UNITED REPUBLIC OF TANZANIA
MINISTRY OF AGRICULTURE

NATIONAL BIOFORTIFICATION GUIDELINES

SHORT VERSION

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NUTRITION INTERNATIONAL
Nourish Life

NUDEC
NUTRITION, HEALTH AND DEVELOPMENT

HarvestPlus
Better Crops • Better Nutrition

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ABBREVIATIONS

ASDP	Agricultural Sector Development Program Phase II
BNFB	Building Nutritious Food Baskets Project
CSO	Civil Society Organization
CIP	International Potato Centre
DQS	Declared Quality Seed
FAO	Food and Agriculture Organization of the United Nations
FLAM	FAO Loss Assessment Methodology
GMO	Genetically Modified Organism
IFA	Iron and Folic Acid
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
MITI	Ministry of Trade and Industries
MoA	Ministry of Agriculture
MoW	Ministry of Water
NBS	National Bureau of Statistics
NMNAP	National Multi-sectoral Nutrition Action Plan
NARES	National Agricultural Research and Extension System
NFFA	National Food Fortification Alliance
OFSP	Orange Fleshed Sweet Potato
PHL	Post-Harvest Losses
PHM	Post-Harvest Management
PORALG	President's Office Regional Administration and Local Government
QDS	Quality Declared Seed
SBCC	Social and Behaviour Change Communication
TBS	Tanzania Bureau of Standards
TFNC	Tanzania Food and Nutrition Centre
TOSCI	Tanzania Official Seed Certification Institute
UN	United Nations
VAD	Vitamin A Deficiency
VAS	Vitamin A Supplementation
VCU	Value for Cultivation and Use
WHO	World Health Organization
WRA	Women of Reproductive Age

FOREWORD

Malnutrition is one of the biggest public health concerns. It affects especially women of reproductive age and children under five years. To a large extent, malnutrition is caused by nutrient deficiency. These nutrients include carbohydrates, proteins, fats, minerals and vitamins. Vitamin and mineral deficiencies have the greatest impact despite showing no visible effects to human body. The consequences of nutrient deficiencies include stunting (physical and mental), wasting, low birth weight, decreased immune function, blindness, infertility, anaemia, and can lead to death in particular among pregnant women and children under five years.

According to the Tanzania Demographic and Health and Malaria Indicator Survey (TDH-MIS 2015/16), 34 percent of children under five are stunted, 4.5 percent are wasted and 14 percent are underweight. In addition, anaemia prevalence in women of childbearing age is 45 percent and for children it is 58 percent. The high level of malnutrition in women and children is of significant concern and it will take effective interventions to improve the nutritional situation for the country's population.

The government has continued various efforts to address malnutrition. One such initiative is the implementation of the National Multi-sectoral Nutrition Action Plan (NMNAP 2016/17–2021/22) which covers various sectors. The Ministry of Agriculture through the Agriculture Sector Development Plan II (ASDP-II), is responsible for ensuring the production, availability and utilization of a variety of food crops and especially biofortified foods with the aim of improving the nutrition status of the community.

Biofortification is one of the key strategies to overcome the challenge of nutrient deficiencies especially for vitamins and minerals. This method is employed during crop production where seed breeding technologies are used. Studies show that because biofortification is simple and cheap, it can reach more people within communities and make a positive overall impact in the prevention and control of micronutrient deficiencies.

At present, Tanzania does not have guidelines governing the implementation of various interventions related to biofortification. Thus, the Ministry of Agriculture in collaboration with other stakeholders has prepared this guideline to enable stakeholders to plan, implement and manage various biofortification initiatives. This guideline involves the entire value chain from seed variety development to crop production, processing, storage, distribution and consumption.

It is my hope that this guideline will be used effectively and will contribute to the control of nutrient deficiencies in various age groups. This will enable the country to have healthy people who will actively participate in economic activities, including agriculture, and thus contribute to national economic development and enable the country to enter the middle economy as the National Development Vision 2025 sets out.

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GLOSSARY

Agricultural extension services
The application of scientific research and new knowledge to agricultural practices through farmer education.

Agro-dealers
Agricultural input suppliers trained in business skills, agro product knowledge, safe handling and use of up-to-date technology. They are expected to provide basic extension services to farmers, creating an invaluable source of knowledge and advice for farmers.

Agro-inputs
Permitted products for use in farming systems including feedstuffs, fertilizers, plant protection substances as well as cleaning agents and additives used in food production.

Agronomic practices
Practices that farmers incorporate to improve soil quality, enhance water usage, manage crops and improve the environment.

Anti-nutrition factors
Biological compounds present in human or animal foods that reduce nutrient utilization or food intake, thereby contributing to impaired gastrointestinal and metabolic performance.

