



**MINISTRY OF AGRICULTURE, ANIMAL INDUSTRY AND FISHERIES**

# **FOOD AND NUTRITION HANDBOOK**



**FOR EXTENSION WORKERS  
OCTOBER 2015**



MINISTRY OF AGRICULTURE, ANIMAL INDUSTRY AND FISHERIES

# FOOD AND NUTRITION HANDBOOK FOR EXTENSION WORKERS

OCTOBER 2015



## Foreword

The overall objective of the National Agriculture Policy is to achieve food and nutrition security and improve household income. Food and nutrition security encompasses issues of food availability, access and utilization for maximum health benefits and social economic development. This can be achieved through enhanced agricultural productivity, proper farm management, agro-processing, marketing, community awareness, enhanced community and household capacity to withstand shocks and adapting appropriate practices that ensure better food utilization, for instance proper home care, personal hygiene, food preparation and feeding practices. Improved food utilization can be achieved through a deliberate effort to integrate nutrition in all agriculture development programs.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) supports households and communities to increase access to and consumption of diversified foods from their own production or purchase throughout the year. In addition, the Ministry plays an important role in reducing post-harvest losses and addressing issues related to women's workload within households. All this is aimed at improving nutrition among households and communities and is in line with the Uganda Nutrition Action Plan (UNAP 2011–2016).

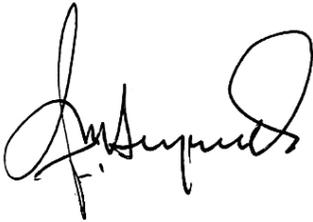
However, malnutrition remains one of the main health and economic problems facing our country and has negative consequences on productivity. The productivity lost when agriculture workers take time off to deal with malnutrition related illnesses or deaths in their families is enormous. For example, the loss caused by iron deficiency anaemia in adults alone is US\$34 million worth of productivity (PROFILES, 2012).

This handbook is designed to help extension workers and other service providers engaged in day-to-day delivery of agricultural extension and advisory services in communities to understand the link between agriculture, food, nutrition and health. General guidelines on proper selection of foods to achieve a balanced diet and issues of food safety have been handled. In addition, examples of recipes for preparation of a variety of

foods for young children from households of different income levels have been tackled. Detailed recipes for all population categories will be given in additional guidelines that are yet to be developed by the Ministry. The knowledge gained from this handbook will help extension workers integrate nutrition in their day-to-day delivery of extension services.

**The handbook will help extension workers to:**

- i. Apply the Essential Nutrition Actions (ENA) at household and the community levels.
- ii. Appreciate the importance of agriculture in improving nutrition and the implications of malnutrition to agricultural productivity.
- iii. Mainstream nutrition in their work plans and routine activities.

A handwritten signature in black ink, appearing to read 'Tress N. Bucyanayandi', with a large, stylized flourish at the end.

Hon. Tress N. Bucyanayandi (MP)

**Minister of Agriculture, Animal Industry and Fisheries**

## Acknowledgments

The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) is greatly indebted to the Technical Working Group and all those who participated in the development of the Food and Nutrition Handbook for Extension Workers.

Special thanks go to:

Staff from MAAIF (Food and Nutrition Division, NARO, Bukalasa Agricultural College and all members of the Nutrition Coordination committee), Nutrition Unit – Ministry of Health, Ministry of Gender Labor and Social Development, Nutrition Secretariat – Office of the Prime Minister, District Local Governments (Masaka, Kalungu, Mpigi, Luwero, Mukono, Jinja, Wakiso, Kamuli, Bugiri, Mayuge and Iganga) and the Food and Nutrition Technical Assistance III Project (FANTA) technical team.

USAID's FANTA Project for the support accorded towards the development of this important reference material is highly appreciated.

FAO, WFP and UNICEF for the previous work in nutrition and for contributing to some of the useful literature and illustrations utilized in developing this reference material.

Appreciation also goes to USAID LEAD project (closed) for providing useful reference materials from their OVC program. The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) appreciates all other individuals and organizations who have not been mentioned by name but in one way or the other had a hand in the process of developing this Food and Nutrition Handbook for Extension Workers.



Vincent R. Rubarema

Permanent Secretary

# Table of Contents

<b>CHAPTER ONE: BASICS OF FOOD AND NUTRITION .....</b>	<b>1</b>
FOOD.....	1
What is food?.....	1
Classification of foods according to their functions.....	1
a) Energy-giving foods (“GO” foods).....	1
b) Body-building foods (“GROW” foods).....	2
c) Protective (“GLOW” foods).....	3
Nutrients in food.....	5
Major nutrients in human nutrition.....	5
1) Macronutrients.....	5
2) Micronutrients.....	8
Vitamins.....	8
Vitamins requirements.....	9
Minerals.....	12
Water.....	15
Water requirements.....	15
NUTRITION.....	15
What is nutrition?.....	16
<b>CHAPTER TWO: MALNUTRITION AND ITS PREVENTION .....</b>	<b>17</b>
What is malnutrition?.....	17
Types of malnutrition.....	17
a) Undernutrition.....	17
b) Micronutrient malnutrition (lack of minerals and vitamins).....	19
c) Overnutrition.....	19
Prevalence of malnutrition in Uganda.....	20
Causes of malnutrition?.....	21
Consequences (cost) of malnutrition.....	24
a) Consequences of undernutrition.....	24
b) Consequences of overnutrition.....	25
Agriculture-based interventions and/or strategies aimed at preventing malnutrition.....	26

<b>CHAPTER THREE: MEAL PLANNING .....</b>	<b>28</b>
Common terms used in meal planning .....	28
Points to consider while planning a meal.....	29
Cost reduction in meal planning.....	30
Selection of foods to achieve a balanced diet.....	30
<b>CHAPTER FOUR: ESSENTIAL NUTRITION ACTIONS IN AGRICULTURE .....</b>	<b>33</b>
Nutrition for pregnant women .....	33
Nutrition for breastfeeding mothers .....	35
Nutrition for children 0 to 6 months .....	36
Advantages of breastfeeding .....	38
Weaning/complementary feeding practices .....	39
<b>CHAPTER FIVE: WATER, SANITATION AND HYGIENE PRACTICES (WASH) .....</b>	<b>43</b>
Water access .....	43
Water quality .....	43
Hand washing.....	44
Food hygiene.....	44
Kitchen and housekeeping.....	46
Proper refuse disposal .....	47
Sanitation .....	47
<b>CHAPTER SIX: AGRICULTURAL PRACTICES THAT PROMOTE HOUSEHOLD FOOD SECURITY AND NUTRITION .....</b>	<b>50</b>
A) PLANNING FOR NUTRITION FRIENDLY AGRICULTURE: NEEDS IDENTIFICATION .....	51
Keys considerations .....	51
B) NUTRITION SENSITIVE AGRICULTURE PRODUCTION PRACTICES .....	53
C) NUTRITION CONSIDERATIONS IN HARVEST AND POSTHARVEST HANDLING....	57
Promote harvesting at the correct maturity stage.....	58
Cleaning .....	58
Discourage processing practices that produce microbial contaminate of the agricultural harvest.....	58
Promote good storage practices to protect the nutrient content of the foods ....	59
Distribution .....	59
Household agroprocessing and value addition .....	59

D) FOOD SAFETY IN AGRICULTURE .....	61
What is food safety? .....	61
Importance of food safety in Uganda .....	62
Potential hazards associated with food in Uganda .....	62
Food safety issues of concern in Uganda .....	63
Impact of food borne diseases .....	64
Effects of aflatoxin/mycotoxin on human health and agriculture.....	64
Action areas for extension workers and others on food safety .....	64
Livestock production.....	65
E) NUTRITION CONSIDERATION IN AGRICULTURAL MARKETING .....	67
F) GENDER DIMENSIONS IN AGRICULTURE & NUTRITION.....	68
Summary of common agricultural projects or actions linked to nutrition .....	71
<b>ANNEXES .....</b>	<b>73</b>
<b>Annex 1.</b> Vitamins and minerals, their sources and recommended dietary allowances.....	73
<b>Annex 2.</b> Preparation of a Variety of Foods to Enrich their Nutrient Composition.....	78
<b>Annex 3.</b> Ways of Boosting the Nutritive Value of Porridge .....	84
<b>Annex 4.</b> Uganda Nutrition Advocacy Messages (PROFILES) .....	86
<b>Annex 5.</b> Technical Working Group for the Nutrition Handbook and FANTA Project Team.....	87
<b>REFERENCES .....</b>	<b>88</b>

## Glossary and Abbreviations

<b>Aflatoxin</b>	<p>Aflatoxins are naturally occurring toxins (mycotoxins) produced by moulds in the food chain. These toxins can cause cancers and liver damage in humans.</p> <p>Aflatoxin contamination can start in the field/ garden and continue throughout the food value chain. Control strategies will therefore involve appropriate pre and postharvest management practices.</p>
<b>Complementary feeding</b>	<p>This refers to giving other foods in addition to breast milk at six (6) completed months of age. The young child gradually becomes accustomed to eating ordinary foods. Breastfeeding should continue until the child is 2 years old or even beyond because breast milk is an important source of nutrients and protective factors.</p>
<b>ENA</b>	<p>Essential Nutrition Actions</p> <p>These are actions targeting different causes of malnutrition that a sector or a nation must undertake through appropriate interventions leading to rapid nutrition improvement at the household level, the community and the nation as a whole.</p>
<b>DGLV</b>	Dark green leafy vegetables
<b>Dietary diversity</b>	<p>Eating a diverse diet means eating many different foods each day that can enable an individual to achieve a balanced diet.</p>
<b>FDA</b>	Food and Drugs Administration
<b>Gender</b>	<p>Gender describes the socially constructed roles, activities and responsibilities assigned to women and men in a given culture, location and time.</p>
<b>Gender roles</b>	<p>These are roles/activities which can be performed by men or women, boys or girls. They are socially and culturally constructed.</p>

<b>Gender empowerment</b>	The creation of an enabling environment where women as well as men participate in, and benefit from the development process in an equitable manner. It entails ensuring that both women and men are actively involved and have control over their own lives and livelihoods.
<b>“GO” foods</b>	Foods rich in carbohydrates and fats are called energy giving foods or “GO” foods. They provide energy to the body and are essential for physical activity and basic functioning of the body.
<b>“GROW” foods</b>	Foods rich in protein are called body building foods or “GROW” foods. These foods help to maintain life and promote growth, repair worn out and damaged body tissues.
<b>“GLOW” foods</b>	Foods rich in minerals and vitamins are known as protective, or “GLOW” foods. They are essential for promoting body immunity and regulate functions.
<b>Food</b>	Food is anything liquid, semi-solid or solid which contains nutrients and when taken or eaten nourishes the body.
<b>Food safety</b>	The protection of consumers from injury or adverse health effects caused by consuming or handling spoilt, adulterated or badly stored foods. Food safety describes the production, handling, preparation and storage of food in a way that prevents foodborne illnesses. This includes a number of routine activities that should be followed to avoid potentially severe health hazards.
<b>Food security</b>	Exists when all people at all times have physical and economic access to sufficient, safe nutritious food that meets their dietary needs and food preferences for an active, healthy and productive life throughout the year.

<b>Kitoobero</b>	A Luganda dialect used to describe a multi-mix food of locally available foods from three or more food groups prepared to preserve nutrients in a balanced manner with the consistency and taste that is child friendly (especially for children under five years).
<b>Macronutrient</b>	Macronutrients are required by the body in large amounts and include carbohydrates, proteins and fat.
<b>Micronutrient</b>	Micronutrients are required by the body in small amounts and include vitamins and minerals.
<b>Nutritious diets</b>	Consumption of a variety food that can potentially supply all the body nutritional requirements on a daily basis.
<b>Nutrition</b>	Nutrition is the process of providing or obtaining the food necessary for health and growth. It broadly encompasses all actions necessary for obtaining, handling, preparing, serving, eating and utilization of food by the body.
<b>Nutrients</b>	Nutrients are the chemical substances found in food. Nutrients are extracted from food as it passes through our digestive system and are used by the body to perform its functions.
<b>RDAs</b>	Recommended dietary allowances
<b>Sex roles/ Biological roles</b>	Are biologically prescribed for a man or a woman and cannot be changed, for example a woman's role of childbearing and breastfeeding cannot be abdicated.
<b>WASH</b>	Water, sanitation, and hygiene  WASH practices involve access to water and considerations of safe handling and disposal of human excreta (for example faeces, urine), management of waste (including trash, waste water, storm water, sewage and hazardous wastes), control of disease vectors (such as mosquitoes and flies) and handwashing with soap.

<b>Wasting</b>	A massive reduction or loss of body weight, it can be moderate or severe (gross loss of muscle bulk, redundant skin and prominence of bones).
<b>WHO</b>	World Health Organization
<b>Zoonotic diseases</b>	Diseases which are transmitted from animals to human beings and vice versa either through direct contact with animals or animal products or through consumption of raw or poorly prepared or poorly stored animal products.

# CHAPTER ONE

## BASICS OF FOOD AND NUTRITION

This chapter provides simple scientific information on food components and nutrition science.

### FOOD

#### What is food?

Food is anything liquid, semi-solid or solid which contains nutrients and energy and when taken or eaten nourishes the body.

Food contains important substances which provide energy to move, think, work, run our body systems, keep us healthy, help to boost our immune system and protect us from infections. When we eat or take food, our bodies absorb useful nutrients into the blood and they are transported to areas where they are needed or stored. The food we eat or take is used for growth, maintenance and body functions.

#### Classification of foods according to their functions

Foods may be classified according to their functions in the body:

##### a) Energy-giving foods (“GO” foods)

Foods rich in carbohydrates and fats are called energy-giving foods or “GO” foods. They provide energy to the body and are essential for physical activity and basic functioning of the body. Foods like cereals, roots, tubers, starchy fruits and vegetables oils, milk, butter and ghee are good sources of energy.



Picture 1: Some of the locally available energy-giving foods

## b) Body-building foods (“GROW” foods)

Foods rich in protein are called body-building foods or “GROW” foods. These foods help to maintain life and promote growth, repair worn out and damaged body tissues. “GROW” foods come from animal and plant sources. Milk, meat, eggs and fish are good sources of animal proteins while legumes and nuts are good sources of plant protein. Animal protein sources are considered to be of high quality compared to plant sources, apart from soybeans.



*Picture 2: Some of the locally available foods that are sources of protein*

### KEY MESSAGE

Protein from animal sources is of high quality compared to protein from plant sources, hence there is great need to promote production and consumption of animal products in a community.

### c) Protective (“GLOW” foods)

Foods rich in minerals and vitamins are known as protective or “GLOW” foods. They are essential for promoting body immunity and regulatory functions. Fruits and vegetables are the main sources of “GLOW” foods. Fortified foods, including iodized salt, are also good sources of “GLOW” foods.



Figure 3: Examples of locally available vegetables and fruits which are rich sources of vitamins and minerals

**Table 1: Basic classification of foods according to their groups, source and function**

Energy-giving foods (carbohydrates and lipids) “GO” foods			
Carbohydrates			
Cereals		Roots	Starchy fruits and vegetables
<b>WHOLE GRAINS</b> Millet Sorghum flour Whole wheat flour (brown) Whole maize meal (brown)	<b>WHOLE GRAINS</b> Cornflakes White wheat flour White maize meal White rice White bread	Cassava Irish potatoes Sweet potatoes Yams	
Fats (solids) saturated		Oils (liquids) unsaturated	
<b>Animal source:</b> Milk fat (ghee), butter, beef fat, chicken fat, pork fat (lard) <b>Plant source:</b> Shea nut butter, margarine, kimbo, cowboy, coconut		<b>Plant source:</b> Sunflower, soybean, corn/maize, cottonseed, sesame, groundnut, olive, sunflower and palm oil	

## Body-building foods (proteins) “GROW” foods

### Animal Source

**Meats:** Beef, mulokony, lamb, pork, veal and game meat (e.g., rabbit, squirrel)

**Organ meats:** Liver, giblets, offal, kidney

**Poultry:** Chicken, duck, goose, quails, pigeons, guinea fowl (domesticated and wild/ game) and turkey, eggs

**Fish:** Silverfish (mukene), Nkejje, Nile perch, tilapia, mudfish, catfish, lungfish

**Dairy products:** Milk, cheese, sour milk, yoghurt

**Edible insects:** Grasshoppers, termites, white-ants, crickets, bee larvae

### Plant Source

**Beans and peas (pulses):** chickpeas, pigeon peas, common beans, iron-rich beans, French beans, lentils, soybeans, white beans, peas

**Processed soy products:** soy milk, soy flour, roasted/fried soy snacks

**Nuts and seeds:** groundnuts, sesame seeds, cashew nuts

## Protective (health-giving) foods (vitamins) “GLOW” foods

### Vegetables

**Dark green leafy vegetables:** Spinach, Dodo/ amarantha, sukumawiki, cow pea leaves, pumpkin leaves, cassava leaves, field pea leaves, immature corn, green pea leaves, yam leaves, sweet potato leaves, broccoli, lettuce, hibiscus leaves (Malakwang)

**Red and orange vegetables:** Carrots, pumpkin, red peppers, sweet potatoes, tomatoes, red amaranths, red hibiscus

**Other vegetables:** Beet roots, cabbage, eggplant, cucumbers, cauliflower, green beans, green peppers, mushrooms, okra, onions, beans sprouts, celery, nswiga (Solanum species)

### Fruits

Bananas, pineapples, papaya (Paw paw), mangoes, guavas, oranges, jack fruit, tangerines, apples, custard fruit (Kitaferi), avocado, passion, orange, apple, melon, grapefruit

**Wild fruits:** Tamarinds, berries, wild grapefruits

## Nutrients in food

Nutrients are substances contained in food that nourish the body. They are required by the body to maintain general health and physiological functions, for example: provision of energy, building the body mass, keeping the body warm, boosting immunity and regulating the various body functions that help someone to live.

