Training Manual on
Integration of Nutrition in to Agricultural Practices

Nutrition Unit

Bangladesh Agricultural Research Council

Training Manual
on
"Integration of Nutrition in to Agricultural Practices"

Compiled and edited

Dr. Md. Harunur Rashid
Dr. Zakiah Rahman Moni

Nutrition Unit
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

Publication
December, 2025

Copies: 35

Publication no: 26

Published by:
Nutrition Unit, Bangladesh Agricultural Research Council, Farmgate, Dhaka-1215.

Cover Design
Mohammad Nazmul Islam
Graphics Designer, BARC.

Funded by: APCU, PARTNER, BARC

Citation:
Rashid, H.R, and Moni, Z.R. "Integration of Nutrition in to Agricultural Practices" 2025. Training Manual., BARC, 80P.

Table of Contents

Concept Note

Training Program on Integration of Nutrition in to Agriculture Practices

1. Background

Agricultural produce, such as cereals, pulses, fruits and vegetables, and reared animals for meat, milk, eggs, farmed fish etc., food and food raw materials are confirming food availability and livelihoods, while nutrition determines how food contributes to human health and development. Though the natural agriculture and nutrition are interdependence, often addressed separately, in policy and program implementation but strengthening the linkages between these sectors is vital for achieving sustainable food systems, improving dietary diversity, and combating malnutrition in all its forms, therefore; integration of nutrition in to agriculture is imperative for making the food system dynamic for addressing malnutrition.

The proposed training program pursues to enhance the understanding and sharing experience. The base of this understanding is to be strengthen through training. of agricultural and nutrition professionals to design and implement nutrition- agricultural interventions that promote both productivity and improved nutritional outcomes.

2. Goal

To strengthen the capacity of agricultural and nutrition professionals to integrate nutrition objectives and actions into agricultural research, extension, and development programs.

3. Specific Objectives

- Explain the interconnections between agriculture, nutrition, and health outcomes
- Identify opportunities and entry points for integrating nutrition objectives within agricultural systems and value chains
- Apply tools and frameworks for planning, implementing, and monitoring nutrition-sensitive agricultural programs.
- Develop context-specific action plans to promote collaboration between agricultural and nutrition sectors.

4. Target Participants

- Agricultural Scientists (Crop, Nutrition, Livestock & Fisheries)
- Extension Officers (participants are expected to play key roles in translating research and extension messages into nutrition-sensitive agricultural practices.

5. Proposed Dates & Venue:

Dates: 9–11 December 2025
Venue: Conference Room 2, BARC

Organizing Institution:

Nutrition Unit, BARC

6. Topic covered

- Overview of the global and national context of NSA
- The role of agriculture in improving nutrition outcomes
- Integrating nutrition objectives in agricultural research, production, and value chains
- Planning, implementation, and action for nutrition integration into agriculture

7. Methodology

The training will use interactive and participatory approaches, including:

- Expert presentations and facilitated discussions
- Group exercises
- Experience sharing among participants

8. Expected Outcomes

- Enhanced understanding of nutrition-sensitive agricultural concepts among participants
- Strengthened collaboration between agricultural and nutrition professionals
- Able to preparing plans for integrating nutrition objectives into agricultural and extension programs
- A network of professionals advocating for nutrition-sensitive agriculture

Contact Person & Coordinator:

Dr. Zakiah Rahman Moni
Designation: PSO (Nutrition) BARC
Email: zakiah@barc.gov.bd & zrmoni@yahoo.com
Phone: +8801712-634352

Diverse food production through Agro-diversity

Dr. Md. Abdus Salam
Executive Chairman
Bangladesh Agricultural Research Council (BARC)
Farmgate, Dhaka 1215
E-mail: ec.barc@barc.gov.bd

1. Introduction

Agrodiversity refers to the diversity of crops, livestock, aquatic species, trees and farming practices within agricultural systems. In Bangladesh, it represents a strategic shift away from rice monoculture toward integrated, mixed farming (e. g. rice-fish systems, intercropping, homestead gardens and crop-livestock-aquaculture combinations). This approach builds resilience against climate risks, improves nutrition and food security, enhances farmer incomes and creates a more sustainable and adaptable food system.

2. Agrodiversity in Bangladesh

Agrodiversity (or agricultural biodiversity) encompasses:

- Genetic Diversity: Varieties of crops and livestock.
- Species Diversity: Mix of crops, trees, animals and fish in a system.
- Ecosystem Diversity: Different agricultural habitats (floodplains, hills, wetlands etc.).
- Management Diversity: Knowledge and practices of farmers.

Table: Agrodiversity in Bangladesh

Component	Traditional Example	Modern/Institutional Initiative	Key Benefit
Genetic	Local landraces of rice, Kalijira rice, Deshi mango	Stress-tolerant (salinity/ flood) HYV rice, revival of millets	Climate resilience, taste, nutrition
Species	Homestead garden (fish, poultry, fruits, veg)	Integrated Rice-Fish-Duck farming, pond polyculture	Nutritional diversity, income stability
Ecosystem	Floating Gardens in haor regions	Saline-agriculture using sunflowers, barley in coastal belts	Adaptation to extreme environments
Management	Intercropping, organic practices	Conservation agriculture, Farmer Field Schools	Soil health, knowledge preservation

3. Why Agrodiversity Matters for Bangladesh?

a) *Nutrition and Food Security*

- Provides households with access to a variety of vegetables, fruits, pulses, fish, eggs and milk.

- Improves dietary diversity and reduces micronutrient deficiencies (*hidden hunger*), especially among children and women.
- Ensures more stable, year-round food availability through staggered cropping and diverse production systems.

b) *Climate Resilience*

- Reduces vulnerability to climate shocks such as floods, salinity, drought, and pest outbreaks.
- Mixed and diversified systems stabilize yields and buffer against total crop failure.

c) *Livelihood Improvement*

- High-value vegetables, fruits, fish, and livestock generate additional and more consistent income.
- Provides alternative employment and empowers rural women through homestead gardening and integrated systems.

d) *Environmental Benefits*

- Enhances soil fertility and organic matter through legumes, crop rotations, and multi-tier systems.
- Conserves local plant genetic resources through homegardens and the use of local landraces.
- Reduces pest pressure and the need for chemical inputs by creating diversified habitats.

4. Agrodiversity Practices Suitable for Bangladesh

- **Rice-fish-vegetable systems:** Cultivation in flood prone areas where fish are raised in paddies and vegetables on bunds, providing protein, vitamins and income.
- **Rice-pulse rotations:** Growing lentils, mung beans, or chickpeas after rice to improve soil nitrogen and diversify diets.
- **Horticulture integration:** Incorporating fruit orchards (mango, jackfruit, banana, papaya) into smallholder farms for nutrition and income.
- **Homestead gardening:** Women-led gardens producing leafy greens, gourds, and spices, directly improving family nutrition.
- **Agroforestry:** Combining timber trees with crops like turmeric or ginger for long-term income and soil conservation.
- **Floating Gardens (*Baira*):** Building rafts from water hyacinth to cultivate vegetables during monsoon floods in low-lying *haor* regions.
- **Integrated Systems:** Traditional models like "Rice-Fish-Duck," where species symbiotically support each other's growth.

5. Motorists for Promoting Agrodiversity

- **Climate Change Resilience:** Diverse systems spread risk against increasing droughts, floods, salinity and cyclones.
- **Economic Risk Mitigation:** Multiple income streams throughout the year buffer against price shocks in any single commodity.

- **Nutritional Security:** Addresses micronutrient deficiencies by moving beyond calorie focused rice monoculture.
- **Soil Health and Sustainability:** Legumes fix nitrogen and crop rotations break pest cycles, reducing reliance on chemicals.

6. Governmental and Institutional Initiatives

- **Promotion of Neglected Crops:** Organizations like BARI, BINA and BRAC are revitalizing indigenous, drought resistant varieties of millets, sorghum and pulses.
- **Stress Tolerant Varieties:** Dissemination of salinity-, flood- and submergence-tolerant crop varieties (e. g. BRRI dhan47, BRRI dhan52).
- **Support for Integrated Aquaculture-Agriculture:** Promotion of pond polyculture and its integration with horticulture.
- **Conservation of Landraces:** Support for community seed banks and farmers' networks to preserve locally adapted seeds.

7. Challenges to Agrodiversity

- **Land Fragmentation:** Small and scattered landholdings (<0.5 ha) limit the scale of diverse systems.
- **Climate Stressors:** Rising salinity, erratic rainfall and floods complicate sustained diversification efforts.
- **Weak Value Chains:** Poor storage, transport and processing facilities for perishable diversified products limit profitability.
- **Policy and Market Bias:** Heavy subsidies, research and infrastructure still favor rice monoculture, limiting incentives for diversification.
- **Knowledge Gaps:** Loss of indigenous knowledge and a need for expanded extension services to train farmers in managing diversified systems.

8. Way Forward

- **Policy Reforms:** Shift subsidies and research support toward pulses, vegetables, horticulture and fisheries.
- **Consumer Awareness:** Create demand and better prices for diverse, nutritious foods through branding and education.
- **Agroecological Zoning:** Tailor diverse systems (e. g. climate smart villages) to specific zones like coastal, char, hilly and floodplain areas.
- **Community Led Initiatives:** Strengthen homestead gardening, women's participation and community seed banks.
- **Value Chain Development:** Invest in cold storage, rural roads, processing facilities and market linkages for diverse products.
- **Farmer Training and Knowledge:** Expand agroecological extension services and blend traditional wisdom with modern science.

9. Conclusion

For Bangladesh, agrodiversity is a critical pathway to a more resilient, nutritious and sustainable food system. Moving beyond the "*rice-first*" paradigm to embrace the country's inherent ecological and agricultural diversity is essential to meet the twin challenges of climate change and population growth. It represents a necessary shift from viewing agriculture solely as calorie production to seeing it as a multifunctional system for ecosystem health, livelihood security and cultural preservation.

Nutrition-Sensitive framework: The Connectivity of agriculture, food security and nutrition

Dr. Md. Harunur Rashid
Director, SAARC Agriculture Centre
&
Director, Nutrition (AC)
Bangladesh Agricultural Research Council (BARC, Dhaka
dir.nutrition@barc.gov.bd

Nutrition Sensitive Framework

- A Nutrition-Sensitive Framework is a holistic approach in agriculture and food systems that goes beyond just producing calories, focusing on designing policies, practices, and systems to improve people's diets and health by ensuring diverse, safe, affordable, and nutrient-rich foods are available, accessible, and consumed, tackling all forms of malnutrition (under nutrition, micronutrient deficiencies, and over nutrition).

- It integrates nutrition goals into various sectors like agriculture, health, water, sanitation, and social protection, making them "nutrition-sensitive" by considering underlying factors like poverty, food security, care practices, and women's empowerment.

Nutrition Sensitive Framework of Bangladesh

- Nutrition-Sensitive framework of Bangladesh is operationalized through the National Food and Nutrition Security Policy (NFNSP) 2020-2030 and its associated Plan of Action (PoA), which integrates a food systems approach to improve nutrition outcomes across sectors.

- The framework guides activities that address the social and economic drivers of malnutrition, complementing nutrition-specific interventions by transforming agriculture, health, and other systems to be more conducive to good nutrition.

Basis of Nutrition Sensitive Framework

The nutrition-sensitive framework of Bangladesh is primarily articulated through key policy documents:

- the National Food and Nutrition Security Policy (NFNSP) 2020-2030,
- the Second National Plan of Action for Nutrition (NPAN-2) 2016-2025, and
- various Country Investment Plans (CIPs).

This framework emphasizes a multi-sectoral approach to address both the direct and underlying causes of malnutrition.

Key Pillars of the Nutrition Sensitive Framework

Integrated policy: The NFNSP (2020-2030) is the central policy, aiming to meet the Sustainable Development Goals related to food and nutrition security.

Multi-sectoral coordination: The framework ensures that multiple ministries, agencies, NGOs, and other stakeholders work together, with nutrition goals being integrated into their respective work plans and budgets.

Nutrition-Sensitive Agriculture (NSA): This approach focuses on how agricultural practices, policies, and systems can improve the availability, access, and consumption of diverse, safe, and nutritious foods.

Key Pillars of the Nutrition Sensitive Framework

Focus on food systems: It recognizes that achieving nutrition security requires a transformation of the entire food system, not just agricultural production.

Prioritizing vulnerable groups: The framework recognizes the need to extend social protection and create resilient food systems for the poor and vulnerable.

Strengthening urban nutrition: A specific strategy aims to enhance nutrition programming in urban areas by improving coordination among different health and nutrition entities and linking them to other sectors like education, food, WASH, and social security.

Key Components of the Framework

The framework is built on the understanding that improving nutrition requires more than just food production; it involves integrating nutrition objectives into various complementary sectors. Key components include mainstreaming nutrition into sector-specific plans, promoting nutrition-sensitive agriculture, and strengthening coordination among 22 relevant ministries.

Multi-sectoral Coordination: The Bangladesh National Nutrition Council (BNNC) coordinates the efforts of 22 relevant ministries. This ensures that nutrition activities are mainstreamed across sectors like health, agriculture, fisheries, livestock, social welfare, water and sanitation (WASH), and education.

Policy Integration: The NFNSP (2020-2030) and its Plan of Action (PoA) serve as the overarching roadmap, building on and updating previous policies to align with the Sustainable Development Goals (SDGs).

Key Components of the Framework

Country Investment Plans (CIPs): These plans, such as the second and third CIPs, propose specific investment programs to improve food and nutrition security in an integrated way, identifying funding gaps and areas for resource mobilization.

Nutrition-Sensitive Agriculture (NSA): A core component that goes beyond staple crops to promote the production, access, and consumption of diverse, nutritious foods like fruits, vegetables, legumes, and animal-source foods. This also involves women's empowerment in agriculture and improving post-harvest handling to retain nutrients.

Social Protection and Safety Nets: The framework emphasizes enhancing access to social protection and safety net programs, sometimes involving cash transfers, to ensure food security for vulnerable populations.

Monitoring and Evaluation (M&E): A result-based monitoring mechanism is built into the framework to track progress, identify challenges, and ensure accountability across all sectors.

Core Principles of Implementation

Effective implementation of the nutrition-sensitive framework requires a multi-sectoral approach guided by specific principles:

Explicit Nutrition Objectives: Designing agricultural policies and programs with clear, measurable nutrition goals and indicators from the outset.

Context Specificity: Tailoring strategies to the local causes of malnutrition, dietary habits, and agricultural practices of specific populations.

Multi-sectoral Coordination: Fostering collaboration and policy coherence among ministries and stakeholders from different sectors (agriculture, health, education, social protection, etc.).

Core Principles of Implementation

Targeting Vulnerable Groups: Focusing interventions on the most nutritionally vulnerable populations, such as women and young children during the "1,000 days of opportunity".

Sustainability: Ensuring that practices are environmentally, socially, and economically sustainable to provide long-term food and nutrition security.

By implementing these principles through various pathways, the nutrition-sensitive framework ensures a holistic approach to transforming food systems and sustainably improving nutrition outcomes.

Examples of Nutrition-Sensitive Actions

- Promoting dietary diversity: Encouraging the production and consumption of a variety of food groups like fruits, vegetables, and animal-source foods.
- Focusing on nutrient-rich crops: Promoting biofortified and traditional nutrient-rich crops.
- Improving access: Ensuring that nutritious food is physically and economically accessible to everyone, especially the most vulnerable.
- Empowering women: Addressing women's empowerment as a key driver of improved nutrition outcomes.
- Integrating technology: Incorporating ICT, e-commerce, and the Internet of Things (IoT) into food systems to improve efficiency and access.

Key Pathways of Connection

The framework highlights several pathways through which agriculture influences food security and nutrition outcomes:

Food Production and Availability: Moving beyond staple crops to promote the production of diverse, nutrient-rich foods (fruits, vegetables, legumes, animal-source foods) at the household and market levels. This can be achieved through interventions like home gardens and integrated farming systems.

Income Generation: Agriculture is a primary source of livelihood for many vulnerable populations. Increased and stable agricultural income allows households to purchase a wider variety of nutritious foods and access healthcare and education, all of which improve nutrition.

Key Pathways of Connection

Food Access and Affordability: Ensuring that nutritious foods are physically and economically accessible to all, especially vulnerable populations. This involves efficient value chains, processing techniques that retain nutrient value, and reduced post-harvest losses.

Women's Empowerment: Empowering women in agriculture is a crucial mediator of family health and nutrition, as women often have significant decision-making power regarding household food use and childcare practices.

Nutrition Knowledge and Education: Integrating nutrition education into agricultural extension services helps farmers and consumers make informed decisions about food production, preparation, and consumption, leading to better dietary habits.