Bioavailability
The proportion of a drug or other substance which enters the circulation when introduced into the body and so is able to have an active effect. Rate of bioavailability depends on factors such as the composition of the diet. In nutrition, bioavailability is the degree to which food nutrients are available for absorption and utilization in the body.

Body Mass Index
Calculated by dividing weight in kilograms by the square of height in metres (kg/m^2) whereby:

- <16 =severe underweight.
- 16-17=moderate underweight
- 17-18.5=mild underweight
- 18.5-25=normal
- >25=overweight
- >30=obese

Conventional plant breeding

The development or improvement of cultivars using conventional tools for manipulating plant genomes within the natural genetic boundaries of the species. It involves identifying and selecting desirable traits in plants and combining these into one individual plant. Plants from a given population that show desired traits can be selected and used for further breeding and cultivation.

Daily nutritional requirements
The levels of intake of essential nutrients that are considered adequate to meet the known nutrient needs of most health individuals.

Dietary modification
Changes made during food preparation, processing and consumption to increase the bioavailability of micronutrients and reduce micronutrient deficiencies in food at the commercial or individual/household levels.

Diversified diet/dietary diversification
An approach that aims to enhance the availability, access and utilization of foods with a high level of bioavailable micronutrient content throughout the year. It involves making changes to food production practices, food selection patterns and traditional household methods for preparing and processing indigenous foods.

Food safety
The proper handling, cooking and preservation of food to protect against foodborne illnesses caused by microbes such as viruses, bacteria, parasites and fungi.

Genetically modified varieties
Crops or plants used in agriculture with DNA modified through genetic engineering methods. In most cases, the aim is to introduce a new trait to the plant which does not occur naturally in the species.

Germplasm
A living genetic resource such as seeds or tissues from any other part of the plant (e.g. leaf, stem, pollen) that is maintained for the purpose of turning it into a whole plant. It contains the information for a species' genetic makeup, a valuable natural resource of plant diversity.

Hidden hunger
A chronic lack of vitamins and minerals (also called micronutrients) that often has no visible warning signs, so people who suffer from it may not even be aware of it. Its consequences are nevertheless disastrous; hidden hunger can lead to mental impairment, poor health and productivity, and even death.

Immune system
The system within the body involving organs and processes that provides resistance to infection and toxins. The organs involved include the thymus, bone marrow, spleen and lymph nodes.

Low birth weight babies
When an infant weighs 2,500 grams or less, regardless of the gestational age. Low birth weight can come about when full-term infants have undergone growth retardation in the womb or when infants are born prematurely (before the due date—see **Premature babies/birth**).

Marker assisted selection
An indirect selection process where a trait of interest is chosen based on a marker (morphological, biochemical or DNA/RNA variation) linked to a trait of interest (e.g. productivity, disease resistance, abiotic stress tolerance and quality), rather than on the trait itself. This process has been extensively researched and proposed for plant and animal breeding.

Micronutrient malnutrition
Diseases caused by a dietary deficiency of vitamins or minerals.

Minimum acceptable diet
The indicator that measures both the minimum feeding frequency and minimum dietary diversity as appropriate for various age groups of children between 6-23 months of age who receive a minimum acceptable diet apart from breast milk.

Miscarriage
The spontaneous or unplanned expulsion of a fetus from the womb before it is able to survive independently. Some use the cut-off of 20 weeks of gestation, after which fetal death is referred to as a stillbirth.

Nutrition-sensitive agriculture
A food-based approach to agricultural development that puts nutritionally rich foods, dietary diversity and food fortification at the heart of overcoming nutritional deficiencies. The overall objective of nutrition-sensitive agriculture is to better equip the global food system to produce good nutritional outcomes

Premature babies/birth
A premature birth is birth that occurs before the start of the 37th week of pregnancy.

Supplementation
The preparation or addition of products to enhance the diet and provide nutrients, such as vitamins, minerals, fibre, fatty acids or amino acids, which may be missing or may not be consumed in sufficient quantities in a person's diet; these products are not considered to be food.

Value chain
A set of activities that a firm operating in a specific industry performs in order to deliver a desired product for the market. For firms that produce goods, a value chain makes up the steps involved in taking a product from conception to distribution, and everything in between.

Vulnerable groups

Groups or sectors of society that are at higher risk of being subjected to discriminatory practices, violence, natural or environmental disasters, or economic hardship than other groups within the population especially during periods of conflict and crisis. The groups can include women, children and the elderly.

CHAPTER 1: BACKGROUND

1.1 Biofortification

The World Health Organization (WHO) describes biofortification as "the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding and genetic modification technology". Agronomic practices involve application of macro- and micronutrients in soils or in the foliage. Conventional plant breeding involves selective, intra-species breeding process where crosses are made naturally through pollination, when deoxyribonucleic acid (DNA) is transferred from one plant to another without an interspecies crossing barrier. Genetic modification technology involves the transfer of DNA between non-compatible species with crossing barriers; the process is done under laboratory conditions using in vitro technology without the natural system of pollination. Biofortified food crops that are already available in Tanzania are developed through the conventional method.