## Major nutrients in human nutrition

Nutrients in food are divided into three major categories: macronutrients, micronutrients and water.

### 1) Macronutrients

These are required in large amounts:

- Carbohydrates
- Proteins
- Fats/oils

### *Carbohydrates*

These are the primary source of energy in most diets. They include starches, fibre and sugars. Sweet foods such as sugar, jam, cakes and sugary drinks are sources of carbohydrates but should be consumed minimally because they do not provide any other nutrients and may increase risk of overweight.

### *Carbohydrate requirements*

Individual carbohydrate requirements vary according to age, sex, physical activity level and physiological status. The recommended daily carbohydrate intake should provide about 45% to 65% of the total body energy/calorie requirements of 2000–3000 kilocalories (kcal). One gram of carbohydrates provides 4 kilocalories.

### *Proteins*

Proteins are body-building foods and are required for growth and development, maintenance and repair of tissues, production of metabolic and digestive enzymes, and formation of certain hormones and all cells and tissues.

## *Protein requirements*

The recommended intake of protein each day is about 1 gram per kilogram of body weight. Example: if a person is 60 kilograms, he will require 60 grams of protein each day. This is equivalent to one egg or a piece of meat about the size of an egg. However, children, teenagers, and pregnant and lactating mothers require more protein as indicated below:

- Children: 30–50 g (half a palm of meat)
- Teenagers: 60–75 g (a palm of meat)
- Adults: 60–70 g (a palm of meat)
- Pregnant and lactating mothers: 90 g (one and a half palm of meat)

### **KEY MESSAGE**

Extra protein is required during illness, convalescence and after surgery because the body has extra demands for protein to replace and repair worn out tissues.

## *Fats and oils*

Fats and oils also known as lipids are derived from both animal and plant sources.

Fats are rich in energy, build body cells, support brain development of infants, help body processes, and facilitate the absorption and use of fat-soluble vitamins A, D, E, and K. The major component of lipids is glycerol and fatty acids. According to chemical properties, fatty acids can be divided into saturated and unsaturated fatty acids. Generally lipids containing saturated fatty acids are solid at room temperature and include animal fats (butter, lard, tallow, ghee) and tropical oils (palm, coconut, palm kernel). Saturated fats increase the risk of heart disease.

Those containing unsaturated fatty acids are liquid at room temperature. These include monounsaturated and polyunsaturated fats and are found in vegetable oils such as sunflower, corn, soybean, canola and olive oils. Replacing saturated fats with unsaturated fats lowers risk of heart disease.

### *Fat/lipid/oil requirements*

Fat provides high amounts of energy to the body; 1 g of fat produces over 9 kcals.

Daily intake of fats/oils should not exceed 30% of total kilocalories. Intake of saturated fats should be 10% or less of the total fat intake per day. Cholesterol intake should not exceed 300 mg.

### *Sources of fats/lipids/oils*

- Animal sources include meat, suet, bacon, oil fish, cheese, butter, lard, milk, and egg yolk.
- Plant sources include groundnuts, soya, cocoa, sim-sim, maize, avocado, margarine, wheat germ, corn, sunflower, and palm oil.

### **KEY MESSAGES**

- Excessive consumption of fat increases risk of heart disease. Use of oils from plant sources and fish reduces risk of heart disease.
- Fat should be consumed in small quantities by adolescents and adults. Saturated fat increases the risk of heart disease. Replacing saturated fat with unsaturated fat lowers risk of heart disease.

### *Dietary fibre*

This is a form of complex carbohydrate that is part of the nondigestible portion of the food.

Dietary fibre increases the body's sense of satisfaction thus preventing overeating. Diets high in fibre protect against constipation. Fibre can slow the body's absorption of sugar and cholesterol protecting the body from diseases of the heart and diabetes. Dietary fibre adds bulk to the faeces. In addition, dietary fibre slows down the breakdown of starch.

### *Main sources of dietary fibre*

- Whole grains of cereals, for example: oats, millet, and maize bran.
- Vegetables, for example: dodo, nakati, malakwang, cabbage, and pumpkin leaves.

- Legumes such as beans, peas, and pigeon peas, among others.
- Fruits such as mangoes, oranges, and pineapples, among others.

## 2) Micronutrients

These are required by the body in small amounts and include: vitamins and minerals.

### Vitamins

Vitamins are organic compounds that perform specific metabolic functions in the body. There are two forms of vitamins:

#### *a) Fat-soluble vitamins*

These are stored by the body and require dietary fat to be absorbed.

They include vitamins A, D, E and K. Fat-soluble vitamins are necessary for development and maintenance of body tissues and their functions, for example: eyes (vitamin A), bones (vitamin D), muscles and blood clotting (vitamin K), protection of cells (vitamin E), synthesis of enzymes and absorption of essential nutrients. Dietary sources of fat-soluble vitamins include carrots, tomatoes, liver, offal, kidney, gizzard, heart, milk and milk products and leafy vegetables.

#### *b) Water-soluble vitamins*

These are not stored by the body and must be consumed regularly.

They include vitamins C (ascorbic acid) and the B complex group. Their functions include releasing energy, supporting utilization of macronutrients and synthesizing red blood cells. Dietary sources of water-soluble vitamins include fruits, dark leafy vegetables, whole grains, meat, fish, poultry and fortified cereals. Citrus fruits are an especially good source of vitamin C. Vitamin C is crucial for improving iron bioavailability from plant food sources.

### KEY MESSAGE

Promote production and consumption of fruits in all households as part of the broad iron deficiency anaemia prevention strategy.

## Vitamins requirements

- Water-soluble vitamins are not stored in the body and must be consumed daily.
- Fat-soluble vitamins are stored in the liver and may not have to be taken daily, excessive intake of these vitamins is toxic (refer to Annex 1 for RDAs).

### KEY MESSAGES

- Promote daily intake of vitamins C and B complex group food sources.
- Be aware of excessive intake of vitamins A, D, E and K especially in this era of aggressive promotion of food supplements.

**Table 2. Essential vitamins and their sources for the proper functioning of the body**

Nutrient	Dietary Sources	Functions/Role(s) in the Body	Symptoms if Deficiency
<b>WATER-SOLUBLE VITAMINS</b>			
<b>Vitamin B<sub>1</sub> (Thiamin)</b>	Whole grain cereals such as maize, millet, sorghum, legumes and oil seeds, fish, liver, milk and egg	Producing energy for the body, supports appetite and central nervous system functions	<ul style="list-style-type: none"> <li>• Failure to grow in children</li> <li>• Weak muscles</li> <li>• Painful and inflamed nerves</li> <li>• Depression, irritability</li> <li>• Beriberi</li> </ul>
<b>Vitamin B<sub>2</sub> (Riboflavin)</b>	Fish, liver, milk, meat and eggs, whole grain cereals, legumes	Contributes to energy production	<ul style="list-style-type: none"> <li>• Failure to grow</li> <li>• Skin lesions</li> <li>• Dermatitis</li> <li>• Conjunctivitis</li> <li>• Sore lips, swollen tongue</li> </ul>

## WATER-SOLUBLE VITAMINS (CONTINUED)

<b>Vitamin B<sub>3</sub> (Niacin)</b>	Fish, meat, chicken, eggs, whole grain cereals	Enables energy production in the body, supports appetite and central nervous system functions	<ul style="list-style-type: none"> <li>• Dermatitis</li> <li>• Dementia</li> <li>• Diarrhoea</li> </ul>
<b>Vitamin B<sub>6</sub> (pyridoxine)</b>	Legumes, avocado, dark green leafy vegetables (DGLV), whole grains, nuts and seeds, cabbage, banana, liver, chicken, meat, fish, potatoes, water melon, sun flowers seeds	Facilitates metabolism and absorption of fats and proteins, promotes red blood cells formation, production of protein and nerve transmitters, antioxidants	Tiredness, anaemia, irritability, depression, sore tongue, nausea, muscle twitching, dizziness, dermatitis (skin problem), neuropathy (nerve problem)
<b>Vitamin B<sub>12</sub> (cyanocobalamin)</b>	Seafood, liver, kidney, heart, whole grains, tuna, yoghurt, eggs, cheese, meat, chicken	Formation of red blood cells, affects white blood cells, maintains nerve and gastrointestinal tissue	Tiredness, anaemia, confusion, numbness, nerve problems, ringing in ears, dementia, memory problems
<b>Folic acid</b>	Kidney, liver, nuts, legumes, eggs, green vegetables, whole grains, avocado, oranges, fish	Contributes to synthesis of new red blood cells and gastrointestinal cells, aids cell division and growth	Diarrhoea, sore red tongue, anaemia, heartburn, fatigue, confusion, depression and dementia
<b>Vitamin C</b>	Guavas, sweet pepper, leafy green vegetables, oranges, lemons, tomatoes, most fruits	Builds healthy bones, teeth and gums, helps fight infection, helps non-heme iron absorption, serves as an antioxidants, helps in protein metabolism	Bleeding gums, bruise easily, slow heal, anaemia, muscle and joint pain, frequent colds

## FAT SOLUBLE VITAMINS

<b>Vitamin A (Retinol)</b>	Yellow/orange fruits and vegetables, DGLV, egg yolk, liver, milk, blue-band/ margarine	Supports immune system and provides resistance to infections, ensures good vision, healthy skin, teeth and bone development, promotes maintenance of epithelial cells and mucous membranes	Eye problems and night blindness, sensitivity to light, scaly and skin and hair, poor teeth and nails, colds
<b>Vitamin D</b>	Produced by the skin on exposure to sunlight  Milk, cheese, butter, blue band margarine, fatty fish eggs and liver	Required for proper formation of bone and teeth  Helps the body to absorb calcium and phosphorus	Poor absorption of iron and phosphorus will lead to formation of weak bones and teeth, growth of children is retarded severe deficiency leads to rickets and osteomalacia in adults/elderly
<b>Vitamin E</b>	Vegetable oils, nuts and seeds, whole grains, eggs, legumes, DGLV	Increases disease resistance, Protects fats and vitamins A and C from oxidation, prevents aging	Tiredness, dry hair, leg cramps, infertility, muscle weakness, impotence, nerve problems and heart disorders
<b>Vitamin K</b>	Vegetables such as spinach, lettuce, cauliflower, and cabbage, broccoli, fish, liver, meat, eggs	Helps with blood clotting	Bleeding

## Minerals

Minerals are required for the normal functioning of body processes, including growth, development, water balance and neurological processes.

### *Minerals of public health importance*

**Iron** is an essential component of blood and helps transfer oxygen to various body tissues. Dietary sources include red meat, fish, poultry (easily absorbed), legumes, leafy green vegetables (less easily absorbed, but absorption increases if eaten with animal source iron or vitamin C).

**Calcium** is a key component of bones and teeth and is needed for a strong skeleton and important in blood clotting. The major source of calcium in the world is milk and milk products. Other sources include fish eaten with bones (silver fish—mukene, haplochromis species—nkeje) and dark green vegetables (plant sources are not well absorbed).

**Iodine** is important for thyroid function and for mental development of children. The most important dietary source is iodized salt.

**Zinc** enhances and strengthens the immune system, helps wound healing, facilitates digestion and is an important component of skeletal muscle. Dietary sources include beef, seafood, liver, nuts, beans and whole grains.

**Other minerals** involved in various body functions are chromium, copper, fluoride, magnesium, manganese, molybdenum, nickel, potassium, phosphorus, sodium and selenium.

### *Mineral requirements*

Minerals that are required by the body in relatively large amounts such as calcium, iron, phosphorus, potassium, sulphur, chlorine, sodium and magnesium require deliberate efforts to be supplied them through increased food production, consumption and supplementation.

Most trace mineral elements such as iodine copper, manganese, fluorine, cobalt, nickel, zinc, chromium and selenium are supplied by a wide variety of foods and the body is unlikely to be deficient in them when one consumes a balanced diet.

## SUMMARY

- Promote the consumption of both animal and plant foods in the community since minerals from plant sources are poorly absorbed.
- Use iodized salt for cooking.
- Consumption of animal source foods is necessary for a family to achieve a balanced diet.
- Animal source foods are a good source of readily digested protein and are rich in energy. Animal source foods are easily absorbable and an efficient source of micronutrients (calcium and B12 from milk, and iron, zinc and vitamin A).
- Animal source foods are exclusive sources of dietary vitamin B12, and a good source of preformed vitamin A, particularly in milk which protects children from diseases.

**Table 3. Essential minerals, sources, functions and symptoms of deficiency**

Mineral	Sources	Functions	Symptoms of Deficiency
<b>Zinc</b>	DGLV, sea food, meat, pumpkin seeds, milk, liver, whole grain, egg yolk, garlic, chicken, fish, legumes	Protects the immune system, needed for digestive and immune system enzymes, wound healing, Vitamin A metabolism, antioxidant.	Slow growth, loss of senses of smell and taste, loss of appetite, diarrhoea, prostate gland problems, poor wound healing, skin problems and ringing in ears
<b>Selenium</b>	Brown rice, nuts, liver, egg yolk, onions, garlic, meat, whole grains, milk	Serves as an antioxidant, prevents the breakdown of fat and other body cells.	Weakness, pancreas damage, impaired growth, hears problems

<b>Magnesium</b>	Legumes, nuts, whole grains, avocado, DGLV	Assists nerve and muscle function and release of energy from fats, proteins and carbohydrates.	Spasms, cramps, tremors, constipation (strained bowel movements)
<b>Iodine</b>	Breast milk from mothers with good iodine status, iodized salt, sea fish, milk from animals with good iodine status, sea weeds, plants from soils rich in iodine	it makes the brain and body function properly it is essential to the healthy development of unborn babies and young children. It helps pregnant women.	Impaired mental and physical development, deaf mutism (child cannot speak), cretinism, spontaneous abortion, still birth and birth defects, swelling of the front neck called goitre
<b>Iron</b>	Meat, liver, eggs, DGLV, seeds, wholegrain, legumes, fish, seafood	Needed for oxygen exchange in the blood, it strengthens the blood. It builds muscles and brain. It helps the body.	Headaches, tiredness, irritability, pale colour, dizziness, anaemia
<b>Calcium</b>	Milk, cheese and other dairy foods, green leafy vegetables, such as cabbage and okra	Helps build strong bones and teeth. Helps muscles and nerves function normally. Helps to ensure blood clots normally.	Myalgia, bone thinness, teeth breakage, bleeding

## Water

Maintains the fluid balance, cell turgidity, media for all biochemical reactions in the body, solvent for certain nutrients, used in removing excreta and keeps some parts of the body moist. Water is essential for life because it forms part of the body cells and fluids, such as blood and digestive juices.

### Water requirements

Drink water everyday especially in hot weather when much is lost through sweating to avoid dehydration. A minimum of 2–3 Litres per day is recommended for an adult person. All drinks such as tea, coffee, fruit juice count towards there commended daily total of at least 8 cups a day (for an adult). Children should drink all the time as they need.

The body requires water for many functions:

- To transport nutrients around the body.
- To make blood, saliva, tears and sweat.
- To enable body processes such as digestion.
- To keep the mouth and lungs moist, and to keep the skin moist and cool.
- To produce breast milk, which is also a source of water.

Extra water is needed:

- During illness when a raised temperature results in increased sweating. If vomiting or diarrhoea has occurred, both of which can cause dehydration especially in babies.
- In lactation when extra water is required for milk production. After intensive activity such as sport.

## NUTRITION

Nutrition is the process of providing or obtaining the food necessary for health and growth. It broadly encompasses all actions necessary for obtaining, handling, preparing, serving, eating and utilization of food by the body. When individuals or communities do not feed appropriately they face a possibility of becoming malnourished and can face serious

health problems. Extension workers should promote good nutrition in the community.