Health, Water, and Sanitation: Nutrition-sensitive approaches coordinate with complementary sectors like health, education, water, and sanitation to address the underlying determinants of malnutrition, such as disease prevalence and poor hygiene practices, which affect nutrient absorption.

Connection of Agriculture, Food Security and Nutrition

- Agriculture, food security, and nutrition are interconnected, with agricultural production being a key driver for both food availability and income that allows access to food, while also directly impacting the nutritional quality of diets.
- This linkage is captured in Sustainable Development Goal 2 (SDG 2), "Zero Hunger", which aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
- The connection is reinforced through the entire food system, from production to consumption, and includes factors like value chains, food loss and waste, and consumer demand.

Agriculture's Role in Food Security and Nutrition

- Food availability: Agriculture is the primary source of food supply, providing the raw ingredients for national and global food availability.
- Economic access: For many, agricultural production is also a source of income, enabling people to purchase a variety of foods to meet their food needs.
- Nutritional quality: The types of food produced by agriculture directly influence the nutritional quality of diets. For example, producing a diverse range of crops can lead to more nutrient-rich diets.

- Food safety: The safety of agricultural products is crucial for nutrition. Malnutrition can increase susceptibility to foodborne diseases, and unsafe food can lead to or worsen malnutrition.

Challenges and Opportunities

- Climate change and resource pressures: Challenges like climate change and population growth put pressure on both agriculture and food security, highlighting the need for sustainable practices.
- Evidence-based action: Effective strategies require better data and analysis to connect indicators and inform decision-making across agriculture, food supply, and health.
- Promoting diversity: Shifting towards more diverse agricultural systems can improve both food security and nutrition, but this needs to be supported by policies that address the entire value chain, from farmer to consumer.

Challenges and Opportunities

- Problems in one area can exacerbate others. For example, food insecurity can lead to poor health and productivity losses, further entrenching poverty and hindering agricultural development.
- Conversely, integrated, nutrition-sensitive policies that leverage connectivity across the rural-urban continuum and address issues beyond just production (e.g., infrastructure, women's empowerment, health services) lead to better outcomes for all three areas.

Postharvest Management of Horticultural Crops for Better Nutrition

Md. Atiqur Rahman, Ph.D
Principal Scientific Officer (PSO)
Postharvest Technology Section
HRC, BARI, Gazipur
e-mail: dratiqbari@gmail.com

1. Introduction:

Fruits and vegetables play a significant role in human nutrition, especially as sources of vitamins, minerals, dietary fibre, and antioxidants. Although Bangladesh has achieved self-sufficiency in food grain but is still deficient in nutrition. The present consumption of fruits and vegetables in Bangladesh is about 346 g $day^{-1}capita^{-1}$, which is still lower than the minimum requirement of 400 g $day^{-1}capita^{-1}$ (WHO, 2018). It is reported that the incidence of infant mortality and health problem in growing children and pregnant women are high in Bangladesh due to micronutrient and vitamins deficiency. Increased consumption of a variety of fruits and vegetables on a daily basis is highly recommended to improve such deficiencies and for other associated health benefits, which include reduced risk of some forms of cancer, heart disease, stroke, and other chronic diseases.

In recent years, fruits and vegetables production has increased so much that their production growth rate places Bangladesh as the 3rd fastest globally. However, being highly perishable fruits and vegetables are quite susceptible to blemishes during postharvest operations and marketing. Both quantitative and qualitative losses occur in horticultural commodities between harvest and consumption. Qualitative losses, such as loss in edibility, nutritional quality, caloric value, and consumer acceptability of fresh produces, are much more difficult to assess than the quantitative losses. The quality and safety of horticultural produce reaching the consumer depend upon pre-harvest factors as well as proper postharvest management practices throughout the value chain, from the field to the consumer. Each stakeholder along the value chain who is involved in harvesting, handling and marketing of fresh produce has a role to play in assuring the food safety and quality of fresh produce.

Postharvest losses of fresh fruits and vegetables in Bangladesh are estimated to range from 22 to 40%, with an overall average of 31% between production and consumption sites. Overall, about one third of horticultural crops produced in the country are never consumed by humans.

Therefore, strategies should be taken to reduce postharvest losses in order to increase food availability to the growing population, decrease the area needed for production, and conserve natural resources. The use of integrated crop management (ICM) systems and Good Agricultural Practices (GAP) result in good quality fruit and vegetables. The use of improved postharvest management practices, on the other hand, is essential to maintain the quality and safety of fresh fruits and vegetables.

---

[1] Paper presented in the training program entitled "Integration of Nutrition into Agricultural Practices" held on 10 December 2025 at BARC, Farmgate, Dhaka-1215.

[2]Principal Scientific Officer, Postharvest Technology Section, HRC, BARI, Gazipur-1701. Cell phone: 0174-3134-584; e-mail: dratiqbari@gmail.com

2. Postharvest losses of fruits and vegetables

It is estimated that due to improper ways and inadequacies in handling, transportation, storage and marketing, postharvest losses of these products can go as high as 40 to 50% (Salunkhe and Desai, 1984). The postharvest losses of fruits and vegetables are even more serious in developing countries like Bangladesh. Postharvest Technology Section, HRC, BARI assessed the postharvest losses of major fruits and vegetables at different marketing channels. The estimated losses were 25% for jackfruit, 31.7% for mango, 20% for banana, 20.6% for guava, 28% for tomato, 21.8% for potato, 29.5% for country bean, 22% for cauliflower, 25% for cabbage, 32% for brinjal and 24.3% for cucumber (Annual Reports 2010-24 HRC, BARI, Hasan et al., 2021, Rahman et al., 2018, 2019, 2023). It is alarming that postharvest losses of different food crops specially fruits and vegetables when valued in monetary term, reflect tremendous loss in economy. This situation not only reduces national income but also compounds the malnutrition problem further and affects the socio-economic conditions of the people. It is therefore, crucial to give more attention on different postharvest aspects of fruits and vegetables to minimize these huge losses.

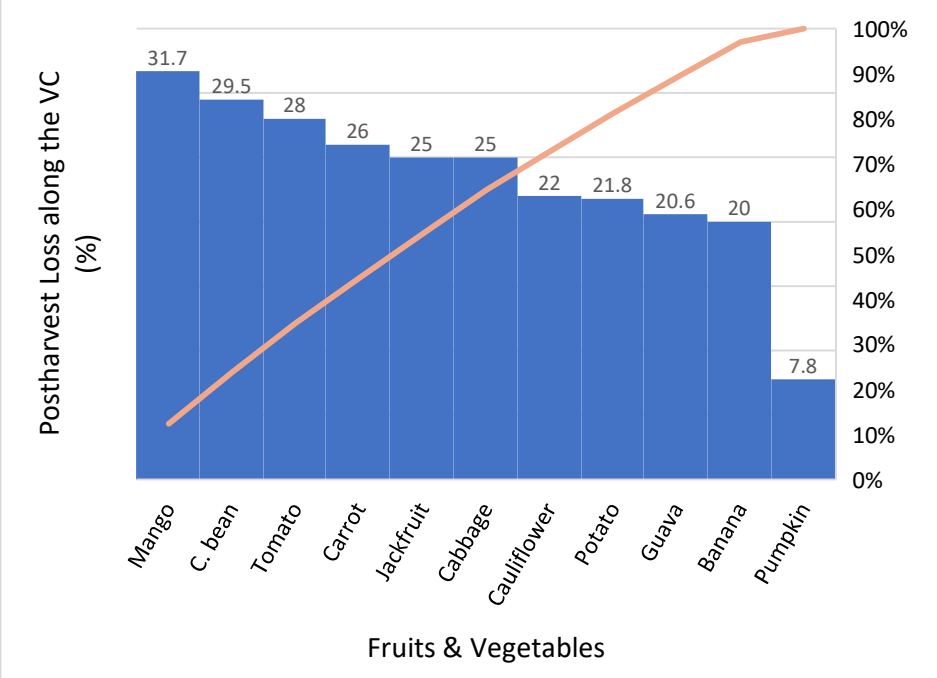


Fig. Postharvest losses of fruits and vegetables
(BARI Annual Reports 2010-24, Hasan et al., 2021, Rahman et al., 2018, 2019, 2023)

- Quality Management of Fruits and Vegetables

Quality: According to Kyriacou and Rouphael (2018), the quality of fruits and vegetables constitutes a dynamic composite of their physicochemical properties and evolving consumer perception, which embraces organoleptic, nutritional and bioactive components.

3.1 Quality factors

Quality is the degree of excellence or superiority, which is a combination of attributes, properties, or characteristics that give each commodity value, in terms of its intended use. The following factors contribute to the various quality attributes of fresh fruits and vegetable:

3.1.1 Visual quality factors

These include size, shape, colour, gloss, and freedom from defects and decay. Defects can originate before harvest because of damage by insects, diseases, birds, chemical injuries and various blemishes such as scars, scabs, skin staining etc. Postharvest defects, on the other hand, may be morphological, physical, physiological, or pathological.

3.1.2 Textural quality factors

These include firmness, crispness and juiciness, depending on the commodity. Textural quality of horticultural crops is not only important for their eating and cooking quality but also for their shipping ability. Soft fruits cannot be shipped over long distances without substantial losses due to physical injuries. In many cases, the shipment of soft fruits necessitates that they be harvested at less-than-ideal maturity, from the flavour quality standpoint.

3.1.3 Flavour and eating quality factors

These include sweetness, sourness, astringency, bitterness, aroma, flavour etc., which involves perception of the tastes and aromas of many compounds.

3.1.4 Nutritional quality factors

Fresh fruits and vegetables play a significant role in human nutrition, especially as sources of Vitamin C, Vitamin A, Vitamin B, thiamine, niacin, minerals and dietary fibre. Different phytonutrients found in fresh fruits and vegetables like carotenoids, polyphenols, tocophenols and lycopene may lower the risk of cancer and other diseases.

3.2 Quality Management Approach

- In order to produce good quality fruits and vegetables, suitable agro-techniques and good produce management throughout the whole chain is essential
- The production of good quality produce starts with the use of good quality planting materials and the growing of cultivars acceptable to the market
- Quality improvement of fresh fruits and vegetables can only be achieved through pursuing Good Agricultural Practices (GAP) incorporating IPM and ICM practices within the framework.
- On the other hand, application of total quality management (TQM) principles should be applied in the whole postharvest handling chain to maintain the produce quality.
- Quality of fresh produces can be maintained through the establishment of cool chain.

- Food Safety Management of Fruits and vegetables
- Food Safety refers to handling, preparing and storing food in a way that best reduces the risk of individuals becoming sick from foodborne illnesses
- According to FAO (1996), ‘Food Safety is the assurance that food will not cause harm to the consumer when it is prepared or eaten according to its intended use’
- At present, food safety is a global concern. The principles of food safety aim to prevent food from becoming contaminated and causing food poisoning.

Food Safety Hazards

Food safety hazards are classified into three main categories, namely, biological hazards, chemical hazards and physical hazards.

4.1 Biological food hazards: Foods like fruits, vegetables, street vending food, salad, semi-processed and processed food can be contaminated by various microorganisms including bacteria, fungi, etc., which are included as biological hazards that causes human diseases.

Major Food Poisoning Microorganisms

Salmonella sp. bacteria	: Causes diarrhoea, typhoid, etc.
Listeria sp. bacteria	: Causes tiredness, Fever, Headaches
Staphylococcus bacteria	: Causes food poisoning & consequent abdominal pain, etc.
Escherichia coli bacteria	: Causes severe illness and even lead to death
Clostridium sp. bacteria	: Causes abdominal pain, tenderness and watery diarrhoea

Major Sources of Hazardous Microorganisms

- The use of untreated organic animal manure as fertilizer
- Improper waste management
- Use of contaminated water for irrigation and for washing
- Poor cleaning and sanitation in the wet market

Steps to be Taken to Reduce Microbial Contamination

- Keep fresh produces in dry and clean place
- Keep fruit & veg separated from fresh fish & meat
- Use potable clean water for washing purpose
- Use recommended disinfectants for washing: 100-200 ppm NaOCl solution or 0.01% scallop powder solution
- Avoid soil contact of the produces
- Ensure personal hygiene of the workers
- Use clean knife and all other utensils
- Cook at proper temperature and duration

4.2 Chemical Hazards

- Chemical contamination can occur on all kinds of agricultural food crops either naturally or during production and postharvest processing
- Food safety hazards can occur when maximum residue limit (MRL) is exceeded
- Major hazardous chemicals are pesticides, herbicides, heavy metals, preservatives, additives, ripening chemicals, etc.
- Hazardous chemicals may cause acute and chronic illnesses and also have significant negative impact on the environment.

4.2.1 Pesticide Residues

- The presence of pesticide residues in food system is one of the most important human-induced safety concerns
- Possibly, this is the most serious chemical hazard prevailing in many Asian Countries including Bangladesh

Reasons for Higher Residues in Food

- Indiscriminate use of non-recommended pesticides
- Application of pesticides at shorter intervals
- Non-compliance with pre-harvest interval

- Use of cocktail of pesticides
- Ignorance of the users
- Lack of media campaign
- Lack of proper guidelines for safe use of pesticides

Ways of Reduction of Pesticide Residues in Fruits & Vegetables

- Use of only recommended pesticides following correct doses
- Following safety guidelines in spraying pesticides
- Maintaining the pre-harvest interval (PHI) strictly for each pesticide
- Following GAP in crop production, with emphasis on use of bio-pesticides, sex pheromone and other IPM methods
- Washing fruits and vegetables properly before eating fresh or before cooking.

Pre harvest interval (PHI)

- Every pesticide has a withholding period. If we use any chemicals to combat the pest infestation, we should maintain the PHI
- PHI is defined as the interval between the last application of pesticide and the safe harvesting of edible crops for immediate consumption
- MRL refer to the maximum amount of a pesticide that is allowed to remain in or on a food. MRLs are typically measured in parts per million (ppm or mg/kg)

Decontamination of Pesticide Residue at Home

- Washing under running tap water for two minutes results in removal of 30-45% pesticide residue from the produce
- Dipping into water for 15 minutes results in 40-60% pesticide removal
- Dipping into 2% sodium chloride (NaCl) solution for 15 minutes and washing with running water results in 60-80% pesticide removal
- Dippingin 2% vinegar(acetic acid) solution for 15 minutes and washing with running water results in70-90% pesticides removal
- Dipping in 2% baking soda ($NaHCO_3$) solution for 15 minutes and washing with running water and cooking could reduce up to 50-85% pesticide residue.

