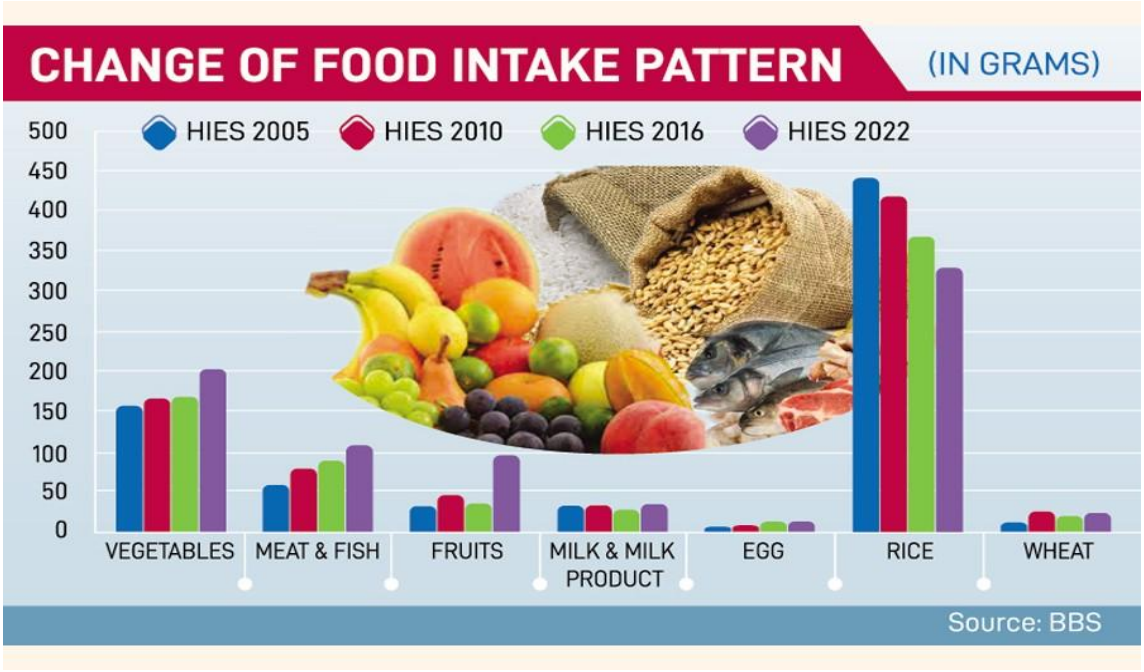

Figure: Changes food intake pattern in Bangladesh

Food loss & waste of Bangladesh: Excessive food waste is a huge problem in Bangladesh, with food waste accounting for 68.3-81.1% of municipal solid waste. Alarmingly, only 40-50% of food waste is managed properly.No specific food waste management policy exists, as food is currently treated under existing regulations on municipal solid waste management. Postharvest losses of paddy at the farm level amount to 9.49%, 10.51% and 10.59%, for Aman, Boro and Aus paddy, respectively. Between 2016 and 2017, nearly 15.85 million tons of food waste occurred between the post-harvest to consumer stage (67% total food waste). Moreover, only 64.61% of the total available harvest reached consumers, meaning 35.39% of the total harvest was wasted during the processing and consumption stages of the value chain. Using combine harvesters over manual harvesting techniques lowers harvesting costs and reduces postharvest loss by 1.84% (Nath*et al.,* 2022). In 2016-2017, it was estimated that 23.69 million tons of food was wasted. Considering Bangladesh's limited production capacity, such high amounts of food waste negatively impacts its economy and environment, posing additional complexities in terms of the country's development (Ananno*et al*., 2021). Thus, reducing food wastage is critical to increasing food supply without incurring substantial environmental costs.

Domestic Food Grains Production: Total foodgrain production in FY 2021-22 was 39.24 MMT which is 1.4% higher than the previous FY. Crop-specific achievements of production were 3.00 MMT Aush, 14.96 MMT Aman, 20.19 MMT Boro and 1.09 MMT Wheat. The annual food grains production target for FY2022-23 has been set by the Ministry of Agriculture at around 42.80 MMT which is 9% higher than that of the previous fiscal year's actual production. The crop-specific targets are 3.69 MMT of Aus, 16.35 MMT of Aman, 21.53 MMT of Boro and 1.23 of Wheat. Annual foodgrain production (MMT) and crop-wise contribution Food grains Import Total import of food grains (public & private) for the FY 2021-22 was 5.00 MMT, of which rice was 0.99 MMT and wheat was 4.01 MMT. In FY2021-22 private sector imported 0.30 MMT rice and 3.47 MMT wheat and public sector imported 0.68 MMT rice and 0.55 MMT wheat. Government has reduced rice import duties up to 31st March/2023 aiming to increase national availability and price stabilization. (Source-DG Food,2023)

Food grains Distributionof Bangladesh: Total food grains distribution through the Public Food Distribution System (PFDS) during FY 2021-22 was 3.08 MMT, which was a record in PFDS in Bangladesh against the revised target of 3.27 MMT set in the food budget. In the FY 2021-22 food grains distribution was 34.4% higher compare to the previous fiscal year's actual distribution which was a post covid-19 response to ensure access to food. During the last FY 2021-22 Public food distribution through the Open Market Sale (OMS) was highest (0.89 MMT), followed by the Food Friendly Programme (FFP) Essential Priorities (EP), Vulnerable Group Development (VGD), Vulnerable Group Feeding (VGF), Gratuitous Relief (GR),Hill traces (HT) and Food For Work (FFW) channels of PFDS . According to the revised food budget of the FY 2022-23 the target of public food grain distribution under PFDS has been set at 3.28 MMT which is 6.6% higher than actual distribution of previous fiscal year. Up to the 3rd quarter (July/22-Mar/23) of current fiscal year total food grains distribution was 2.14 MMT which was 65% of revised budget. Government has expanded the OMS programme considering to price stability as well as economical access to food.

How can food systems be transformed?
Food system transformation requires a focus on transition pathways, driven primarily at the national level but linked to local processes and enabled by larger-scale system change at regional and global scales.