1.2 Malnutrition

Malnutrition is primarily caused by insufficient nutrients in the body together with various diseases. It has been established that 45 percent of childhood deaths—especially from diarrhoea, malaria, pneumonia and measles—are directly related to malnutrition. Deficiency of proteins, carbohydrates and fats can cause malnutrition in all its forms, such as stunting, wasting and underweight. Increased intake of nutrients can cause overweight and obesity. Micronutrient deficiencies may not show in obvious symptoms or diseases but instead can contribute to sub-optimal health, hence the term "hidden hunger", which is often used to describe their effects. Effects of micronutrient deficiencies can cause night blindness, anaemia and cretinism. Nutrient deficiencies can affect all age groups, but mainly affects pregnant women, breastfeeding mothers and children under five. However, the effects of nutrient deficiencies that occur during the first 1,000 days of life (from conception to a child's second birthday) are of public health and economic significance as they may result in sub-optimal reproductive outcomes and may affect the cognitive and physical development of children.

1.3 Extent of Malnutrition

1.3.1 Global Malnutrition

According to the 2018 Global Nutrition Report, approximately 150.8 million (22.2 percent) children younger than five years are stunted, and 50.5 million (7.5 percent) are wasted. Approximately 462 million adults are underweight with a Body Mass Index (BMI) of less than 18.5. Altogether, micronutrient malnutrition is estimated to affect 2 billion people around the world (Global Nutrition Report, 2018). Over 2.01 billion adults are overweight, which is equal to one-third of all adults in the world. Among these, 678 million people are obese. Furthermore, micronutrient malnutrition is estimated to affect 2 billion people (Global Nutrition Report, 2018).

1.3.2 Malnutrition in Tanzania

- **Stunting, Wasting, Underweight and Overweight**

  The 2018 Tanzania National Nutrition Survey (TNNS) covered children aged 0-59 months and women of reproductive age (WRA) between the ages of 15-49 years. The survey revealed that approximately 31.8 percent of children were stunted, 14 percent were underweight, 3.5 percent were wasted, and 2.8 percent were overweight. Among WRA, 7.3 percent were underweight, while 31 percent were overweight and 10 percent were obese (TNNS, 2018).

- **Micronutrient Deficiencies**

  The Tanzania Demographic, Health and Malaria Indicator Survey (TDH-MIS) 2015/16 showed that 58 percent of children between the ages of 6-59 months and 45 percent of WRA had anaemia. The main cause of anaemia is iron deficiency. Other causes include deficiency of other nutrients that play a significant role in manufacturing red blood cells—including proteins, copper, folate, vitamins A, B6, and B12. Additionally, malaria, intestinal worms (especially hookworms), schistosomiasis, chronic diseases like HIV/AIDS and tuberculosis (TB), excessive bleeding and inherited diseases like sickle cell can also contribute to anaemia.

  Vitamin A deficiency (VAD) affects 33.5 percent of children aged 6-59 months and 35.9 percent of women of reproductive age (WRA) (DHS,2010). Although there is no recent national representative data on the impact VAD has on vision, mild VAD is associated with night blindness, while severe VAD may lead to blindness.

  The prevalence of zinc deficiency among children aged 6–59 months was reported to be as high as 70 percent in a study of hospitalized children in Tanzania (Veenemans *et al*, 2011).

1.4 Economic Impact of Nutrient Deficiencies

In addition to its health consequences, malnutrition has a major effect on the economic status of individuals, families and the community. Studies have shown that deficiencies of iron, vitamin A and folate alone are estimated to cost Tanzania over US$518 million, around 2.65 percent of the country's GDP. Also, using findings from the DHS 2010 and other relevant sources of nutrition information for Tanzania, it is estimated that if the prevalence of iron deficiency anaemia can be reduced between 2014-2025, the economic productivity gains in adult women could be as high as US$382 million.

1.5 Rationale for Developing the Biofortification Guidelines

Tanzania is implementing the National Multi-sectoral Nutrition Action Plan (NMNAP 2016/17–2021/22), which enables both nutrition-specific and nutrition-sensitive interventions to be implemented synergistically. Components three and four of the

Agriculture Sector Development Plan II (ASDP-II) have a major focus in nutrition. Therefore, the Ministry of Agriculture (MoA) is developing the current biofortification guideline to enhance existing nutrition-related policies and implementation plans that currently have minimal coverage on biofortification. The MoA is developing this guideline to contribute to policies, guidelines and other existing plans which address the problem of malnutrition in the country.