4.2.2 Ripening Agents

- Uniform ripening of fruits and vegetables is needed for commercial agriculture
- In Bangladesh, artificial fruit ripening is being done but using non-recommended chemicals, which is the burning issue of the country
- Different synthetic chemicals namely ethephon, calcium carbide, etc. are randomly used following inappropriate method for ripening of climacteric fruits like mango, banana, papaya, tomato and jackfruit. Some non-climacteric fruits like pineapples are also being exposed to ripening chemicals
- Calcium carbide is banned to use
- On the other hand, ethephon spray or fruit dipping in ethephon solution is not permitted globally for enhancing fruit ripening

Safe Methods of Fruit Ripening

- Application of heat treatment for banana
- Use of high ethylene-releasing ripe fruits (banana and apple) for triggering ripening of other fruits
- Ethylene gas (C_2H_4) based ripening chamber is a globally recommended method for commercial ripening of fruits

4.2.3 Heavy metals

Presence of heavy metals, namely arsenic (As), lead (Pb), mercury (Hg), cadmium (Cd), chromium (Cr), etc. in food system, is one of the important threats related to food safety. Possible sources of heavy metals in food are:

- Contaminated water and soil
- Inadequately composted manures like poultry manure
- Pollution of water bodies with industry wastes

4.3 Physical Hazards

- Physical hazards mainly consist of foreign bodies that include residual soil and dusts on vegetables, remains of packaging materials, filth and foreign materials resulting from poor practices during harvesting, washing and packaging operations
- Illness and injuries can result if the agricultural products are contaminated with foreign bodies
- Appropriate quality control system should be developed and implemented to meet the food safety standards for domestic and international trade
- Food Safety Act 2013 (Pure Food Ordinance 1959 has been repealed with this Act)
- The 'Food Safety Act 2013' was enacted on 10 October, 2013
- The act came into force on 01 February, 2015
- An Act made provisions for the establishment of an efficient and effective Authority and for regulating, through coordination, the activities relating to food production, import, processing, stock, supply, marketing and sales to ensure the rights toward access to safe food through appropriate application of scientific process.
- In this Act of 2013, for various offense related to food adulteration or use of harmful agents in food, a range of punishments have been included, and the maximum penalty fixed in the law is 5 years imprisonment along with a fine of BDT 20 lakh
- Formalin Control Act 2014 has also been enacted

Bangladesh Food Safety Authority (BFSA)

Under the Food Safety Act 2013, Bangladesh Food Safety Authority (BFSA) has been established on 02 February, 2015

Major Functions of the BFSA

- Food Standard Setting: Updating or upgrading permissible limits at its highest safety level for foods in regard to use of contaminants, toxins and harmful residues, radiation limits, etc.
- Food Laboratory Networking: Formulating procedural guidelines for accrediting food testing laboratories and implementing monitoring system
- Risk-eliminating food inspection and enforcement: Introducing Risk-eliminating Food Inspection, Seizing, Detaining and Destruction

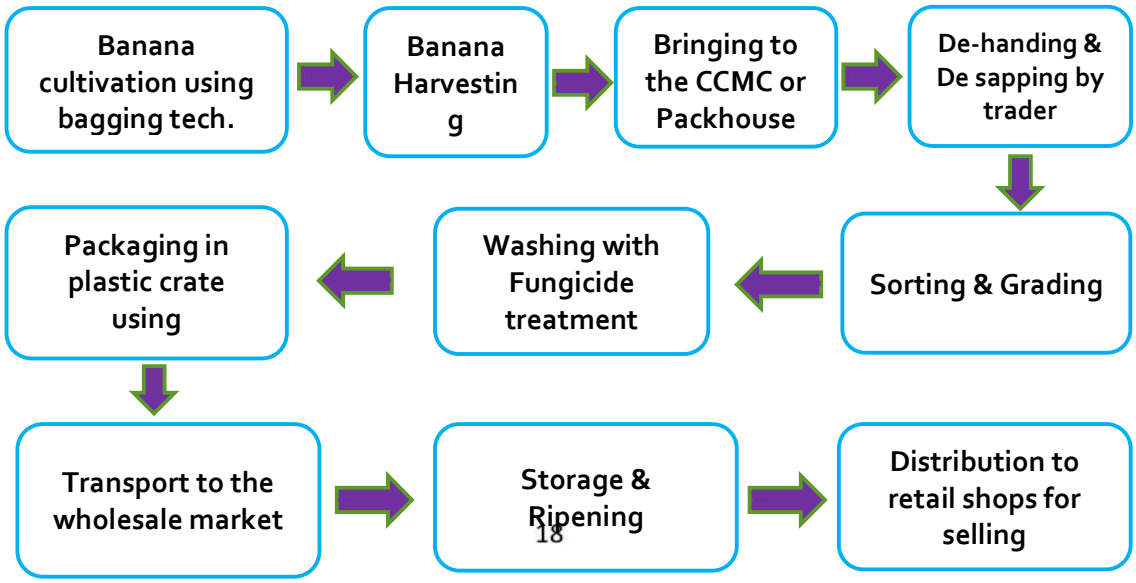
- Data Collection and Monitoring: Registration of food premises, surveillance, residue monitoring, outbreaks, etc. Prescribe the procedures for risk assessment, communication, management and control
- Science-based policy advice: Provide scientific advice and technical support to government in formulating, revising or upgrading food and nutrition policy or regulations
- Food Safety Awareness: Major work for current situation
- Training of Food Inspectors and Food Handlers
- Status of Existing Value Chain of Fruits & Vegetables in Bangladesh (Ref. Crop Banana)

- Bananas are grown in the field following traditional method without using bagging technology
- After harvest whole banana bunches are carried to the local assembly markets by different local vehicles for selling
- Traders purchase the banana bunches and transport to the long-distance wholesale market by open truck without any packaging
- At wholesale markets, banana bunches are gathered in dirty places that causes bruising, black spot and microbial contamination
- No sorting, grading or washing are practiced
- All postharvest operations are done roughly resulting huge postharvest loss
- Calcium carbide or ethyphon solutions are usually sprayed and bananas are then covered with polyethylene for quick ripening
- In the entire value chain bananas are transported in unpackaged condition resulting in 26% postharvest loss and also quality loss due to abrasion, bruising, compression damage

1. Cultivation of Safe Banana

- Clean cultivation of banana following recommended practices and GAP code
- Bagging of banana bunch is essential to protect the fruits from beetle and other insects
- Bagging also reduces the use of pesticides, thus can get us safe and quality fruit

6.2 Improved Banana Value Chain for Quality and Safety Assurance



- Conclusion

The health benefits associated with regular consumption of fresh fruits and vegetables is widely accepted and is encouraged by national and international nutrition and health authorities. However, fresh fruits and vegetables decompose much faster than other crop products and have more risks from harmful microbial contamination if not handled with extra care. There has been an increase in the number of outbreaks of illness associated with the consumption of contaminated fresh produces. Therefore, maintaining food safety and quality is very much important. To meet the challenges on global quality and safety requirements, necessary steps should be taken throughout the value chain from *'farm to plate'* for maintaining quality and safety of fruits and vegetables in order to stay healthy, and to be competitive both in the domestic and export markets.

- **Recommendations**

It has been amply demonstrated that application of improved postharvest management system is necessary to ensure quality and safety of fruits and vegetables. However, this can only succeed with quality produces. Therefore, some salient quality production features are recommended at the outset followed by PHM requisites.

- Emphasis must be given in producing good-quality fruits & vegetables following modern agro-techniques based on the code of GAP
- Pre-harvest interval should strictly be followed during pesticide application and proper maturity and harvest index be followed
- Green belt should be identified across the country for production of quality and safe fruits & vegetable
- Produce quality should be maintained in the value chain based on TQM principles
- Instead of bulk packaging in plastic or jute sack, the use of Plastic Crates should be mandatory for packaging of most of the fruits & vegetables during transportation & marketing, which can reduce PH loss by 18-20%
- Well facilitated packhouse or CCMC must be established in all production hub across the country for application of improved PHT
- Capacity building of actual value chain actors including fruit & vegetable traders, packers, handlers, truck driver, wholesalers and retailers on “Improved Postharvest Management and Food Safety” should be undertaken
- Part of the Agricultural Incentive provided by the government should be shared in the postharvest sector particularly in packaging of fresh produces
- National food control and regulatory systems should be strengthened in harmonization with Codex, HACCP & Food Hygiene standards to ensure quality and safe products for both domestic and overseas consumers
- Pesticide residue analysis laboratory should be established in major production areas as well as city wholesale markets to meet requirements of international standards
- Provision for grant of Certification System for “Quality Produce” is to be developed through an institutional arrangement.

References

Kader, A. A. and Rolle, R. S. 2004. The role of post-harvest management in assuring the quality and safety of horticultural produce. FAO agricultural services bulletin, 152. FAO of the United Nations, Rome.

Kyriacou, M.C. and Rouphael, Y. 2018. Towards a new definition of quality for fresh fruits and vegetables. Sci. Hort. 234: 463–469.

Roy, K. C. 2009. Engineering Approaches to Minimize Postharvest Loss in Agriculture Towards Attaining Food Security in Bangladesh. Key-note paper presented at the Institution of Engineers' Bangladesh on 12 April 2009, IEB HQ, Ramna, Dhaka.

Salunkhe, D. K. and Desai, B. B. 1984. Postharvest Biotechnology of Fruit, Vol. 1. CRC Press, Boca Raton, Fla. P. 184.

WHO. 2018. Increasing fruit and vegetable consumption to reduce the risk of non-communicable diseases.http://www.who.int/elena/titles/fruit vegetables_ncds/en/

Biofortification: Development and use of nutrient-rich crop varieties to improve micronutrient intake

Dr. Khandakar Md Iftekharuddaula
CSO and Head Plant Breeding Division
Bangladesh Rice Research institute, Gazipur
head.breeding@brri.gov.bd

1. Introduction

Biofortification refers to the process of increasing the concentration of essential vitamins and minerals in staple crops through conventional plant breeding or modern biotechnology. It is a sustainable and cost-effective strategy to address "hidden hunger"—micronutrient deficiencies such as zinc (Zn), iron (Fe), iodine (I), and vitamin A—particularly in developing countries where diets rely heavily on cereals.

In recent years, consumer preference has also expanded toward nutraceutical crop varieties that help combat lifestyle-related diseases such as diabetes, cancer, and cardiovascular disorders.

2. Micronutrient Deficiencies in Bangladesh

Micronutrient malnutrition remains a serious public health concern in Bangladesh.

- Zinc deficiency affects a large proportion of children and women, leading to impaired immunity and growth retardation.
- Iron deficiency is a primary cause of anemia, particularly among women of reproductive age.
- Vitamin A deficiency contributes to visual impairment and increased child mortality.

These deficiencies underline the urgent need for biofortified staple crops, especially rice, which constitutes the major part of the daily diet.

3. Varietal and Technological Achievements of BRRI

Bangladesh Rice Research Institute (BRRI) has released 121 modern rice varieties, including:

- 113 inbred varieties and 8 hybrid varieties
- Seasonal adaptation:
    - T. Aman (Rainfed Lowland Rice): 51
    - Boro (Irrigated Rice): 55
    - T. Aus (Partially Irrigated Rice): 7
    - B. Aus (Broadcast Rice): 6
    - Others (Aus–Boro adaptable): 12

Stress-Tolerant Varieties (38 varieties)

- Salinity tolerant: 13
- Submergence tolerant: 4
- Drought tolerant: 4
- Cold tolerant: 4
- Tidal submergence & water stagnation tolerant: several varieties

Quality and Nutritional Varieties

- Premium grain quality: 14
- Nutritional & nutraceutical rice varieties: 28

Nutritional traits include: - High protein content (10.0–10.8%) - Zinc: 20.0–27.7 ppm - Iron: 10–12 ppm - Low Glycemic Index (GI 52–55) - Antioxidant and GABA-rich rice

BRRI has also developed over 300 crop production technologies.

4. Biofortified Rice Varieties Developed by BRRI

4.1 Zinc-Enriched T. Aman Varieties

BRRI dhan62 and BRRI dhan72

Parameters	BRRI dhan62	BRRI dhan72
Growth duration (days)	100	125-130
Grain yield t/ha	4.5-5.0	6.0
Zinc content (mg/kg)	20	22.8
Special features	LS grain	LB grain

4.2 Biofortified and Premium Quality Rice

BRRI dhan84:

- High Zinc content (27.6 mg/kg)
- Red pericarp grain with 10 ppm Iron
- Long slender grain
- Growth duration 140-145 days
- Grain yield potential 7.0 t/ha

BRRI dhan100 (Boro):

- Yield potential: 8.8 t/ha
- GD: 148 days
- Grain: Nizersail and Jira type
- Zinc content: 25.7 mg/kg
- Amylose: 26.8%
- Head rice yield: 64%

BRRI dhan102 (Boro):

- High zinc content (25.5 mg/kg)
- Growth duration 150 days
- Clean rice size and shape Long slender
- 1000 GW 22.7 g
- Amylose 28.0%
- Yield potential 9.6 t/ha

5. Bioavailability of Zinc in Biofortified Rice

- Zinc bioavailability in biofortified rice varieties is approximately 20%, compared to 16 ppm in non-biofortified rice.
- Biofortified rice can provide up to 50% of daily zinc requirements for children.
- Although milling and processing cause nutrient loss, zinc-enriched rice remains a reliable dietary source.
- Zinc bioavailability depends on rice genotype, enrichment method, and growing environment.

Zinc and Iron-Enriched Rice (BINA dhan20)

- Zinc: 26.5 ppm (brown rice)
- Iron: 20–31 ppm (brown rice)
- Grain: Reddish, long slender
- Yield potential: 5.5 t/ha

6. Low Glycemic Index (GI) and Special Purpose Rice

BRRI dhan105:

- Grain yield 7.61 t/ha
- Medium GI Boro variety (Diabetic rice, GI value: 55.04)
- Medium slender grain
- 1000 grain weight 19.4 gm
- Amylose: 27%

- Growth duration 148 days
- Plant height 100 cm

7. Biofortified Non-Rice Crops

Protein-Enriched Maize (BARI hybrid maize5)

- High-quality protein (total protein 11%)
- Distinct anthocyanin pigmentation
- Thousand kernel weight: 290–310 g

Zinc-Enriched Wheat (BARI gom33)

- Zinc content: 50–55 ppm
- Yield: 4.8–5.5 t/ha
- Heat tolerant and disease resistant

8. Nutritional and Nutraceutical Rice Research at BRRI

- Increasing rice protein by 1% can supply 6.5% additional daily protein requirement.
- Target: Develop rice varieties with 12–13% protein to meet up to 80% daily needs.
- Zinc-enriched BRRI varieties can already meet 30–60% of daily zinc demand.
- Future target: dual micronutrient varieties with ~45 ppm Zn and 15 ppm Fe.

9. Golden Rice and Antioxidant-Rich Rice

GR2-E BRRI dhan29 (Golden Rice)

- Contains ~12 ppm carotenoids in milled rice
- Can meet 50–70% of daily vitamin A requirement
- No yield penalty compared to BRRI dhan29

Proposed Varieties

- BRRI dhan115 (Vitamin E enriched, Boro)
- High antioxidant rice with elevated C3G and total antioxidant capacity (TAC)

10. Current Breeding Strategies at BRRI

- Rapid Cycle Recurrent Selection-based forward breeding systems
- Mainstreaming grain zinc content @ 1 ppm per year
- Use of high-throughput phenotyping (e.g., XRF machines)
- Marker-assisted and molecular breeding approaches

11. Ongoing and Future Research Programs

Zn-Enriched Rice (ZER)

- Advanced breeding lines evaluated in T. Aman and Boro seasons
- Trait-marker profiling applied

Healthier Rice Initiative

- Introgression of *Zmpsy1* and *ApFer* genes
- Development of rice enriched with beta-carotene, iron, and zinc

12. Way Forward

- Development of high-yielding biofortified varieties with export potential
- Integration of stress tolerance with nutritional traits
- Development of biofortified hybrid rice
- Application of bioinformatics, genome editing, and haplotype breeding
- Improved post-harvest management: milling, grading, storage, and packaging

Conclusion

Biofortification represents a powerful, science-based approach to improving national nutrition security. Through sustained research, innovation, and dissemination, BRRI continues to play a pivotal role in developing nutrient-rich, high-yielding crop varieties for Bangladesh.

Research Methods for Strengthening Nutrition–Sensitive Agriculture

Anil Kumar Das (PhD in Agronomy)
Senior National Programme Specialist
FAO of the United Nations, Bangladesh
Mail: anil. das@fao.org

Definition of research:

Research is **"a systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions."** It involves structured inquiry, methodological rigor, and critical analysis to generate empirical evidence, validate theories, or solve real-world problems. Unlike casual information gathering, research emphasizes transparency, objectivity, and reproducibility.

Classification of research:

1. Classification Based on Purpose

- Basic (Pure) Research

Aims to expand theoretical knowledge without immediate practical application.
Example: Studying the nature of dark matter.

- Applied Research

Focuses on solving real-world problems using existing knowledge.
Example: Developing a vaccine for a specific virus.

2. Classification Based on Objectives

- Descriptive Research

Describes characteristics of a phenomenon or population. Answers "what" questions.
Example: Demographic studies.

- Correlational Research

Examine relationships between variables without manipulation.
Example: Relationship between stress and heart disease.

- Exploratory Research

Investigates new or unclear phenomena to generate initial insights.
Example: Exploring customer behavior toward a new product.

- Explanatory Research

Seeks to explain why and how phenomena occur.
Example: Why are certain groups prone to specific health conditions.

3. Classification Based on Approach

- Qualitative Research

Uses non-numerical data to understand experiences and social processes.
Example: Interviews to study coping strategies for stress.

- Quantitative Research

Use numerical data and statistical analysis to measure relationships.
Example: Impact of study hours on academic performance.

- Mixed Methods Research

Combines qualitative and quantitative approaches for comprehensive insights.

4. Other Common Types

Experimental Research – Controlled testing to determine cause-effect relationships.
Case Study Research – In-depth analysis of a specific instance or event.
Longitudinal Research – Studies conducted over a long period to track changes.
Cross-sectional Research – Snapshot study at a single point in time.

What is Nutrition–Sensitive Agriculture (NSA)?
Nutrition-sensitive agriculture refers to agricultural strategies and interventions that aim to improve nutrition outcomes by addressing the underlying causes of malnutrition. It integrates nutrition objectives into agricultural programs and policies.

Research Methods for Strengthening Nutrition Sensitive Agriculture (NSA)
To strengthen NSA, research must combine agricultural, nutritional, and socio-economic dimensions. Common methods include:

1. Baseline and Needs Assessment

Purpose: Understand the current nutritional status, dietary patterns, and agricultural practices.
Tools: Household surveys, anthropometric measurements, food frequency questionnaires.
Example: Conducting a survey in rural communities to assess prevalence of micronutrient deficiencies and crop diversity.