- A consumption shift to sustainable and healthy diets.
- An equitable economic shift to ensure food economy producers and workers, have a fair living income including being able to afford healthy diets.
- A shift toward nature positive approaches for food production, processing and distribution which have a net-zero climate impact and operate within a sustainable and safe zone of utilizing natural resources.
- A shift towards mechanisms of resilience for food systems which can ensure societies a large to not risk food insecurity and that groups who are poor or vulnerable are protected.

Nutrition-sensitive agriculture must be covers three main areas:
(i) Making food more available and accessible by increasing agricultural production that improves both health and economic status of households; while sustained income growth reduces malnutrition
(ii) Making food more diverse and production more sustainable through nature-friendly production practices like conservation agriculture, water management, and integrated pest management (IPM) that improve nutrition levels without depleting natural resources. For instance, family farming, home gardens and homestead food production can make a wider variety of crops available at the local level; and
(iii) Making food itself more nutritious. Fortification can prevent micronutrient deficiencies by enhancing micronutrient content in foods through processing, plant breeding and improved soil fertility.

Bangladesh must transform its food system to address three ongoing trends:
i) Changing demand for food commodities - more and more people are consuming high value commodities, and demand for processed foods is also increasing.
ii) Changing demographics - a large segment of the population are youths and their preferences are different from older population. Urbanization is also increasing at rapidly resulting in changes in the consumption pattern and marketing of the food commodities.
iii) Climate change and frequent natural disasters require that the participants of the food system to become more resilient and manage their risks more prudently.
iv) Food value chains contribute about a third of total greenhouse gas emission. Agriculture and fishing are by far the largest causes of biodiversity loss and ecosystem degradation. These impacts on the environment cycle back to undermine the Earth's very capacity to produce food for the long run.

Table: Overview of key food system actors and their main activities in Bangladesh

Production	Processing	Marketing	Retail	Consumer
Rural smallholder farmers: • Account for 57.60% of all households in rural areas (BBS, 2019) • Supply ≈60% domestic food • More than 95% grow rice, • 81% raise livestock & grow crops, 55% sell poultry, 75% raise goats for income (Anderson *et al*., 2016)	**Agri-processing:** ● 468 agri-processing manufacturers ● Employ ≈40% of labour force (BIDA, 2021), PRAN is the largest .	**Informal trade:** • Seed trade with India • 98% informal cattle trade sourced from India (Khatun*et al*., 2016; Rahman & Bari, 2018)	**Open air temporary shops:** ● In urban and rural areas & sell primary commodities: fruit, vegetables, semi-processed homemade food &fish(Katalyst. (2016).	**Low-income consumers:** • Consume liquid milk as a source of animal protein, occasional consumption of small & dried fish • Consume less fruit than the rich • Consume more khesari dal (hardy pulse)
Urban/peri-urban small-scale farmers: • Dairying and poultry production • Nursery industries • Rooftop gardening (fruits &vegetables) & kitchen gardening • Peri-urban areas produce< 5 of vegetables marketed in Dhaka (Pramanik, 2013)	**Processing agricultural crops:**A.Primary processing ● All exported fruit and vegetables go through this stage ● Engages a significant number of women involved in drying, shelling/threshing, cleaning, grading & packaging ▪ Edible oils, dairy products and snacks dominate the packaged	**Domestic markets:** • Smallholder farms sell to individual buyers who distribute to domestic markets. • Large farms/processors directly distribute to domestic markets or use distributors	**Roadside shops:** • Include village markets • 85% of households in Dhaka buy their food from fresh markets • Sell a wide range of products: poultry, fish, meat, eggs, vegetables, fruits, grains, legumes	**High-end consumers:** • Consume large variety of protein • Frequent consumption of small and large fish (Ayubi&Ara, 2017)

	food market (BIDA, 2021)			
Large-scale farmers: • In rural areas, these households account for 0.34% of all households (BBS, 2019). • More dependent on hired labour • Grow diverse crops (Quddus&Kropp, 2020)	**B.Secondary processing:** ● Conversion into value-added products (use of secondary ingredients), e.g. pureeing, cooking, grinding, frying, baking. ● All processed products are stored & distributed through various channels (Katalyst, 2016)	**Import & Export:** • Food imports ≈17% of total imported merchandise; food exports ≈3% (World Bank, 2015a; World Bank, 2015b) • Main import items: palm oil, wheat, beet sugar • Main export items: frozen fish & shrimp (>50% agricultural exports), tea, spices, fruits (incl. dried fruit) (BIDA, 2021; Ministry of Foreign Affairs, 2021)	**Municipal cooperation markets:** • Sell specific food types e.g. vegetables, meat, fish, fruits &processed & imported foods • 22% of the food retail sector	**Rural consumers:** • Decreasing consumption of wheat: 23.3 to 13.3 g/capita/day from 12010 to 2022 (HIES, 2022) • Decreasing consumption of rice 441.6 to 349.1 g/capita/day from 2010 to 2022 (HIES, 2022)
Agricultural input suppliers: • Supply of seed, fertilizer, insecticides, pesticides & machineries			**Supermarkets:** • ≈30 companies, >200 outlets, key players: Shwapno, Agora &Meena Bazar • Growth rate ≈15% per year (Rahman *et al*., 2019) ● Visited by middle/above middle income group	**Urban consumers :** • Stable consumption of wheat: 33.6 to 33 g/capita/day from 2010 to 2022 (HIES, 2022). • Decreasing consumption of rice: 344.2 to 284.7 g/capita/day from 2010 to 2022 (HIES, 2022).
Production facilitators: • Extension work done by the personnel of Department of Agricultural Extension, Department of Fisheries, Department of Livestock			**Neighborhood grocery store:** ● ¾ households in Dhaka purchase from small grocery stores ● Visited especially to purchase dry goods, vegetables, eggs (Islam, 2019)	

Global Hunger Index (GHI) in Bangladesh: Bangladesh has shown "remarkable progress" since 2015 in combating hunger riding on the declining trend of undernourishment, child stunting, child mortality and child wasting, according to the Global Hunger Index (GHI) 2023.Bangladesh ranked 81st out of the 125 countries in the 2023 edition of the index, released on 12 October, positioned above its neighbors Pakistan (102nd), India (111th), and Afghanistan (114th) in reducing hunger.

