



Biofortification

Participant's Guide



Training of Trainers (ToT) Module on Biofortification: A Sustainable Solution to Hidden Hunger

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Foreword

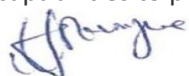
Biofortification is the process of increasing nutritional value of food crops by increasing the density of vitamins and minerals in a crop through either conventional plant breeding, agronomic practices or biotechnology. It is one of the key nutrition interventions that addresses micronutrient malnutrition among populations / groups who consume most of the staple foods that they produce, especially the poor, rural, and other vulnerable populations. Often, they have limited access to diverse diets, supplements, and commercially fortified foods that provide essential micronutrients necessary for ensuring healthy and productive lives. Adoption of biofortified food crops such as vitamin A rich orange-fleshed sweetpotato (OFSP); provitamin A (PVA) maize, high iron and zinc beans and vitamin A cassava, is an effective way of addressing micronutrients malnutrition because it is sustainable, cost-effective and culturally acceptable.

The Building Nutritious Food Baskets (BNFB) project is a three-year project (November 2015 to October 2018) implemented in Nigeria and Tanzania and funded by the Bill & Melinda Gates Foundation. The goal of the project is to accelerate and support scaling up of biofortified crops for food and nutrition security and to help reduce hidden hunger by catalyzing sustainable investment for the utilization of biofortified crops (OFSP, PVA maize, high iron beans and vitamin A cassava) at scale. BNFB develops institutional, community and individual capacities to produce and consume biofortified crops. The objectives of the project are to strengthen the enabling environment for increased investments in biofortified crops and to develop institutional and individual capacities to produce and consume biofortified crops.

To sustainably support the implementation of BNFB's capacity development efforts, the project has developed a training of trainers (ToT) module titled ***Training Module on Biofortification: A Sustainable Solution to Hidden Hunger***. The module includes a PowerPoint presentation, an annotated facilitator's guide and a handout for participants. It is useful for setting the context or as an introduction to biofortification during training on specific biofortified crops, for example the ToT module on *Everything You Ever Wanted to Know about Sweetpotato*, the ToT module on *ProVitamin A Maize: A Biofortified Solution for Vitamin A Deficiency* and the ToT module on *High-Iron Beans: A Biofortified Solution for Iron Deficiency*. However, it is also self-contained and may be delivered independently if that is more appropriate for the target audience. Partner institutions; academic institutions and other users are encouraged to adapt and reproduce these instructional materials and where appropriate, integrate the teaching and learning into existing curriculum.

This module is designed to potentially serve a wide variety of audiences (nutritionists and agronomists, policymakers, extension workers, community development workers, farmers etc.). Not all the materials will be relevant to all audiences but facilitators can adapt the content to their audience and facilitation best practices. To ensure sustainability and wide reach; BNFB will apply a cascading approach in the delivery of training; where key experts (agriculturalists, nutritionists, health workers, marketing and gender experts) will attend more detailed ToT workshops. The experts trained will then become primary facilitators and drive the agenda for biofortification. They will in turn deliver shorter version courses and step-down the training to various levels of audiences (secondary and tertiary). This trend will continue until the training cascades down to "farmer trainers" who finally train the end users in their communities.

This module greatly contributes to BNFB's efforts in strengthening institutional and community capabilities to produce and consume biofortified crops (entire value chains) and to reach a critical mass.



Dr Hilda Munyua

Project Manager - Building Nutritious Food Baskets Project, International Potato Center - March 2018

Acronyms and Abbreviations

ALT	Adult Learning Theory
BNFB	Building Nutritious Food Basket
BPI	Biofortification Priority Index
CGIAR	Global Research Partnership for a Food Secure
CIAT	International Center for Tropical Agriculture
CIMMYT	International Wheat and Maize Improvement Center
CIP	International Potato Center
FARA	Forum for Agricultural Research in Africa
GMO	Genetically Modified Organisms
HIB	High Iron Beans
IITA	International Institute of Tropical Agriculture
NEPAD	New Partnership for Africa's Development
NGO	Non- Governmental Organizations
PVA	Pro-Vitamin A
SSA	Sub-Saharan Africa
TOT	Training of Trainers