2. Participatory Rural Appraisal (PRA)

Purpose: Engage communities to identify local food systems, constraints, and opportunities.
Tools: Focus group discussions, mapping exercises, seasonal calendars.

Example: Farmers and researchers co-create a seasonal crop calendar to identify gaps in nutrient-rich food availability.

3. Randomized Controlled Trials (RCTs)

Purpose: Test the impact of specific interventions on nutrition outcomes.
Tools: Experimental design with treatment and control groups.
Example: Introducing biofortified sweet potatoes to one group and comparing vitamin A levels with a control group.

4. Value Chain Analysis

Purpose: Identify how agricultural products move from farm to plate and where nutrition can be improved.
Tools: Market surveys, stakeholder interviews.
Example: Studying the dairy value chain to ensure milk reaches vulnerable populations without nutrient loss.

5. Monitoring and Evaluation (M&E)

Purpose: Track progress and measure impact of NSA interventions.
Tools: Indicators like Minimum Dietary Diversity Score (MDDS), Household Food Insecurity Access Scale (HFIAS).
Example: Monitoring changes in dietary diversity after introducing kitchen gardens.

6. Mixed-Methods Approach

Purpose: Combine quantitative (surveys, trials) and qualitative (interviews, observations) data for holistic understanding.
Example: Surveying households for dietary intake and conducting interviews to understand cultural food preferences.

Example in Practice

Project: Improving Nutrition through Diversified Home Gardens
Research Steps:
Baseline Survey: Assess household dietary diversity and micronutrient deficiencies.
Intervention: Introduce nutrient-rich crops (e.g., leafy greens, legumes) and provide training.
Monitoring: Use MDDS to measure improvement in diet quality.
Impact Evaluation: Compare intervention households with control households after one year.

Potential Outcome: Increased consumption of iron-rich vegetables and reduction in anemia prevalence among women and children.

Logical Framework

Hierarchy of Objectives	Indicators	Means of Verification	Assumptions
Goal: Improved nutritional status of target households through sustainable food production	- % reduction in malnutrition rates among target households - Dietary diversity score improved by X%	- Household nutrition surveys - Health records	- Stable socio-economic conditions - No major climate shocks
Purpose: Increased availability and consumption of diverse, nutrient-rich foods from home gardens	- % of households adopting diversified home gardens - Average number of food groups produced per household	- Project monitoring reports - Household interviews	- Households have access to land and water - Community participation remains high
Outputs:			
1. Home gardens established and diversified	- Number of households with functional home gardens - Number of crops/varieties introduced	- Field visit reports - Training records	- Seeds and inputs available locally
2. Capacity of households strengthened on nutrition-sensitive gardening	- Number of training sessions conducted - % of participants applying learned practices	- Training attendance sheets - post-training evaluation	- Households willing to adopt new practices
3. Community awareness on nutrition improved	- % increase in knowledge scores on nutrition - Number of	- Pre/post campaign surveys - IEC materials distributed	- Cultural norms support dietary diversity

Market Access and Nutrition: Urban and Peri-Urban Agriculture

Dr. Md. Mosharraf Uddin Molla
Member Director
Agricultural Economics and Rural Sociology Division
Bangladesh Agricultural Research Council, Dhaka
E-mail: md.aers@barc.gov.bd

Market access

Market access for goods in the WTO means the conditions, tariff and non-tariff measures, agreed by members for the entry of specific goods into their markets. Tariff commitments for goods are set out in each member's schedules of concessions on goods.

Market access in agriculture

Market access in agriculture refers to the ability of farmers to sell their products to buyers, which can be improved through infrastructure like roads and storage, and by farmers forming groups to increase their bargaining power and meet buyer requirements. Better market access improves farmers' incomes, enhances food security, and encourages more diversified agricultural production. Organizations and governments promote market access by investing in physical infrastructure, facilitating collective action among farmers, and connecting them to various buyers.

Urban Agriculture

Urban agriculture is the practice of growing, processing and distributing food in or around cities or towns. Urban agriculture contributes to food security and food security in two ways. On the one hand, it increases the amount of food needed by people living in cities, and secondly, it allows fresh vegetables and fruits and meat products to be available to urban consumers. Because urban agriculture encourages energy-efficient local food production, urban and peri-urban agriculture is generally viewed as sustainable agriculture.

Urban agriculture defined in simple terms is the growing, processing, and distribution of food and other products through intensive plant cultivation and animal husbandry in and around cities (Bailkey et al., 2000). Urban Agriculture contributed much to cities and their inhabitants, providing fresh produce; low energy consumption for distribution of produce to consumers, recycling of urban organic wastes back into food production, and bringing greenery to the cities (Bodlovich, 2001).

Both rural and urban agriculture are equally important in Bangladesh. For commercial food production, we have no chance in urban agriculture. On the other hand, food, nutrition, and climate will not be fulfilled without urban homestead agriculture. There is no doubt that rural agriculture is important as the economy of Bangladesh depends on agriculture, but urban agriculture is also very important particularly in the peri-urban agriculture practices. This is important if we consider from the point of food security and food safety. (Chowdhury, 2023).

Peri-urban agriculture

Peri-urban agriculture is farming within or near cities, blending urban and rural practices to provide fresh, local food, create jobs, and build resilient food systems by using city resources and reducing transport. It involves diverse scales, from community gardens to larger operations, and plays a crucial role in urban sustainability, food security, and connecting residents with food production.

Examples

- Community gardens in vacant city-owned lots.
- Small farms selling produce directly at urban markets.
- Integrating agriculture into urban planning for green spaces, etc.

Urban and peri-urban agriculture (UPA)

Urban and peri-urban agriculture (UPA) can be defined as practices that yield food and other outputs from agricultural production and related processes (among others, transformation, distribution, marketing, recycling), taking place on land and other spaces within cities and surrounding regions, involving urban and peri-urban actors, communities, methods, places, policies, institutions, systems, ecologies and economies, largely using and regenerating local resources to meet the changing needs of local populations while serving multiple goals and functions.

Urban and peri-urban agriculture (UPA) in Bangladesh is a vital strategy for improving food security, nutrition, and livelihoods, particularly for low-income urban residents. Common practices include home gardens, rooftop farming, and vertical farming, which provide fresh produce, generate extra income, and enhance the urban environment through greening. Despite challenges like lack of land access and financing, UPA plays a significant role in a nation facing the pressures of rapid urbanization and climate change.

Market access for urban and peri-urban agriculture

Market access for urban and peri-urban agriculture in Bangladesh is crucial for improving food security, but it faces challenges like poor infrastructure and limited government support, especially for small-scale farmers. Solutions include creating more farmers' markets, developing digital platforms, and improving supply chains to connect producers with consumers, which can reduce waste and provide access to fresh produce.

How market access works

- **Physical access**: This involves building and maintaining infrastructure like roads, bridges, and storage facilities, which reduces transportation costs and helps preserve food quality.
- **Collective action**: Farmers can form groups, cooperatives, or associations to pool their produce, which provides a larger, more consistent supply that is more attractive to large buyers.
- **Value chain development**: This includes all stages from production to processing and marketing, enabling producers to add value to their products.
- **Market information**: Farmers need information about prices and demand to make informed decisions, and organizations help provide this.

Key challenges to market access

- **Rapid urbanization:** The fast, often unplanned, growth of cities like Dhaka and Chattogram puts pressure on peri-urban agricultural land, leading to its loss and damaging the environment.
- **Infrastructure and logistics:** Challenges exist in transportation and storage, particularly in getting produce from farms to urban consumers efficiently.
- **Weak linkages:** There is a lack of strong backward and forward linkages between producers and markets, making it difficult for local produce to reach wider consumer bases.
- **Informal markets:** Informal food markets face issues like weak food safety provisions, gender inequity, and a lack of nutrition awareness.
- **Lack of planning:** Planning challenges, land issues, and exclusion of key actors have been noted as barriers.

Efforts to improve market access

- **Private investment:** Promoting private investment in the agri-food supply chain, including inputs, processing, storage, and marketing, is seen as crucial for improving market access.
- **Producer groups:** Strengthening farmer capacity through producer groups and cooperatives can create economies of scale, which helps in accessing larger markets.
- **Urban and peri-urban aquaculture:** Expanding aquaculture in and around cities, such as polyculture of carp and catfish, directly supplies the growing urban fish demand.
- **Government policies:** The government is implementing plans to protect rivers and reservoirs and has promoted decentralization of activities to address urban sustainability challenges, which can indirectly help rural-to-urban food flows.
- **Technology and services:** Improving farmer access to extension services and encouraging innovative farming technologies can increase on-farm productivity, which is necessary to meet market demand.

Benefits of urban and peri-urban agriculture

Urban food systems are impacted by global trends like population growth, urbanization and globalization and face challenges such as climate change, pandemic, conflicts, hunger, food insecurity, malnutrition, obesity and diet-related non-communicable diseases, as well as recent crises such as COVID-19 pandemic and Ukraine conflict. Mitigating these challenges and increasing the resilience of urban food systems requires stable food production, as well as shorter and simplified supply and distribution chains. In this context, UPA is increasingly being adopted by city dwellers and promoted by local institutions to face the above-mentioned challenges.

Benefits

- **Improved food security and nutrition:** UPA provides direct access to fresh, nutritious fruits and vegetables, which is especially important for low-income families who can use it to meet their dietary needs for vitamins and minerals.
- **Economic opportunities:** It offers a source of extra income for households through the sale of surplus produce and supports entrepreneurship along the supply chain.
- **Environmental benefits:** Urban farming helps green the environment, can lead to reduced waste, and can create cooler microclimates.

- **Climate change adaptation:** Practices like hydroponics can be particularly beneficial as they use significantly less water, which is critical in a country vulnerable to droughts.

However, a study carried out in 2019 by the Dhaka North Community Federation and FAO found that poor households were spending up to half their income on food. The COVID-19 pandemic exacerbated problems and there are increasing rates of hunger in urban communities. For many of the urban poor, growing their own food has been a lifeline. Promotion of urban gardening by FAO and organizations including BRAC, Proshika, POCAA, and Islamic Relief, has benefited hundreds of vulnerable families in Bangladesh (FAO, 2021).

Common practices and forms

- **Rooftop gardening (RTG):** This is a well-established practice in urban areas, utilizing rooftop spaces to grow a variety of crops.
- **Home and balcony gardening:** Families use small spaces like balconies, yards, and containers to cultivate food for self-consumption.
- **Peri-urban farms:** These are more commercial, semi- to fully-commercial farms located on the outskirts of cities that produce vegetables, raise livestock, or produce milk and eggs for the urban market.
- **Hydroponic and vertical farming:** Modern techniques are gaining traction, allowing for higher yields in limited spaces.

Challenges to implementation

- **Limited access to land:** The high cost and limited availability of land in urban areas is a major constraint, especially for the poor.
- **Financing:** Lack of financial support and credit is a significant barrier to expanding UPA initiatives.
- **Knowledge and awareness:** Some urban residents lack the necessary knowledge and skills for effective gardening.
- **Infrastructure and security:** Concerns like building suitability for rooftop gardens, water shortages during the dry season, and security for gardens, particularly commercial ones, pose challenges.
- **Policy and planning:** UPA is often not officially recognized in urban planning and agricultural policies, hindering its potential.

Way Forward

- **Establish more farmers' markets:** Governments can support the establishment of more farmers' markets to improve market access for peri-urban farmers.
- **Develop digital platforms:** Creating digital platforms can improve market access by connecting producers and consumers directly and efficiently.
- **Improve infrastructure:** Investing in better food distribution and access infrastructure in urban areas is critical.
- **Promote small-scale farming:** Supporting small-scale urban farms with necessary permissions and resources can help them thrive and access markets.
- **Promote value addition:** Encouraging activities like waste recycling and the creation of bio-gas and bio-fertilizers can create new revenue streams and sustainable development opportunities for urban agriculture.

Conclusion

Urban and peri-urban agriculture (UPA) has become a key component of the survival strategies of poorer sections of the population while also providing a significant contribution to the urban fresh food supply chain. The positive impacts of this industry include improved nutrition and health, an improved environment for living, increased entrepreneurship and poverty alleviation. Urban agriculture is one of the most effectual concepts of sustainable development. It improves the quality of urban environment through greening and reduction in pollution. In many developed and also in some developing countries, local authorities start to recognize the role of urban agriculture for local economic development, enhancing urban food security and offering recreational services to urban citizens.

In a developing country like Bangladesh, where a huge number of people face food insecurity, practice of urban and peri-urban agriculture can play a vital role in supplying fresh foods. Urban planners in developing countries should pay more attention to peri-urban agricultural practices which could assist in improving urban environment, generating employment and reducing future food insecurity (Ananya et al., 2012).

****

Social and institutional dissemination for NSA
&
One health Approach: Linking Human, Animal and Environment health for better nutrition

Anil Kumar Das
(PhD in Agronomy)
Senior National Programme Specialist
FAO Bangladesh
E-mail: anil.das@fao.org

Introduction

Social and institutional roles are very important for spreading knowledge about Nutrition Sensitive Agriculture (NSA). Social groups like farmers, women's organizations, and community leaders help share ideas and practices that improve nutrition through farming. Institutions such as government agencies, NGOs, and research organizations support this by creating policies, training programs, and providing resources. Together, they help people understand how agriculture can improve health and nutrition. Their cooperation ensures that nutrition-sensitive farming reaches more communities and becomes part of everyday agricultural work.

Social dissemination

Social dissemination of Nutrition-Sensitive Agriculture (NSA) involves strategic communication, community engagement, and multi-sectoral collaboration to promote practices that improve diet quality and nutrition outcomes. Key methods include interpersonal communication, community-based approaches, nutrition education, and leveraging various media and social networks to reach vulnerable populations effectively.

Key Strategies for Social Dissemination

Interpersonal Communication (IPC) and Community Based Approaches: Face-to-face interaction and dialogue within communities are the most widely used and effective approaches for behavior change in NSA. This involves:

Engaging local stakeholders: Including farmers, community leaders, and health workers to foster ownership and ensure sustainability.

Participatory methods: Involving communities in decision-making, such as identifying local nutritional problems and co-creating solutions (e.g., cooking demonstrations using locally available nutrient-rich foods).

Peer educators and local champions: Utilizing respected community members to disseminate information and model desired behaviors (e.g., "positive deviance" approach).

Nutrition Promotion and Education: Education is a critical, complementary component of NSA interventions.

Building on local knowledge: Tailoring educational content to existing local knowledge, attitudes, and practices to ensure cultural appropriateness and effectiveness.

Addressing cultural norms and taboos: Engaging with traditional leaders and community members to challenge harmful social norms (e.g., restrictions on women and children consuming certain nutritious foods).

Practical skills development: Providing training on food preparation, preservation, and storage techniques to retain nutritional value and ensure year-round access to diverse diets.

Leveraging Various Media and Technology: Traditional media: Using radio and TV programs for mass education and public awareness campaigns.

Social media and ICTs: Utilizing platforms like WhatsApp, Facebook, and YouTube for faster and wider information dissemination, networking among farmers, and accessing timely information on weather, pests, and market prices.

Print media: Using flip charts, pamphlets, and posters to reinforce messages delivered through other channels.

Empowering Women: Dissemination efforts must specifically target and empower women, who play a crucial role in household nutrition and agriculture. Strategies include:
Increasing women's access to income-generating opportunities, land, and resources.
Engaging men in gender issues and promoting shared household responsibilities.

Multi-sectoral Collaboration and Advocacy: Malnutrition has multiple, interconnected causes, requiring a holistic approach involving agriculture, health, education, and social protection sectors.

Policy integration: Advocating for the integration of nutrition-sensitive strategies into national policies and programs.

Stakeholder partnerships: Working with government, NGOs, research institutions, and the private sector to create a supportive environment for nutrition-sensitive practices.

Challenges

Challenges include a lack of awareness among farmers and community members, limited access to resources and infrastructure (e.g., high data costs, poor communication systems), and the need to tailor interventions to diverse local contexts. Misinformation from unauthenticated sources on social media can also be a concern. Effective dissemination requires a candid assessment of the local context and a multi-faceted approach to address these barriers.

Institutions dissemination

Institutions play a crucial role in the dissemination of nutrition-sensitive agriculture (NSA) by providing policy frameworks, coordination mechanisms, educational platforms, and practical support necessary to integrate nutritional goals into agricultural practices and food systems. They act as change agents across local, national, and global levels.

Key roles of institutions in NSA dissemination:
Policy and Governance: Government bodies and international organizations (e.g., FAO, IFAD) create an enabling environment for NSA by integrating nutrition-sensitive strategies into national agricultural and rural development policies. This includes establishing accountability systems, setting standards, and ensuring financial and logistical support for NSA initiatives at all levels.

Capacity Building and Education:
Agricultural colleges and research institutions incorporate nutrition core competencies into agricultural education and training curricula for future professionals and current extension agents.