Nutrition for Concern: The Global Food Security Index is based on three key factors which are affordability, availability and food quality and safety. Among these three, Bangladesh ranks worst in terms of food quality and safety in 107 out of 113 countries.A comparison of the average global and regional scores in different indicators in the Quality and Safety issue with the scores of Bangladesh paint an appropriate picture of the current scenario of Bangladesh.It is evident that a major concern of Bangladesh is the unavailability of micronutrients (Vitamin A, D, calcium, Iron, and Zinc) and the poor quality of protein in the general diet. A few of the major concerns regarding nutrition in Bangladesh have been identified.

Policies, Strategies and Institutions:

The Constitution of Bangladesh: Article 15 of the Constitution of Bangladesh provides basis for right to food under the title 'Provision of basic necessities' which speaks that `It shall be a fundamental responsibility of the State to attain, through planned economic growth, a constant increase of productive forces and a steady improvement in the material and cultural standard of living of the people, with a view to securing to its citizens. The provision of the basic necessities of life, including food, clothing, shelter, education and medical care.16Article 18(1) of the Constitution speaks that 'the state shall raise the level of nutrition and improve public health as its primary duties'. It shall also adopt effective measures to prevent the consumption of harmful drugs, drinks and alcohols. Both the articles imply food safety requirements for consumers.17Article 27 states that "All Citizens are equal before law and are entitled to equal protection of law."

National Food and Nutrition Security Policy in Bangladesh: In continuity with the previous FNS-related policies and investment plans, the National Food and Nutrition Security Policy (NFNSP) approved in August 2020, takes into account the increasing role of the private sector in food production, processing and marketing,

the importance of partnerships, multisectoral convergence, and the enabling role of policymakers. Incentives, legislations and regulations represent the main policy instruments to encourage welfare, food safety, healthy diets and xii nutrition improvements and changes in the economic decisions of food value chain actors – i.e., farmers, processors, marketers and consumers. The National Food and Nutrition Security Policy Plan of Action 2021-2030 (PoA) aims to make the NFNSP actionable, by translating the initiatives in the policy into time bound interventions coordinated by relevant GoB agencies. The ten-year PoA covers the Eighth and Ninth Five Year Plan periods and aligns to the GoB priority of achieving FNS-related SDGs and fulfilling relevant national and international commitments by 2030.

Governance Structure Institutions: Food Policy Monitoring Unit (FPMU)-

- Formed in 1979 as Food Planning & Monitoring Secretariat, subsequently renamed FPMU - the national focal point of food security investments and coordinates all the food and nutrition security stakeholders including development partners.
- Under the Ministry of Food and coordinates with 18 Ministries
- Provides technical support to policymakers on food and nutrition security policy oriented analysis and research.
- Prepares Food Policy, Plans of Action and undertakes investment planning on food and nutrition security (Country Investment Plan).
- Enhances inter-ministerial collaboration for implementation of the national food and nutrition security policy and its plan of action.
- Undertakes monitoring of national food and nutrition security policy implementation.

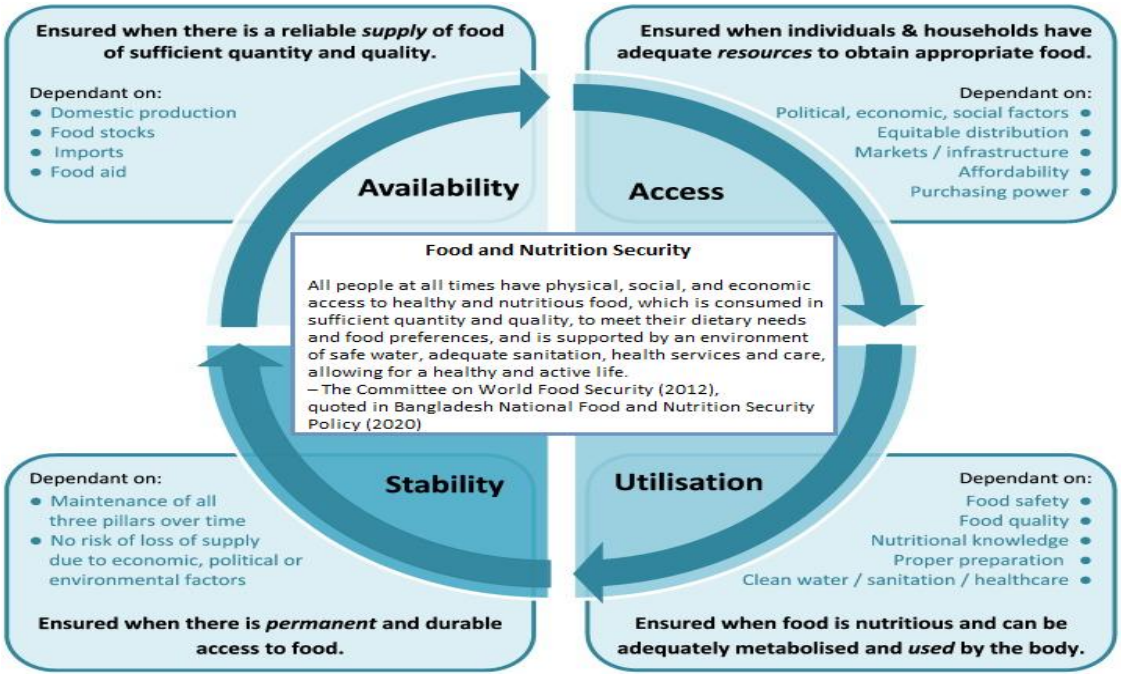

Figure: The four components of food system with their major elements (Source: Ingram *et al.* 2005)

Unbalanced Diet: The food consumed in Bangladesh, especially in rural areas, often lacks essential nutritional requirements. This is evident in Bangladesh's unusual score in terms of dietary diversity on the Food Security Index.According to the Food and Agricultural Organization (FAO), nearly two-thirds of the regular diet includes mostly rice, some vegetables, a small amount of pulses, and small quantities of fish if and when available. Meat consumption in Bangladesh is especially low and is mostly consumed in urban areas. Despite a per capita requirement of 43.25 kg of meat, Bangladesh only has an availability of 9.12 kg. The meat available is not distributed evenly due to income disparity which has led the per capita meat consumption to be only around 4 kg.