## What is nutrition?

Good nutrition refers to a state when the food we eat is able to provide the recommended amounts of nutrients for the body to perform all its physiological activities. It is dependent on one's age, physiological status, physical activity level and sex. Good nutrition is important throughout the life cycle; right from pre-conception, conception, pregnancy, infancy, childhood, adolescence and adulthood. Good nutrition makes an individual healthy, more productive and improves the quality of life.

Good nutrition means:

- Eating the right food.
- At the right time.
- The right amounts (quality and quantity) to ensure a balance diet and should be prepared in the correct way and right place.

Good nutrition is important because it:

- Enhances physical and cognitive development.
- Enhances breast milk production for the mother to adequately breastfeed her child.
- Builds and or boosts body immunity reducing susceptibility to disease.
- Reduces costs involved in disease management and control
- Enhances productivity.

A person with poor nutrition is at high risk of:

- Poor growth and development of the body and the brain (especially in young)
- Frequent illness, infections and prolonged (delayed) recovery
- Reduced ability learn or perform in school
- Reduced ability to work and earn a living
- Death

## CHAPTER TWO

# MALNUTRITION AND ITS PREVENTION

This chapter defines malnutrition, its prevalence, consequences and possible agriculture based strategies to prevent or alleviate malnutrition.

A malnourished and sickly population has low agriculture productivity.

The extension worker should demonstrate to community and households the gravity of the malnutrition situation and thus the need to prevent it.

### What is malnutrition?

Malnutrition is a condition that develops when the body does not get the right amount of the nutrients it needs to maintain healthy tissues and organ function. It includes conditions, such as undernutrition, overnutrition and micronutrient deficiency diseases (like vitamin A deficiency, iron deficiency anaemia, iodine deficiency disorders and zinc deficiency).

Malnutrition affects MOSTLY people of the following categories:

- Infants and children from pregnancy to two (2) years of age
- Non-breastfed children
- Pregnant and lactating women
- People suffering from chronic or infectious disease
- People are food insecure

### Types of malnutrition

#### a) Undernutrition

This is a nutrition deficiency resulting from inadequate intake of food or inability of the body to convert or absorb food.

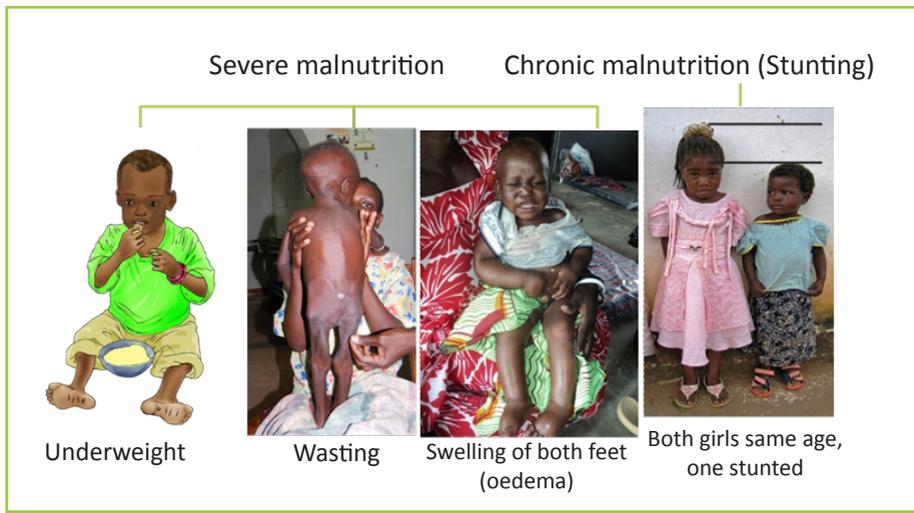
Undernutrition is the most common and easily observable type of malnutrition. Undernutrition often presents itself in two forms: acute and chronic.

### 1) Acute malnutrition: Underweight/wasting

Acute malnutrition takes place within a short time and can present loss of muscles in bulk. When severe, presents with visible wasting (prominence of bones) and/or symmetrical swelling of the body starting from both feet.

### 2) Chronic malnutrition: Stunting

A child's height is one of the most important indicator of his/her well-being. Height reflects the accumulated total of early-life health and diseases. The problems that prevent children from growing tall also prevent them from growing into healthy, productive, smart adults. Height predicts adult economic outcomes. Chronic undernutrition that affects children right from pregnancy to 5 years of age affects their growth and leads to reduced growth in stature (short-for-age). Chronic malnutrition is due to prolonged long term deprivation of proper nutrients/foods to children.



Picture 4: Common Forms of Undernutrition (Source: Integrating Nutrition Assessment, Counselling and Support into Health Service Delivery 2015)

## **b) Micronutrient malnutrition (lack of minerals and vitamins)**

This type of malnutrition is called “hidden hunger;” and is due to inadequate intake of dietary mineral salts and vitamins leading to vitamin mineral deficiencies (VMDs). This form of malnutrition cannot be identified easily except in advanced stages when clinical signs appear.

Minerals and vitamins are required by the body in very small quantities, they are very important in protecting the body against infections. Usually, their absence in the diet does not cause a person to “feel hungry.”

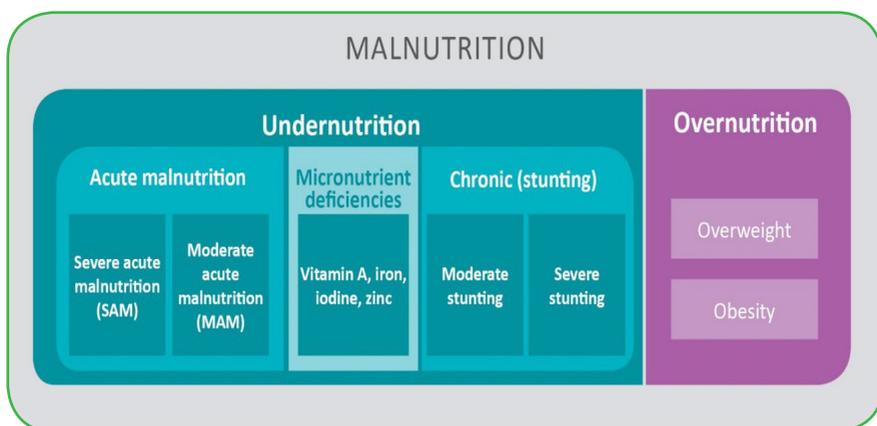
Micronutrient deficiency disorders of public health significance in Uganda are:

- Iron deficiency anaemia (IDA)
- Vitamin A deficiency (VAD)
- Iodine deficiency disorder (IDD)
- Zinc deficiency disorder (ZDD)

## **c) Overnutrition**

This is the excessive intake of nutrients in foods over a given period of time exposing individuals to poor health. Overnutrition results in overweight, obesity, or vitamin toxicity. Overnutrition may be caused by any of the following factors:

- Eating habits (overeating)
- Health conditions
- Taking too many unprescribed dietary supplements
- Lack of physical activity (sedentary lifestyle)
- Psychological factors (stress)
- Environmental factors (unsafe foods, e.g., heavy metals in food, peer pressure)
- Medication
- Genetic factors



**Figure 1. Summary of types and categories of malnutrition**

## Prevalence of malnutrition in Uganda

Malnutrition is one of the main public health and economic and development problems facing Uganda. Children below the age of five years and women in reproductive age including pregnant women and lactating mothers are mostly affected (UDHS 2011). Children below the age of 5 years suffer mostly from under nutrition with:

- 33% of these children suffer from chronic undernutrition (they are stunted)
- 14% are underweight (body weight too light for their age)
- 49% suffer from iron deficiency anaemia (lack of iron/blood)
- 60% suffer from different forms of iodine deficiency disorders (IDD) Likewise women in reproductive age (15–49 years) also suffer from malnutrition:
- 52% of pregnant women and lactating mothers have vitamin A deficiency
- 23% suffered from iron deficiency anaemia

## Causes of malnutrition?

There are several interconnected causes of malnutrition, ranging from policy issues to underlying community and cultural situations to household conditions and are commonly categorized into immediate causes, underlying cause and basic causes.

### *Immediate causes include:*

- Inadequate dietary intake including poor quality and quantity of food in the diet (poor dietary diversity).
- Infection and diseases such as malaria, diarrhoeal diseases, acute respiratory infections, measles and worm infestations.
- Low intake of foods rich in appropriate nutrients.
- Low intake of substances like vitamin C that enhance nutrient absorption.
- High intake of factors like phytates and tannins that inhibit nutrient absorption.
- Food insecurity.

### *Underlying causes include:*

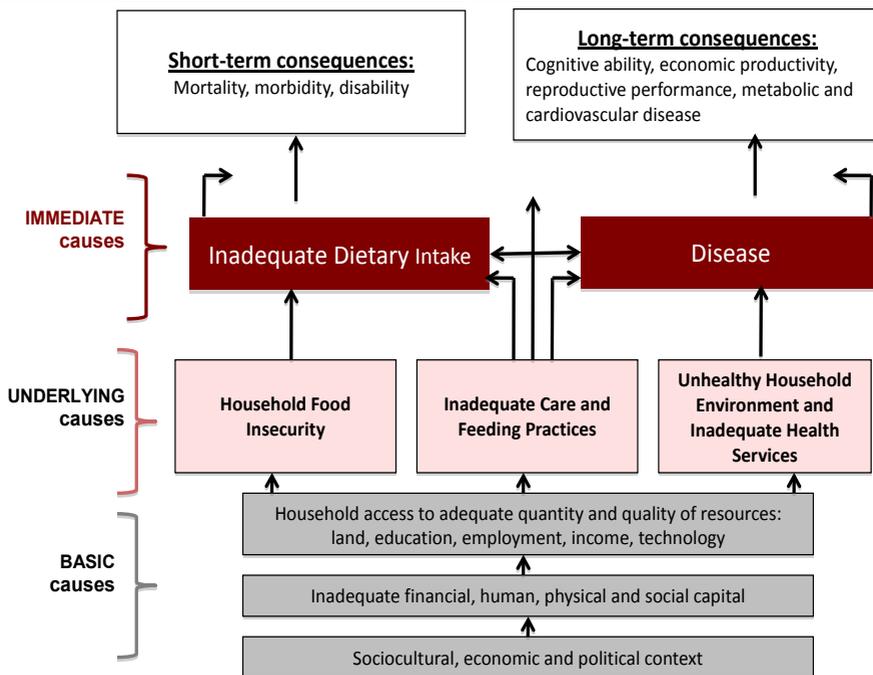
- Household food insecurity including poor access to a diverse diet, inadequate quantity of food available and accessible, and seasonal fluctuations in food availability.
- Inadequate maternal and childcare, including suboptimal maternal nutrition and infant feeding practices, often a result of heavy workloads for women and frequent births.
- Poor access to healthcare and inadequate water and sanitation, leading to increased illness.
- Inadequate and/or incorrect feeding practices.
- Inadequate caring capacity for example inadequate time, inadequate knowledge.
- Low levels of family education, awareness, knowledge and motivation.
- Intrahousehold maldistribution of access to food, health services and care.

- Poor food preparation, storage, preservation and processing practices at household levels.
- Beliefs and practices that restrict access to certain foods for some family members (food taboos).
- Poor health services and/or agricultural infrastructure.
- Lack of institutional capacity in nutrition and/or personnel trained in the various components of community nutrition programs.
- Low production of diversified nutritious foods.
- Lack of household level gardening.
- Insufficient marketing infrastructure for key food.
- Poorly developed commercial food processing industry.

***Basic causes include:***

- Limited livelihood opportunities and unequal economic structure.
- Inadequate educational opportunities.
- Priorities guiding the allocation of public funding and other resources.
- Quality of social and political leadership, e.g., poor economic or physical access to markets.
- Little or no productive land.
- High prevalence of certain endemic diseases, e.g., tuberculosis and HIV/AIDS.
- Low status of and lack of resource control by women.
- Failure to consider nutrition needs in agriculture and health policy-making.
- Lack of resources to produce nutrient-rich foods.
- Poor economic or physical access to markets.
- Little or no productive land.
- Lack of access to safe water for drinking, hygiene and/or irrigation.
- Seasonality of food availability.
- Low status of and lack of resource control by women.

## Causes of Malnutrition: Conceptual Framework: Determinants of Malnutrition



**Figure 2. The conceptual framework showing the causes of malnutrition**  
(Source: Adopted from the UNICEF conceptual framework 1990)

## Consequences (cost) of malnutrition

### a) Consequences of undernutrition

#### *Child deaths, diseases and disability*

- Newborns who are born small (low birth weight, that is less than 2.5 kg) for their gestational age are more likely to die than children born with a healthy weight.
- A severely stunted child is four times more likely to die than a healthy child (Lancet 2008).
- A severely wasted child is nine times more likely to die than a healthy child (Lancet 2008).
- Micronutrient deficiencies—including vitamin A, zinc and iron—impair the immune system, increasing risk of illness and death.
- Anaemia increases risk of maternal and perinatal deaths (death of infant in the womb and during the first 6 weeks of birth).
- Vitamin A deficiency causes blindness.
- Malnutrition has negative consequence on physical productivity, health and education outcomes with consequential negative impacts on socioeconomic development in Uganda.

#### *Malnutrition weakens brain development and nervous system*

- Impaired brain development, poor school achievement, absenteeism (stunting, iron deficiency, anaemia, iodine deficiency)
- Neural tube defects: undeveloped back bone and the nervous system (folic acid deficiency)
- Impaired foetal brain development, brain damage, severe mental retardation, or congenital abnormalities (iodine deficiency in pregnancy)
- Diminished income: earning capacity in adulthood

#### *Malnutrition decreases productivity and economic growth*

- When malnourished individuals are sick, they are weak and cannot perform their daily work for example sick farmers.
- Individuals with iron deficiency anaemia (particularly women) become tired easily and cannot work for longer hours.

- Shortage of iodine decreases IQ and causes a productivity loss.
- Farmers with low literacy levels are less likely to adopt improved agricultural practices hence leading to poor agricultural production and productivity.
- People with low literacy levels are bound to have poor health seeking behaviours and access to quality health services.
- Mothers with low education level are likely to follow poor feeding practices hence affecting the nutritional and health status of family members.
- Contributes to poverty.
- Cost of treating illnesses attributable to malnutrition.
- Cost of caring for sick.
- Lost care for other (not sick) household members.

## **b) Consequences of overnutrition**

Malnutrition can lead to multiple medical conditions including:

- Coronary heart disease (heart attack)
- Diabetes (high blood sugar)
- Gout (swollen painful joints)
- Hypertension (high blood pressure)
- Overweight
- Obesity
- Death

### ***Malnutrition increases the risk of death and illnesses***

Malnutrition weakens immunity and predisposes individuals to different infections.

- More than half of infant deaths are associated with malnutrition.
- Marasmus and kwashiorkor and finally death are caused by severe malnutrition.
- Goitre due to iodine deficiency.
- Night blindness to complete blindness from vitamin A deficiency.
- Anaemia from iron deficiency.

## Agriculture-based interventions and/or strategies aimed at preventing malnutrition

- Promoting production of nutrient-rich foods and rearing of livestock.
- Promoting backyard farming, kitchen gardening, and hanging gardens.
- Encouraging rearing of small livestock and consumption of their products.
- Promoting production and consumption of biofortified foods.
- Promoting consumption of nutritious meals and diet diversification.
- Encouraging proper food preparation and feeding practices.
- Supporting and promoting nutrition education and good child caring practices.
- Supporting and promoting labour-saving technologies to reduce women's workload, e.g., establishment of woodlots, water harvesting technologies and various energy saving technologies.
- Promoting household and community-level food processing technologies.
- Promoting good post-harvest handling practices and food safety along the value chain.
- Promoting water, sanitation and hygiene (WASH) practices.
- Promoting community-based food and nutrition information system to track vulnerable households and communities for corrective action.
- Integrating appropriate essential nutrition actions in the agricultural extension system.
- Mainstreaming gender considerations in agriculture development programs.

## SUMMARY

- Malnutrition can be undernutrition or overnutrition.
- Undernutrition includes acute malnutrition, chronic malnutrition and micronutrient deficiencies.
- Undernutrition has immediate causes (inadequate food intake and illness), underlying causes (household food insecurity, inadequate maternal and child care practices, poor access to health, water and sanitation services) and basic causes (sub-optimal political, economic, and social policies and systems).
- Consequences of malnutrition include increased illness and death, poor growth and development, lower labour productivity, poorer educational attainment, and noncommunicable disease like diabetes and hypertension.
- Undernutrition occurs across the life cycle and can pass from one generation to another.
- It is important to break this cycle through interventions to promote nutritional status of adolescent girls and women of reproductive age and from pregnancy through 24 months of age.

