Participatory Small Scale Irrigation Development Project II

A Guide for Mainstreaming Nutrition Sensitive Agriculture and Nutrition Profile Tracking at Farm Households in Irrigation Systems

Training Manual for frontline agriculture and health extension workers in Ethiopia

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ACRONYMS

AME	Adult Male Equivalent
ANC	Antenatal Care
CGIAR	Consultative Group on International Agricultural Research
CSA	Central Statistics Agency
DALYs	Disability Adjusted Life Years
DAs	Development Agents
EAR	Estimated Average Requirement
ENA	Essential Nutrition Action
EPHI	Ethiopian Public Health Institute
FAO	Food & Agriculture Organization
FDRE	Federal Democratic Republic Ethiopia
FGD	Focus Group Discussion
FMOH	Federal Ministry Of Agriculture
FNP	Food And Nutrition Policy
FVS	Food Variety Score
GDP	Gross Domestic Product
HDDS	Household Diet Diversity Score
HFIAS	Household Food Insecurity Assessment Scale
HWT	Household Water Treatment
ICRAF	World Agroforestry
ICRISAT	International Crops Research Institute For The Semi-Arid Tropics
IMNCI	Integrated Management Of Neonatal And Childhood Illnesses
IWMI	International Water Management Institute
IYCF MDD	Infant And Young Children Minimum Diet Diversity
KII	Key Informant Interview
LMICs	Low and Middle Income Countries
MAD	Minimum Acceptable Diet
MAD	Minimum Acceptable Diet
MDD-W	Minimum Dietary Diversity For Women

MMF	Minimum meal frequency
NNP	National Nutrition Program
NNSA	National Nutrition Sensitive Agriculture Strategy
NSA	Nutrition Sensitive Agriculture
PASIDP	Participatory Small-Scale Irrigation Development Program
PMTCT	prevention of mother-to-child transmission of HIV
RBCs	Red Blood Cells
SNNP	Southern Nations, Nationalities & People
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation & Hygiene
WHO	World Health Organization

1. Introduction

The Ethiopian Ministry of Agriculture has initiated a Participatory Small-Scale Irrigation Development Program (PASIDP) and constructed several community-managed irrigation schemes through the financial support of the International Fund for Agricultural Development (IFAD). The program has strived to complete the construction of more than 150 small-scale irrigation schemes and implement irrigated agriculture in more than 18400 ha lands in the four regions of Ethiopia such as Amhara, Oromia, SNNP and Tigray regions. Being a continuation of PASIDP I, the PASIDP II has focused on achieving improved farm incomes and food security for rural households on a sustainable basis. Therefore, nurturing nutrition-sensitive agriculture systems in the small-scale irrigation schemes has been aptly considered in the PASIDP II program.

To effectively implement nutrition-sensitive agriculture interventions in each area of irrigated agricultural development, household nutrition profile tracking should be implemented. The quick assessment could help to understand the share of household dietary scores from own production and purchase; and identify the most deficient nutrients at target household and community levels. Accordingly, the nutrition-sensitive agriculture interventions can be adjusted to fill the real nutrition-related gaps. Therefore, this toolkit accommodates the necessary knowledge and skills on the main concepts of nutrition sensitive agriculture, and step-by-step procedures for implementations of nutrition profile tracking among farm households and contextualizes nutrition interventions in irrigated and rain-fed production systems.

The main target groups of this guide are frontline extension staffs who provide agriculture and health related extension services through trainings and coaching/mentoring for smallholder farm households. Hence, the toolkit can help them to understand the basic knowledge and skills on nutrition profile assessments and proper planning and implementations of nutrition-sensitive agriculture interventions.

2. Overview of Human Nutrition

2.1. Technical Definitions

Food is substance originated from plant, animal or fungal origin, which consists essential nutrients to be used by the human body to produce energy, detect and respond to environmental surroundings, move, excrete wastes, respire (breathe), grow, and reproduce. There are six classes of nutrients required for the body to function and maintain overall health. These are carbohydrates, lipids, proteins, water, vitamins, and minerals. Foods also contain non-nutrients that may be harmful (such as cholesterol, dyes, and preservatives) or beneficial (such as antioxidants). It can be cultivated or collected from the wild that can be raw, processed or cooked.

Food-based approach is an approach which recognizes the central role of food for improving nutritional status. A food-based approach recognizes the multiple benefits (nutritional, physiological, mental, economic, social and cultural) that come from enjoying a variety of foods.

Food environment is defined as the "collective physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence people's food and beverage choices and nutritional status **(Swinburn et al. 2013; Turner et al., 2018)**. It includes four types of food sources, namely; market-based food sources, own-production, wild harvested foods, and transfers – including gifts. It is also defined as the physical presence of food that affects a person's diet, a person's proximity to food store locations, the distribution of food stores, food service, and any physical entity by which food may be obtained, or and the connected system that allows access to food.