Extension services educate farmers on producing nutrient-rich crops, adopting diversified farming systems, and improving post-harvest handling, storage, and processing techniques to minimize nutrient loss.

Community based initiatives like Farmer Field Schools and workshops promote nutrition literacy, healthy eating habits, and food preservation methods among farming communities.

Coordination and Partnership: Institutions facilitate multi-sectoral collaboration among the agriculture, health, education, and social protection sectors. This ensures a holistic approach to addressing the complex causes of malnutrition and avoids working in silos.

Research and Evidence Generation: Research institutions conduct policy-relevant research, impact evaluations, and data collection (e.g., on food composition and dietary needs) to build the evidence base for effective NSA practices and guide decision-making.

Market Access and Value Chains: Institutions support the development of nutrition-sensitive value chains and facilitate market access for nutritious foods, helping farmers, especially vulnerable groups like women, to generate income and improve household diet diversity.

Community Empowerment and Targeting: Institutions help target vulnerable populations and empower communities, particularly women, in agricultural decision-making processes, which is a key driver for improved household nutrition outcomes.

Innovation and Technology Transfer: They promote the adoption of innovative techniques such as biofortification, integrated farming systems, and climate-smart agricultural technologies to enhance food quality and resilience.

By performing these roles, institutions bridge the gap between agricultural production and nutritional outcomes, ensuring that agricultural development effectively contributes to public health and well-being.

Government and Policymakers:
Policy and Regulatory Frameworks: Governments create and integrate nutrition-sensitive strategies into national agricultural development policies to ensure programs are funded and implemented.

Cross Sectoral Coordination: They facilitate collaboration among various sectors, including agriculture, health, education, water, and sanitation, which is essential for a holistic approach to addressing malnutrition's underlying causes.

Enabling Environment: They provide the political commitment and infrastructure (e.g., roads for market access, water management systems) necessary for NSA practices to thrive.

Program Implementation: Government agencies like agricultural extension services implement national programs, such as "One-house-one-farm" projects, that promote diversified home-stead food production to reduce malnutrition.

Non-Governmental Organizations (NGOs) and International Agencies
Community Intermediaries: NGOs serve as a bridge between vulnerable populations and government/international resources, leveraging local knowledge to tailor interventions to specific community needs.

Capacity Building and Training: They empower communities, particularly women, through training programs on sustainable agricultural practices, livestock management, and nutrition education.

Emergency Response and Aid: In crises, NGOs provide immediate food assistance while also focusing on long term solutions, such as cash transfer programs that empower families to buy nutritious food and stimulate local economies.

Advocacy and Innovation: They advocate for policies that support smallholder farmers and engage in research to identify and promote effective, innovative interventions like biofortification.

Research and Academic Institutions
Knowledge Generation and Dissemination: They conduct research on the complexities of food systems and effective interventions, addressing knowledge gaps and producing evidence-based practices to inform programs.

Curriculum Development: Agricultural colleges integrate nutrition-sensitive concepts into their curricula, training the next generation of extension agents and professionals to act as change agents for a nutritionally sensitive transformation of agriculture.

Technological Innovation: They work on developing nutrient-dense crop varieties (biofortification) and climate-smart agricultural practices to enhance food quality and resilience.

Community-Based Institutions and Farmer Groups
Local Adaptation and Ownership: Farmer co-ops, field schools, and community groups ensure interventions are culturally relevant and adopted long-term by fostering community ownership.

Peer-to-Peer Learning: They facilitate knowledge sharing among farmers through approaches like Farmer Field Schools, which use hands-on training to promote diversified farming and healthy eating habits.

Market Access: Farmer associations help members pool resources, access market information, and negotiate better prices for nutritious products, thereby increasing income that can be used for purchasing diverse foods and health services.

In sum, institutions facilitate the dissemination of NSA through a combination of policy support, education, resource provision, and community empowerment, working across sectors to address the complex and underlying causes of malnutrition.

Programs are more effective and sustainable when they are adapted to local settings and include regular monitoring.

Ongoing engagement and oversight at the institutional level help maintain NSA practices beyond a single project cycle.

Conclusion

Spreading Nutrition Sensitive Agriculture (NSA) works best when both communities and institutions work together. Community members help share useful farming and nutrition ideas through conversations, education, and media. Institutions like governments, NGOs, and schools support these efforts by making policies, offering training, and providing resources. Together, they help people grow and eat healthier food, especially by supporting women. To make NSA successful in fighting malnutrition, everyone needs to keep working together, be creative, and adjust plans to fit local needs.

Safe Harvests, Healthy Diets: The Role of Hygiene in Nutrition-Sensitive Agriculture

Dr. Zakiah Rahman Moni
Principal Scientific Officers (Nutrition)
Bangladesh Agricultural Research Council (BARC), Dhaka
E-mail: zakiah@barc.gov.bd

Nutrition-sensitive agriculture focuses not only on increasing food production but also on improving the nutritional quality of diets. A vital but often ignored component of this approach is **hygiene**. Poor hygiene at any stage from production to consumption can reduce food quality, introduce pathogens, cause illness, and ultimately undermine nutritional benefits.

2. Components:

2.1 Preventing Foodborne Diseases

- Contaminated soil, water, or tools can transmit harmful pathogens (E. coli, Salmonella, parasites).
- Foodborne infections reduce nutrient absorption, leading to undernutrition.

2.2 Protecting Nutrient Quality

- Clean handling and safe storage protect food from spoilage.
- Nutrient-rich foods (vegetables, fruits, animal-source foods) are highly perishable and easily contaminated.

2.3 Breaking the Cycle of Malnutrition and Infection

Repeated infections (diarrhea, intestinal parasites) reduce appetite, damage the gut, and impair nutrient uptake, creating a cycle:
Poor hygiene → Illness → Poor nutrition → Lower immunity → More illness

Source: One Health Perspectives on Food Safety in Minimally Processed Vegetables and Fruits: From Farm to Fork by Maria Isabel Santos, Madalena Grácio, Mariana Camoesas Silva, Laurentina Pedroso, andn Ana Lima

3. Hygiene Components in Agriculture

3.1 Water

Use safe, uncontaminated water for irrigation, washing tools, and processing harvests.

- Avoid irrigation near wastewater drains or animal waste.
- Promote water testing and filtration when possible.

3.2 Soil and Field Hygiene

- Prevent contamination from animal waste, sewage, and chemicals.
- Practice crop rotation and proper composting of manure (hot composting kills pathogens).
- Maintain clean harvesting paths and avoid placing produce directly on soil.

3.3 Personal Hygiene of Farmers and Handlers

- Handwashing with soap before harvesting, feeding animals, and handling produce.
- Avoid working with open wounds or infections.
- Use gloves, boots, and clean clothing during handling and packaging.

3.4 Tool and Equipment Hygiene

- Regularly wash harvesting tools, crates, and containers with clean water.
- Use designated containers for harvesting only—not for fertilizers or chemicals.

3.5 Post-Harvest Hygiene

- Wash produces with clean water only.
- Ensure clean drying mats, racks, and storage facilities.
- Protect harvested crops from animals, insects, dust, and moisture.

4. Hygiene in Animal Production (Livestock & Poultry)

- Keep animal houses clean and dry.
- Ensure clean drinking water and uncontaminated feed.
- Proper dung management—dispose of waste away from crops and water sources.
- Follow biosecurity practices to prevent disease spread.
- Milk, eggs, meat must be handled using sanitary techniques to avoid contamination

5. Role of Hygiene in Improving Dietary Outcomes

5.1 Ensures Safe, High-Quality Food

Consumers receive food that is free from harmful bacteria, chemicals, and toxins.

5.2 Enhances Bioavailability of Nutrients

When people are not sick, their bodies absorb nutrients more effectively.

5.3 Supports Maternal and Child Nutrition

Children and pregnant women are highly vulnerable to foodborne illness. Clean food means:

- better growth
- better immunity
- reduced stunting and wasting

5.4 Increases Consumer Confidence in Local Produce

Safe, hygienic produce attracts better markets and improves income for farmers.

6. Hygiene and Women's Roles

- Women often handle post-harvest work, household food preparation, and feeding.
- Training women in hygiene leads to improved family nutrition.
- Time-saving hygiene tools (clean water sources, drying racks, proper storage) reduce workload and improve efficiency.

7. Practical Hygiene Interventions for Farmers

Low-Cost, High-Impact Practices

- Handwashing stations near fields
- Controlled composting of manure
- Clean harvesting mats
- Raised drying racks
- Covered storage bins

- Separate areas for animals and crops
- Training on safe pesticide use
- Good Agricultural Practices (GAP)

8. Integrating Hygiene into Nutrition-Sensitive Agriculture Programs Approaches

- Train farmers on hygiene as part of extension services
- Promote WASH (Water, Sanitation & Hygiene) alongside agricultural training
- Strengthen food safety standards and monitoring
- Involve community leaders in awareness campaigns
- Link farmers to certification systems (GAP, safe food certification)

9. Conclusion

Nutrition-sensitive agriculture cannot achieve its goals without strong hygiene practices. Safe production, handling, and storage ensure that the food reaching households is not only abundant and diverse but also **safe, nutritious, and beneficial for health**.

Advance Behavior Change Communication (BCC) for Nutrition-Sensitive Agricultural

Mr. Mehedi Hasan Bappy
Project Coordinator
Youth and Adolescent Nutrition
GAIN, Bangladesh
E-mail: mbappy@gainhealth.org

OVERVIEW OF NUTRITION-SENSITIVE AGRICULTURE.

Bangladesh has made significant progress in agriculture, food production, and economic growth over the past decades. The country is now self-sufficient in rice, has expanded vegetable and fish production, and continues to strengthen livestock and poultry sectors. Yet, despite these achievements, many families still struggle with poor diet diversity, micronutrient deficiencies, and limited access to nutrient rich foods. National surveys show that a large share of households consume mainly rice with few vegetables, limited protein, and very low intake of micronutrient dense foods. These dietary patterns contribute to persistent undernutrition, anemia in women and adolescent girls, and low levels of essential nutrients among children.

These challenges show that increased production alone does not guarantee better nutrition. To improve national nutrition status, people need to adopt food practices that support healthier diets. This requires changes in how households grow, select, prepare, store, and consume food. Nutrition Sensitive Agriculture helps bridge this gap by linking agriculture with nutrition outcomes. It encourages diversified crop production, small fish culture, homestead gardening, small livestock rearing, improved food processing, safe storage, reduced food loss, and active participation of women in food decisions. All these actions directly influence what families actually eat.

However, promoting these practices requires more than technical training. It requires influencing behaviours at both household and community levels. Research from Bangladesh shows that when farmers and families receive simple, clear, and repeated nutrition messages alongside agricultural support, adoption of improved practices increases significantly. Program evaluations by FAO, GAIN, IFPRI, and various government departments highlight that behaviour change communication increases dietary diversity, improves feeding practices for women and children, and motivates households to consume part of their own production.

Government officials play a central role in this process. Extension officers, researchers, field staff, district officials, and communication units interact with communities regularly. They are trusted sources of information and have the authority to introduce new practices,

reinforce positive behaviours, and guide local decision making. When these officials integrate SBCC into their routine work, they strengthen the connection between agriculture and nutrition in a practical and accessible way.

This session aims to equip individuals with the knowledge and tools to use Social and Behaviour Change Communication effectively within their own sectors. The session explains core concepts of SBCC, shows how to identify priority behaviours, provides guidance on developing simple and actionable messages, and demonstrates how to use available government and community channels to reach farmers and families. The content is designed to help officials from crop, fisheries, livestock, marketing, and communication departments integrate SBCC into their everyday responsibilities.

Improving nutrition in Bangladesh requires consistent effort from all sectors. By strengthening SBCC skills officials can help ensure that the benefits of improved production translate into healthier diets, stronger communities, and better nutrition outcomes for the country.

SESSION OBJECTIVES

By the end of this session, participants will be able to:

- Describe the basic idea of Social and Behaviour Change Communication (SBCC) and why it is important for nutrition sensitive agricultural practices.
- Identify one or two priority behaviours in their own sector that can improve nutrition outcomes.
- Develop a simple, clear SBCC plan using basic message building steps.
- Outline one small SBCC action after the training

BASIC IDEA OF SOCIAL AND BEHAVIOUR CHANGE COMMUNICATION (SBCC):

Behaviour Change Communication (BCC) thus emerged as a more strategic use of communication with an explicit focus on behaviour change (i.e. not just, for example, on increasing people's awareness). While this was not a common practice, at least some of the BCC interventions made the effort to employ a more systematic process, beginning with defining the desired behaviours and the people who should practice them, formative research identifying the key barriers to practicing these behaviours, development of the key messages, and subsequent communication planning, implementation, monitoring and evaluation. They also took greater advantage of behaviour change theories that were built across disciplines over decades, including marketing, economics, public health, behavioural science, behavioural economics, psychology, medicine, and anthropology. BCC efforts have largely focused on individual behaviour change.

However, a growing understanding that behaviour change is not just a matter of an individual's decisions and abilities resulted in an expansion of the approach to become

Social and Behaviour Change Communication (SBCC). SBCC is guided by a recognition that people's behaviour is influenced by a range of external 'influencers', such as the opinions and attitudes of their family members and friends, local culture, the economic situation in their area, availability of resources, (lack of) services provided by the private sector, government policies, extent to which a government supports its citizens, and many other factors that are beyond an individual's control. BCC was changed

to SBCC because it was increasingly clear that a long-term change in people's behaviours often cannot be achieved without shaping the social and environmental factors that influence these behaviours.

Moreover, BCC (Behaviour Change Communication) focuses on changing individual knowledge, attitudes, and behaviors, while SBCC (Social and Behaviour Change Communication) expands this by integrating the broader **social context**, addressing norms, cultural factors, policies, and environmental systems, recognizing that individual change relies on supportive societal structures for lasting impact. Essentially, SBCC evolved from BCC by adding the "S" to emphasize a more holistic, multi-level approach to social and health challenges, acknowledging that individual actions are shaped by and impact their community and environment.

WHAT CAN WE LEARN FROM BEHAVIOUR CHANGE THEORIES

There are a large number of useful theories and models that aim to explain human behaviour change across different contexts. Some of the most prominent are: The Health Belief Model, Theory of Planned Behaviour, Socio-Ecological Model, The Stages of Change Model, Exchange Theory, Diffusion of Innovations Model, Theory of Gender and Power, Fear Management Theory, Social Learning Theory, Social Cognitive Theory, and Communication Theory.

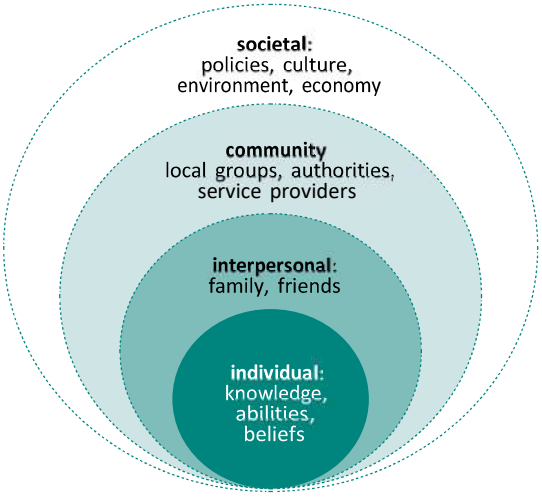
There are two practical models / theories shared here that are frequently used in development interventions.

1. THE SOCIO-ECOLOGICAL MODEL

The Socio-Ecological Model is a theory-based model for understanding the various factors that on several different levels influence people's behaviours. It covers the essence from most of the other models regarding the individual level and adds in the socio-ecological aspect, acknowledging the great impact community, society, policy, natural environment and other factors have on individuals' behaviours. According to the Socio-Ecological Model, our behaviour is determined by a range of personal and external factors at the following levels:

- **Individual level** includes a person's knowledge, skills, self-confidence, life experience, socio-economic status, age, health, and other factors.
- **Interpersonal level** includes a person's partner, family, friends or the closest classmates/colleagues.

- **Community level** includes various local-level groups and institutions (e.g. presence of a saving group or of a school), local authorities (e.g. traditional leaders) and providers of commercial and public services (shops, health facilities, transportation).
- **Societal level** includes factors at the highest level that an individual is least able to influence, such as government policies, budget allocation, culture, religion, media, the economy and the environment.