## CHAPTER THREE MEAL PLANNING

**M**eal planning is a process of determining, selecting and preparing foods to ensure a balanced diet for target groups or individuals. People will always want to eat food that is acceptable, therefore knowing the consumers' characteristics, food preferences and location is important in proper meal planning.

### Common terms used in meal planning

**A meal** is a selection of foods prepared and served in a single serving. The number of meals an individual eats in a day depends upon age, physiological status, health status, and physical activity level. Children eat small portions because their stomachs are small. However, they have increased nutrient requirements for growth and development and thus require more frequent feeding compared to adults.

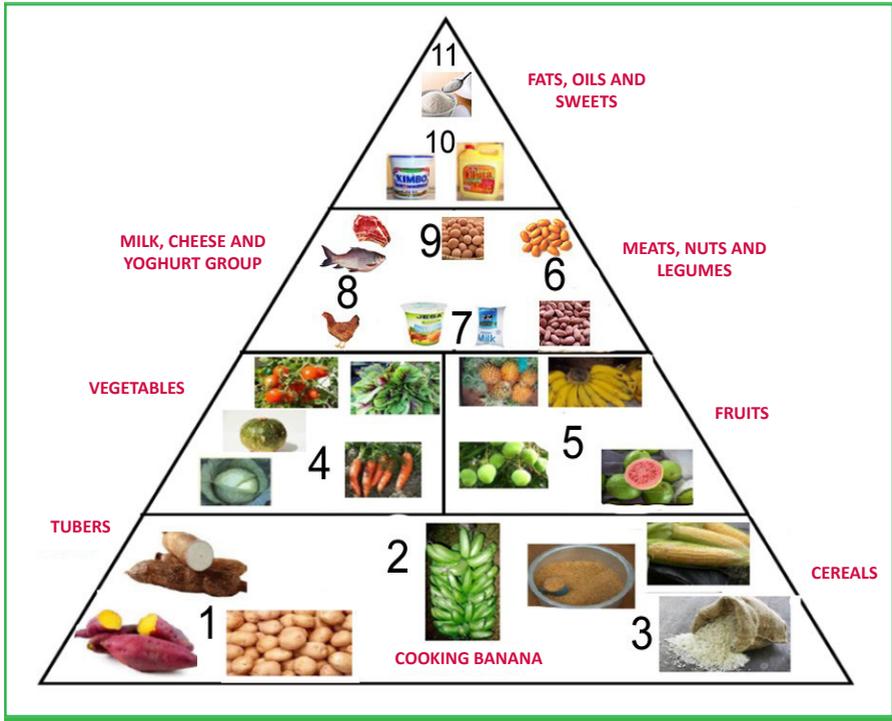
**A balanced diet** is a feeding pattern that provides adequate amounts of nutrients in their correct proportions as required by the body at a particular time. In order to obtain an adequate supply of nutrients human beings need at least three balanced meals a day in case of adults and at least five meals a day for children. Attaining a balanced diet requires that one: eats various food stuffs in a day, makes careful food choices from different food groups, and eats food in the right proportions and quality as required by the body.

**Variety** means including different foods from different food groups and within each food group, for example consuming cereals, root tubers (sweet potatoes, cassava), meat, vegetables and variety of fruits.

**A serving** is a quantity of food suitable for or given to one person in one meal.

**Moderation** means keeping servings reasonable. This involves self-control and addresses the aspect of too much food intake that leads to becoming overweight and obese.

A food pyramid is a guide showing how different categories of foods should be utilized to achieve proper health. The foods at the base of the pyramid can be eaten more and those at the tip of the pyramid eaten in small amounts or sparingly. All of these types of foods shown in the pyramid should be eaten but foods at the bottom should be eaten most and those at the top more sparingly.



Picture 5: The Food Pyramid showing locally available foods and how they should be utilized. (Source: UGAN)

### Points to consider while planning a meal

- Family incomes and lifestyles
- Individual habits and preferences
- Nutritional/health status of target consumers
- Daily routines of family members such as work and school

- Availability of storage and cooking facilities
- The occasion for which meals are required
- Food availability and season
- Nutritional needs of targeted consumers
- Time available for cooking
- Balance and variety in making food choices
- Type of fuel available for food preparation
- Meals are attractive and enjoyable
- Meals satisfy the appetite
- Meals are available when needed

## Cost reduction in meal planning

Important issues to be considered:

- Knowledge about nutrient content of foods, food groups and food guides. Foods are selected from each of the groups according to the required servings.
- Plan several meals in advance.
- Consider foods available according to season.
- Take off time to look for affordable places to buy food to reduce on expenditure.
- If possible purchase in bulk as it reduces expenditure.
- Avoid foods which are poor value for money such as food containing only energy, e.g., sodas and many artificial soft drinks.
- Except for special occasions, plan several meals at least a week before.
- Within a week or the day take advantage of opportunities when food supply is plentiful and cheap. For instance on market days or times of the day when farmers are selling directly to urban consumers.

## Selection of foods to achieve a balanced diet

### *Energy giving foods the “GO” foods (carbohydrates)*

As much as possible eat more of cereals (millet, maize and sorghum) compared to tubers (cassava, sweet potato and banana). At least take

cereals in porridge form if you can't manage them in the bread form every day.

### ***Body building foods "GROW" (proteins)***

The best sources among these foods are animal foods i.e., milks, meats, fish, eggs, poultry. However, for those with a lot of money it is important to note that too much feeding on red fatty meat (meat from animals with four legs and hoofs, e.g., beef, goat, pork, and sheep) and eggs can also be dangerous. It can result in diseases such as high blood pressure, heart attack and to some extent diabetes.

Fish is the best among these animal proteins, followed by poultry and to some extent rabbits.

Many people cannot afford animal protein. In that case they can use much of plant protein, e.g., soybeans, peas, cow peas, pigeon peas, common beans and ground nuts. Soy bean protein is exceptional in the plant group as it is almost equivalent to animal meats except it needs better processing in order to utilize it in the body.

Feed on some little animal protein in particular milk which is also rich in protective nutrients, if you are getting most of your protein supply from plants. This lowers the cost of feeding but maintains the quality.

Milk is both a protective food and a body building food. Thus, as much as possible, it must be put in place for families to access it.

### ***Protective foods "GLOW" (vitamins and minerals)***

Select dark green leafy vegetables (DGLV), e.g., dodo, malakwang, (at least one serving per day) and yellow fruits (ripe bananas [2 small ripe apple/sweet bananas or 1 bogoya per day], one orange or one mango). Citrus fruits are very good but we don't have much in some parts of Uganda. The guavas can however substitute the citrus fruits well. Two guavas per day can be very healthy.

## An example of a mixed meal guide to achieve a balanced diet



Picture 6: Examples of a variety of the locally available foods from the three main food groups

### SUMMARY

- Eat a lot of whole cereals and beans or legumes generally, if you can't afford animal protein and as much as possible take some milk in your meals.
- Eat a variety of food types from different main three groups (energy giving, body building and protective foods) at a very meal.
- For lunch and supper take a fruit and a serving of vegetables (100g or one handful of fresh vegetables).
- Avoid eating too much salt, too much sugar, drinking too much alcohol and too much fatty red meat.
- These feeding habits predispose people to diseases such as: high blood pressure, diabetes, overweight, obesity.

## CHAPTER FOUR

# ESSENTIAL NUTRITION ACTIONS IN AGRICULTURE

The Ministry of Agriculture, Animal Industry and Fisheries shares a role in executing essential nutrition actions. Those areas where the ministry of agriculture can contribute towards nutrition improvement are:

- Promoting control of anaemia.
- Promoting production and consumption of iron-rich foods.
- Promoting production and consumption of vitamin A-rich foods.
- Promoting consumption of iodized salt.
- Promoting vitamin A supplementation.
- Ensuring adequate intake of quality food for the household members.
- Reduction of women workload in agriculture.

Therefore, consistent with these actions, the Ministry is concerned with nutrition for pregnant mothers, breastfeeding mothers and children below five years.

### Nutrition for pregnant women

It is necessary that a woman is well nourished before pregnancy so that by the time she conceives, the body has sufficient capacity to meet both her and the baby's needs. A malnourished woman may fail to deliver baby alive or if she does, the baby is likely to be underweight (the normal range is 2.5–4.5 kg at birth). One of the leading causes of maternal death at childbirth is insufficient blood.

During pregnancy women have high nutrient needs because they have to build foetus tissue, build reserves for breast milk and also cater for their own nutritional needs. On average women should gain 8–12 kg in the course of pregnancy. Pregnant women need to eat more food rather than decrease the intake.

- Pregnant women need to consume balanced diet following the

guidelines for selecting energy-giving foods, body-building foods and protective foods. Pregnant women especially need foods rich in iron and vitamin A in addition to the balanced diet. Iron needs are highly increased partly due to the need to build reserves for child up to six months after birth before initiating complementary food intake.

- Pregnant women need to take foods rich in calcium, e.g., milk and mukene (silver fish) partly to take care of the increased requirement for building the foetus skeletal structure.
- Pregnant women have higher needs for nutrients generally and should take snacks in between meals.

In addition, pregnant women should be educated to strictly observe the following:

1. Take the required amounts of iron and folic acid supplements to prevent anaemia.
2. Sleep under an insecticide-treated mosquito net.
3. Visit the nearest health facility at least four (4) times for antenatal care. This will enable them access a number of services that prepare them to deliver a healthy baby.
4. Deliver in a healthy facility with the help of a skilled health worker.
5. Get deworming pills, IPT and tetanus vaccine from a health facility.
6. Avoid excessive workloads therefore community and family support mechanisms should be encouraged.
7. Pregnant women should limit intake of alcohol, cigarettes. These cause negative effects on the foetus.
8. Should strictly take drugs on advice of the health personnel as some of them are potentially harmful to the unborn child.
9. Avoid negative cultural practices that reduce the intake of nutritious foods or impact negatively on their health such as:
  - Not consuming chicken and eggs.
  - Pregnant women not defecating in toilets/pit latrines.

## KEY MESSAGES

- Ensure that a pregnant mother has a balanced diet, with a variety of foods from the food groups, and has one additional meal in addition to the 3 meals she receives daily. The fourth meal caters to her physiological needs.
- Pregnant women should take iron and folate tablets daily in addition to foods rich in iron, calcium and vitamin A.

## Nutrition for breastfeeding mothers

Nutritional requirements during breastfeeding are higher than during pregnancy because the mother has to produce enough milk to sustain a baby (bigger than the foetus) for the first six months and beyond. Breastfeeding women need to eat a wide variety of foods.

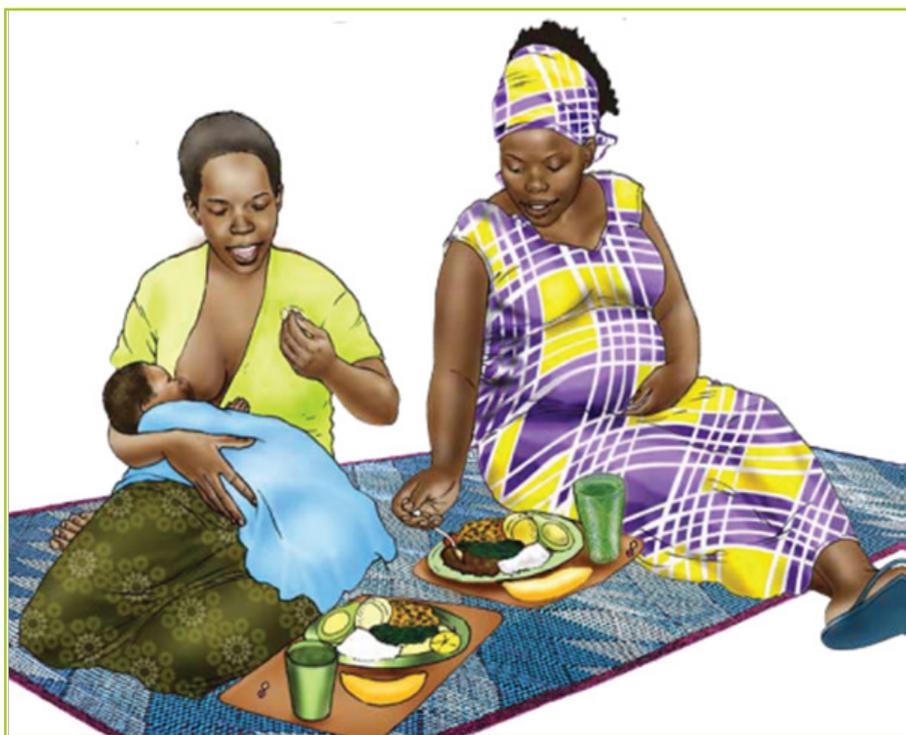
Nutrition guidelines for pregnant women as well apply here but a lactating mother needs to eat much more; that is to say one extra meal (five meals in total).

Breastfeeding mothers should also take a lot of fluids to cater for the high amounts of water used to make breast milk. They should avoid self-medication, smoking and alcohol to prevent intoxicating the baby.

Breastfeeding mothers should avoid stress and have enough rest.

## KEY MESSAGES

- Ensure that a breastfeeding mother take a balanced diet and in addition to 3 meals daily receives 2 extra meals a day to maintain her health and that of her baby.
- A pregnant woman and breastfeeding mother should eat a variety of foods from the main food groups daily.



*Picture 7: A pregnant woman and a breastfeeding mother should eat a variety of foods from the food groups, extra meals and take iron and folate daily.*

## **Nutrition for children 0 to 6 months**

Breastfeeding and complementary feeding behaviours are important predictors of infant and child nutrition, health and survival. Breast milk is the best food for babies and is all the baby needs up to six months of age. Children from birth to six months of age should be exclusively breastfed. If you introduce any food before six months you will potentially expose the baby to unsafe and poor quality meals.

Exclusive breastfeeding refers to feeding a child on breast milk only for the first six months. Mothers are advised to breastfeed their babies as many times as the baby demands to be fed (at least 8 times a day, every 2–3 hours). This will help maintain milk production. Even when the child is ill, continue breast feeding.

## KEY MESSAGES

- A baby from birth to 6 months of age should be fed only on breast milk and no other milk or foods.
- A breastfeeding mother should take a balanced diet and in addition to 3 meals daily should eat 2 extra meals a day to maintain her health and that of her baby.



*Picture 8: A mother breastfeeding her baby and hand expressing her milk to leave for the baby when she is away.*

## Advantages of breastfeeding

- Breast milk is the best nutritionally balanced food for the baby. It contains all the nutrients required by the baby in the correct proportions. The nutrients are in forms that are easy for the baby to digest and absorb.
- Breast milk contains substances that help the baby to fight infections and stay healthy. Most of these substances are found in the yellowish milk (colostrum) that is produced in the first few days afterbirth.
- Breast milk is released at a correct temperature suitable for baby.
- Breast milk is safe, there is no danger of contamination during preparation.
- Breast feeding is relatively cheap compared to other alternatives.
- Breast feeding promotes bonding between mother and baby.
- Delays return of menstruation and delays the next pregnancy thereby spacing the children.
- Helps the mother to shrink the uterus back to its normal size.
- Exclusive breastfeeding for the first six months helps a child's mental (brain) development.

### SUMMARY

- Exclusive breastfeeding is the safest and healthiest way to feed a baby for the first 6 months.
- Babies need to be breastfed 8–12 times a day after every 2–3 hours or more as needed, in the first six months.
- Mothers should continue to breast feed their babies up to the age of 2 years or more even after introducing complementary feeding (weaning). Give food daily according to age, for example:
  - 6–8 month: feed 2–3 times a day
  - 9–11 month: feed 3–4 times a day
  - 12–24 month: feed 4–5 meals a day

## Weaning/complementary feeding practices

Weaning is the gradual introduction of food into the diet of the child. Alongside breast milk at the age of six months, beyond 6 months, breast milk alone is not enough to meet the child's increased nutritional needs for proper growth and development. During weaning there are six principles to follow: meal frequency, amount, thickness, variety, active feeding and hygiene. This is commonly referred to as the FATVAH.

**1. Frequency of meals** refers to the number of meals eaten in a day. In order to meet the child's body's needs, for growth, development, and activity, we must feed them frequent meals, meaning 3 meals and 2 snacks each day.

**2. Amount of foods** refers to how much food is eaten at each meal. It is important to eat foods in the appropriate amounts, again to ensure that we are not getting too little or too much food. For example, the youngest child needs less while the eldest child needs more amount of food for each meal as shown on table 3.

**3. Thickness of foods/consistency** (not too thick as to have difficulty chewing or swallowing, not too watery). The thickness of foods/ consistency is an important factor to eating well, because if food is too thick, it might make it difficult to chew and swallow. However, if food is too watery, the energy value of the food is reduced.

**4. Variety of different foods** from each food group. In session 2 we learned about the food groups and their importance. We now know that each food serves the body differently ("GO", "GLOW", "GROW"), therefore it is important to have a variety of foods from each food group in order to eat well. Use fortified foods, when available; give vitamin/mineral supplements when animal products, fortified foods, or micronutrient (vitamin A, Fe & Zn) rich foods are not readily available.