This guideline engages other stakeholders implementing various interventions that address the breeding of the desired seeds, crop production, processing, marketing, distribution and use of foods. Implementation of biofortification interventions will contribute to the national strategy toward meeting the targets for 2030 as stipulated by United Nations Sustainable Development Goals (UNSDGS, 2025) to end hunger, achieve food security, improve nutrition and promote sustainable agriculture.

1.6 Scope of the Guideline

The guideline focuses on biofortification with nutrients (mainly minerals, vitamins and protein) into staple or common crops. In the beginning, crop biofortification will include vitamin A, iron, zinc and protein (mainly lysine). Future plans for biofortification will focus on the need of nutrients in the community. The guideline will cover the whole food chain from variety development to consumption of biofortified foods.

1.7 Purpose and Objectives

The process of developing the guideline was participatory and involved key stakeholders from both government and the private sector. The guidelines are intended for use by implementors in planning, management, production, processing, storage, marketing and utilization of biofortified products at all levels. Initial production of biofortified crops will be focused on regions with greater micronutrient deficiencies among the population and will later expand to the whole country.

The main objective of the guideline is to contribute to improved health and nutrition status of vulnerable group, mainly WRA and children under five. The guidelines will be used to plan, implement, monitor and evaluate various biofortification interventions at all levels.

CHAPTER 2: EXISTING NUTRITION AND BIOFORTIFICATION INTERVENTIONS

2.1 Existing Interventions to Address Malnutrition and Challenges

The existing nutrition-specific and nutrition-sensitive interventions for addressing malnutrition are illustrated in the conceptual framework adopted by the NMNAP (Appendix 1). The existing interventions and their challenges include:

i. Agriculture, which focuses on availability and accessibility of foods that promote good nutrition through home gardens for vegetables and fruits and keeping of small animals for household consumption. The main challenge of these interventions is sub-optimal dietary diversification among communities and poor post-harvest handling of food crops.

ii. Behaviour change promotion focusing on food consumption patterns that target the needs of different population groups, particularly among children under five years of age, pregnant and lactating women. Challenges facing these interventions include inadequate knowledge about good nutrition, preparation of nutritious foods and use of diversified diets. Other challenges include sub-optimal cultural feeding practices and low household incomes resulting in inability to access essential nutritious foods for the most vulnerable groups.

iii. Food fortification that involves the addition of nutrients such as vitamins and minerals after crops are harvested. This is done for food crops consumed by much of the population, such as maize. In 2016, the government initiated the National Food Fortification Programme targeting both industrial and household levels to enable many communities to benefit from the fortification intervention. The challenges facing these interventions include inadequate knowledge on the importance of fortified foods, low availability of fortified foods in rural areas and inaccessibility to fortified foods by some low-income households.

iv. Supplementation involving the direct consumption of additional vitamins and minerals (notably vitamin A, folic acid, iron and zinc) for vulnerable groups. The challenge of this intervention is sustainability of supplies, low compliance by users and access to supplements for people living in rural regions.

v. Public health interventions aim at improving the health and nutrition of communities through prevention and disease control interventions that minimize the risk of direct loss of nutrients and reduced bioavailability in the body. The government is implementing national programs for the control of malaria, infestation with intestinal worms, diarrhoea, HIV/AIDS and TB. Other public health interventions promote access, availability and use of safe water and sanitation facilities including good toilets. The main challenges of public health interventions are that they are resource-intensive, there is inequity in

geographical distribution in rural areas and some communities do not always adhere to health regulations.

2.2 Current Status and Efforts to Address Micronutrient Deficiency Through Biofortification

2.2.1 Global Situation

Up to 2019, biofortified crops that have been researched internationally include orange-fleshed sweet potatoes (vitamin A), beans, pearl millet and wheat (zinc), yellow cassava (vitamin A) and yellow maize (vitamin A). Acceding to HarvestPlus, a global organization leading the development and distribution of biofortified food crops, research has been carried out in 30 countries and biofortified crops have been tested and grown in more than 40 countries.

2.2.2 Biofortification in Tanzania

By 2019, nine biofortified seed varieties of three common staples (beans, maize and sweet potatoes) developed by the Consultative Group on International Agricultural Research (CGIAR) centres have been introduced in Tanzania. They have been tested locally by CGIAR and local agricultural research institutes and have been approved by the government. These biofortified seeds include:

i. Two (2) high iron and zinc bean varieties (Selian 14 and Selian 15) released in 2018 by Selian Agricultural Research Institute (SARI)

ii. Two (2) vitamin A maize varieties (VAH 517 and VAH 519) released for commercial production by the Meru Agro Seed Company (MERUAGRO) in collaboration with the International Centre for Maize and Wheat Improvement (CIMMYT)

iii. Five (5) vitamin A orange-fleshed Sweet Potato (OFSP) varieties (Ejumula, Kiegea, Mataya, Kakamega and Kabode) released by Tanzania Agricultural Research Institute (TARI)

Other nutrients of importance that could be considered in biofortification programs in Tanzania include micronutrients (e.g. iodine, folate, vitamin B6), as well as amino acids (e.g. lysine and tryptophan) for the prevention and control of stunting, underweight, wasting and other nutrition-related growth disorders.