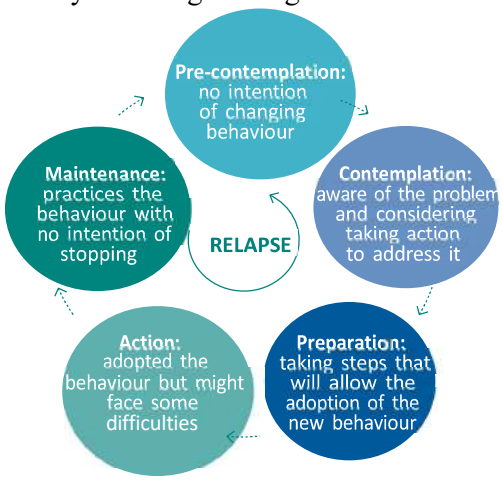
Source: Adapted from Schmied, P. (2017) Behaviour Change Toolkit

2. STAGES OF CHANGE MODEL

How does behaviour change happen? This is a question that the scientists Prochaska and DiClemente tried to answer more than 35 years ago through their Stage of Change Model. According to the model, **when adopting a behaviour, people go through several different stages**. As the illustration shows, they range from a 'pre-contemplation' stage, when a person has no intention of changing her/his behaviour, to a 'maintenance' stage, when the person routinely practices the behaviour and does not intend to stop. At the same time, as the spiral shows, the person can relapse anytime and move from one stage to any of the previous stages (e.g. from the action stage to the contemplation stage).

Here is an example of this model by illustrating a farmer's journey in adopting homestead vegetable production and regular household consumption, which is an important Nutrition Sensitive Agriculture practice:

• **Pre-contemplation stage:** The farmer does not see any need to grow vegetables at home. He believes buying vegetables occasionally is enough for the family. He focuses only on rice cultivation and cash crops. Since his family does not complain about their meals, he thinks everything is fine and has no intention to change his current practices.



• **Contemplation stage:** The farmer becomes aware through a community meeting or extension worker that poor diet diversity affects women and children's nutrition. He hears that homestead vegetables can improve health and reduce household expenses. He recognizes the

value of the idea, but still takes no action because he worries about lack of space, water, or time.

• **Preparation stage:** The farmer decides he wants to start a small vegetable plot near his home. He discusses it with his spouse and collects seeds or basic information from the agriculture office. However, he is uncertain whether the family will maintain the garden or whether pests and weather conditions will cause problems. He wants to change but is not fully confident.

• **Action stage:** The farmer begins growing a few seasonal vegetables such as Red Amaranth / Red Spinach, Bottle Gourd, Bottle Gourd Leaves, Okra etc. The family uses some of these vegetables in their daily meals. The farmer follows the advice of extension staff and begins watering and caring for the plot regularly. The behaviour is new, but he is actively practicing it.

• **Maintenance stage:** The farmer routinely grows and consumes vegetables from his homestead garden. The family now eats

vegetables more frequently, and they notice improvements in taste, affordability, and meal variety. The practice becomes a habit, and the farmer even encourages neighbours to start their own gardens.

Just like in any behaviour, there is also a risk of relapse. At any time, the farmer may face challenges that push him back to earlier stages. A flood or drought may damage the garden. Increased work pressure during harvesting season may reduce his motivation. A family member might insist that vegetables should be sold instead of eaten. In such cases, the farmer may slip from the action stage back to contemplation or preparation, being aware of the importance of nutrition but not taking active steps to maintain the practice.

As you can imagine, **people that are in different stages of change require different types of support**. For example, a person who does not see a problem in her/his current behaviour is likely to need very different support from a person who is determined to change her/his behaviour but is unable to overcome some of the obstacles s/he faces. Interventions that are designed without understanding the stage that most of their priority group members are in, are less likely to be effective simply because they might be providing a different type of support from what people need.

Working out the proportion of your priority group members in the various stages of change is not difficult – you can assess it during your baseline survey by gauging people's:

- **Awareness:** Are they aware of the problem?
- **Attitudes:** What are their attitudes towards the desired behaviour?
- **Practices:** Do they already practice the behaviour properly

(e.g. exclusive breastfeeding until 6 months) or partially
(e.g. exclusive breastfeeding until 4 months)?

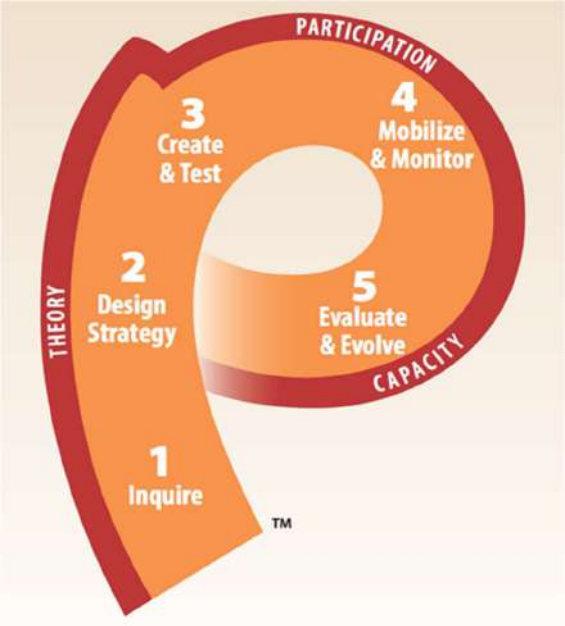
THE KEY STEPS INVOLVED IN SOCIAL AND BEHAVIOUR CHANGE IN PROGRAMMING

Behaviour change interventions are likely to be much more effective if they are based on a clear strategy. Online you can find various tools and guidance on how to design a SBC strategy. Although they differ in name, most of them cover more or less the same points: they describe who exactly is supposed to follow which behaviours, what is preventing them from doing so, what may motivate them to adopt the behaviours, what needs to be done to address the barriers, what environ- mental cues or supports can be put in place, and other essential information. Examples include:

A. PROCESS MODEL[1]

[1] *Health Communication*, Piotrow et al. Praeger, 1997, page 27; and Health Communication Partnership (December 2003), The P Process: Five Steps to Strategic Communication [PDF], Health Communication Capacity Collaborative (November 2013), and Health Communication Capacity Collaborative (HC3) website, November 12 2013. *Image credit:* CCP

"The P Process is a step-by-step roadmap that can guide you from a loosely defined concept about changing behavior to a strategic and participatory program that is grounded in theory and has measurable impact."



Updated in November 2013 by the Health Communication Capacity Collaborative (HC3), P Process is a tool originally developed by the Johns Hopkins Center for Communication Programs (CCP) in 1982. P Process is a tool for planning strategic, evidence-based, health-centred social and behaviour change communication (SBCC) initiatives. Communication professionals around the world use P Process to design, implement, monitor, and evaluate communication strategies, materials, and programmes.

The steps include:

1. ***Inquire*** - In this step, you will:
    - Begin to understand the extent of the problem

https://global.comminit.com/content/p-process-model

- Identify your audiences
- Uncover your intended audiences' barriers to behaviour change (economic, social, structural, cultural, educational, or something else entirely)
- Identify facilitating factors to behaviour change, including potential messengers and media
- Develop a succinct problem statement

2. **Design your strategy** - This involves:
   - Bringing together all the relevant players to participate in the strategy development process
   - Agreeing on the scope of the programme and discussing any limitations imposed by the budget, political situation, timeframe, etc.
   - Choosing a behaviour change model/theory and theoretical framework. (See box of commonly used theories on page 9.)
   - Deciding, given budget, time, and other constraints, on: primary and secondary audiences; structural and communication interventions that are needed to overcome identified barriers to change; communication objectives (what do you want each audience to do?); programme approaches and positioning (be able to explain how these choices will overcome the audience's barriers to behaviour change); communication channels (a combination of mass media and community-level or individual approaches works best); implementation plan and timeline, including roles and responsibilities; monitoring and evaluation plan; and dissemination plan to share project results

3. **Create & Test** - In this step, you will: develop the programme's communication products. These could include mass media and print materials, participatory processes, trainings, and more. In this step you will combine art and science - the creative and artistic vision needed to move audiences and inspire them to change and the analysis, theory, and strategic decisions of Steps 1 and 2. You will also test your ideas and designs with your intended audiences to ensure that messages are clear and actionable.

4. **Mobilise & Monitor** - In this step, you will: Implement your programme and monitor its progress. You and your partners will distribute your products and conduct activities as described by the strategic plan developed in Step 2. Designated players will monitor activities to make sure distribution and roll-out proceed as planned and potential problems are identified and addressed as quickly as possible.

5. **Evaluate & Evolve** - This involves: measuring outcomes and assessing impact through surveys and other evaluation techniques; disseminating results (even if not entirely positive) with donors, partners, key stakeholders and decision-makers, media, and other interested individuals and organisations; and indicate in your final report future opportunities, how to apply lessons learned, where follow-up is needed, and how results could be scaled up.

A cross-cutting concept throughout this process is that of learning through capacity strengthening at the individual, organisational, and system levels.

B. Designing for Behaviour Change (DBC)

The Designing for Behaviour Change (DBC) framework is most likely the easiest tool used for developing behaviour change strategies. As the template below shows, it requires the user to:

- state the desired behaviour
- describe who should practice the behaviour and who influences them
- identify the barriers and motivators
- based on the findings define what needs to change (also called the 'bridges to activities')
- design activities to achieving these changes

The Designing for Behaviour Change (DBC) Framework[2]

Desired Behaviour	**Priority and Influencing Groups**	**Barriers and Motivators**	**Bridges to Activities**	**Activities**
Indicator:				**Indicators:**

11 KEY FACTORS THAT INFLUENCE HUMAN BEHAVIOUR

There are many factors that influence people's behaviour, and each of them can be tackled in many different ways (depending on the local context, available resources, etc.). Therefore, it is not possible to prescribe solutions that could be 'copy pasted' from one context to another. What can be recommended are practical tools, tips, and guidance that can help an individual to design and implement a SBC strategy in a way that is more likely to achieve the desired change. And that is exactly what this chapter is about.

Before we start describing the various steps involved in de- signing, implementing and evaluating SBC strategies and activities, let us highlight several considerations that can make your job much easier.

The following eleven factors, often called 'determinants', were identified as those that influence whether we adopt and sustain a given behaviour or not. They are frequently used in assessments that aim to understand which factors prevent people from practicing the

1

https://www.behaviourchange.net/docs/designing_for_behavior_change_a_practical_field_guide.pdf

desired behaviours (and on the other hand, what could motivate them to practice these behaviours). The main reason why so many of them include the word 'perceived' is because **what matters most is not what we think about these determinants but how the priority group members perceive them** (for example, what THEY think the positive or negative consequences of a given behaviour are).

If you are interested in learning more about these determinants, take advantage of the examples and guidance available in the training manuals Practical Guide to Conducting a Barrier Analysis and Designing for Behavior Change: For Agriculture, NRM, Health and Nutrition[3]. Notice how many determinants cannot be addressed through communication only (such as posters, awareness-raising sessions, radio shows) as they require a much broader range of solutions.

1 - Perceived self-efficacy is about an individual's belief that s/he can do a particular behaviour given her/his current knowledge, abilities, self-confidence or resources . For example, farmers growing vegetables for household consumption might not feel confident that they can deal with the pests that affect their crops .	**2 - Perceived social norms** is about the perception that people who are important to an individual think that s/he should (not) do the behaviour. For example, husbands might be concerned that their friends will laugh at them if they start helping with 'women's tasks' at home (e.g. collecting water, feeding children). A mother who observes a local celebrity breastfeeding her child may perceive that people living the life she aspires to approve of breastfeeding.
3 - Perceived positive consequences are about the positive things a person thinks will happen as a result of performing a behaviour. These may be, for example, health-related (e.g. "feeding my child an egg every day will help her to grow well") or may go beyond health (e.g. "feeding my child an egg every day will help her to be smart and sharp in school"). They can also be much less 'rational', such as positive feelings of comfort, peace of mind or feeling good about oneself	**4 - Perceived negative consequences** are about the negative things a person thinks will happen as a result of performing a behaviour (including negative feelings such as disgust, fear or uncertainty). For example, caregivers might be concerned that if young babies receive only breastmilk, they will be hungry or thirsty
5 - Access is about the extent to which the priority group members feel that the goods (e.g. fertilizers, soap) or services (e.g. animal vaccinations) required to	**6 - Cues for action or reminders** are about the extent to which the priority group members think it is difficult for them to remember 1) to do the behaviour or 2) how to do the behaviour. For example, stickers can

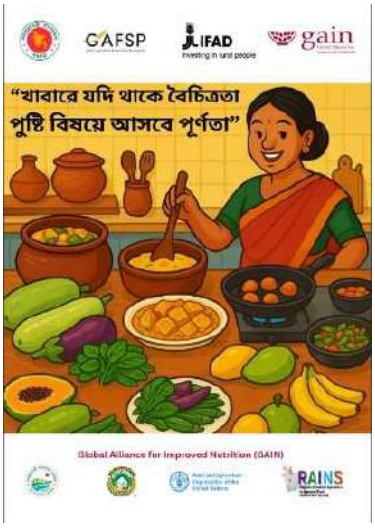
[1] https://www.behaviourchange.net/docs/dbc_english.pdf

practice the behaviour are available. Access is affected by barriers related to costs, distance, language, culture and gender. For example, members of ethnic minorities might find it difficult to access those government extension services provided in a different language from their own.	remind caretakers of the steps involved in preparing an oral rehydration solution to prevent dehydration.
7 - Perceived vulnerability (also referred to as susceptibility or risk) is about a person's perception of how vulnerable s/he feels with regard to the problem. For example, a mother's opinion on how likely it is that her child could become undernourished	**8 - Perceived severity** is about a person's belief that the problem (which the behaviour can prevent) is serious. For example, women may think that it is not a problem if their children are obese as some other children in their community are also chubby. Others may underestimate the threat that malaria poses for children
9 - Perceived action efficacy is about a person's belief that practicing the behaviour is effective in avoiding or addressing the problem. For example, a poultry farmer might not believe that vaccinating his chickens will be effective in reducing their mortality.	**10 - Policy** is about laws, regulations and rules (both formal and informal) that make it more difficult or easier to practice the desired behaviour. For example, the Baby-Friendly Hospital policy forbids the sale of baby formula at health facilities and thus helps promote exclusive breastfeeding.
11 - Culture is the set of history, customs, lifestyles, values, and practices within a self-defined group. It may also be associated with ethnicity or lifestyle (e.g. youth culture). As opposed to the social norms, culture includes a much broader spectrum of people. An example of a culture-related determinant is a belief that girls are destined to marry young and become housewives and thus do not need much education.	

REFERENCE: LEARN MORE ABOUT SBCC FROM THE FOLLOWING DOCUMENTS

- https://www.behaviourchange.net/docs/giz_sbc-pratitioners-guide_web.pdf
- https://resourcecentre.savethechildren.net/pdf/sbcc_in_nsa.pdf
- https://openknowledge.fao.org/server/api/core/bitstreams/be4f89bd-01b7-4c48-a4d6-edef30f31ff4/content
- https://bnnc.portal.gov.bd/sites/default/files/files/bnnc.portal.gov.bd/publications/ec2d5e79_dd3c_4a06_b399_a849f63699d8/2021-02-08-14-27-74ba501c2f1006a7cbd68d13196a4bd3.pdf

ANNEX:



Integrating Nutrition in resource management resilience in agriculture

Moin Us Salam, PhD
Consultant (Human Resources Development)
PARTNER, APCU-BARC
Bangladesh Agricultural Research Council (BARC)
Farmgate, Dhaka 1512, Bangladesh
E-mail: moinsalam1@gmail.com

1. Integrating nutrition in resource management for agricultural resilience is the nexus of health and habitat

The global food system stands at a critical juncture, tasked with feeding a growing population amidst the escalating challenges of climate change, resource depletion, and persistent malnutrition. Traditional agricultural models, often focused narrowly on calorie-rich staple crop yields, have inadvertently contributed to both environmental degradation and "hidden hunger" - a lack of essential micronutrients that affects billions worldwide. A paradigm shift is necessary, one that integrates nutrition security within the broader framework of sustainable agricultural resource management and resilience-building. This integrated approach, often termed "nutrition-sensitive agriculture," posits that robust nutrition is both a critical input to and an essential outcome of a resilient agricultural system. This essay explores the imperative, strategies, benefits, and challenges of this integration, arguing that a holistic approach to managing natural resources is fundamental to achieving sustainable human and environmental health.

2. The Imperative for integration

The intertwined crises of malnutrition and climate vulnerability underscore the urgency of a unified approach. Climate change exacerbates food insecurity through erratic weather patterns, such as droughts and floods, which disrupt agricultural production and compromise yields. These shocks disproportionately affect vulnerable populations, particularly smallholder farmers in developing countries, whose livelihoods and dietary quality are intrinsically linked to the stability of their local environment.