Nutrition during Pregnancies: Undernourished pregnancies are rooted in child marriage which eventually leads to undernourished children or maternal death. According to global data, adolescents aged between 15 and 19 are twice as likely to die during pregnancy than women aged more than 20. This has contributed to 38% of all babies being born to be of low birth weight. Moreover, 39.9% of women in their reproductive age have anaemia.

Trends in child under nutrition: Bangladesh has made significant improvements in the rates of child stunting and underweight. Stunting has declined from 41% in 2011 to 24% in 2022, whilst the prevalence of underweight reduced from 56% in 1996-97 to 22% in 2022. Although the prevalence of wasting showed a sharp decrease in 2017-18, it slightly increased in 2022 from 8% to 11% (Figure) (FPMU, 2023). Stunting rates in the country remain higher than the regional average (28% in Bangladesh vs 21.8% in the Asian region). Wasting patterns follow a similar outcome, as 9.8% of children under five years in Bangladesh remain affected, which is higher than the regional average (8.9%).

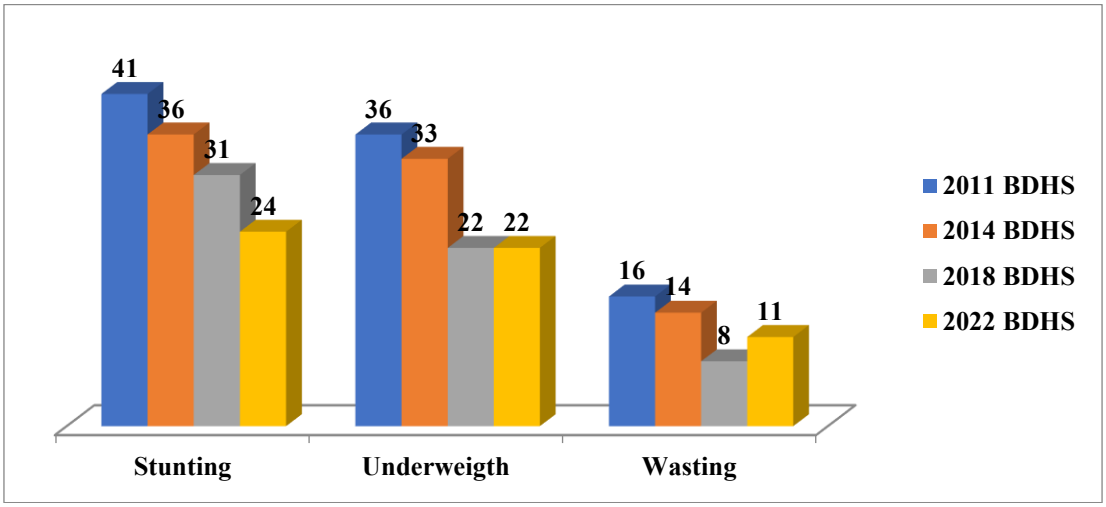

Figure: Trends in child under nutrition Source: NIPORT and ICF, 2020

The double burden of malnutrition: The prevalence of overweight and obesity is increasing over time, which translates into another poor health outcome From 2011 to 2014, the proportion of women aged 14-49 considered very thin (defined as having a BMI of less than 18.5) rose from 24 percent to 17 percent. In contrast, the proportion of women considered overweight and obese (defined as having a BMI of over 23) has increased from 29 to 39 percent. This increase in women's overweight and obesity has increased faster than the speed of decline in women's thinness.Overweight or obesity is known as one of the major risk factors for a list of non-communicable diseases (NCDs) such as cardiovascular diseases and diabetes (Nordestgaard*et al*., 2012; Zahangir*et al*., 2017).Consistent with the recent and rapid rise of overweight prevalence in the country, overweight-related NCDs are contributing an increasing proportion of disability and mortality. In 2017, stroke, ischemic heart disease, and diabetes ranked first, second, and sixth among all causes of deaths in Bangladesh, accounting for 7.7%, 6.8%, and 2.7% of total DALYs (disability-adjusted life years), respectively. The contribution of ischemic heart disease and diabetes to deaths has grown rapidly, increasing by 44.5% and 51.8%, respectively,from2007 to 2017 (IHME, 2019).

Micronutrient deficiencies: The majority of rural Bangladeshi women have their first child before reaching the age of 18 years, which frequently has a detrimental effect on both maternal and child health (NIPORT, 2013.). According to the Bangladesh Demographic Health Survey (BDHS) 2017–18, 24% of ever-married women aged 15 to 19 years old were chronically energy deficient [body mass index (BMI) < 18.5] and 9% were moderate to severely thin (BMI < 17.0)(NIPORT, 2020). Hence, to break the vicious cycle of intergenerational malnutrition, adolescence is the last opportunity to catch up on any growth faltering experienced during childhood and support the growth spurt alongside skeletal development observed during this period2. Micronutrient deficiency is a major public health concern worldwide, with adolescents being one of the most susceptible groups(ZiauddinHyder, S. *et al.* 2007), primarily due to poor micronutrient content and bioavailability in diets, as well as poor hygiene and infections(Ahmed, F.,*et al*.2016). A household survey in Bangladesh showed that the median intakes of key micronutrients by pregnant adolescent girls were below the estimated average requirements (EARs)(Nguyen, P. H. *et al* 2018). The requirement of micronutrients increase among adolescent girls during periods of peak physical growth when the body needs an increased input of dietary iron, calcium, zinc, iodine, vitamin A, and vitamin D(Kliegman, R. M. *et al.* 2017).