**5. Actively feed and support** is important, particularly for PLHIV. This is more than just feeding PLHIV (both adults and children), but involves a number of actions to support PLHIV to have access to food, grow foods, and prepare these foods.

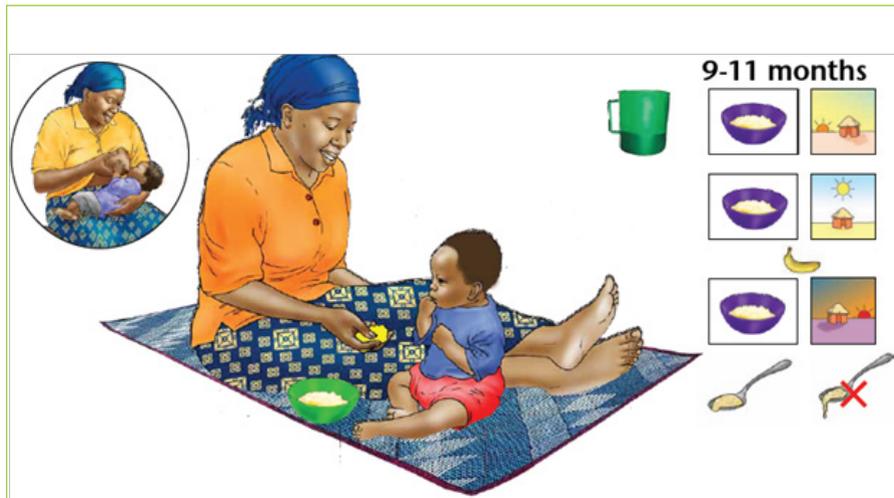
**6. Food Hygiene.** Proper hygiene practices will prevent disease occurrences and hence ensure good child growth and development: washing hands before eating and handling foods, clean utensils and clean water. This is a very important factor needed for eating well. Good hygiene reduces the risk of diseases.

**Table 4. The Frequency, Amount, Thickness and Variety of Foods by Child Age-Group**

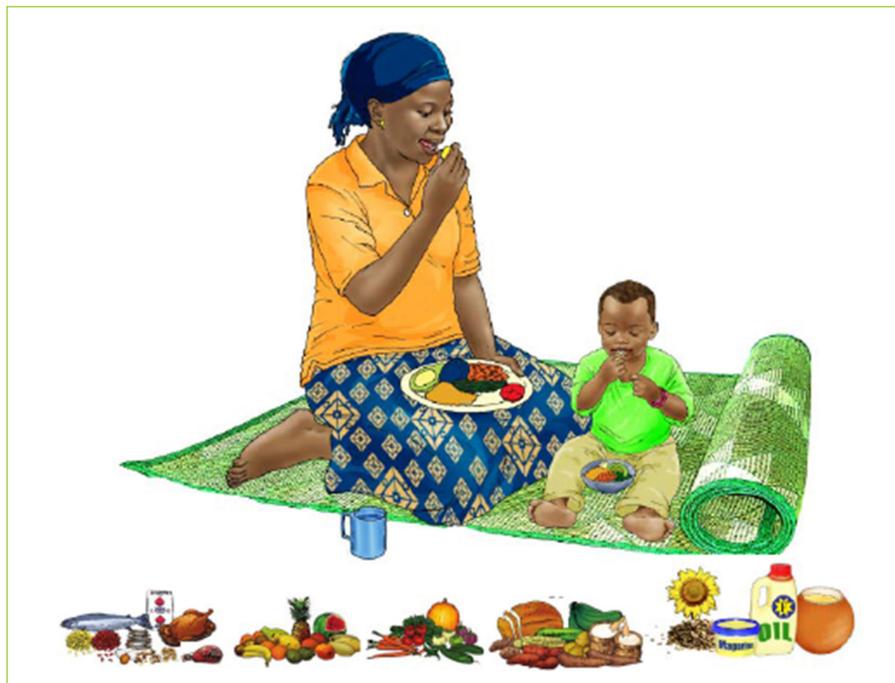
Age	Texture	Frequency	Amount
<b>6–9 months</b>	Start with thick porridge, well mashed foods. Continue with mashed family foods.	2–3 meals per day plus frequent breastfeeding. Based on child’s appetite, 1–2 snacks may be offered.	Start with 2–3 tbsp per feed increasing gradually to half of a 250 ml cup.
<b>9–12 months</b>	Finally chopped or mashed food and foods that the baby can pick up with fingers.	3–4 meals per day and 1–2 snack.	Half a cup at each meal.
<b>12–24 months</b>	Family foods; chopped or mashed if necessary.	3–4 meals plus frequent breastfeeding, based on child’s appetite.  1–2 snacks may be offered.	Half of a 250 ml cup/bowl.



Picture 9: A mother feeds a baby 6–8 months old; breast feeds and feeds thick complementary foods made from a variety of foods from the food groups and made soft/mashed.



Picture 10: A mother breast feeds and actively feeds the child soft, thick foods prepared from a variety of foods from the food groups.



Picture 11: A mother encourages and supervises her child's feeding following the six principles of complementary feeding practice from the age of 12–24 months.

## KEY MESSAGES

- From 6 months and beyond, children should be fed on other foods on top of the mother's breast milk. Milk should form the foundation of the child's diet between the ages of 0 to 2 years.
- Use biofortified and/or fortified foods, when available; give vitamin/mineral supplements when animal products, fortified foods, or micronutrient (vitamin A, Fe & Zn) rich foods are not readily available.

## CHAPTER FIVE

# WATER, SANITATION AND HYGIENE PRACTICES (WASH)

**W**ASH practices help to prevent caregivers and other household members from contracting water-related diarrhoea diseases and associated food borne diseases. A healthier and stronger household is more economically viable and resilient in the face of nutritional challenges. WASH practices benefit everyone, and integrating these practices into nutrition care programs provides additional opportunities and resources to improve overall health outcomes.

### Water access

- Access to safe water is considered a basic human need and, in most countries, a basic human right.
- For many people especially in rural communities, there is lack access to safe water.
- The negative effects of lack of access to sufficient quantities of water, water of reasonable quality, basic sanitation and hygiene are magnified for sick people including the malnourished clients.
- The added burden of unsafe water affects not only the malnourished individual, but the entire family, increasing the risk of diarrhoea disease and lost productivity.

### Water quality

- Piped water is available in some areas, but is often untreated or is contaminated between the source and the home.
- Simple, low cost technologies for treating and safely storing water at the household level can greatly improve the microbial quality of water and can significantly reduce diarrhoea achieving outcomes comparable to those achieved by hand washing and safe handling and disposal of faeces.
- Several technologies are viable for treating water in the home: chlorination; use of aqua safe and water guard, use of various types of filters; proper boiling.

- All drinking water should be boiled including water harvested from iron sheet-roofed houses and from the trees.



*Picture 12: Making drinking water safe through boiling and keeping drink water covered and safe, cover water containers, wash hands after visiting toilet and always wash fruits before giving to child.*

## Hand washing

If done properly and at critical times, washing hands with soap or an abrasive substance such as is effective in preventing diarrhoea.

## Food hygiene

Although statistics of food borne illnesses are scanty in Uganda, many people die as a result of diarrhoea disease cases. These are attributed to contaminated food or water, universal precautions apply to food handling like washing of raw fruits and vegetables.

### *Good practices to improve food hygiene*

- Wash hands thoroughly before handling, preparing and eating food.
- Wash the knives, chopping boards and all surfaces thoroughly with clean water before and after use.
- Prepare and serve food when hot or warm.

- Always boil/reheat left over food thoroughly before eating. Cover well all the foods in the house away from flies and other pests.
- Keep the kitchen very neat.
- Keep cooked food away from contact with raw food.
- Avoid eating mouldy or rotten food.
- Avoid taking oil seeds whose skin has been cracked, e.g., groundnuts, soybeans.
- Wash vegetables with plenty of water at least three times before cutting it.
- Avoid taking raw or partially cooked foods of animal origin.
- All food grains and seeds such as maize and groundnuts should be properly dried and stored in a dry place. Use clean stores for storing foods.

### KEY MESSAGE

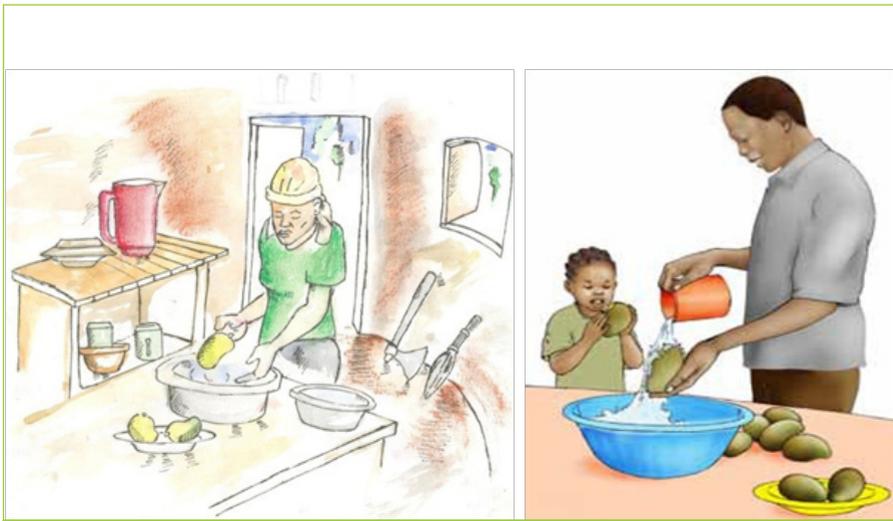
Always follow recommended postharvest handling measures given by agricultural extension officers in your area, when drying and storing foods.



Picture 13: Washing utensils; an example of proper hygiene practices.

## Kitchen and housekeeping

- The kitchen and house should be kept clean because it can be a serious cause of food contamination if it is not well tended to.
- The inside of the house should be kept neat and invitingly well organized/arranged to allow thorough cleaning.
- The kitchen should have a door for the safety of the items kept there.
- Keep the inside of the house tidy by regular cleaning.
- It should have good ventilation to avoid growth of fungi and mould.
- There should be a simple rubbish bin for putting in refuse before disposal into the compost pit. The rubbish bin should have a cover.
- Use fuel saving stoves.
- Do not sleep with animals in the same house.
- If the house is not cemented, it should be smeared at least once a month.



*Picture 14: Food hygiene and safety is one of the main ways of preventing infections: washing fruits before slicing and eating them. Note: also a clean and well organized kitchen.*

## Proper refuse disposal

Wastes and kitchen refuse should not be littered everywhere in the compound lest flies will be invited.

- Use a garbage bin/pit for the disposal of wastes generated in the home.
- A compost pit should be dug in the kitchen's vicinity to accommodate kitchen and house refuse.
- Garbage should be burnt or buried in garbage pits to avoid breeding grounds of pests and rodents.
- Before disposal to the compost pit nondegradable garbage such as polythene bags should be separated out and preferably recycled in the appropriate facility.
- Compost manure from these pits can be used for agricultural purposes to improve soil fertility. This in turn is nutrition advantageous.

## Sanitation

- Children are particularly susceptible to contracting diarrhoea when any faecal matter is present in the environment and may lead to malnutrition.
- Safe handling and disposal of faeces can reduce the risk of diarrhoea disease.
- Latrine should be located at least 6 meters away from the main house and routinely maintained and roofed:
- Kept clean and free from flies by routine sweeping and smoking, or by applying used car oil.
- Have a door and a cover for the latrine hole. Improved latrines, e.g., Ventilated Improved Pit (VIP) latrines are recommended.

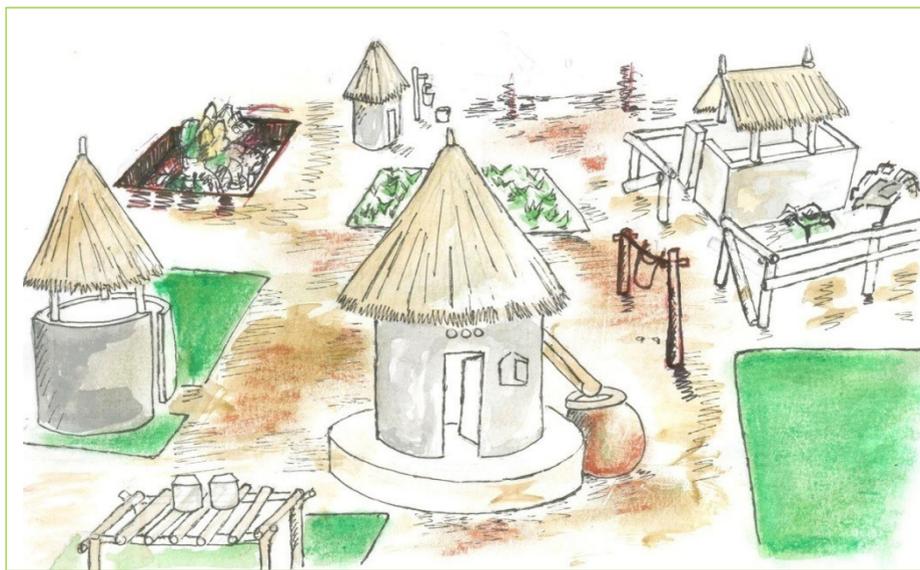
A locally fabricated hand washing facility (tippy tap) should be strategically positioned near the latrine for hand wash water and soap/ash after visiting the latrine.



*Picture 15: Examples of proper hygiene practices. Washing hands after visiting toilet.*

A clean, organized home environment prevents us from diseases, keeps us comfortable and adds beauty and scenic appeal to our homes. When diseases occur, they directly and negatively affect the nutritional status of a person no matter how well fed he/she was. It is possible to attain good standards of hygiene and sanitation regardless of where we live and under what conditions we live in. By maintaining a clean environment through practicing proper sanitation and hygiene, we prevent many infections and therefore save on resources (money, energy and time for treatment). Prevention is better than cure:

- Ensure good personal hygiene by regularly bathing, washing your clothes, trimming hair and nails.
- The home surrounding should be kept clean by:
  - Sweeping the compound every day.
  - Keeping grass low.
  - Draining all stagnant water around the house to keep away the mosquitoes.
  - Building animal houses.



*Picture 16: A clean organized home environment with a rubbish pit, a separate kitchen, separate house for animals, place for hanging washed clothes, plates drying rack, latrine and water to wash after visiting latrine.*

### **KEY MESSAGE**

In addition to the balanced diet, ensure an organized, clean health environment at household and consumption of safe food for all household members.

## CHAPTER SIX

# AGRICULTURAL PRACTICES THAT PROMOTE HOUSEHOLD FOOD SECURITY AND NUTRITION

**N**utritionally friendly agriculture technology practices are very important in diversifying the household food and nutrient intake and also ensure that at least each meal the family is served has a protective, body building and energy giving food groups.

Nutritional well-being requires access to enough nutritious and safe food to meet the dietary needs of all members of the household throughout the year. Attaining better food supplies and nutritional well-being is more than just producing enough food locally. It also requires sufficient resources (such as land and labour), tools, skills and knowledge. Roads and transport to markets are necessary so that food and other essentials can be traded. Also, household members can find employment as well as have access to other commercial and government services.

For enhanced nutrition, agricultural practices that promote increased production and access of highly nutritious foods are emphasized in the community. Likewise, quality and safety of food produced should be maintained throughout the entire value chain. Good Agricultural Practices (GAP), Good Hygiene Practices (GHP) and Good Manufacturing Practices (GMP) prevent foodborne diseases attributed to livestock and crops.

Zoonotic diseases such as salmonellosis are from eggs, brucellosis and tuberculosis from milk and meats and aflatoxin from maize and ground-nuts should also be prevented.

It is therefore important to have built-in nutrition consideration that ensures access, safety and stability of nutritious foods.

Nutrition-friendly agricultural practices can be divided into three broad areas:

## **A) PLANNING FOR NUTRITION FRIENDLY AGRICULTURE: NEEDS IDENTIFICATION**

The process of identification of farmer needs is the first entry point for integration of nutrition services. Farmers should be provided nutrition information and facilitated to articulate nutrition sensitive requirements during this process.

### **Keys considerations**

**Quality of farming inputs:** Encourage farmer group to plan for diversified inputs which are nutrient rich including fruits and vegetables; biofortified foods; animal source products.

**Ensure Male and female involvement in participatory planning (farmer group discussions):** In Uganda women provide the majority of the labour force in agriculture and are basically the caregivers in homes including all aspects of child feeding and home management. Therefore they need deliberate targeting to increase farm productivity and adaption of positive childcare practices. However, they also need support of their male counterparts to ensure home harmony and sustained change.