2.3 Policy and Legal Framework on Biofortification

The government has been implementing various national public policies (including plans and strategies) and government regulations that aim to improve nutritional status of the population. Though they do not target biofortification directly, many create an enabling environment for the institution of biofortification interventions.

2.3.1 National Public Policies

The relevant national public policies, plans, and strategies include:

i. **National Agricultural Policy (2013)**:

In relation to biofortification, the National Agricultural Policy requires the user to abide by the biotechnology and bio-safety measures to minimize risk. The policy also emphasizes the Plant Breeders Rights Act, which protects the newly released biofortified varieties that have potential for commercialization.

ii. The **National Multi-Sectoral Nutrition Action Plan (NMNAP) July 2016 – June 2021,** brings together various sectors (health, agriculture, water and sanitation, finance, social protection, etc.) to address malnutrition. Scaling up interventions for the prevention and control of micro- and macronutrient deficiencies is among seven priority interventions.

iii. Clause 89 of the **National Nutrition Strategy July 2011/12 – June 2015/16** recognizes the need to implement multiple strategies to prevent and control nutrient deficiencies by increasing dietary intake of vitamins and minerals. The agricultural strategies include crop diversification and biofortification.

iv. **Agricultural Sector Development Programme II (ASDP-II) 2017/18 – 2027/2028**:

The implementation of the ASDP-II is embedded with the necessary features of nutrition-sensitive agriculture. The ASDP-ll emphasizes growing and using nutrient-rich crops, including those that are biofortified.

v. **The National Biotechnology Policy of Tanzania (2010)** promotes investment in biotechnology in production and processing of food crops to enhance agricultural efficiency and improve food availability, nutrition and health, while also being environmentally friendly.

vi. The national **Child Development Policy (2010)** emphasizes the need for good nutrition for children and that it is a fundamental right for all children to have available food with adequate nutrients.

vii. The **National Health Policy (2017)** recognizes that good nutrition is essential for the promotion and maintenance of physical and mental health. It also emphasizes promotion of availability of adequate food in quality and quantity among vulnerable groups, specifically children, pregnant and lactating women.

2.3.2 Acts and regulations

Acts and regulations relevant to biofortification include:

i. **The Tanzania Food, Drugs and Cosmetics Regulation (2010)** directs food producers and sellers to give correct information about the types of nutrients contained in their crops and food products. These regulations will also apply to biofortified crops.

ii. **Tanzania Official Seed Certification Institute (TOSCI)** directs that all seeds produced or brought into the country are controlled by TOSCI to ensure they have the required characteristics and acceptable standards. This will equally apply to biofortified crops.

CHAPTER 3: KEY BIOFORTIFICATION GUIDES

This chapter highlights key areas in the value chain and outlines the key steps towards development of biofortified food crops as summarised in Table 3.1.

Table 3.1: Key Biofortification Steps and Guides

	STEPS	KEY GUIDES	KEY MESSAGES
1.	Variety Development and Release	i. Researchers shall abide by the relevant national policies and regulations for production of any seed variety; ii. Research institutions shall conduct screening and evaluation of the germplasm (local and exotic) to develop varieties with quality nutritional attributes; iii. Researchers shall conduct trials at different ecological zones for adaptability and community acceptability; iv. Research institutions should provide guidance to extension workers and different stakeholders on production, processing and preparations of biofortified food crops; v. Researchers shall submit new seed varieties to appropriate regulatory body for testing; vi. The National Variety Release Committee shall approve, endorse and authorize the distribution of new seed varieties; vii. The National Seed Committee shall register new released varieties in the National Variety List.	i. Biofortified varieties developed through conventional plant breeding methods **are not GMOs** and are in line with Tanzanian policies and regulations; ii. Biofortified crop varieties provide sustainable and cost-effective means of addressing micronutrient deficiencies; iii. Research institutions should use participatory plant breeding approaches which involve key stakeholders (farmers and consumers) in the value chain to ensure acceptability and ownership of the biofortified varieties.