Iodine deficiency among adolescent girls can lead to goiter, mental and physical growth retardation which later on may extend upon their fetuses and newborns via intergenerational effect (Zeru, A. B. *et al.* 2021). Adolescent girls are particularly at risk in Bangladesh because 40% of the school children had mean UIC below 100 µg/l1. Vitamin D is important for calcium homeostasis to maintain skeletal integrity. A study in Bangladesh found an aging-related rise in both the prevalence of vitamin D insufficiency (S-25OHD 25–75 nmol/L) and the deficiency (S-25OHD < 25 nmol/L) among adolescents, with nearly all adolescents aged 12–16 years being

either deficient (46%) or insufficient (52%)(Zaman, S. *et al.* 2017). Both iron deficiency (ID) and iron deficiency anaemia (IDA) are global health problems. However, the adolescent girls(Kumari, R. *et al.* 2017) are more likely to suffer from growth retardation(Bandhu, R.,*et al* 2003). According to a study, 32% of the adolescent girls living in peri-urban areas had iron deficiency anaemia(Ahmed, F. *et al*., 2000) Another essential micronutrient is vitamin A, which has a variety of physiological functions. Vitamin A deficiency (VAD) results in night blindness, severe anaemia, wasting, reproductive infirmity, infectious morbidity, and increased risk of mortality(Akhtar, S. *et al*.,2013) In Bangladesh, one-third of the non-pregnant and non-lactating populations are experiencing mild grade of vitamin A deficiency(Rahman, S. *et al.*,2017) Hence, consumption of micronutrient-rich foods should suffice all micronutrient requirements.

Best practices/ ongoing initiatives on nutrition sensitive agriculture:

Rice Fortification: Rice fortification is the practice of increasing the content of essential micronutrients in rice and improving the nutritional quality of rice. A major problem in the regular diet of Bangladeshis is its lack of micronutrients. Since a major portion of the diet consists of rice, fortification of rice can be a revolutionary solution in dealing with micronutrient deficiency. The Bangladesh Government has plans to introduce Fortified Rice in the Open Market Sale (OMS) to introduce it to the general populace. Currently, Abdul Monem Ltd. Bangladesh produces fortified rice, but it has a huge potential in the rice production industry. Bangladesh Rice Research Institute and Bangladesh Institute of Nuclear Agriculture developed biologically fortified rice varieties BRRI dhan 100, BRRI dhan 62, 74, 84, BINA dhan 18 respectively.

Vertical Gardening throughout the Country: Cultivable land in the country is shrinking rapidly in Bangladesh. Vertical farming can be done in small spaces, even in urban areas. Farming vegetables with micronutrients can help Bangladesh eradicate the micronutrient deficiency in the diet of Bangladeshi people. Moreover, this will also assist in solving the pollution problem and can help increase household incomes.Bangladesh has made notable strides in solving the nutrition problem since its independence. Both government and non-government organizations have been doing commendable work in this sector. With proper policies and collaboration from private organizations, this problem can be solved completely within a short time.

Alternative Protein Sources: Protein deficiency has been one of the major drawbacks of the Bangladeshi diet. However, meat has often been out of the reach of the lower income people. This problem can be solved by finding and funding alternative protein sources like mushrooms, nuts, different lentils, etc. The Bangladesh Agricultural Development Corporation (BADC) and DLS encourage and incentivize farmers to produce such alternative protein sources.

A nutrition-sensitive food systems approach: The CIP2 adopts a nutrition-sensitive food systems approach to encapsulate the most urgent needs for investment along the food value chain . Nutrition must be rooted in local food systems based on food sovereignty, small-scale producers, agro-ecological principles, sustainable use of natural resources, local seeds and livestock breeds, traditional knowledge and practice, local markets, guaranteeing sustainable and resilient biodiversity as well as diversity of diets18. By putting nutrition at the centre, it also stresses its commitment to the SUN and Renewed Efforts Against Child Hunger (REACH) initiatives. Concomitantly, it involves all sectors -18 ministries and divisions-, DPs, private sector agents and civil society stakeholders whose involvement is needed to achieve food and nutrition security for all at all times.

Minimum Dietary Diversity for Women (MDD-W): The guideline on Minimum Dietary Diversity for Women (MDD-W) was developed and released by the FAO of the United Nations and FHI 360 in 2016; it proposes a simple dichotomous indicator to assess the dietary quality of women of reproductive age at the population level (FAO, FHI360, 2016), replacing the earlier 9 food groups score (Ruel, Deitchler and Arimond, 2010). As per the CIP2, MDD-W for women was 46 percent in 2015, though this was calculated for 5 out of 9 food groups, and the target set has been 75 percent by 2030, for 5 out of 10 food groups. Not much information regarding MDD-W is known, particularly the geographical difference, rural-urban segregation and differences due to education and wealth.

School Feeding Programme in Bangladesh: The National Micronutrient Survey (NMS) 2011-12 revealed that a significant proportion of preschool children live with multiple micronutrient deficiencies; for example, one in five preschool children were found to have vitamin A deficiency and two in five preschool children were found to have vitamin D deficiency. The prevalence of anemia in the preschool age children was 33% and in the school age children was 19% and 17 % respectively in the 6-11 year and 12– 14-year groups. The national prevalence of zinc deficiency was 44.6% in the preschool age children. It appeared to be higher in the slum children (51.7%) compared to urban children (29.5%). The prevalence of calcium deficiency among preschool children was 24.4 percent. According to Bangladesh Demographic and Heath Survey 2017-18, 31% of children under age 5 were stunted, 8% were wasted, 22% were underweight, and 2% were overweight. There was a rural-urban gap in stunting, with a higher prevalence among rural (33%) than urban (25%) children. Stunting was found least common among children in the highest wealth quintile and most common among those in the lowest quintile (17% and 40%, respectively).

Government of Bangladesh and the United Nations World Food Programme (WFP) have been implementing 'School Feeding Programme in Poverty-prone Areas' since 2011.The programme initially supported only 55,000 children but now it supports 3 million children. The programme provides 75g packet of biscuits to pre-primary and primary school children six days per week. The biscuits provide 338 kcal per day and from time to time, taste of the biscuits is changed. The biscuits are fortified, and the micronutrient content is sufficient to meet on average 67 percent of the children's daily micronutrient requirements. The school feeding programme also provides learning packages to children, parents and other community members. These involve setting up school vegetable gardens and conducting lessons on water, sanitation and hygiene, health, nutrition and social issues, such as dowry and early marriage and pregnancy. Deworming tablets are also provided by the Government.