**Involvement of the most vulnerable farming households:** Traditional extension had ignored these categories because they don't easily adapt the technologies being promoted. This further increases their vulnerability to malnutrition. They need consideration and deliberate targeting.

**Labour saving technologies:** Provision of agriculture labour has a direct effect on childcare practices within the agricultural households. Usually caregivers in agriculture households leave children under the care of older siblings; may have one meal a day which contributes to the poor nutrition status of children. Planning should focus on adoption of labour saving technologies to free time for provision of child care.

**Involvement of the youth:** Uganda has a younger population and the youth are the majority in most communities. This same group typically rejects careers in the agriculture and food system. Involvement of the

youth is critical in building the next generation of agricultural leaders and thus creates sustainable change in the community.

**Nutrition and agriculture information sharing:** During planning ensure that farmer groups provide a forum to discuss nutrition issues; groups can set rules ensuring all members practice essential nutrition actions (refer to chapter 3). Groups can buy labour saving technologies to address the issues of labour and child care; and empower farmers to demand for appropriate nutrition advice and information. Extension workers should train farmers to identify and articulate their nutrition needs.

**Selection of enterprise mixes that have a high nutrition impact:** There is a tendency to focus of high yielding and profitable products in farming as a business. The prioritization and allocation of enterprises (zoning) across Uganda has emphasized food availability and commercialization with minimal emphasis on nutrition security. Extension workers should encourage and ensure farmers' enterprise selection provides for both nutrition and income generation benefits.

Enterprise mixes with potentially strong nutrition impacts should have a mix of the following characteristics in addition to the high market potential:

- Provision of nutrients which are commonly deficient in the community for example orange fleshed sweet potatoes, fruits, vegetables, small animals and others.
- Ensure the selected enterprise mix and/or actions along the value chain have inbuilt childcare considerations, e.g., reduction, of women's workload to free time for childcare, promotion of community based childcare centres as part of agricultural development programs, promotion of household level income generation activities for women such as cottage level agroprocessing and others.
- Promote agricultural enterprise mixes and/or actions along the value chain that ensures table food availability and more frequent flow of incomes for households (weekly or monthly).
- Promote production practices that protect the environment and/or reduce natural risks, e.g., climate change associated risks.

- Have inbuilt food safety considerations and control of diseases associated with agricultural systems (for example aflatoxin, zoonoses, bilharzias and others).
- Promotion of enterprise mixes and marketing systems that increases the participation and ownership/stake of the poor and other vulnerable groups along the value chain activities.

### SUMMARY

- Train farmers to articulate their nutrition related needs during the planning process.
- Equal male and female involvement in selection of agriculture and nutrition farm needs.
- Ensure/encourage diversification of farm needs to include both animal and crop products.
- Built-in child care considerations as part of enterprise mix design.
- Quality of farming inputs for improved nutrition.
- Involvement of the most vulnerable farming households in agricultural development activities.
- Select enterprise mixes that maximize both income and nutrition outcomes.
- Integration of ENA in agricultural extension system.

## B) NUTRITION SENSITIVE AGRICULTURE PRODUCTION PRACTICES

There are 6 Sensitive Agriculture Production Key Practices:

1. Production of a variety of crop and animal source foods for nutrient dense diet.
2. Adoption of farming systems that conserve the environment and promote nutrition.
3. Promote use of labour saving technologies.

4. Control diseases, agricultural chemical and veterinary drug residues associated with food production systems.
5. Integrate gender consideration in agricultural production practices.
6. Design enterprise mixes or farming systems with inbuilt risk mitigation (market and natural/environment risk) especially for the vulnerable groups.

**1) Production of a variety of crop and animal source foods for nutrient-dense diet.** The farmers should be encouraged to provide land for rearing animals/small livestock and for crop productions of home crops such as fruits and vegetables which are high in nutrients yet require limited agriculture inputs. Fruits and vegetables are high yielding, require limited space and can be used for a variety of cropping systems selected by the farmers. Examples of these farming systems that promote diversified production are hedge gardening and kitchen gardening for fruits and vegetables:

- It is advisable that food be grown on fertile soils that are rich in nutrients.
- Proper timing of planting, weeding, irrigation, pests and disease control and other important farming practices.
- Foods rich in protective nutrients (vitamins and minerals) should be produced: These include orange fleshed sweet potato varieties (OFSP which is rich in vitamin A), iron rich beans, carrots rich in vitamin A, pumpkin seed rich in zinc, dark green leafy vegetables and fresh fruits rich in vitamins.
- Foods rich in protein from crops source such as high quality protein maize (QPM) and legumes especially soya bean. Foods rich in protein from animal source (those which can easily be kept by women or children for consumption or sold in the market to earn cash for household health expenditure without exciting men to resist). These include: poultry, rabbits, guinea pigs, fish farming, goats and pigs.
- Foods rich in proteins such as insects (grasshoppers, white ants, caterpillars, termites) should be promoted.
- Encourage kitchen gardens and growing of fruits as part of local government bylaws. Integrate nutrition along the strategic agricultural value chains by promoting the production of biofortified food varieties.

ies for the selected strategic enterprises, e.g., vitamin A and protein rich maize, iron rich beans, vitamin A rich bananas and cassava.

**2) Adoption of farming systems that conserve the environment and promote nutrition.** Intercropping or crop rotation is one of the farming systems that has soil health and nutrition benefits. Legumes are ideal for intercropping with other crops because they fix nitrogen in the soil resulting in high yields from improved soil health. Others include:

- Agroforestry
- Integrated farming systems (animal & plants)
- Soil and water conservation practices
- Organic/sustainable agriculture

**3) Promote use of labour saving technologies.** The use of labour saving technologies such as rain water harvesting; use of animal traction (ploughing, carrying manure/ mulch, water, firewood and harvest), improved cooking stoves, planting of woodlots, minimum tillage (use of pesticides and herbicides) will reduce women workload and allow ample time for child care.

**4) Control diseases, agricultural chemical and veterinary drug residues associated with food production systems.** These diseases can be broadly classified as follows:

- *Water-associated/waterborne diseases* caused by use of contaminated water from faecal material (cholera) and chemical intoxication. In addition, diseases caused by vectors living in stagnant water and or storage systems (Malaria, schistosomiasis/bilharzia worms, River blindness).
- *Zoonoses diseases* are diseases transmitted from animals to human being. Examples include: tuberculosis, brucellosis, salmonellosis, rabies, SARS/avian influenza and ebola.

Control of these diseases is important because they can be transmitted to human beings, imposing on them poor health and attendant undesirable nutrition related effects including the disease burden.

- *Occupational disease* and drug resistance as a result of exposure to range of antibiotics used in animals leading to drug resistant bacteria in humans.
- *Foodborne diseases* such as diarrhoea, toxins and chemical hazards associated with food are also important health threats, and in many cases can be prevented only by farm-level intervention.

### **5) Integrate gender consideration in agricultural production practices.**

It is important that both men and women of working age and of all categories, including youth and persons with disabilities participate in agricultural processes to ensure.

- Production decisions are made in a participatory manner and selection of enterprises addresses both commercial and nutrition needs.
- Land is made available for both commercial and nutrition oriented production.
- Equitable sharing of roles to ensure women are freed from overburdening work load.
- Dialogue on what and how much to sell and how much to keep for household consumption.
- Dialogue on how to utilize agricultural income in a manner that contributes to better nutrition while not ignoring competing needs.

**6) Design enterprise mixes or farming systems with built-in risk mitigation** (market and natural/environment risk) especially for the vulnerable groups. This will include enterprise diversification producing a product that has markets in domestic, regional and if possible international market:

- Promotion of crops and animals that are resistant to adverse effects of climate change.
- Promotion of urban farming for the vulnerable households in the target areas.
- Establishment of school, and home orchards and gardens.
- Integrating community based food security information system as part of agricultural extension programs design to track food availability and access for the vulnerable groups.

- Design of agricultural enterprise mixes or value chains that ensure stable food availability throughout the year, more active participation of the vulnerable groups and/or more frequent flow of incomes for those households.

### SUMMARY

- Promote the production of a variety of crop and animal source foods to ensure a diversified diet.
- Control diseases associated with agriculture systems.
- Promote use of labour and energy saving technologies.
- Integrate gender consideration in agricultural production.
- Adoption of farming systems that conserve the environment and promote nutrition.
- Design enterprise mixes or agricultural value chains with in-built risk mitigation (market and natural/environment risk).

## C) NUTRITION CONSIDERATIONS IN HARVEST AND POSTHARVEST HANDLING

Agriculture produce in Uganda can be classified into three categories based on their degree of perishability:

- 1) Durable produce (cereals, legumes, coffee)
- 2) Semi-perishable (roots and tubers, bananas)
- 3) Perishable produce (meat, milk, fruits and vegetables)

Harvest and postharvest handling practices for cereals, legumes, fruits and vegetables in Uganda are characterized by traditional practices that result in considerable deterioration in the physical and nutritional qualities of the harvested produce resulting in high losses.

Promotion of market oriented agriculture has resulted in increased production; however limited emphasis has been placed on reducing postharvest losses and increasing shelf life to ensure availability during lean periods. Postharvest losses in quality and quantity may be attrib-

unable to absorb adequate processing and preservation facilities among farming households; poor handling during loading and unloading at market points; bruising, puncturing, and crushing due to improper packing; absence of grading especially for fruits and vegetables and inadequate knowledge among farmers on cottage processing. Retention of physical and nutritional qualities of agricultural produce can be ensured by developing appropriate and improved postharvest handling, storage and cooking. This keeps consumers healthier and improves the marketability of farm produce.

### **Promote harvesting at the correct maturity stage**

- Harvest food at the right stage of maturity to ensure maximum nutrient availability, e.g., most fruits and vegetables have greater vitamin content if they are picked ripe from the plant, rather than being picked before they have fully ripened.
- Over ripening of fruits will reduce the nutritional quality of fruits.
- Avoid physical and mechanical damages during harvesting to ensure longer storage and safe food following the harvest.
- Early planting prevents nuts from maturing during periods of low rainfall, which stresses a plant and encourages growth of the fungus on ripening crops.

### **Cleaning**

- Drying of produce should be done on a clean and dry surface to avoid moisture and reduce the risk of contamination. As much as possible tarpaulins should be used.
- It is recommended that drying is done on a raised platform, one (1) meter above the ground to reduce contamination from animals passing by.

### **Discourage processing practices that produce microbial contamination of the agricultural harvest**

- Ensure crop is not left on the ground or on bare soil during drying, shelling and threshing, where fungal spores develop. The practice of moistening the unshelled nuts to make them easier to shell results in higher contamination from aflatoxin and should therefore be strictly discouraged.

- Clean and sort to remove broken kernels, foreign matter, and diseased and rotten foods (grains, nuts, fruits, vegetables); these attract moisture and pests leading to spoilage and/or fungal growth.
- Ensure crops are properly dried immediately after harvesting; however, drying will not reverse the effect of poison in the already contaminated foods, but it may inhibit further growth of moulds and other microbes.

## Promote good storage practices to protect the nutrient content of the foods

- Proper storage spaces should have clear pathways to allow good airflow; ensure timely pest control interventions; ensure that grains are bagged in natural fibre bags for storage (not plastic). Improved storage and storage techniques can increase availability of nutritious foods during the lean season, reduce food safety concerns such as aflatoxin and increase marketability and trade in nutritious foods.

## Distribution

- Distribution should also ensure that risks of contamination are reduced. For example, containers should be clean and dry.

## Household agroprocessing and value addition

- Household or on-farm processing gives food security and nutrition benefits in addition to higher, potentially stable and regular incomes.
- Simple/hand coffee processing tools will ensure that coffee husks remain and act as manure for crop enterprises.
- Many foods that are transported to the urban centres and other markets in their very fresh forms result in considerable soil nutrient mining of the production areas and burdening of the waste disposal systems in the target markets. A case in point is the banana market in Uganda.

### KEY MESSAGE

Promote household/cottage level agriculture value addition for better incomes and as part of sustainable agricultural production systems for improving food security and nutrition.

## SUMMARY

- Minimize storage losses attributable to harvesting, weevils and farm processing.
- Harvest food at the right stage of maturity (avoid harvesting immature or over-mature produce in case of fruits don't harvest under ripe or over ripe ones).
- Avoid physical or mechanical damage during harvesting, transportation and handling of foods.
- Avoid drying, shelling, threshing and winnowing food on bare ground (problems with contamination by microorganisms, sand and stones).
- Sort and clean the food to remove diseased and poor quality produce and impurities.
- Make sure that the produce is prepared under hygienic conditions all the time.
- Recommended storage practices are very important for both perishables (fresh fruits and vegetables, meat, fish, poultry and eggs) and non-perishables like cereals and legumes).
- Maintain hygienic environment wherever food is produced and handled.
- Practice appropriate food preservation in homes, e.g., drying, smoking or salting of meat and fish, preservation of fruits and vegetables by use of solar drying.
- Discourage processing practices that contaminate the agriculture harvest.
- Promote good storage practices that ensure safe and nutritious foods.
- Not all food should go to the market.
- Use income from non-food items to buy food.

## D) FOOD SAFETY IN AGRICULTURE

Issues of food safety are gaining prominence each and every day worldwide because of urbanization, changing food habits, preferences, lifestyles and food preparation methods. Street foods, food vending, restaurants and hotels have become quite common of recent.

Food becomes unsafe for human consumption when the concentrations of the following (referred to as hazards) are above tolerance levels:

- Microorganisms (bacteria, fungi, viruses), parasites
- Biological toxins such as mycotoxins
- Physical materials like metal chips, sand, faecal material, stones
- Chemical residues including heavy metals such as lead, mercury, copper and others

Microorganisms including (bacteria, fungi, viruses) are the leading cause of food poisoning in the world. Physical aspects of food items affected by microbial activity with potential toxin formation include the following:

- Discoloration
- Mouldy and other unpleasant tastes
- Production of off odour

Aflatoxins caused by the moulds of *aspergillus* spp are especially associated with occurrence of liver cancer in humans. There is also growing evidence that aflatoxins and mycotoxins in general can lead to reduced immunity and other associated effects such as incidence of HIV/AIDS and undernutrition. It is also linked to negative outcomes in animal growth and reproduction. Aflatoxins are commonly found in human food and animal feeds in the humid conditions of the tropics.

### What is food safety?

Food safety describes a process where food is free from hazardous contaminants and when eaten will not cause damage or disease to human beings. Food safety is the protection of consumers from injury or adverse health effects caused by consuming or handling spoilt, adulterated or badly stored foods. Generally, food safety describes the handling, preparation and storage of food in ways that prevent food

borne illnesses. This includes a number of routine activities that should be followed to avoid potentially severe health hazards.

Food safety is a public health priority because millions of people worldwide fall ill every year and many die as a result of eating unsafe food.

### Importance of food safety in Uganda

- As the country develops, an increasing percentage of the population is eating food prepared from outside the home or at least processed away from home. The majority of the market participants in the food industry are not aware of food safety issues and this is increasingly exposing the population to unsafe food consumption.
- Current practices of food production, postharvest handling, processing, packaging, transportation, retailing and food preparation in the homes, street food vending and some restaurants may lead to food becoming unsafe for consumption.
- Food safety related illnesses and problems such as cancer prevalence are now a common occurrence in Uganda.
- Much of this burden of illness results from basic sanitation failures that occur in food production, processing, storage, transportation, retailing and handling in the home or streets, restaurants and hotels.

### Potential hazards associated with food in Uganda

**Microbial pathogens** for example: salmonella, campylobacter and escherichia coli are associated with Diarrhoea diseases.

**Zoonotic diseases** transmitted from animals to humans through food products, for example tuberculosis and brucellosis.

**Parasitic organisms**, in particular cysticercosis, tape worms other intestinal worms from poorly cooked pork or beef.

**Naturally occurring toxicants** for example, mycotoxins like aflatoxin.

**Agrochemical and veterinary drug** residues that are used in crop agricultural production including pesticides or animal production for example, antibiotics like tetracycline.

**Heavy metals** such as lead and mercury that cause neurological damage in infants and children.

**Physical contaminants and adulterants** for example: glass, metal, animal faecal materials, sand, soil, stones, grass.

### Food safety issues of concern in Uganda

**Cereals & pulses:** Groundnuts, Maize, sorghum contamination by aflatoxin and Fusarium (fumonisins), this is highly prevalent but is not checked neither is there any regulation or control measures in place.

**Dairy products:** *Brucella abortus*, *Escherichia. Coli* O157:H7, coliforms, tuberculosis are of interest. Dairy Development Authority and Uganda National Bureau of Standards laboratories carry tests for coliforms, *Escherichia coli*, total plate count, salmonella and staphylococcus.

**Fish:** There is no published information on incidence of contamination risk in aquaculture. Tests are carried out by the fish laboratories at the Department of Fisheries Resources (DFR) MAAIF on *Vibrio cholerae*, *Salmonella*, poisoning using chemicals, lead, mercury, pesticides, *Escherichia coli*, *Salmonella* and *Campylobacter*.