2	Seed Multiplication and Distribution	i. Researchers shall refer and abide to Acts, National Regulation and Breeders' Rights ii. Seed multipliers shall be approved under the supervision of regulatory bodies; iii. Seed multipliers shall avail the seeds to farmers; iv. Seed dealers shall ensure packaging in different weight lots and use labels that contain important information about the biofortified seeds; v. Seed dealers shall ensure provision of genuine biofortified seeds with an inserted flier providing instructions on how to store, plant and cultivate seeds; vi. Seed business shall be conducted by qualified personnel.	i. Proper packaging with appropriate colour code facilitates identification and usage of biofortified seeds. Well-trained agro-dealers are key to ensuring farmers have access to quality seeds and follow good agricultural practices.
3	Production of Biofortified Crops	i. Biofortified seed dealers and distributors must obtain permits from authorities responsible for quality assurance of seeds; ii. Producers of biofortified crops shall apply Good Agricultural Practices (GAP) accordingly.	i. Use of genuine biofortified seeds and other recommended agro-inputs together with application of GAP enhance production and yield of biofortified crops.

4	Post-Harvest Management (PHM)	i. Farmers should harvest food crops in a timely manner and according to technical information provided by experts and extension workers for each specific crop variety; ii. Farmers should sort seeds before storage; iii. Farmers and stakeholders should practice GAP on PHM of food crops; iv. Transporters should adhere to guidelines and technical information from experts on transportation of specific biofortified crops; v. Food traders should abide by PHM systems to prevent loss of nutrients during marketing.	i. To maintain intended qualities and quantities of biofortified crops, stakeholders along the value chain must adopt recommended agricultural practices and measures to mitigate Post-Harvest Loss (PHL).
5	Processing and Marketing of Biofortified Crops	i. Food processors shall abide by the food quality standards established by respective regulatory authorities; ii. Food processors shall abide by agro-processing and marketing policies, regulations and guidelines by seed developers in order to minimize loss of nutrients; iii. Food processors shall use proper labels on identification of biofortified food crops and accurate instruction on how to use them; iv. Food processors should abide to guidelines on food packaging materials as provided by food safety regulatory bodies	i. Processers of biofortified food products should consider that consumer acceptance depends largely on sensory characteristics, nutritional value, keeping qualities and/or shelf life; ii. Promotion of biofortified foods is key to ensure acceptability.

6	Utilization of Bio-fortified Foods	i. Institutions responsible for food safety shall ensure implementation of food safety measures and make regular inspection of food vending sites to ensure adherence to food safety procedures; ii. Food vendors shall observe guidelines on food preparation and recipes prepared by biofortification researchers and food and nutrition experts; and use methods which will ensure maximum retention of micronutrients from biofortified products; iii. Nutritionists/food scientists from different institutions should develop different recipes for biofortified foods to meet the nutritional needs of different demographic groups; iv. Extension/field workers from agriculture, community development and health sectors shall promote production and consumption of biofortified foods; and v. The MOA in collaboration with MoHCDGEC and MoE shall promote and coordinate use of biofortified foods in institutions providing mass catering such as hospitals, boarding schools, colleges; prisons, hotels, restaurants and food vendors like *"Mama Ntilie".*	i. Observing principles of hygiene and safety is necessary during preparation of biofortified foods to minimize contamination and food borne diseases; ii. Mass feeding with biofortified foods is useful for wider population coverage to make a substantial impact on reducing micronutrient deficiencies.
7	**CROSS-CUTTING ISSUES**		
7.1	Gender	i. Gender issues shall be mainstreamed in biofortification initiatives, policies and programs in order to reach marginalized and vulnerable groups; ii. Promotion of production and use of biofortified crops should ensure both women and men in a household are equal owners of assets and both contribute to decision-making on resources.	i. Gender mainstreaming in biofortification initiatives is essential in scaling-up, adoption and consumption of biofortified foods.

7.2	Social and Behaviour Change Communication (SBCC)	i. Political leaders, influential people and extension workers should create awareness among community members on changing behaviour towards production and consumption of biofortified food crops. ii. Biofortification initiatives shall incorporate SBCC strategies to support uptake and effective roll-out of interventions for production, utilization and consumption of biofortified foods; and iii. Awareness shall be created among political leaders to support biofortification initiatives.	i. SBCC messages should target beneficiaries, influencers, enablers and those involved in delivering the interventions to increase use of biofortified foods.
7.3	Climate Change	i. The development of biofortified crop varieties that are resilient to climate change shall be prioritized; and ii. Production of biofortified crops shall be integrated in conservation agriculture.	i. Development of biofortified varieties with resilience to climate change will ensure sustained production and utilization of biofortified products; ii. Many of the developed varieties are resilient to climate change.
7.4	HIV/AIDS and Tuberculosis	i. Developers of new seed varieties should link with institutions engaged in interventions for addressing HIV/AIDS and TB before they develop new seed varieties; ii. This guideline should be used in conjunction with the National Guidelines on Nutrition and HIV/AIDS; iii. The consumption of biofortified foods shall be promoted for use by people living with HIV/AIDS and TB	i. Promote the use of iron/zinc-rich biofortified foods among people living with HIV/AIDS and TB to increase micronutrient intake.