Biofortification Module Overview

Module Objectives

Upon completing this module, participants should be able to:

- Explain how biofortification can address micronutrient malnutrition among vulnerable populations
- Compare biofortification to other common interventions for micronutrient malnutrition
- Summarize the process that breeders follow to produce biofortified varieties of staple crops
- Outline strategies for promoting biofortified crops to farmers, consumers and partner organizations
- Describe the ways that international, national and local stakeholders can help to make biofortification sustainable over the long term

Module Outline

The 'Biofortification' module is divided into units and sub-units, as follows:

- 1) Introductions and housekeeping
- 2) Micronutrients and biofortification: An introduction
 - a) The problem of "hidden hunger"
 - b) Biofortification: An intervention for "hidden hunger"
- 3) Developing biofortified crops
 - a) Developing biofortified crops to address micronutrient malnutrition
 - b) The breeding process
- 4) Fostering demand for biofortified crops
 - a) Introducing biofortified crops
 - b) Promoting farmer adoption
 - c) Promoting consumer demand
 - d) Nutrition messaging
 - e) Engaging partners
 - f) Technical support and research
- 5) Scaling biofortification
- 6) Conclusion

Unit 1 – Introductions and Housekeeping

1.1 Ground Rules

- Mobile phones off
- In addition to lecturing, there will be opportunities for discussions and asking questions.
 - To keep things moving, we might have to cut some conversations short and move on to the next topic
 - Not everyone will get to answer every question, but everyone will get multiple chances to speak and be heard throughout the session
 - If one or two people are answering every question, we will politely ask them to give someone else a chance to speak.
- As participants in this learning experience, we need to:
 - Share our ideas without fear of criticism, and listen to the ideas of others without criticizing
 - Engage in discussions without arguing
 - Help other participants and accept help from others
 - Create a safe, supportive environment for everyone to learn
 - Have fun

Unit 2 - Micronutrients and Biofortification

2.1 Objectives

By the end of this unit, participants should be able to:

- List and describe the three types of malnutrition
- Define 'hidden hunger' and explain the importance of micronutrients for good health
- Identify natural sources of micronutrients
- List and describe common interventions for micronutrient deficiency
- Define 'biofortification'
- Compare biofortification to other interventions and summarize its major advantages and challenges
- Differentiate between biofortified crops produced through selective breeding and GMOs

2.2 Synopsis

This unit introduces the basic concepts of micronutrient malnutrition and biofortification.

2.3 Key Points

- Micronutrient malnutrition is a serious public health issue
- While everyone is affected, children and women of reproductive age are most vulnerable
- Biofortification is a promising new intervention for micronutrient malnutrition that can be quite effective for vulnerable populations, especially in combination with other interventions
- Biofortification involves the development and distribution of new staple crop varieties with higher micronutrient levels than traditional varieties
- The crops discussed in this program are all the product of *selective breeding* (i.e., natural reproduction) and are **not** GMOs



Unit 3 - Developing Biofortified Crops

3.1 Objectives

By the end of this unit, participants should be able to:

- Explain how the Biofortification Priority Index (BPI) helps researchers prioritize development of biofortified crops
- Summarize how micronutrient targets are set for biofortified varieties
- List causes for micronutrient losses
- Describe the characteristics that make a variety appealing to farmers and consumers
- Outline the major stages of the breeding process
- Explain why breeders might 'fast-track' the release of certain varieties

3.2 Synopsis

This unit reviews the process for developing biofortified crop varieties including selecting promising crops and countries using the Biofortification Priority Index, setting nutritional targets and the steps involved in breeding and testing new varieties.