Dietary diversity is a measure of the number of individual foods or food groups consumed a day. Dietary diversification is a common food-based approach used to enhance nutrient intakes of vulnerable population groups and the total population. Dietary diversity is considered low when the number of food groups consumed is below four food groups for children and five food groups for women within a day out of the seven and ten standard groups. Adolescents and adult population groups need to make their food intake as diverse as possible to meet their body food and nutrient demand for an active and healthy life.

Food Safety: Assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.

Food security is ensured when all people, at all times, have physical and economic access to safe, sufficient and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Food system is a complex web of activities involving the production, processing, transport, and consumption. Issues concerning the food system include the governance and economics of food production, its sustainability, the degree to which we waste food, how food production affects the natural environment and the impact of food on individual and population health

Healthy diets are diets that provide protection against malnutrition in all its forms, as well as non-communicable diseases.

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Nutrients are components in foods that an organism uses to survive and grow. There are two types of nutrients: **Macronutrients and micronutrients**. Therefore, **Macronutrients** provide the bulk energy an organism's metabolic system needs to function. It includes carbohydrates, proteins and fats. Water is usually forgotten, but it is a major and essential nutrient for living organisms. On the other hand, **Micronutrients** are nutrients needed by organism than macronutrients to provide the necessary co-factors for metabolism to be carried out and include vitamins and minerals.

Nutrient dense foods are foods that are known with their high nutrients but relatively low in calories. Examples of nutrient-dense foods include fruits and vegetables, whole grains, low-fat or fat-free milk products, seafood, lean meats, eggs, peas, beans, and nuts.

Nutrition is the process of taking in food and converting it into energy and other vital nutrients required for life. In the process of nutrition, organisms utilize energy and nutrients.

Nutritional requirements refer to the amount of different nutrients required by the body for energy, growth and repair, as well as protection from disease. Nutritional requirements differ according to age, gender, physical activity, height, weight, and health status of the individual.

Nutrition security is when all people at all times consume food of sufficient quantity and quality in terms of variety, diversity, nutrient content and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health and care.

Malnutrition is an abnormal physiological condition caused by deficiencies, excesses or imbalances in energy and/or nutrients necessary for an active, healthy life, considering the requirement based on age, gender, physical activity, height, weight, and health status of the individual. It includes under nutrition, over-nutrition (overweight including obesity), micronutrient deficiencies, and these conditions may exist in separately or the occurrence of these conditions in co-existence. Under nutrition is the outcome of insufficient intake, and/or poor absorption and/or poor biological use of nutrients consumed as a result of repeated infectious disease.

Micronutrient deficiency (hidden hunger) is defined as lack of vitamins and minerals which are essential for the proper functioning, growth and metabolism of a living organism. It is usually caused by consumption of poor-quality diet. As it is named, it is hidden and cannot be detected easily, but it may cause death, and co-exists with any form of malnutrition including overweight and obesity.

Stunting is defined as being short in length/height from the standard expected for the specific age. **Underweight** occurs when someone is having low weight expected for his or her age.
Wasting which refers to being below the expected weight for the height or length of an individual.
Nutrition Sensitive Agriculture (NSA): is an approach that seeks to ensure the production of a variety of nutritious, affordable, culturally appropriate and safe foods in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner.

Nutrition-sensitive interventions are interventions in any sector, which do not necessarily have nutrition as predominant goal but are designed to also address some of the underlying causes of malnutrition (which include household food security, care for mothers and children, and primary health care services and sanitation).

Nutrition-specific interventions is interventions with the predominant goal of nutrition, designed primarily to address immediate determinants of malnutrition such as adequate food and nutrient intake, treatment of acute malnutrition, care-giving practices and reducing the burden of infectious diseases.

GAP (Good Agricultural Practices): A collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while considering economic, social and environmental sustainability.

Home garden: Home garden can be described as a mixed cropping system that encompasses vegetables, fruits, plantation crops, spices, herbs, ornamental and medicinal plants as well as livestock that can serve as a supplementary source of food and income.

a. The 6 Food Groups in Food-Based Dietary Guidelines of Ethiopia

To maintain good health, proper growth and development, eating from diversified food groups with adequate amounts is mandatory that help to get different nutrients with adequate amounts needed by our body. This is basically related to the diversity of nutrients and their difference in the amount of different foods. In this regard, except breast milk for the case of infants below six months), there is no a single food that contain all the nutrients needed for health, physical and brain growth. Despite that, the consumption of diversified diet and meal frequency are much low among Ethiopian children (Figure 1) and women at reproductive age.

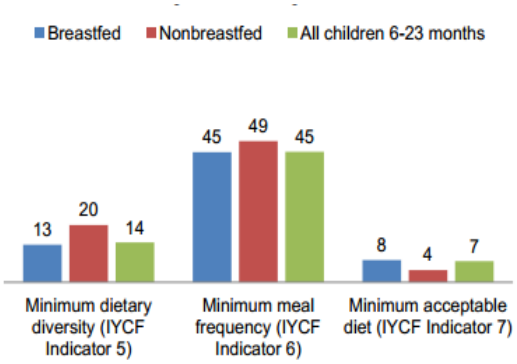

Figure 1: IYCF indicators on minimum acceptable diet (MAD) for 6-23 months old children in Ethiopia

The recently developed Ethiopian food based dietary guideline promotes the consumption of diversified diet with adequate amount. For this purpose, the guideline classifies the foods into six major groups, in which different food subgroups are included. These are, 1) cereal, grains, white roots and tubers; 2) legumes; 3) nuts and oil seeds; 4) milk and dairy foods; meat, fish and egg; 5) fruits and vegetables; and 6) fats and oils.