**Beef and Pork:** Anthrax, Mycobacterium bovis, Tuberculosis, Brucellosis are the zoonoses of interest. Cysticercosis, trichinosis, Botulism, diseases arising from consumption of meat infected after slaughter with certain bacteria agents resulting into decomposition of meats. Cysticercosis (*Taeniasolium*): in pork are tested for by municipal inspectors.

**Water:** Water quality testing is done by the National water laboratory under MoWE on microbes (*Escherichia coli*, coliforms and plate counts) and nutrient/organic matter. Heavy metals tests were to start in 2012 when equipment was acquired, pesticides are not tested.

**Methanol poisoning:** methanol content exceeding acceptable levels.

**Street vending:** microbes, dust, storage, handling, sanitation and hygienic practices.

## Impact of food borne diseases

- Food borne diseases cause acute illnesses, disability and even early death.
- Increase the risk of chronic diseases such as cancer.
- Mostly affects children, pregnant women, the elderly and people already affected by other diseases.
- Food borne diseases significantly affect people's health and wellbeing, reduce economic productivity resulting into a substantial burden on healthcare systems.
- Economic consequences for individuals, families, communities and businesses.
- Much of the burden of illnesses result from basic sanitation failures that occur in food production, processing, storage, transportation, retailing and handling in the home.

## Effects of aflatoxin/mycotoxin on human health and agriculture

Mycotoxins are of economic, health and agricultural significance because:

- Mycotoxins can cause acute toxicity leading to death or chronic toxicity leading to liver cancers, immune suppression, Kwashiorkor and stunted growth.
- Mycotoxins are also harmful to animals for instance, in poultry production, it reduces feed intake, reduces egg production, has carryover in eggs and meat and causes death.
- Aflatoxin, a type of mycotoxins which contaminates food has been associated with hepatoma (diseases of the liver) frequency in Uganda.

## Action areas for extension workers and others on food safety

- Train/sensitize farmers, consumers and all stakeholders along the food value chain, on the need for good hygienic practices right from the farm at harvesting to drying, storing/processing and packaging, transportation and preparation of food.
- Impart Good Agriculture Production Practices (GAPP) and Good Manufacturing Practices (GMP) among food value chain actors.

## Livestock production

- When animals have been treated with veterinary drugs, the drug withdrawal period for each drug should be observed before the animals are sold for slaughter or the animal products such as milk are released for human consumption.
- The farmer should consult a veterinary doctor for guidance. If the animals or animal products are released for human consumption before the drug withdrawal period is over, the drug or its metabolites is still in the animal/animal product and when consumed may lead to drug resistance in human or failure to respond usual human drug treatment.
- Animal products are highly perishable and germs easily multiply in them so should be properly handled and cooked before consumption.
- Provide information/guidelines on the effect of poor handling of produce to various players throughout the value chain and how it can be prevented. Sustained public awareness campaigns are essential in order to improve the situation. Food quality along the value chain right from production through marketing to consumption must remain a key element in the food security and nutrition agenda.

## Recommended actions for aflatoxin prevention and or reduction in foods

- *Aspergillusflavus* fungus which produces aflatoxins grows best on maize at 18.0 to 18.5 percent moisture. Moisture content below 13 percent prevents growth of *Aspergillusflavus*.
- After harvest, the moisture content of produce must be dried to 12 to 14 percent for safe storage with minimum deterioration.
- Reducing drought stress through irrigation and limiting insect damage by the application of good agricultural and pest control practices, including use of high quality seeds is essential.
- Rapid drying limits aflatoxin proliferation for example, the piling of maize in stacks in the field extends drying time and therefore the potential for aflatoxins to be produced during the drying process. Wet-shelling of groundnuts prior to drying can also promote mould growth.

- Greater use of wooden pallets for drying, natural fibre bags, hermetic bags and various categories of insecticides could all help improve the quality of products and their readiness for storage.
- Proper produce storage practices. The ideal storage consists of dry, impermeable spaces kept at low temperature. If crops are kept on damp floors or in pits (even in bags) or humidity rises above 80 per cent, the likelihood of *Aspergillus* growth and aflatoxin production is very high.
- Integrated pre and postharvesting interventions should be put into consideration because aflatoxins are heat stable, even dry roasting does not remove aflatoxin contamination. Hand sorting at the household level may remove the worst (most mouldy) grain, seed contamination, but much of aflatoxin spoiled food is retained for consumption by households.
- Adoption of best practices requires education at all levels including: social marketing, awareness creation in media, awareness campaigns on dangers and options at the household level, teaching at the farm and market levels (through extension and training), and promotion of risk minimization at industry processing (better understanding of use of screening critical control points) and retail levels.

### KEY MESSAGE

Agriculture interventions cannot ensure food security and nutrition without considering food safety. Integrate food safety issues in the whole food value chain (production, postharvest handling, marketing and consumption) as part of increasing the nutrition sensitivity of agriculture activities.

## E) NUTRITION CONSIDERATION IN AGRICULTURAL MARKETING

Marketing is key to agricultural production because without it there is no financial return on investment in agriculture. Marketing stimulates and sustains production. It is understandable when farmers seek to get market for their produce because it makes business sense. However marketing should not compromise household food security and nutrition for the producer and consumer:

- Marketing should consider nutrition of the end user/consumer and thus packaging should be done in dry and clean packs/materials/containers.
- For marketing to result in improved nutrition gender relations in the homes are very critical.
- Both men and women should participate in marketing of farm produce, but because gender relations are still complicated women could be allowed to be in charge of marketing traditional 'low value' crops.
- Women should also be allowed to have control and access of the incomes accrued from their participation in the marketing of foods.
- It is highly likely that women will use the incomes they have got from food sales to buy other nutritious foods for the whole household.
- Income from the sale of farm produce can be spent on a number of priority areas but food and dietary needs should not be compromised.

### KEY MESSAGE

Agricultural marketing should ensure food and nutrition security for the producer and consumer. Gender relations are very critical in nutrition sensitive marketing.

## F) GENDER DIMENSIONS IN AGRICULTURE & NUTRITION

Gender describes the socially constructed roles, activities and responsibilities assigned to women and men in a given culture, location and time. There is a difference between gender and sex.

Sex describes the biological and physiological differences between men and women while gender is a broader term defining cultural or social roles and expectations attached to men and women. Such roles and expectations vary from society to society and from time to time and impact on agricultural production and nutrition.

### *Manifestation of gender expectations and roles in agricultural processes*

Sociocultural attitudes and perceptions influence how women and men perceive themselves and their roles in society consequently influence agriculture and nutrition outcomes. For example: women are responsible for the bulk of food production but continue not to participate in most agricultural projects due to limited powers in influencing decisions that are taken at various levels.

- Yet few women own and control land but the majority can access it through their husbands or male relatives and thus utilize it according to specific instructions. Such instructions may not necessarily guarantee food security and nutrition.
- Few women determine what enterprises to be done on the land
- Men decide cash crop enterprises while women may decide food crop enterprises.
- Food crop enterprises are restricted to small plots leaving the bigger portions for cash crops.
- Men are in charge of marketing most of the produce.

### *Implications of uneven role expectations*

- Women are overwhelmed with productive and reproductive work.
- Women's work load impacts on their capacity to pay adequate attention to nutrition issues.
- Household food allocation expectations traditionally and culturally favour men and this adversely affects nutrition of women and chil-

dren contributing to child malnutrition, child and maternal mortality and bad pregnancy outcomes such as obstructed labour, premature birth and low weight babies.

- Men dominate the marketing of farm produce and control incomes there from farm produce income, men are more likely to buy non-food items.



*Picture 17: The burden women face; excessive workload, frequent pregnancies home and child care.*

### ***What can be done to improve gender relations to favour agricultural production, food security and nutrition?***

- Making sure that both women and men participate in agriculture technology transfer activities.

- Facilitate the community to select enterprises that take care of both women and men needs.
- Women should be given power to access to information related to agriculture and health in order to help them care for the children and produce more food for the household.
- Men need to support women to reduce the work burden and free time for child care.
- Energy saving technologies should be adopted to free women from some of the work load to pay attention to nutrition issues of their children.
- Parents should be encouraged to educate both boys and girls because the ability to care for children is at times compromised by women's lack of education, limited opportunities to earn income as well as lack of freedom outside the home.
- Women who are educated or at least literate easily care for their children and have a high possibility of having well fed children. Lack of self-esteem makes some women unable to take part in income generation activities. In addition, education further empowers women and makes them easily look for family planning services which can help space children.
- Well-spaced children will reduce burden on the women, improve care for both the mother and child and consequently improve nutrition for the whole household.
- Extension workers should support farmers to select enterprises that promote household food security and nutrition and follow this up with adequate extension services.
- Women should be encouraged to take part in leadership roles and be part of the decision making process, even if it begins at village level. This will position women to articulate issues that promote food security and nutrition.
- Women should be encouraged to form and/or join savings and credit associations as this will ease their access to affordable credit to invest in agricultural production.

## Summary of common agricultural projects or actions linked to nutrition

- Backyard gardens for fruits, vegetable and herbs strategically placed near the home to enable easy watering using waste water during the dry season (picture 18).
- Rearing of small animal and birds such as poultry, fish, goats, pigs, guinea pigs and rabbits that can be reared in the backyard.
- Rearing local chickens are quite easy to keep by both women and children. They multiply very fast, supply high quality protein, have a good market potential and can be kept both for household nutrition and income generation.
  - The kroiller birds adapted from India have both the characteristics of the local chicken and the modern poultry breeds (picture 18).
  - Rabbits are very good for nutrition improvement. They multiply very fast, supply high quality body building foods and can easily be reared by children (picture 18).
- Zero grazing dairy enterprises especially under women groups.
- Built-in food safety nets actions that reduce risks.
- Household food processing and preservation technologies that increase availability, access, security and utilization of most deficient nutrients.
- Integrating gender and child care considerations in agricultural program design and implementation.
- Encouraging the production, consumption and marketing of staple foods with high nutrition value, e.g., orange fleshed sweet potatoes, iron rich beans, soy beans, foods fortified with micronutrient, e.g., vitamin A fortified oil, vitamin A fortified flour and iron fortified flour.
- Giving special considerations for the participation and benefits access to vulnerable people such people living and affected by HIV/AIDS, diabetes, cancer, infants, pregnant and lactating women, children, the sick, the elderly, the displaced and the poor.
- Integrating nutrition education into agricultural extension programs.



*Picture 18: A back yard garden and small animals and local chickens*

## ANNEXES

### Annex 1. Vitamins and minerals, their sources and recommended dietary allowances

Vitamin/Mineral	Source	RDA <sup>a</sup>	Its function in the body
<b>Vitamin A (Retinolor Beta-carotene)</b>	Liver, egg yolk, dairy products, margarine. Beta carotene (pro-vitamin A) is found in dark green and deep yellow fruits and vegetables.	5,000 IU <sup>b</sup>	Keeps eyes healthy; develops bones; protects linings of respiratory, digestive and urinary tracts; maintains healthy skin and hair. Beta carotene fights free radicals (chemicals that damage cells).
<b>Vitamin B<sup>1</sup> (Thiamine)</b>	Whole grains, cereals and enriched grain products; also legumes (dried beans, peas, and nuts), organ meats, lean pork and eggs.	1.1 – 1.5 mg	Promotes healthy functioning of the nerves, muscles and heart. Metabolizes carbohydrates
<b>Vitamin B<sub>2</sub> (Riboflavin)</b>	Organ meats, enriched breads and cereals, legumes, almonds, cheese and eggs; also meat, fish, and dark green vegetables.	1.3 – 1.7 mg	Metabolizes carbohydrates, fats and proteins, produces hormones; promotes eye and skin health.
<b>Vitamin B<sub>3</sub> (Niacin)</b>	Meat, organ meats, whole grains and cereals, and legumes; also eggs, milk, green leafy vegetables and fish.	15 – 19 mg	Metabolizes carbohydrates and fats; helps functioning of digestive system; maintains health skin.
<b>Vitamin B<sub>5</sub> (Pantothenic Acid)</b>	Organ meats, yeast, raw vegetables, eggs and dairy products.	None; 4–7 mg suggested	Produces hormones and maintains body's immune system.

<sup>a</sup> Recommended Dietary Allowances

<sup>b</sup> International Units

Source: <http://www.nutrition.org/nutinfo/>

Vitamin/Mineral	Source	RDA <sup>a</sup>	Its function in the body
<b>Vitamin B<sub>6</sub></b> <b>(Pyridoxine)</b>	Whole-grain products ,poultry, fish, and nuts; also meat, most fruits and vegetables, eggs and dairy products	1.6 – 2 mg	Metabolizes protein; helps produce haemoglobin; promotes functioning of digestive and nervous systems, and healthy skin.
<b>Vitamin B<sub>12</sub></b> <b>(Cyanocobalamin)</b>	Primarily organ meats; also fish, lean meats, poultry, cheese, and eggs.	2 µg	Builds genetic material of cells and produces blood cells.
<b>Vitamin C</b> <b>(Ascorbic Acid)</b>	Almost exclusively fruits and vegetables (especially citrus fruits, tomatoes, peppers, strawberries, and cantaloupe) although breast milk and organ meats contain small amounts.	100 – 200 mg	An antioxidant, fights and resists infection; heals wounds; promotes growth and maintenance of bones, teeth, gums, ligaments and blood vessels.
<b>Vitamin D</b> <b>(Cholecalciferol)</b>	For most people, sun exposure is the primary source of vitamin D. Food sources include Vitamin D-fortified milk, eggs, fish-liver oils and fatty fish such as herring, mackerel and salmon.	400 IU	Builds strong bones and teeth and maintains the nervous system.
<b>Vitamin E</b> <b>(Tocopherol)</b>	Vegetable oils, nuts, wheat germ and whole-wheat products, egg yolks and green leafy vegetables	Women 8 mg; Men 10 mg	Protects the lungs, nervous system, skeletal muscle and the eye's retina from damage by free radicals; may reduce risk of heart disease by protecting against atherosclerosis.

Vitamin/Mineral	Source	RDA <sup>a</sup>	Its function in the body
<b>Vitamin H (Biotin)</b>	Oats, organ meats, yeast and eggs (cooked); also whole-wheat products, dairy products, fish and tomatoes.	None; 30 – 200 µg suggested	Metabolizes proteins and carbohydrates; breaks down fatty acids.
<b>Vitamin K</b>	DGLV, eggs, cheese, pork and liver.	60 – 80 mg	Promotes normal blood-clotting.
<b>Vitamin B<sub>9</sub> (Folic Acid)</b>	Vegetables (especially dark-green ones), organ meats, whole-wheat products, legumes and mushrooms.	180 – 200 µg	Synthesis of protein and genetic materials; may help prevent some cancers, heart disease and stroke; when taken during pregnancy, protects against some birth defects.
<b>Calcium (Ca)</b>	Primarily in milk and dairy products; also dark-green vegetables, legumes, shellfish, Fish with edible bones and tofu; also calcium-fortified orange juice.	800 – 1,200 mg	Builds bones and teeth; promotes blood clotting, contraction of muscles and nerve impulses.
<b>Chromium (Cr)</b>	Whole wheat and other whole grains and molasses.	None; 50–200 µg suggested	An essential nutrient required for normal sugar and fat metabolism; may also help prevent high cholesterol and atherosclerosis.
<b>Copper (Cu)</b>	Organ meats, shell fish, whole-grain products, legumes and dried fruits.	None; 2 – 3mg suggested	Builds bones, red blood cells and hemoglobin; metabolizes iron, maintains connective tissue and blood vessels; may play a role in cancer prevention.

Vitamin/Mineral	Source	RDA <sup>a</sup>	Its function in the body
<b>Fluoride (F)</b>	Seafood, tea, coffee and soybeans; sodium fluoride is often added to the water supply to prevent tooth decay.	None	Promotes bone and tooth formation; prevents tooth decay.
<b>Iodine (I<sub>2</sub>)</b>	Saltwater fish, shell fish, sea kelp and iodized salt.	150 µg	Helps produce thyroid hormones; adequate iodine intake during pregnancy is crucial to normal fetal development.
<b>Iron (Fe)</b>	Iron is poorly absorbed from food. The richest sources are red meat and organ meats; other sources include whole-wheat products, shell fish, nuts and dried fruit. Many breads and cereals are enriched with iron. Vitamin C aids absorption of iron and is often added to iron supplements.	Women 15 mg; Men 10 mg	Helps produce hemoglobin and red blood cells; delivers oxygen to muscles and other body tissues; protects against effects of stress
<b>Magnesium (Mg)</b>	Legumes, whole-grain cereals, nuts and dark-green vegetables; also meat, seafood and dairy products.	Women 280 mg; Men 350 mg	Builds bones and teeth; involved in functioning of muscular and nervous systems and heart and circulatory system.
<b>Manganese (Mn)</b>	Tea, green vegetables, legumes, oats and rice.	2 – 5 mg	Involved in reproductive processes, sex hormone formation; essential for normal brain function and bone development.