3.3 Key Points

- The Biofortification Priority Index supports data-driven decision making about which crops to develop for which countries
- Nutritional targets are set based on the needs of women and children – the most vulnerable groups – and must account for micronutrients lost during storage, processing and/or preparation
- Breeders must also account for agronomic qualities and consumer preferences
- Selectively breeding varieties with the desired traits involves years of work, developing “parent” lines, testing their nutrient content in the lab as well as their performance in the field
- Breeders might “fast track” release of promising varieties that do not fully meet the targets, in order to help vulnerable populations benefit from biofortified crops sooner



Unit 4 - Fostering Demand for Biofortified Crops

4.1 Objectives

By the end of this unit participants should be able to:

- Identify key stakeholders for biofortification initiatives
- Differentiate between different seed systems, and summarize the advantages and disadvantages of each for biofortification
- Suggest activities to promote farmer adoption of biofortified crops, particularly for your country/region
- Suggest activities to promote consumer adoption of biofortified crops in your country/region
- Develop promotional messaging for different stakeholders and identify the best channels for reaching audiences in your country/region
- Identify partnering opportunities to promote biofortification in your country/region

4.2 Synopsis

This unit focuses on strategies for supporting the introduction of biofortified crops within a country and influencing farmers, consumers and partner organizations to support biofortified crops.

4.3 Key Points

- Biofortification cannot succeed if farmers do not grow biofortified crops and consumers do not purchase and eat them
- Ensuring a secure seed system is critical (if farmers cannot acquire seeds, they cannot grow biofortified crops): the best way to accomplish this depends on the type of plant and local economy
- Emphasizing the agronomic qualities of biofortified varieties is often an effective way of promoting adoption among farmers
- Consumers generally prefer the sensory qualities of biofortified varieties, and providing them with nutrition information can further increase demand
- There are many possible channels and media for distributing promotional messages, though studies have shown that broadcast media such as radio is often more cost-effective than delivering messaging face-to-face
- Potential partners for promoting biofortified crops include local governments, seed companies, NGOs, multilateral organizations and various participants in the agricultural value chain (e.g., food processors)



4.4 Activities

Cooking with PVA maize (Breakout Groups)

4.4.1 Recipes

High-Iron Beans Samosas

Ingredients for the dough:

2 cups wheat flour

350 ml cooking oil for frying

1 tsp baking powder

Water

Salt to taste



Method:

- Sieve the flour together with baking powder and rub in a bit of oil.
- Add the salt and mix properly.
- Add water gradually until mixture reaches stiff consistency.
- Roll out dough and cut into the shape of samosas.

Ingredients for stuffing:

1 Tomato

1 Onion

100g HIB beans

1 Green pepper

1 tsp curry or spice

Salt to taste

Method:

- Wash and slice all ingredients for the stuffing.
- Mix ingredients with salt and curry or spice.
 - This mixture is not cooked, because most of the vegetable nutrients would be lost.

Making the samosas:

- Put the stuffing into the cut samosa shapes and seal shut.



- Heat cooking oil until smoke point and deep fry the samosas until golden brown.

Beans muffins

Ingredients:

¼ cup mashed cooked HIB beans
(MAC44/RWV1129)
1 ¼ cup baking wheat flour
3 Eggs
¼ cup castor sugar
3 tbsp margarine
3 tsp baking powder
½ tsp salt



Method:

- Preheat oven to 220 - 230°C.
- Sieve the flour, baking powder and salt.
- Cream together margarine, sugar and egg in a bowl. (For a light texture, use 2 whole eggs and only the white of the third).
- Combine the dry ingredients, mashed beans and margarine and egg mixture.
- Stir with a wooden spoon until just mixed. Do not over mix. The mixture should be lumpy.
- Grease the baking tins.
- Spoon the batter into the greased tins using a scoop.
- Reduce oven heat to 180°C and bake for 25 to 30 minutes.
- Cool and serve

Beans balls

Ingredients:

2 cups cooked HIB beans
1 tsp curry
1 onion, finely chopped
1/4 cup cassava flour
1 green pepper, finely chopped
Salt to taste
½ cup cooking oil for frying



Method:

- Mash the beans.
- Add the onion, green pepper, curry powder and salt to the beans.
- Add cassava flour for binding.
- Shape mixture into balls and fry in cooking oil until golden brown.
- Serve

High-Iron Beans Stew

Ingredients:

1 cup dried high-iron beans (MAC44 or RWV1129)
1 tbsp cooking oil
1 Onion
1 Tomato
¼ tsp curry powder
¼ tsp salt
Water