Social Safety Net Programs: Social safety net programs in Bangladesh are an essential component of the government's efforts to eradicate poverty, reduce inequality and promote social inclusion.These programs aim to provide a safety net for individuals and communities, shielding them from the adverse effects of poverty, vulnerability, and social shocks (Rahman, 2019). The government of Bangladesh has implemented a wide range of targeted social safety net programs to address different forms of risks and vulnerabilities They are designed to address the immediate needs of individuals and families, while also supporting long-term poverty reduction and sustainable livelihoods (Morshed, 2009).The Government of Bangladesh spends a considerable sum of money in the budget to execute various social safety net programs. Bangladesh is proposed to allocate a total of Tk 1.13576 trillion in the budget for the fiscal year 2022-2023 for the social safety net which is 16.75 percent of the total budget and 2.55 percent of GDP. A total of 10 million families including the families who have received Tk 2,500 as cash assistance during the pandemic period are getting a family card of TCB.

Nutrition sensitive training: Aiming to improve the nutritional status of the people, BIRTAN, MoA conducts food and nutrition research, conducts training and seminars/workshops and increases awareness on nutritional issues.01 day and 03 days applied nutrition training is conducted by BIRTAN to people from different strata of society.Participate in training:Teacher of educational institution, Member of UP, imam, Local social workers,NGO representative, farmer ,Agricultural Extension worker, Department of Fisheries, Department of Livestock, Department of Women and Child Affairs and others stakeholder. A total of 1 lakh 13 thousand 5 hundred and 52 people have been brought under BIRTAN training during the financial year 2015-16 to 2023-24.

Opportunity:

Shifting from food security to nutrition security: Rural development is largely linked to agricultural activities and food production, especially in areas where other income opportunities are lacking.Access to sufficient food has been a concern throughout the history – expressed as "food security".However, food security does not always lead to an improved nutritional situation. As a means to get a more explicit understanding and handle on those factors that are influencing and contributing to an improved nutrition, the concept of "nutrition security" has been emerging. Here, 'utilization' is a key feature, meaning that sufficient and adequate food is consumed and absorbed by the body – which, for instance, is not the case if sufficient food is available in the household.

Nutrition sensitive agriculture is aiming at both food and nutrition security: Food and nutrition security is achieved, if adequate food – in regard to quantity, quality, safety, socio-cultural acceptability – is constantly available and accessible for and satisfactorily utilized by all individuals of rural households.

Introducing nutritious / nutrient dense foods (crops & animals) : Depending on consumption habits and the type of (unbalanced) diet, crops or animal foods are introduced that are especially 'nutritious' or rich in regard to the limiting nutrients. In most developing countries, 'nutritious' relates mainly to food sources high in iron, vitamin A, zinc and protein. In practice, foods rich in these nutrients are promoted, e.g. beans, fruits, vegetables, orange flesh sweet potato, plus animal productions (i.e. eggs, milk, meat).

Promoting biodiversity and diet diversity: Another way to promote a better and more balanced nutrition is by fostering the diversity of production, and thus consumption. In this case, not a specific food is promoted, but a diversified production system and a diet which relies on more variety in terms of food items / ingredients, which altogether provide a wider range of nutrients. To explain which combination of foods give a balanced diet, food is normally categorized in food groups. Most common is the differentiation of food groups by content, based on three main categories: (a) energy rich food ("go food"), (b) protein rich food ("grow food"), and micronutrient rich food ("glow food"). Government institutions and NGOs commonly produce such education material featuring most relevant local food sources.

Awareness creation and education for nutrition & health aspects: Due to high market prices, most nutritious foods may be sold and inferior foods may be purchased. An important driver of changing food and eating habits is people understanding what nutritious food is and how it contributes to health and well-being. In this sense, increased awareness is an important element of education activities that generate knowledge and knowhow in regard to improved food preparation, ways to better preserve nutrients, and how to integrate such better practices in daily activities. As health and hygiene strongly impact the absorption rate of nutrients, also these

aspects must be an integral part of such awareness creation and education efforts within nutrition sensitive agricultural projects.

Sensitize the General Population: People nowadays are highly concerned about the quality of food they consume and how it affects their health. But outside of the urban population centre, the general population is highly price-sensitive and still does not value nutrition as a key factor when making food choices. Mass awareness and sensitization campaigns should be undertaken to educate the public on nutrition.

Focus on women's empowerment: Women's empowerment and gender equality are at the nexus of agriculture, nutrition and health sectors. Women play an essential role in the value chain of the food system and in the nutrition of their families. They often ask which crops and varieties to grow, eat and sell.They are increasingly active as labor -paid or unpaid- for pre-and post-harvesting activities e.g. planting of seedlings and saplings, irrigation, harvesting, threshing, storing seeds, nursery management, jute extraction, vegetable plantation, horticulture, preparation of bio and compost fertilizer. Women also mostly manage household food preparation and consumption, making them ideal targets for nutrition-specific and sensitive programmes that can provide adequate and healthy food especially to children in their formative years. As the bearers of children, their own nutritional status matters in providing the nutrients required for brain development, healthy growth and a strong immune system to babies in the womb and while they are being breastfed. A final consideration are the trade-offs in the allocation of time to the dual productive and reproductive roles of women.

Modernization and expansion of laboratory testing and research facilities: Some recent initiatives by the government towards augmenting laboratory testing facilities of food samples have taken place in Bangladesh that include opening of the modern National Food Safety Laboratory, establishment of the Bangladesh Food Safety Laboratory Network (comprising of more than 20 food analysis laboratories all over the country), and upgrading of existing laboratory facilities. Although these developments have somewhat eased the crisis of food analysis and testing facilities, limitations posed by inadequate equipment still exist.

Constraints:

The major problems faced by the rural people in achieving household food security were inadequate land for farming, lack of money or capital or necessary fund, inadequate training facilities, lack of knowledge on different aspects of improved farming enterprises and insufficient credit facilities.