Malnutrition, in turn, reduces the capacity of individuals and communities to be resilient. Stunted children, for instance, often suffer lifelong cognitive and physical impairments, reducing their future productivity and ability to adapt to challenges, including climate shocks. Thus, a vicious cycle is created: climate vulnerability leads to poor nutrition, which in turn diminishes resilience to future shocks. Breaking this cycle requires a deliberate strategy that embeds nutritional objectives and indicators into the design and implementation of agricultural and resource management policies and programs.

3. Strategies for nutrition-sensitive resource management

The operationalization of nutrition-sensitive agriculture involves a multi-pronged approach that moves beyond mere calorie production to encompass diet quality, resource efficiency, and community well-being. Key strategies include:

a. **Diversification of production systems**: A core strategy is the promotion of diversified, climate-smart food systems. Relying solely on staple crops like rice or maize leaves farming systems vulnerable to specific pests, diseases, and climate variations. Integrating nutrient-dense crops, such as fruits, vegetables, legumes, and raising small-scale livestock, enhances dietary diversity at the household level and provides alternative income streams, which in turn improves economic resilience. Legumes, for example, not only offer protein and minerals but also improve soil fertility through nitrogen fixation, a vital resource management practice.

b. **Integrated nutrient management (INM)**: Sustainable resource management is key to long-term productivity and resilience. Integrated Nutrient Management (INM) is a vital practice that optimizes plant nutrient supply by combining organic resources (manures, composts, crop residues) with judicious application of inorganic fertilizers. This approach maintains or improves soil health and fertility, making the land more robust and productive in the face of climate stressors. Healthy soil retains moisture better and supports more nutritious crops, addressing nutrient-specific disorders in both plants and humans.

c. **Sustainable water and land management**: Efficient use and conservation of natural resources like water and land are critical. Techniques such as rainwater harvesting, efficient irrigation methods, reduced tillage, and enhancing soil organic matter improve water use efficiency and protect the land from degradation and erosion. Projects in regions like Sudan have successfully integrated irrigation management training with nutrition education, showing improved dietary outcomes and hygiene practices among participants.

d. **Nutrition-sensitive value chains and post-harvest management**: Production is only the first step. Ensuring that nutritious foods reach the table requires attention to the entire value chain. Improving processing, storage, and preservation techniques helps retain nutritional value, reduces post-harvest losses, and ensures year-round availability of diverse foods. Women's groups in Niger, supported by the IFAD-backed Family Farming Development Programme, have established grain stores and "nutrition gardens" to increase food availability during the lean season, directly enhancing household nutrition and resilience.

e. **Empowerment and education**: Gender dynamics play a significant role in nutrition outcomes. Empowering women, who are often central to household food preparation, childcare, and farming activities, leads to better family nutrition. Paired with targeted nutrition education and awareness campaigns, households can make better-informed decisions about production, consumption, and the importance of a balanced diet, even with limited resources. The Essential Nutrition Actions framework can be used to deliver key messages through existing agricultural extension services.

4. Benefits and case studies

The benefits of integrating nutrition and resource management extend beyond mere yield increases, fostering a sustainable cycle of improved health, economic stability, and environmental well-being. Good nutrition is an outcome of resilience, but it also strengthens the capacity of individuals to withstand future shocks.

A notable example is the Diversified Resilient Agriculture for Improved Food and Nutrition Security (RAINS) project in Bangladesh, which aims to build the resilience of rural households to environmental and economic shocks by promoting diversified, climate-sensitive production systems. By incorporating nutrition as an explicit objective, the project addresses the root causes of malnutrition while simultaneously building climate resilience.

Similarly, the concept of biofortification—enhancing the micronutrient density of staple crops through breeding—offers a promising, sustainable strategy to combat hidden hunger and enhance nutritional quality within existing resource bases.

5. Challenges and the path forward

Despite the clear benefits, several challenges hinder widespread integration. These include a lack of coordination between the health and agriculture sectors, policy frameworks that prioritize calorie metrics over nutrient density, and limited understanding of nutrition-sensitive approaches among extension workers.

Overcoming these requires several actions:

a. **Policy alignment**: National policies must explicitly recognize and integrate nutrition objectives into agricultural and climate resilience plans.
b. **Capacity building**: Training agricultural extension workers and community leaders to deliver nutrition education and implement integrated practices is essential.
c. **Context-specific solutions**: Interventions must be tailored to local contexts, building on existing knowledge and practices to ensure relevance and adoption.
d. **Monitoring and evaluation**: Robust monitoring and evaluation systems using nutrition and health metrics, not just yield data, are needed to track progress and adjust programs effectively.

6. Conclusion

Integrating nutrition into resource management is not just a moral imperative but a practical necessity for building resilient agricultural systems capable of withstanding the pressures of the 21st century. By adopting a holistic, multi-sectoral approach that links sustainable farming practices, natural resource conservation, and improved dietary outcomes, we can foster a future where food security translates directly into nutritional security, and where communities are fundamentally healthier and more resilient to climate variability. This integrated strategy is the cornerstone of sustainable development, ensuring that the agricultural systems of today nourish both the people and the planet of tomorrow.

Food system resilience: Robust and adaptable food systems to withstand shocks

Moin Us Salam, PhD
Consultant (Human Resources Development)
PARTNER, APCU-BARC
Bangladesh Agricultural Research Council (BARC)
Farmgate, Dhaka 1512, Bangladesh
E-mail: moinsalam1@gmail.com

1. Conceptualizing the topic

The global food system, a complex web connecting production, processing, distribution, consumption, and waste, is fundamentally vulnerable to a myriad of shocks and chronic stressors. Building robust and adaptable food systems—food system resilience—is therefore not merely an academic concept but a critical imperative for ensuring global food security and sustainable development in the 21st century.

Food system resilience can be defined as the capacity of interconnected food system components to withstand immediate disruptions (shocks), adapt to long-term pressures (stressors), and ultimately transform toward a more desirable, equitable, and sustainable state without compromising the ability to provide sufficient, safe, and nutritious food. This capacity moves beyond simply "bouncing back" to previous, often fragile, configurations; it involves "bouncing forward" into a more robust paradigm.

2. The imperative for resilience

The urgency to cultivate resilience is underscored by the increasing frequency and intensity of global disruptions, as explained below.

Climate Change: A primary driver of instability, manifested in extreme weather events like prolonged droughts, devastating floods, heat waves, and shifts in growing seasons. These events directly impact agricultural yields, disrupt supply chains, and displace populations, leading to food price volatility and insecurity.

Pandemics and public health crises: The COVID-19 pandemic starkly illuminated vulnerabilities. It triggered labor shortages in harvesting and processing, bottlenecks in logistics, shifts in consumer demand (e.g., the collapse of food service demand while retail demand surged), and exposed the fragility of just-in-time logistics models.

Geopolitical and economic instability: Conflicts, trade wars, energy crises, and economic downturns can restrict access to vital agricultural inputs (like fertilizer), disrupt trade flows, and diminish household purchasing power, often disproportionately affecting the world's poorest populations.

Ecosystem degradation: Long-term stressors such as soil erosion, water scarcity, and biodiversity loss systematically erode the natural capital upon which food production depends, reducing the inherent buffering capacity of agroecosystems.

These shocks rarely occur in isolation. They interact in complex, cascading ways. For instance, a climate event can trigger an economic crisis, which in turn exacerbates a public health challenge. A resilient food system must be designed to absorb these compounding impacts.

3. The anatomy of a resilient food system: Key properties

The design of robust food systems hinges on several interconnected properties: diversity, connectivity, buffering capacity, and agency.

Diversity is the cornerstone of resilience. In ecological systems, biodiversity provides a functional redundancy that allows the system to withstand disturbances. In food systems, diversity must be applied across multiple dimensions:

a. **Biological diversity**: Moving away from monocultures toward diversified farming systems (agroecology, intercropping, agroforestry) that incorporate a wide range of crop varieties and livestock breeds better suited to varying climate conditions and pest pressures. This redundancy ensures that the failure of one crop does not lead to total system collapse.
b. **Geographic diversity**: Balancing production and sourcing across different regions to mitigate localized climate risks.
c. **Supply chain diversity**: Maintaining a mix of localized, regional, national, and global supply chains. When global logistics falter, strong regional chains can step in as a critical buffer.

Connectivity refers to the strength, quality, and structure of relationships between actors and components within the system. High connectivity facilitates the rapid flow of information, resources, and responses during a crisis. Strong producer-consumer links in localized food networks, for example, can quickly reroute supply in the face of supermarket distribution failures. However, excessive connectivity in highly centralized, hyper-efficient global systems can also act as a transmission mechanism for shocks, allowing a single failure point (like a major port closure) to rapidly destabilize the entire system. Resilience requires an optimal balance—strong functional connectivity without brittle hyper-efficiency.

a. **Buffering capacity** involves having reserves or "slack" in the system to absorb shocks without immediate failure. This includes:
b. **Physical buffers**: Strategic food reserves, water storage infrastructure, and redundant physical assets like multiple processing plants or transport routes.

c. **Economic buffers**: Financial safety nets, insurance schemes for farmers, and stable fiscal policies that protect vulnerable populations from price spikes.
d. **Natural buffers**: Healthy soil, functional watersheds, and biodiverse landscapes that inherently regulate water flow and support agricultural productivity even under stress.

Agency relates to the capacity of individuals and groups within the food system, particularly vulnerable populations like smallholder farmers, to make decisions, access resources, manage risks, and enact change. Empowering farmers with access to finance, market information, social protection programs, and participation in governance structures enables proactive adaptation rather than reactive vulnerability.

4. Strategies for transformation: Building Forward

Building resilience is not a passive endeavor; it requires deliberate, coordinated action across the public, private, and civil sectors.

a. **Investing in local and regional infrastructures**: Strengthening mid-level supply chains—regional storage facilities, processing hubs, and localized distribution networks—reduces reliance on global chokepoints and provides necessary infrastructure for diversified food sources to reach markets efficiently during a crisis.
b. **Adopting climate-smart and agroecological practices**: Shifting production methods toward those that regenerate the environment is crucial. Practices such as conservation agriculture, sustainable intensification, and integrated pest management build soil health, conserve water, and enhance on-farm biodiversity, making farms inherently more resilient to weather extremes.
c. **Leveraging data and technology for early warning**: Utilizing digital technologies, satellite data, and AI can help predict climate events, track pest outbreaks, and forecast supply chain disruptions, allowing actors to respond proactively rather than reactively. Innovation also involves social technologies, like community-supported agriculture (CSA) schemes and food policy councils, which build strong social capital and local governance.
d. **Implementing supportive and coherent policies**: Governance is pivotal. Policymakers must create an enabling environment that incentivizes long-term sustainability over short-term efficiency gains. This includes revising agricultural subsidies to support diverse, resilient farming systems rather than commodity monocultures, and integrating food security into national disaster risk reduction plans.
e. **Fostering equity and inclusive governance**: Resilient systems are inherently more equitable. Shocks disproportionately affect the poor and marginalized. Building resilience requires addressing systemic inequalities in access to land, credit, and markets. Inclusive governance ensures that the voices and needs of all actors, particularly the most vulnerable, are central to decision-making processes.

5. Conclusion

Food system resilience is not a singular end goal but a dynamic process of continuous adaptation and transformation. By embracing diversity, strengthening connectivity, building strategic buffers, and empowering stakeholders, we can move from vulnerable, hyper-efficient systems that prioritize cost minimization above all else, to robust, adaptable systems capable of sustaining current and future generations in an unpredictable world. This transformation represents one of the most pressing challenges and significant opportunities of our time.

Use of ICT and digital tools in promoting Nutrition-Sensitive Agriculture

Dr. Md. Golam Mahboob
Chief Scientific Officer (Forestry)
Natural Resources Management Division
Bangladesh Agricultural Research Council
Email: Golam.Mahboob@gmail.com

1. Introduction

Nutrition-sensitive agriculture (NSA) emphasizes not only increasing food production but also improving the nutritional quality, diversity, and safety of food systems. In Bangladesh, malnutrition and micronutrient deficiencies remain pressing challenges, particularly among rural populations. ICT (Information and Communication Technologies) and digital tools can transform agriculture into a more nutrition-sensitive system by:

- Providing timely information to farmers and extension officers.
- Enhancing decision-making for crop selection, soil fertility, and pest management.
- Linking farmers to markets for nutrient-rich crops.
- Supporting policy monitoring and evaluation.

Digitalization is now recognized as a critical pathway for food security and nutrition in Bangladesh.

2. Why ICT Matters for Nutrition Outcomes

- Bridging information gaps
- Real-time decision support for farmers
- Improving access to advisories and services
- Improve Gender & Inclusiveness

3. Types of ICT Tools in Agriculture

- Mobile phones and SMS services
- Smartphone apps
- GIS and remote sensing
- IoT devices and sensors
- Digital platforms and dashboards

4. Role of ICT in Nutrition-Sensitive Agriculture

4.1 Information Access

- Mobile phones, SMS services, and call centers deliver crop, nutrition, and market information.
- Farmers receive weather forecasts, pest alerts, and crop calendars, enabling better planning.

4.2 Decision Support Systems

- ICT platforms integrate soil health data, crop suitability maps, and nutrition indicators.
- AI-driven advisory systems help optimize fertilizer use and detect nutrient deficiencies.

4.3 Knowledge Sharing

- E-learning platforms, farmer field schools, and social media groups (WhatsApp, Facebook) disseminate nutrition-sensitive practices.
- Extension officers can share nutrition-focused messages alongside agronomic advice.

4.4 Market Linkages

- Digital marketplaces connect farmers directly to consumers and institutional buyers.
- Promotes production of nutrient-rich crops (vegetables, pulses, fruits) by ensuring fair prices.

4.5 Policy & Monitoring

- GIS mapping and dashboards track nutrition-sensitive indicators.
- Supports government programs like *National Nutrition Services* and *Food Security Strategy*.

5. Digital Tools and Technologies

Tool/Technology	Application in Nutrition-Sensitive Agriculture	Example in Bangladesh
☎ Call center	Disseminate crop & nutrition info	16123- Krishi Call Center
📱 Mobile Apps	Disseminate crop advisory	Khamari, Krishi Projukti Vandar
🌐 GIS & Remote Sensing	Identify nutrient-sensitive zones, crop suitability	CZIS of BARC (https://czis.cropzoning.gov.bd)
🤖 AI & Big Data	Predict yield, detect nutrient deficiencies	Dr.Chashi- AI-based pest/disease diagnosis mimba- Cattle farm management
🚜 Precision Agriculture	Optimize fertilizer & water use	IoT-based fertilizer and irrigation e.g. www.nodesdigitalbd.com
🔗 Blockchain	Traceability of food value chains	Pilot projects in safe vegetable supply e.g. *ShrimpChain*
📊 Digital Dashboards	Monitor nutrition-sensitive indicators	MoA MIS systems

6. Global Examples

- **India's mKisan Portal:** SMS-based advisories including nutrition-sensitive messages. (https://mkisan.gov.in)
- **Kenya's Digital Green:** Uses community videos to promote nutrition-focused agricultural practices. (https://digitalgreen.org/)

8. Bangladesh Context

Bangladesh has made significant strides in ICT adoption:

- National Agriculture Policy (2018) emphasizes ICT-based extension.
- Digital Bangladesh Vision 2021 promotes ICT integration across sectors, including agriculture.
- NAP 2023-2050: One of the 6 Goals (Goal 2) of National Adaptation Plan 2023-2050 aims at developing CSA for food, nutrition and livelihood security.
- Krishi Call Center (16123) of AIS: Farmers can call for advice on crops, livestock, fisheries, and nutrition.
- ACASA: Atlas of Climate Adaptation in Agriculture (https://apps.barc.gov.bd/acasa/)

- Nutrition-sensitive crop promotion: ICT tools (e.g. Khamari, CZSIS etc.) are used to encourage production of pulses, fruits, and vegetables to combat hidden hunger.

Despite progress, challenges remain:

- Rural women often have less access to mobile phones and digital literacy.
- ICT platforms rarely integrate nutrition indicators directly.
- Sustainability of donor-funded ICT projects is uncertain.

9. Global Frameworks

- FAO's Digital Agriculture Strategy: Encourages ICT adoption for food security and nutrition.
- SDG-2 (Zero Hunger): ICT tools help track progress on food availability, access, and utilization.
- Global Open Data for Agriculture and Nutrition (GODAN 2.0): Promotes open data for nutrition-sensitive agriculture.
- World Bank Digital Agriculture Initiatives: Support ICT-enabled extension and nutrition-sensitive value chains.

10. Challenges

- Digital Divide: Limited ICT literacy among farmers, especially women and marginalized groups.
- Connectivity Gaps: Rural areas face poor internet and mobile coverage.
- Integration Issues: Nutrition indicators are often missing in ICT platforms.
- Sustainability: Many pilot projects lack long-term financial and institutional support.