CHAPTER 4: INSTITUTIONAL ARRANGEMENT

The institutional framework that enables the efficient and smooth implementation of a biofortification program will involve both national and international institutions. The implementation of the biofortification initiatives will be aligned with the ASDP-II under the thematic area of the Building Nutritious Food Baskets (BNFB) project and the NMNAP under the thematic working group on control of micronutrient deficiency and nutrition-sensitive actions. Different institutions and development partners are shown in Table 4.1 and Figure 4.1.

Table 4.1: Roles and Responsibilities of Different Ministries and Organizations

A: NATIONAL LEVEL	
Ministry/Organization	**Key Roles and Responsibilities**
Ministry of Agriculture	• Promote and coordinate implementation of biofortification guideline. • Create awareness on roles and responsibilities of different ministerial departments and institutions. • Ensure production and distribution of biofortification seeds, appropriate storage systems and affordable prices.
Ministry of Agriculture in collaboration with PO-RALG, Prime Ministers Office, Regions, the Media and TFNC	• Educate policy makers, farmers and the community on biofortified crops and consumption. • Ensure timely availability of agro-inputs at affordable prices.
Ministry of Agriculture in collaboration with agricultural research institutes and academia	• Conduct research and disseminate findings especially on seed varieties. • Ensure authenticity of seeds that are produced and sold.
Ministry of Health in collaboration with TFNC	• Create awareness on gender mainstreaming.
Ministry of Industry and Trade	• Using guidelines and trade policy, ensure availability and distribution of biofortified products that meet quality standards for the national, regional and international markets. • Ensure timely availability of agro-inputs at affordable prices.

Ministry of Education	• Oversee incorporation of biofortification in study curricula at schools and higher learning institutions. • Advocate for consumption of biofortified foods in schools and higher learning institutions.
Ministry of Justice	• Supervise adherence to seed laws and regulations.
Ministry of Finance	• Ensure provision of funds for research and production of biofortified varieties and seeds.
PO-RALG	• Oversee and coordinate all issues on biofortified crops at national, regional, district and local government authorities.
Regulatory bodies	• Ensure standards and safety of biofortified products. • Ensure that processed biofortified food products carry instructions from the manufacturer which clearly show how the product should be prepared to attain/retain maximum nutrient content.
Development partners	• Provide international advocacy and support availability of technical and financial resources to biofortification programs.
Private sector	• Support and participate in biofortification activities including variety development, seed production and distribution, and processing.
Non-state actors	• Support on raising awareness and provide material and financial support on biofortification programs.
Cooperatives	• Provide inputs and marketing channels for biofortified products.

Financial institutions	• Provide credits to farmers, processors and distributors of biofortified varieties and products.
B: REGIONAL LEVEL	
Regional Secretariat	• Oversee and monitor implementation of this guideline at regional, district and Local Government Authority levels.
C. DISTRICT LEVEL	
Local Government Authority (LGA)	• Integrate biofortification interventions in Council Management Plans including incorporation of biofortification indicators into comprehensive council information systems.
D: WARD LEVEL	
Ward Development Committees	• Plan, implement and monitor biofortification interventions at the community level.

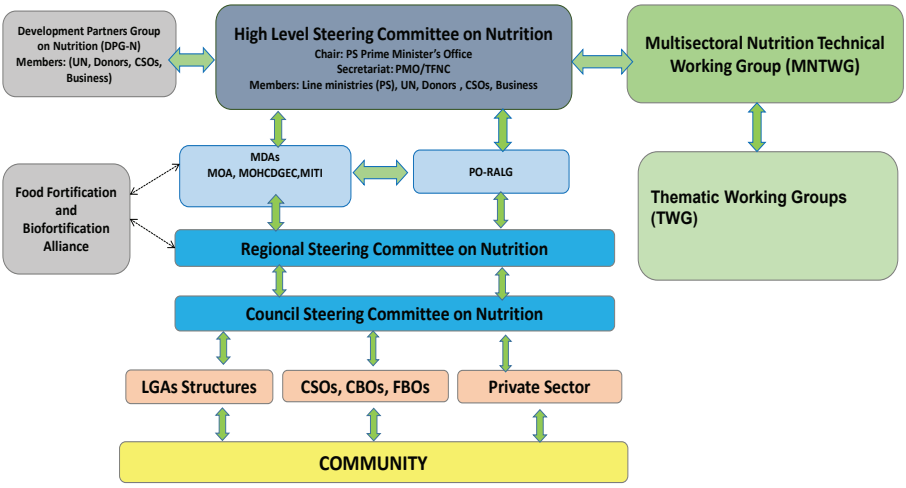


Figure 4.1: Governance and Operational Structure for Biofortification in Tanzania.