Lack of proper distribution channel: Majority of the food in Bangladesh is distributed through informal distribution channels and traditional community markets. This is particularly so for highly perishable fresh foods including meat, fish, and vegetables– the wet markets. Small convenience stores serve the demand for other agri-products and processed foods. In the face of lack of infrastructure and marketing facilities coupled with poor connectivity to growth centers, the presence of middlemen has emerged as a predominant feature of the food distribution system in Bangladesh. Often the food passes through a series of middlemen before reaching the final point of sale. Infrastructural constraints such as outdated modes of transportation, lack of cold-holding transport, inappropriate storage facilities, etc., imply that a substantial amount of time elapses before the food reaches the final consumer. The longer the length of the distribution channel, the greater the chances of contamination and adulteration, and higher the need to enhance the 'longevity' of the food. Thus, greater is the food tampering. A typical example of food contamination during storage and distribution is that of fresh water fish and seasonal fruits. The lack of suitable collection centers, where fish can be temporarily kept at appropriate temperatures, and poor transport facilities, compel sellers tomix formalin in fish in order to keep it 'fresh' for a long time. Artificial ripening of fruits, especially during the beginning of a fruit season when the demand in high, is rampant. The inadequate storage facilities, drive traders to ripen them using carcinogenic calcium carbide and other harmful chemicals in large doses to hastily get them ready for sale.

Climatic barrier: Climate change is regarded as one of the several interacting factors that affect food system in many ways. Firstly, agriculture, forestry and fisheries all are sensitive to climate change as their production system are likely to be affected by climate change. Other food system processes, such as food processing, distribution, acquisition, preparation and consumption, are as important for food security as food and agricultural production are. However, as the frequency and intensity of severe weather increase, there is a growing risk of storm damage to transport and distribution infrastructure, with consequent disruption of food supply chains. The rising cost of energy and the need to reduce usage of fossil fuel along with the food chain have led to a new calculus – "food miles", which should be kept as low as possible to reduce emissions. These factors could result in more local responsibility for food security, which needs to be considered in the formulation of adaptation strategies for people who are currently vulnerable or who could become so within the foreseeable future (FAO, 2008).

Unrest global political condition: Bangladesh is heavily dependent on the import of numerous food and non-food items to feed its growing population. Between 2016 and 2021, Bangladesh sourced over 60% of its wheat from Ukraine and over 80% of their chemical fertilizer from Russia and Belarus (FAO, 2022b). Due to the

global price shocks resulting from the conflict, Bangladesh saw a -2.3% change in their agri-food system GDP. According to Arndt *et al.* (2022), the fertilizer price shock is the most significant driver of agrifood system GDP losses, as it causes indirect downstream disruptions.

Food adulteration: The problem of adulteration persists at every level of food from preparation to consumption. Most of the food manufacturers, processors, restaurant owners and so forth are all involved in one way or another in this unethical practice of adulteration. Foods are adulterated by using various harmful chemicals and toxic artificial colors. Rotten and perishables foods are stored, sold and served to consumers. Uses of poisonous chemicals in perishable foods are evident in highest degrees which are endangering the lives of the people (Derek, 2013). The supply of unsafe foods is negatively contributing to the public health seriously with numerous acute and chronic diseases. This paper has focused the blindfolding of the traders and retailers to social commitment and the limitation of law implementation agencies to combat the current food security problems prevailing in Bangladesh.

High population growth: Bangladesh has a total population of 173 million living in an area of 147,570 sq. km. As such, it remains the most densely populated country in the world, facing tremendous pressure on food system, agricultural land and settlement. Although the economy recorded a sizable growth due to government initiatives in the last few years, there are reasons to fear that the country will not be able to attain its wider development goal unless its demographic pressure is not overcome through appropriate social and human development. It may not be able to show real progress unless it attends to other indicators of development, such as environmental protection, healthcare facilities, decreasing pollution, minimizing the income gap, etc.

Lack of awareness and promotion: It has been observed that the community members have considerable low knowledge and awareness regarding a number of nutrition-related issues, including minimum acceptable diet (MAD), minimum dietary diversity for women (MDD-W), handwashing at critical times, etc.

Lack of advocacy: In some cases, issues with program design or implementation modalities created hindrance for the coverage of nutrition sensitive interventions.16 For example, in spite having the facilities,lack of regular maintenance and limited programs to increase utilization of WASH facilities was found to be a programmatic bottleneck for handwashing at critical times. In other cases, issues with program management could be identified as underlying cause (e.g. ineffective workload distribution of frontline workers limiting domiciliary visits). In such cases, advocacy activities have been recommended to sensitize the influencers to aware their supervisors or do the actions by themselves to address the respective bottlenecks. Unlike the awareness and promotion, some of the activities may require additional resources, for which, the influencers require support from their supervisors or higher authority. Motivating and sensitizing them, hence, have been recommended as actions for the influencers under advocacy activities.

Lack of Coordination: Lack of coordination or liaison among upazila level entities implementing interventions targeting same broad goal was also found as programmatic bottleneck limiting coverage of some of the nutrition sensitive interventions. However, for coordination actions, the influencer, rather than through the implementers, will directly coordinate among the relevant stakeholders, or support another influencer in such coordination.

Enforcement: This type of actions has been proposed in case where imposition of relevant regulatory instruments was found to be irregular or inadequate. For example, improper enforcement of the relevant clauses of the Child Marriage Restraint Act 2017 may lead to increased early marriage and early pregnancy, resulting nutrition issues like, maternal malnutrition and LBW. Similarly, improper imposition of the clauses of the Food Safety Act, 2013 may increase aggressive promotion and distribution of junk food and processed food. There are specific actors responsible for enforcement of such regulatory instruments at upazila level, which have been proposed as influencers under this category of actions. However, unlike other set of actions, influencers are expected to implement the enforcement actions by themselves with the help of local influencers. In most of the cases, the enforcements are expected to be done by the formal influencers, i.e. relevant government departments. However, in some cases, informal influencers like local business associations may also impose their own enforcement on their members.

II. Recommendations:

Policies:

- Include clear nutrition objectives and indicators in the design and track and mitigate potential losses.
- Assess the context at the local level, to design appropriate activities to address the types and causes of malnutrition.
- To develop food base nutrition sensitive agricultural policy.
- The policies can promote improved school nutrition through school gardens, healthy school meals, and integration of nutrition education in school curricula.
- Building strong linkages with nutrition-specific interventions such as the promotion of exclusive breastfeeding and complementary feeding practices. Promote adequate use of agricultural inputs such as pesticides, insecticides and fertilizers for safer food through the integral role of extension services.