Method:

- Put the dried high-iron beans in a bowl and remove any foreign particles
- Wash the beans in cold water
- Soak the beans overnight in cold water (this reduces the cooking time)
- Replace soaking water in the saucepan with fresh water and boil beans until tender
- Drain the stock from beans and set aside
- Heat the oil
- Peel the onions and cut into cubes
- Fry the onions until tender (do not brown them)
- Peel the tomatoes and slice into small pieces
- Add the tomatoes to the onions and stir until tomatoes are tender
- Add the curry powder and stir
- Add the beans and salt and stir with a wooden spoon.
- Add the stock and continue stirring
- Reduce the heat and simmer for 15-20 minutes
- Serve warm or cold with ugali/sima or rice.



Recipes

Orange Maize Queen Cake

Ingredients:

- 75g butter, softened
- 75g fine sugar
- 3 eggs, separated
- 2 levelled cups orange maize meal
- 1 teaspoon vanilla essence (or substitute lemon zest and juice)
- ½ cup wheat flour
- ½ teaspoon salt
- 3 teaspoons baking powder
- 2/3 cup milk
- 100g raisins



Method:

- Mix butter and sugar in a bowl and beat together until light and fluffy.
- Add egg yolks, one at a time, beating well after each addition.
- Add vanilla (or lemon zest and juice) and raisins, and mix well.
- Whisk egg whites until stiff, then fold into mixture.
- Pour mixture into a greased cake pan and bake in a preheated oven at 180°C for 20 to 50 minutes, until golden brown and firm to touch.
- Transfer to a wire rack and let cool.

PVA Maize Fruit Cake

Ingredients:

- 3 cups grated fresh orange maize
- 75g sugar
- 2/3 cup cooking oil
- 4 eggs
- 2 cups self-raising flour
- 2 teaspoons cinnamon
- 1½ cups mixed fruit



Method:

- Mix sugar, cooking oil and eggs in a bowl.
- Sift together flour and cinnamon (adding 2½ teaspoons baking powder if not using self-raising flour).
- Mix all ingredients together and bake at 180°C for 25 minutes.
- Reduce heat to 120°C and bake for 15 minutes.

Orange Maize Fritters

A fritter is a common snack made with wheat flour, egg, liquid (can either be water or milk) and cooking oil.

Ingredients:

1 cup wheat flour
1 cup orange maize meal
1 cup legume flour
2 teaspoons sugar
¼ teaspoon salt
1-2 eggs
1 cup milk
2 teaspoons baking powder
Cooking oil for frying



Method:

- Sieve flour, salt and baking powder together.
- Add sugar and mix well.
- Make a depression in the mixture and mix in eggs.
- Add milk gradually.
- Heat oil in frying pan.
- Use a tablespoon to carefully drop spoonfuls of mixture into hot oil.
- Fry each fritter on both side until golden brown

PVA Maize Porridge

Ingredients:

1 cup PVA maize flour

2 cups liquid milk

Salt and sugar to taste

Method:

- Mix PVA maize flour and milk in a pot.
- Add sugar and salt.
- Stir continuously until porridge starts to boil.
- Cook for 10 to 15 minutes.
- Serve warm.



Unit 5 - Scaling Biofortification

5.1 Objectives

By the end of this unit participants should be able to:

- Describe the major challenges for scaling and anchoring biofortified crops within national food systems
- Recognize the potential impact of policies and regulations on promotion of biofortified crops
- Evaluate the potential to support biofortification through trade
- Summarize the importance of integrating biofortification into international standards

5.2 Synopsis

In this unit we explore long-term strategies for “scaling” and “anchoring” biofortification within national food systems, including the impact of policy, regulations, trade and international standards on the promotion, adoption and sustainability of biofortified crops.

5.3 Key Points

- The introductory phase of intensive promotion and support for biofortified crops is not intended to last forever
- Goal is to achieve sustainability and transfer ownership to local stakeholders
- Creating incentives and supports through policy, regulations, trade and international standards can help to ensure that biofortified crops become permanently anchored within local food systems



Unit 6 - Conclusion

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