11. Way Forward

- Capacity Building: Training extension officers and scientists in ICT use for nutrition-sensitive agriculture.
- Localization: Tools must be available in Bangla and tailored to local contexts.
- Public-Private Partnerships: Collaboration with agri-tech startups, NGOs, and government agencies.
- Policy Integration: Nutrition indicators should be embedded in agricultural ICT systems.
- SDG Alignment: ICT-driven NSA supports SDG-2 (Zero Hunger) and SDG-3 (Good Health and Well-being).

12. Key Takeaways

- ICT and digital tools make agriculture nutrition-sensitive by improving access to knowledge, ensuring traceability, and supporting evidence-based policy.
- Bangladesh is at a critical stage of digital transformation in agriculture, with strong government and donor support.
- Scientists and extension officers play a pivotal role in ensuring that ICT innovations translate into better nutrition outcomes for communities.

Bibliography

1. USAID. *Feed the Future Bangladesh Digital Agriculture Assessment Follow-On.* Strategic Impact Advisors, 2020. Retrieved from: https://www.digitaldevelopment.org/wp-content/uploads/2023/09/Bangladesh_Digital_Agriculture_Assessment_public_version-1.pdf
2. Sarker, F., Mamun, K.A., Uddin, J., Ahmed, S., Nisha, N.A., Joshi, D. *Digital Inclusion in Agri-food Systems in Bangladesh: The Digital Innovation and Transformation Initiative.* CGIAR & IWMI, 2023.
3. FAO Bangladesh. *Digitalization of Agriculture Needed for Bangladesh's Food Security.* FAO, Dhaka, 2022. Retrieved from: www.fao.org/bangladesh/news/detail-events/en/c/1611289/
4. Khan, M. A., Hossain, M. E., Shahaab, A., & Khan, I. (2022). ShrimpChain: A blockchain-based transparent and traceable framework to enhance the export potentiality of Bangladeshi shrimp. *Smart Agricultural Technology*, 2, 100041. doi:10.1016/j.atech.2022.100041
5. Trendov, N., Liu, B., Anta, M., & Zeng, M. (2020). *Digital solutions for nutrition-sensitive SME transformation.* Food and Agriculture Organization of the United Nations (FAO).
6. Pérez-Ruiz, M., & Slaughter, D. C. (2024). Applicability of technological tools for digital agriculture with a focus on estimating the nutritional status of plants. *AgriEngineering*, 7(5), 161. doi:10.3390/agriengineering7050161
7. Chandio, A. A., Jiang, Y., Rehman, A., & Magsi, H. (2025). Developing pathways for modern and sustainable agriculture in emerging economies: Investigating the impact of ICT adoption on food security. *Frontiers in Sustainable Food Systems*, 9, 1496295. doi:10.3389/fsufs.2025.1496295

Linking Data to Diets: The Role of Food Composition Tables in Nutrition-Sensitive Agriculture

Professor Dr. Nazma Shaheen
Former Director
Institute of Nutrition and Food Science University of Dhaka
E-mail: nazmashaheen@du.ac.bd

Introduction

Why Linking Agriculture to Nutrition Matters

Agriculture remains the backbone of food production and a source of livelihood for billions of people across the world. Yet, despite improvements in agricultural productivity over recent decades, better nutritional outcomes have not followed automatically. Many low- and middle-income countries continue to face a complex nutrition landscape characterized by the triple burden of malnutrition: **persistent undernutrition, widespread micronutrient deficiencies, and rising levels of overweight and obesity**. This coexistence of contrasting forms of malnutrition points to deeper systemic challenges within food systems.

The paradox is clear. Even as overall food availability increases, diverse nutritional problems persist. This occurs because agricultural success is often measured using narrow indicators such as **yield, tonnage, or calorie output**, the metrics that reveal how much food is being produced, but not necessarily whether the food system is delivering adequate nutrients. A system that produces sufficient energy can still fail to provide essential micronutrients like iron, vitamin A, zinc, folic acid, vitamin B12 or iodine, as well as high-quality proteins and other components vital for human health and development. As a result, populations may have enough food to satisfy hunger but still face nutrient deficiencies that compromise their well-being.

Understanding and addressing this gap requires a shift in perspective: agriculture must be viewed not only as a means of producing food but as a pathway to improved diets and better nutrition. This shift demands accurate, detailed, and contextually relevant information about the **nutrient content of foods** that are produced, consumed, or available in markets. Such information is essential for designing policies, programs, and interventions that intentionally align agricultural activities with nutrition goals.

This is where **Food Composition Tables (FCTs)/Database** become indispensable. FCTs provide the scientific basis for understanding the nutrient composition of foods in their raw, cooked, and processed forms. They offer comprehensive data on macronutrients, micronutrients, and other

dietary components, allowing researchers, policymakers, and practitioners to analyze diets with precision. By serving as a bridge between agricultural production and nutritional needs, FCTs make it possible to assess dietary adequacy, identify nutrient gaps, and evaluate how food systems contribute to—or hinder—public health outcomes.

In essence, FCTs enable a more nutrition-sensitive approach to agriculture, helping ensure that food systems not only produce enough to feed populations but also provide the nutrients required to sustain healthy, productive lives.

What Are Food Composition Tables?

Food Composition Tables or database are structured, standardized databases that provide information on the nutrient content of foods in both raw and processed forms. They typically include macronutrients such as protein, carbohydrates, and fats, as well as essential micronutrients like iron, vitamin A, zinc, and calcium. Some tables also present data on fiber, water content, and bioactive compounds. Because of their depth and detail, FCTs form the foundation for dietary assessments, nutrition research, public health monitoring, and the design of food and agricultural policies. Without accurate food composition data, it becomes extremely difficult to evaluate the nutritional quality of diets or understand how agricultural practices and outputs influence **human nutrition**.

Food Composition Tables are **standardized databases** that list the nutrient content of foods in their raw and processed forms. They typically include:

- **Proximate composition:** protein, carbohydrates, fats, moisture, Total dietary fiber, ash
- **Micronutrients:** iron, vitamin A, zinc, calcium, folate
- **Other components:** dietary fiber, anti-nutrients, and sometimes bioactive compounds

Because they provide detailed and reliable nutrient values, FCTs are widely used in:

- Dietary and nutrition assessments
- Research and program evaluation
- Public health monitoring
- Agricultural and food policy planning

Without accurate FCTs, it is difficult to assess dietary quality or understand how agriculture contributes to nutrition of the population.

Why FCTs Matter for Nutrition-Sensitive Agriculture

In the context of nutrition-sensitive agriculture, FCTs serve as a vital link between what farmers grow and what people ultimately consume. When agricultural production data—such as crop yields, livestock outputs, or household food supply—is combined with nutrient information from FCTs, it becomes possible to estimate the nutrient availability at the community, regional, or national level. This integration enables analysts to move beyond calorie-based assessments and consider whether essential nutrients are sufficiently available to meet population needs. For example, FCTs make it possible to evaluate iron availability, vitamin A density, protein quality, and overall micronutrient sufficiency. In this way, the tables help identify potential dietary gaps and allow policymakers and practitioners to design interventions that strengthen the nutritional impact of agricultural systems.

Nutrition-sensitive agriculture aims to make **food systems contribute more directly to improved diets and health**. FCTs play a central role because they create the link between **what farmers grow** and **what nutrients people actually receive**.

By combining agricultural data (e.g., crop yields, livestock production, household food availability) with nutrient values from FCTs, analysts can estimate:

- The **quantity of nutrients** available to households or populations
- Whether **key micronutrients are adequate** to meet nutritional needs
- How agricultural patterns affect **dietary diversity and nutrient density**

This helps shift agricultural planning from a **calorie-focused** approach to a **nutrient-focused** one.

Practical Applications of FCTs in Agriculture and Nutrition

These linkages have broad practical applications. FCTs support crop and livestock diversification efforts by helping practitioners identify nutrient-rich crops and underutilized species that can improve diet quality. They also play an important role in plant breeding and biofortification initiatives by guiding the selection and development of crop varieties with enhanced micronutrient profiles. At the national level, FCTs make it possible to analyze the nutrient content of the food supply by linking production and import data with nutrient values. Such analyses help identify shortages of key nutrients like iron, vitamin A, or folate and support policies such as food fortification or supplementation. Even in community and extension settings, FCTs provide evidence that can be used to promote food groups that improve dietary diversity and overall health.

FCTs support a wide range of activities, including:

a. Crop and livestock diversification

Identifying underutilized and nutrient-rich foods that can improve diets.

b. Biofortification and plant breeding

Guiding the development and promotion of crops with enhanced micronutrient content.

c. National food supply analysis

Combining production and import data with FCTs to assess whether foods supply enough iron, vitamin A, protein, or other nutrients.

d. Food fortification policies

Determining which nutrients are lacking and where fortification or supplementation is needed.

e. Nutrition education and extension

Providing evidence to encourage the consumption of diverse and nutrient-rich foods.

Overall, FCTs help shape **better policies, programs, and agricultural investments** that support healthy diets.

Challenges in Using Food Composition Tables

Despite their value, the use of Food Composition Tables also comes with significant challenges. In many countries, existing FCTs are outdated, incomplete, or inconsistent. Some contain little information on traditional foods, wild foods, or locally consumed varieties. In other cases, nutrient values may not reflect regional variations resulting from differences in soil type, climate, crop diversity, post-harvest handling, or cooking methods. As a result, the averages presented in many FCTs may not accurately represent the foods eaten in particular communities. The growing consumption of processed foods adds another complication, as nutrient information for many processed products—especially fortified foods—is often missing. Furthermore, differences in analytical methods, sampling protocols, and reporting standards across countries make it difficult to compare food composition data or to integrate them into regional or global databases.

Despite their importance, many countries face challenges with their FCTs:

- Outdated or incomplete data
- Limited information on **traditional, wild, and indigenous foods**
- Nutrient values that do not reflect **local variations** in soil, climate, or cooking methods
- Inadequate data on **processed and fortified foods**, which are increasingly consumed
- Differences in **analytical methods and reporting standards** that affect comparability

These gaps can limit the accuracy of dietary studies and hinder effective nutrition-sensitive planning.

Bangladesh has updated and comprehensive FCDB/FCT with global standards, which was updated on 2013 under the National Food Policy Capacity Strengthening Programme (NFPCSP) implemented by FPMU, Ministry of Food, Government of Bangladesh.

Emerging Opportunities

Even so, there are promising opportunities ahead. Advances in laboratory technology, including spectroscopy and mass spectrometry, are making nutrient analysis faster, more accurate, and less expensive. The digitization of food composition data has increased accessibility through online platforms, mobile applications, and integrated dietary assessment tools. International efforts, such as those led by FAO/INFOODS, are improving the standardization and harmonization of food composition databases. These efforts are creating more robust, comparable datasets that can better support national decision-making. At the same time, the integration of FCTs into digital agriculture systems is expanding. Linking nutrient data with farm management tools, agricultural forecasting systems, and real-time diet tracking technologies opens new possibilities for predicting nutrient supply and assessing nutritional gaps with greater precision.

Advances in technology and global collaboration are improving food composition data:

a. Better laboratory methods

New techniques (e.g., spectroscopy, mass spectrometry) offer faster and more accurate nutrient analysis.

b. Digital tools and online accessibility

Food composition databases are increasingly available through:

- Mobile apps
- Online platforms
- Integrated digital diet assessment tools

c. International standardization

Efforts led by **FAO/INFOODS** are harmonizing data collection and reporting standards.

d. Integration with digital agriculture

Connecting FCTs with smart farming tools, forecasting systems, and real-time diet monitoring can enhance precision planning for nutrient supply.

These improvements strengthen the ability of agricultural and nutrition systems to work together effectively.

Conclusion

Ultimately, Food Composition Tables are far more than static scientific documents. They are dynamic, indispensable tools that allow the agricultural sector to meaningfully contribute to improved nutrition and public health. By strengthening and utilizing FCTs, countries can design food systems that not only produce more food but also deliver the nutrients required for healthy lives. This is becoming even more essential as food systems face new challenges associated with climate change, urbanization, and shifting dietary patterns. Ensuring that FCTs are up-to-date, comprehensive, and widely used is therefore a critical step toward building resilient, nutrition-focused agricultural systems capable of nourishing populations and supporting sustainable development.

Food Composition Tables are **essential tools** for linking agriculture to nutrition outcomes. They help countries:

- Understand the nutrient content of their food supply
- Identify dietary gaps
- Promote nutrient-rich food production
- Support policies that enhance nutrition and public health

In a world facing climate change, urbanization, and evolving diets, maintaining **up-to-date, comprehensive, and widely used FCTs** is critical. Strengthening these datasets will help build more resilient and nutrition-sensitive food systems that truly nourish populations.

Training Schedule

"Integration of Nutrition in to Agricultural Practices"

Organized by : Nutrition Unit, Bangladesh Agricultural Research Council
Venue : Conference Room-2, BARC, Dhaka.
Date : 09-11 December 2025

Inaugural Session

Time	Topics
09:00-09:10	Registration: Muhammad Habibur Rahman, Office Assistant cum-Computer Operator, BARC.
09:10-09:15	Recitation from the Holy Quran
09:15-09:20	Remarks by Chief Guest Dr. Md. Abdus Salam, Executive Chairman, BARC
09:20-09:25	Speech by the Special Guest Ajit Kumar Chakraborty, Member Director (Fisheries), BARC.
09:25-09:30	Address by the Chairperson Dr. Md. Harunur Rashid, Director (Nutrition), BARC.

Day-1 (09/12/2025)		
	Opening Ceremony	
Time	**Topic**	**Resource Specker**
9:30 - 10:30	1. Diverse food production through Agro-diversity	Dr. Md. Abdus Salam, Executive Chairman, BARC.
10:30 - 11:00	**Tea & Health break**	
11:00 - 12:00	2. Nutrition-Sensitive framework: The Connectivity of agriculture, food security and nutrition	Dr. Md. Harunur Rashid, Director (Nutrition), BARC.
12:00 - 1:00	3. Post-harvest management for better nutrition	Dr. Md. Atiqur Rahman, PSO, Postharvest Technology Section, HRC, BARI, Gazipur.
1:00 - 2:00	**Prayer and lunch break**	
2:00 - 3:00	4. Biofortification: Development and use of nutrient-rich crop varieties to improve micronutrient intake	Dr. Khandakar Md Iftekharuddaula, CSO and Head Plant Breeding Division, BRRI, Gazipur.
3:00 - 4:00	5. Research Methods for Strengthening Nutrition–Sensitive Agriculture Linkages	Dr. Anil Kumar Das National Consultant (Program), FAO, Dhaka.
4:00 – 5:00	6. Market Access and Nutrition: Urban and Peri-Urban Agriculture	Dr. Md. Mosharraf Uddin Molla, Member Director, AERS, BARC
Day-2 (10/12/2025)		

9:30 - 10:30	7. Social and institutional dissemination for NSA	Dr. Anil Kumar Das National Consultant (Program), FAO, Dhaka.
10:30 - 11:00	**Tea & Health break**	
11:00 - 12:00	8. One health Approach: Linking Human, Animal and Environment health for better nutrition	Dr. Anil Kumar Das National Consultant (Program), FAO, Dhaka.
12:00 - 1:00	9. Safe Harvests, Healthy Diets: The Role of Hygiene in Nutrition-Sensitive Agriculture	Dr. Zakiah Rahman Moni, PSO (Nutrition), BARC
1:00 - 2:00	**Prayer and lunch break**	
2:00 - 3:00	10. Advance Behavior Change Communication (BCC) for Nutrition-Sensitive Agricultural	Mr. Mehedi Hasan Bappy, Project Coordinator, Youth and Adolescent Nutrition, GAIN, Bangladesh
3:00 - 4:00	11. Integrating Nutrition in resource management resilience in agriculture	Dr. Mouin us Salam, Consultant (HDR), PARTNER, APCU-B ARC.
4:00 – 5:00	12. Food system resilience: Robust and adaptable food systems to withstand shocks	
Day-3 (11/12/2025)		
9:30 - 10:30	13. Use of ICT and digital tools in promoting Nutrition-Sensitive Agriculture	Dr. Md Golam Mahboob, Chief Scientific Officer (Forestry), BARC, Farmgate, Dhaka.
10:30 - 11:00	**Tea & Health break**	
11:00 - 12:00	14. Linking Data to Diets: The Role of Food Composition Tables in Nutrition-Sensitive Agriculture	Professor Dr. Nazma Shaheen, Former Director, Institute of Nutrition and Food Science University of Dhaka.
12:00 - 1:30	15. Designing a Nutrition-Sensitive Agriculture, Developing Action Plans for Integration	Group Work & Presentation
1:30 - 2:30	**Prayer and lunch break**	
2:30 - 3:00	Training Evaluation	
3:00 - 4:00	**Certificate Distribution and Closing Ceremony**	

Bangladesh Agricultural Research Council