- Develop nutrition education materials for different types of audiences.
- Carry out national nutrition survey to guide development of nutrition-sensitive programmes.
- Agro-processing of small indigenous fish (SIS) into chutney and fish powder – particularly mola, dhela and puti as per the National Nutrition Policy (NNP), but also other fish that are rich in protein need to be considered.
- Develop nutrition education and sensitization in social safety net programmes and generally with a focus on women.

Researcher:
- Improve processing, storage and preservation to retain nutritional value and food safety, to reduce seasonality of food insecurity and post-harvest losses, and to make healthy foods convenient to prepare.
- Facilitate production diversification, and increase production of nutrient-dense crops and small-scale livestock, fisheries.
- Maintain nutritious value along the value chain, whilst removing anti-nutritional factors from products. Particularly highlighted was the reduction of BOAA content in khesari and reduction of erucic acid in mustard oil.
- Improve post-harvest facility through: Increasing storage facilities for food safety issues; Improving processing and preservation techniques -handling, transportation, packaging and storage, etc.- for perishable fruits and vegetables.
- Consider bio-fortification and HYVs as important measures for nutrition holistically along with other measures to better target the 1,000-days window of opportunity for nutrition.
- Fortify food based safety nets with micronutrients.
- Identify nutritional needs of older people and invest in this aspect given the ageing population.

Extension:
- Expand market access for vulnerable groups, particularly for marketing nutritious foods. Incorporate nutrition promotion and education that builds on existing local knowledge, attitudes and practices.
- Conduct strong agricultural extension services, in terms of: Diversifying food production, including homestead and rooftop gardening, crop diversification, small-scale fish culture and livestock husbandry
- **Sensitization of relevant stakeholders:** Once the effectiveness of the model is tested and an updated version is prepared, BNNC should advocate for the scale up of the model, which should be initiated through sensitization of the relevant stakeholders. Sensitization workshops should be arranged in which appropriate infographics and relevant tools should be used for effective visualization of the model and its effectiveness in addressing programmatic bottlenecks at upazila level and below. The workshops should be conducted at central level with senior policy makers from respective ministries and departments, as well as at implementation level with DNCC and UNCC. Along with sensitization, BNNC should liaison with senior level policy makers from respective ministries and departments and advocate for supporting the scale up of the model through DNCC and UNCC.
- Expand markets and market access for vulnerable groups, particularly for marketing nutritious foods.
- Improve reach of vulnerable groups in the community/areas/regions and prevent/mitigate/address major disasters occurring.
- Build awareness of farmers -and others- on need to have a balanced diet.

Governance:
- Target the vulnerable and improve equity through participation, access to resources and decent employment. Collaborate with other sectors and programmes.
- Shifting consumption patterns towards healthier diets, reflecting dietary diversity -yellow, orange, dark green and leafy vegetables, fruits, dairy products, pulses, fish and meat- akin to the nutrition plate endorsed by the Ministry of Health and Family Welfare.
- Raising awareness on food hygiene, ideal cooking practices and sanitation; Raising awareness on food safety and quality, food adulteration and contamination and mitigation measures targeted for various actors along the food chain.
- Increase the productivity of rice, which is relevant and provide further emphasis on this to free land and water resources for production diversity -crop diversification, horticulture, livestock, etc.
- Collaborate among sub-sectors in agriculture to integrate nutrition outcomes – crops, fisheries, livestock, horticulture and forestry and multi-sectorally with health particularly with NNS, Water, Sanitation and Hygiene (WASH), education, gender and climate change.

- Improve access to land and resources for smallholders for production diversification. Include focus on obesity in policy and programming alongside undernutrition. Establish a common database relating nutrition and agriculture.
- Develop national capacity - Agricultural Policy Support Unit (APSU), BIRTAN, BARC, BFSA and FPMU - the last two are supported by FAO.
- Promote multi-agency and multi-sectoral collaboration to build common indicators.
- Enhance private sector engagement through: Building awareness of nutrition along the food chain -maintain quality control, food safety and nutrient contents in foodand of good agricultural practices.
- Facilitating better access to low-interest loans for small and medium enterprises for maintenance of quality and food safety along the food chain.
- Attaining mainstream export markets, but not at the cost of domestic consumption.
- Engage with the Ministry of Finance to leverage nutrition-sensitive agriculture finance.
- Regulate advertisements on trans fats and salt rich foods, junk foods.

III. Conclusion:

Effective implementation of NSA interventions and their sustainability within a traditional agri-food system requires consideration of complex factors that span across multiple domains like Nutrition sensitivity of existing policies(National Agriculture Policy 2018, and the Country Investment Plan) cultural, social and economic environment; local capacity; other programs and projects; and the biophysical environment, characteristics of actors, intervention characteristics, and implementation process. Interventions need to consider local capacity and household capacity to absorb and sustain uptake to achieve sustainable impact. Nutrient and safe food production is now a top priority in crop production systems.Food and nutrition security requires stable access to affordable, safe, diverse and nutritious food. Child stunting, which reflects chronic malnutrition, has declined by a third over the past 20 years.This accounts for the strong association between family wealth, large gains in parental education, and child growth outcomes.Other factors that may affect child nutrition include improved access to health services, hygiene and sanitation, low fertility rates, long birth intervals and weak multisectoralpolicies.Vitamin D deficiency is highly prevalent in women and warrants urgent attention of the policymakers and the programmemanagers for introducing Vit D supplementation in the national program. Government emphasizes on the engagement of women in agriculture through homestead gardening, one house one farm program, providing loan and training, cash incentives, easy access to financial institutes, empowering through group approach.Changing climate and lack of proper food distribution channel is major barrier for Sustainable and Nutrition Sensitive Food Systems in Bangladesh. Problems faced by the rural people in achieving household food security were inadequate land for farming, lack of money or capital or necessary fund, inadequate training facilities, lack of knowledge on different aspects of improved farming enterprises and insufficient credit facilities. In order to keep the food system viable, natural disaster resilient technologies must be developed so that damage can be avoided.So, building on these remarkable declines, accelerated efforts through comprehensive nutrition sensitive policies can help to meet the national nutrition targets and pave the way for sustainable food systems.

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