Vitamin/Mineral	Source	RDA <sup>a</sup>	Its function in the body
<b>Molybdenum (Mo)</b>	Dairy products, legumes, whole-grain cereals and organ meats.	75 – 250 mg	Involved in enzyme activities.
<b>Phosphorus (P)</b>	Meat, fish, eggs, legumes and dairy products; also whole wheat, corn and rice.	1 g	Builds bones and teeth.
<b>Potassium (K)</b>	Potatoes, dried fruits, bananas, legumes, raw vegetables, avocados and mushrooms; also lean meat, milk and fish.	None; 3.5 g suggested	Helps nerves and muscles function; regulates heart's rhythm; regulates bodily fluids.
<b>Selenium (Se)</b>	Whole-grain cereals, fish and shell fish, meat and dairy products.	Women 55 µg; Men 70 µg	An antioxidant, helps protect cells and tissues from damage by free radicals; may also protect against some cancers.
<b>Sodium (Na)</b>	Naturally in many foods and is added to many prepared foods.	2,400 mg	Maintains body's fluid balance; important for nerve function and muscle contraction; controls heart's rhythm.
<b>Zinc (Zn)</b>	Shell fish(particularly oysters), organ meats and lean red meat, yeast, whole-grain cereals, and legumes.	Women 12 mg; Men 15mg	Involved in growth, skin health and wound healing, development of the reproductive organs, protein metabolism and energy production.

## Annex 2. Preparation of a Variety of Foods to Enrich their Nutrient Composition

Examples of recipes which can be formulated from food stuffs to achieve a proper meal for a child's growth and development under different cost scenarios to ensure access to nutritious food for children from households of various socioeconomic status.

Cost category	Quantities of Ingredients	Method of Preparation
Relative high cost meal	<p><b>Meat, beans, or peas, matooke mixture</b></p> <p>1 palm of dry beans or peas (90 g)</p> <p>1 fist of meat (60 g)</p> <p>3 fingers of matooke (300–500 g)</p> <p>1 pinch of salt</p> <p>½ mug of water</p>	<p>Soak beans/peas overnight or for about 6 hours. Remove the skins and wash them.</p> <p>Scrape the meat, mix it with clean water which had been boiled and cooled, in a container and try to separate the particles of the meat.</p> <p>Peel the matooke, cut them into pieces and wash them.</p> <p>Mix the skinned beans, scrapped meat, pieces of matooke, water and salt into a clean saucepan. Cover and steam for 3 hours.</p> <p>Serve the child.</p> <p>When the food is ready, mash and divide into two halves for lunch and supper. Note: Any tuber (Irish potatoes, sweet potatoes, cassava, yams) can be prepared the same way as matooke. Dry peas can be prepared the same way as dry beans.</p>

Cost category	Quantities of Ingredients	Method of Preparation
Low cost	<p><b>Ground Nuts, powdered nkejje or silverfish (mukene) powder and maize flour</b></p> <p>1 palm of raw groundnut (90 g)</p> <p>2 teaspoonful of fish powder (10 g)</p> <p>2 palms of maize flour (180 g)</p> <p>1 mug/tumpeco of water (500 ml)</p> <p>1 pinch of salt</p>	<p>Sort the dried groundnuts and pound them well. After pounding, use half for lunch and keep the other half for supper.</p> <p>Put the small fish in the sun to dry, after which you pound and sieve into fine powder.</p> <p>Mix 1 &amp; 2 and the maize flour in a clean saucepan, add water into the mixture and pinch of salt, mix, cover and steam.</p>

#### RECIPES FOR ENRICHED PORRIDGES

Low cost for resource-poor households	<p><b>Cereal and legumes</b></p> <p>90 g (one handful) of cereal (millet, sorghum, maize, rice)</p> <p>90 g (one handful) of legume (beans, peas, pulses, soya)</p> <p>20 g (two tablespoonful) of sugar</p> <p>1.5 litres (3 nice mugs) of water</p>	<p>Soak legume overnight, remove testa and boil till soft and mash. Cook cereal porridge (gruel) as usual.</p> <p>Add 2 to 3, mix and simmer for 2–3 minutes</p> <p>Add sugar and serve</p>
Low cost	<p><b>Cereal and nuts</b></p> <p>90 g (one handful) of cereal (millet, sorghum, maize, rice)</p> <p>90 g (one handful) of groundnuts, cashew nuts)</p> <p>20 g (2 tablespoons) of sugar</p> <p>1.5 litres (3 nice mugs) of water</p>	<p>Toast nuts</p> <p>Remove cover and pound or grind to soft paste</p> <p>Mix 2 with hot water to make thick soup</p> <p>Cook cereal porridge (gruel) as usual</p> <p>Add 3 to 4, mix well and simmer for 2–3 minutes</p> <p>Add sugar and serve</p>

Cost category	Quantities of Ingredients	Method of Preparation
<b>RECIPES FOR ENRICHED PORRIDGES (continued)</b>		
Low cost	<p><b>Cereals, tubers and seeds</b></p> <p>90 grams (one handful) of cereal (millet, sorghum, maize, rice)</p> <p>90 g (one handful) of seeds (Sim-Sim, sorghum)</p> <p>90 g (one handful) of root flour (Cassava, taro, potato)</p> <p>100 g (one handful) of nuts (groundnuts, cashew nuts)</p> <p>20 g (2 tablespoon) of sugar</p> <p>1.5 Litres (3 nice mugs) of water</p>	<p>Soak legume overnight Remove cover and pound or grind to soft paste</p> <p>Mix 2 with hot water to make thick soup</p> <p>Cook cereal porridge (gruel) as usual</p> <p>Add 3 to 4, mix well and simmer for 2–3 minutes</p> <p>Add sugar and serve</p>
Low cost	<p><b>Roots and seeds</b></p> <p>90 g (one handful) of root flour (cassava, taro, potato)</p> <p>150 g (one handful) of seeds (sim-sim, sorghum)</p> <p>20 g (2 tablespoon) of sugar</p> <p>1.5 litres (3 nice mugs) of water</p>	<p>Toast seeds</p> <p>Pound or grind to soft paste</p> <p>Mix 2 with hot water to make thick soup</p> <p>Cook root flour porridge (gruel) as usual</p> <p>Add 3 to 4, mix well and simmer for 2–3 minutes</p> <p>Add sugar and serve</p>

Cost category	Quantities of Ingredients	Method of Preparation
<b>RECIPES FOR ENRICHED PORRIDGES (continued)</b>		
Low cost	<p><b>Nuts and seeds</b></p> <p>90 g (one handful) of nuts (groundnuts, cashew-nuts)</p> <p>20 g seeds (sesame, sunflower)</p> <p>20 g (2 tablespoon) of sugar</p> <p>1 Litre (3 nice mugs) of water</p>	<p>Toast nuts and seeds in turn</p> <p>Remove cover and pound or grind to soft paste</p> <p>Mix 2 with hot water to make thick soup</p> <p>Cook cereal porridge (gruel) as usual</p> <p>Add 3 to 4, mix well and simmer for 2–3 minutes</p> <p>Add sugar and serve</p>
Low cost	<p><b>Cereal and animal products</b></p> <p>90 g (one handful) of cereal (millet, sorghum, maize, rice)</p> <p>1 medium-sized egg</p> <p>20 g (2 tablespoon) of sugar</p> <p>1.5 litres (3 nice mugs) of water</p>	<p>Make porridge from cereals</p> <p>Put egg in cold water and heat</p> <p>Remove egg out just as the water starts boiling</p> <p>Beat up the egg and mix in the porridge</p> <p>Add sugar and serve</p>
Fair cost	<p><b>Cereal and Milk</b></p> <p>90 g (one handful) cereals</p> <p>20g (2 tablespoon) of sugar</p> <p>1 litre of water 500 g of milk (1 nice mug of sour or fresh milk)</p>	<p>Make porridge from cereals</p> <p>Add milk and sugar, mix well and serve</p>

Cost category	Quantities of Ingredients	Method of Preparation
<b>TRIPLE MIX</b>		
Low cost	<p><b>Cereal, nuts and seeds</b></p> <p>90 g of cereals</p> <p>90 g of nuts</p> <p>20 g of seeds (sesame, sunflower)</p> <p>20 g (2 tablespoonful) of sugar</p> <p>2 litres of water (4 nice mugs)</p>	<p>Toast nuts and seeds in turn. Pound or grind to soft paste. Mix with some hot water to make thick soup. Add 2 to 3, mix well and simmer for 2 minutes</p> <p>Add sugar and serve</p>
Low cost	<p><b>Cereal, legume and oil</b></p> <p>90 g (one handful) of cereal (millet, sorghum, maize, rice)</p> <p>90 g (one handful) of legumes (beans, peas, pulses, soya)</p> <p>25 g (10 mls) of oil</p> <p>20 g (2 tablespoon) of sugar</p> <p>1.5 litres (3 nice mugs) of water</p>	<p>Soak legume overnight Remove testa and boil till soft and mash</p> <p>Cook cereal porridge (gruel) as usual</p> <p>Add 2 to 3, mix well and simmer for 2–3 minutes</p> <p>Add vegetable oil and mix well</p> <p>Add sugar and serve</p>
Low cost	<p><b>Roots and legumes</b></p> <p>90 g (one handful) of root flour (cassava, taro, potato)</p> <p>100 g (one and half handful) of legumes (beans, peas, pulses, soya)</p> <p>20 g (2 tablespoons) of sugar</p> <p>1.5 Litres (3 nice mugs) of water</p>	<p>Soak legume overnight. Remove testa and boil till soft and mash.</p> <p>Cook root flour porridge as usual</p> <p>Add 2 to 3, mix well and simmer for 2–3 minutes</p> <p>Add sugar and serve</p>

## Annex 3. Ways of Boosting the Nutritive Value of Porridge

### How to further boost nutritive value or food value of porridge

- Add vegetable oil to porridge improve its energy value.
- Add eggs, milk to improve protein.
- Use of flour made out of sprouted and dried cereal grains like millet. The presence of amylase partially digests the complex and bulky carbohydrates and makes the porridge more energy dense.
- Add fruit juices like lemon, oranges, lime etc. just before serving porridge increases vitamin C value, palatability/ taste and enhances absorption of nutrients.

Porridge made from fermented cereals or legumes reduce incidence of diarrhoea during weaning. Addition of juice from fruits (ascorbic acid) to porridge greatly enhances absorption of minerals like iron and improves the taste. Such food preparation methods should be encouraged in the communities.

The advantages of sour and fermented porridge as a weaning food:

- It is more difficult for harmful bacteria to grow in. It keeps safely for 2–3 days even in warm weather. It is therefore less likely to give a child diarrhoea than ordinary porridge.
- It is thinner and easier for a baby to eat and digest than plain porridge.
- The absorption of non-haem iron, zinc and some other minerals is increased.

### Suggestions for stopping the child from breast feeding

Complete withdrawal of a child from breast milk should be a slow and gradual process. Encourage the mother to systematically stop breast feeding by following the steps below:

- Make sure that the child continues to feed well at least four to five times a day.

- If necessary, increase the amount of food and the number of meals that the child eats.
- Increase the length of time between breast feeds, so that the number of breast feeds decreases gradually.
- Apart from those times when you decide to breastfeed, avoid situations that make the child think of breastfeeding for example, having the child on her lap if she sits down to eat or to have a drink.
- The child should be given extra loving attention, and the child-mother bond should be strengthened.
- Do not push the child away from the breast when she/he tries to breast feed as this may make the child feel anxious and unhappy.
- The mother should stop the night breast feeds last of all.
- Supervise the care and feeding of the child at all times.

## Annex 4. Uganda Nutrition Advocacy Messages (PROFILES)

The productivity lost when agriculture workers take time off to deal with malnutrition-related illnesses or deaths in their families. The country losses about US\$34 million worth of productivity because of iron deficiency anaemia among adults. Women of reproductive age with anaemia accounted for 75 percent, or US\$25 million, of that loss. The total loss estimated at about 0.4 percent of the gross domestic product/GDP.

Stunting in early childhood affects productivity in adulthood. For every 1 percent that the height of a child under 2 years of age is below the norm, the child's productivity from manual labour as an adult declines by 1.4 percent. Uganda losses about US\$210 million worth of productivity from childhood stunting. These two conditions alone (iron deficiency anaemia and stunting) are associated with productivity loss of about US\$290 million per year (PROFILES, 2009).

Vitamin A deficiency, which affects mainly women and children in Uganda, increases the risk of blindness and susceptibility to diseases, mainly diarrhoea and acute respiratory infections in children. Children with vitamin A deficiency are 1.4 times more likely to die of these and other childhood illnesses than ones that are not deficient.

Iodine deficiency disorder (IDD), is the single most common cause of preventable mental impairment, brain damage, and physical disabilities among children in Uganda. Women with IDD give birth to children with reduced ability to learn, lower school performance, higher rates of school-age repetition, and poor speech and hearing ability. What is especially tragic is that the effects of iodine deficiency are permanent. Because of IDD, in the year 2009 alone, 2,100 children were born as cretins in Uganda and likely will require 100 percent care in their entire lives, 59,000 children were born with mild or moderate mental disabilities and Uganda lost US\$8.6 million in productivity (Uganda Profiles 2012).

## Annex 5. Technical Working Group for the Nutrition Handbook and FANTA Project Team

#	Name	Institution
1.	Ms. Byarugaba B. Beatrice	MAAIF
2.	Mr. Alex Bambona	MAAIF
3.	Mr. Stephen Biribonwa	MAAIF
4.	Dr. Jolly Hoona	MAAIF
5.	Ms. Daisy Eresu	MAAIF
6.	Ms. Namaloba Beatrice	MAAIF
7.	Ms. Margaret Massete	MAAIF
8.	Mr. Andrew Alio	MAAIF
9.	Ms. Grace Anyango	MAAIF
10.	Mr. Joseph Oke	MAAIF
11.	Dr. Hanifa Bachou	FANTA Project
12.	Mr. Francis Muhanguzi	FANTA Project
13.	Brenda Shenute Namugumya	FANTA Project
14.	Karen Tumwine	FANTA Project
15.	Juliet Nandawula	WASHplus Project

## REFERENCES

Food and Agriculture Organization (FAO). 1997. *Agriculture, food and nutrition for Africa: A resource book for teachers*. Rome: FAO.

FAO. 2008. *Mycotoxin Prevention and Control in Food Grains*. Rome: FAO.

FAO/World Health Organisation (WHO). 2008. *Document for Information and Use in Discussions Related to Contaminants and Toxins of the GSCTF*, Report No. CF/2 INF/1 to the Codex.

Gbemenou Joselin Benoit Gnonlonfin, PACA Training Notes, Aflatoxin analysis in food and feed Uganda, September 2014.

Hoona, J. 2013. Presentation on Food safety, in Australia.

Hoona, J. 2014. Presentation on Food Safety, Addis, Ethiopia. Nutrition Implications of Aflatoxin Exposure: An Analysis of Mothers and Children in Timor-Leste's. Food and Nutrition Survey. A report to UNICEF and Australian Aid.

International Food Policy Research Institute (IFPRI). *Decisions, Gender and Development. A Synthesis of Recent Research*, Washington D.C.

IFPRI. 2014. *Global Nutrition Report: Actions and Accountability to Accelerate the World's Progress on Nutrition*.

IFPRI. 2001. *Vision for Food, Agriculture and the Environment*.

Scrimshaw, N.S. 2009. *Malnutrition, brain development, learning, and behavior nutrition*.

Quisumbing, A.R. 2003. "What Have We Learned? From Research on Intra household Allocation?" in "Household"

Quisumbing, A.R, and Meinzen R.S, *Empowering Women to Achieve Food Security*. Focus 6. A2020.

Ross, I.J.; Hamilton, H.E.; and White, G.M. 1990. "Principles of Grain Storage", AEN-20.

Smith, L.C. and Haddad L. 2000. *Overcoming Malnutrition in Developing Countries. Past Achievements and Future Choices*. Food, Agriculture and the Environment. Discussion Paper 30, IFPRI.

Uganda Bureau of Statistics. 2012. *Uganda Demographic and Health Survey*. Entebbe and ORC Macro, Calverton, Maryland, USA.

USAID's FANTA Project. 2012. *Uganda PROFILES Consequences PowerPoint Presentation*.

**MINISTRY OF AGRICULTURE,  
ANIMAL INDUSTRY AND FISHERIES  
P.O. Box 102 ENTEBBE - UGANDA**

[www.agriculture.go.ug](http://www.agriculture.go.ug)