CHAPTER 5: MONITORING AND EVALUATION FRAMEWORK

The Ministry of Agriculture will establish a Monitoring and Evaluation (M&E) framework to provide feedback on the biofortification implementation efforts. The framework (Figure 5.1) consists of two main areas whereby data quality assurance is maintained throughout. The two main areas of the framework are: *implementation and outcome monitoring* and *evaluation of impact.*

5.1 Implementation and Outcome Monitoring

Implementation monitoring involves four key steps:

i. The extent to which awareness and/or interest in the society exists with respect to biofortification.

ii. The extent to which public sector and development partners fund biofortification interventions.

iii. The extent to which biofortified seeds and planting materials are released.

iv. The extent to which biofortified seeds and planting materials are distributed.

5.2 Evaluation of Impact

Impact measurement is a method of assessing the effectiveness of an intervention. For the biofortification guideline, impact measurement assesses progress made toward reduction of macro- and micronutrient deficiencies in Tanzania. The key indicator (Figure 5.1) is change in the prevalence of intake of macro- and micronutrients required for good health and nutrition.

Importantly, data Quality Assurance will be employed at all steps to ensure the quality of data collected and used for M&E, standard tools and methods. Experts from TFNC and National Bureau of Statistics (NBS) will be consulted for advice.

Figure 5.1: Outline of the Monitoring and Evaluation Framework.

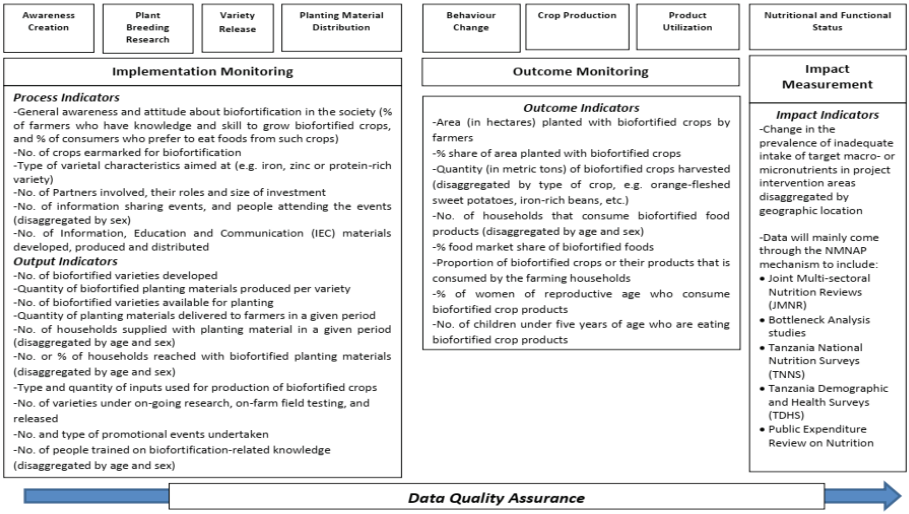
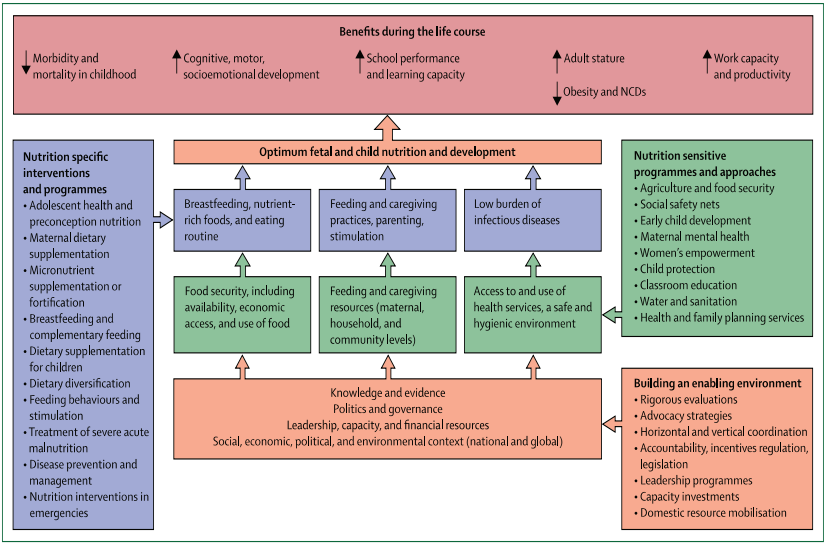


Figure 5.1: Outline of the monitoring and evaluation framework.

APPENDIX I: THE CONCEPTUAL FRAMEWORK ADOPTED BY THE NMNAP



Source: The Lancet Series on Maternal and Child Undernutrition - 2013

APPENDIX II: TASKFORCE TEAM FOR THE DEVELOPMENT OF THE BIOFORTIFICATION GUIDELINES

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