Staple foods: Cereal, grains, white roots and tubers

This food group contains cereal grains and root crops. Among the cereals, such as teff, barley, maize and sorghum are mentionable while enset and cassava are included in the root crops and tubers sub-group and they are the major staple foods in Ethiopia. The staple foods that are mentioned here are good sources of energy, plant protein, B vitamins, minerals and dietary fiber. More specifically, the consumption of whole grains should be promoted as it helps to reduce the risk of all-cause mortality and death from cancer, cardiovascular disease (CVD), diabetes, respiratory disease, infections, and other causes.

Legumes

In this food group, protein source foods such as peas, lentils, broad beans and soya beans are included and they are also good sources of fiber, protein, carbohydrate, B vitamins, iron, copper, magnesium, manganese, zinc, and phosphorous. Legumes are naturally low in fat, are practically free of saturated fat, and because they are plant foods, they are cholesterol free as well. They are also an integral part of many healthy eating patterns, including the Mediterranean style of eating, vegetarian and vegan diets, and lower-glycemic-index (GI) diets. Besides being highly nutritious foods, legumes can play an important role in the prevention and management of a number of health conditions by lowering BMI slows down weight gain over time and decreases occurrence of CVD and T2DM.

Nuts and oil seeds

Foods in this food group are also good sources of minerals and unsaturated fat. Groundnuts, sunflower seeds, sesame seeds and Niger seeds are the common type of food items that are consumed in Ethiopia. They are known with their high content of vitamins with anti-oxidative properties such as vitamin E and beta-carotene. For instance, adding sunflower seeds and peanuts

in kolo (roasted cereals and legumes served as a snack) is an established practice in Ethiopia, which should be practiced. They have also antioxidants that help to protect cells against free radicals, which may play a role in heart disease, cancer and other diseases.

Milk and dairy foods; meat, fish and egg

Milk and dairy products are nutrient-dense foods, supplying energy and high-quality protein with a range of essential micronutrients (especially calcium, magnesium, potassium, zinc, and phosphorus and vitamin D) in an easily absorbed form. Milk minerals are crucial for human health and development. They play a key role in healthy human nutrition and development throughout life, but especially in childhood. Adequate calcium intake influences skeletal calcium retention during growth and thus affects peak bone mass achieved in early adulthood. The high levels of calcium play an important role in the development, strength, and density of bones for children and in the prevention of bone loss and osteoporotic fractures in elderly people. Calcium also has been shown to be beneficial in reducing cholesterol absorption, and in controlling body weight and blood pressure.

All flesh foods (meats of cattle, goat, lamb and chicken and fish) are important sources of high-quality protein and bioavailable micronutrients, notably iron, zinc and vitamin B_{12} (available only from animal-source foods). Yet, excess consumption of red meats and processed meats can have major health and environmental consequences. Studies have also shown that diets high in red and processed meats increase the risk of type 2 diabetes, cardiovascular disease and cancer. Fish is has several health benefits, including anti-oxidation, anti-inflammation, wound healing, neuro-protection, cardio-protection, and hepato-protection properties. Fish proteins, such as immunoglobins, act as defense agents against viral and bacterial infections and prevent protein-energy malnutrition. Besides, fish oil constituents plenty of polyunsaturated fatty acids (PUFAs) including omega-3 and omega-6 fatty acids. n-6 and n-3 PUFA polyunsaturated fatty acids (PUFAs) play a central role in the normal development and functioning of the brain and central nervous system.

Chicken eggs are commonly consumed in Ethiopia. Relatively, eggs are relatively affordable animal source foods providing high-quality protein with all essential amino acids, essential fatty acids, and an ample quantity of different types of vitamins and minerals required for early growth and development. Consumption of eggs support significant reduction of stunting,

underweight and anemia. However, chicken has been grown in most of rural communities of Ethiopia freely, thus the chicken feces are heavily contaminating households and the surrounding environment, which is the main source of Campylobacter infection that affects the gut of infants and young children causing Environmental Enteric Dysfunction (EED). EED is one of the important causes of stunting among under-five children in communities that keep free-range poultry.

Moreover, the recent FAO stat report (2023) on per capita consumption of egg in Ethiopia has shown a decreasing trend. For instance, the historical high per capita consumption of egg was 0.470 kg in 2001, but declined much and reached 0.340 kg in 2020. This is an alarming result in the existing efforts to promote healthier and diversified diet in Ethiopia (FIGURE XXX). Unavailability of egg in the home related to ownership of chicken and also market and economic inaccessibility of egg to poor households and cultural taboos are some of the reasons mentionable.

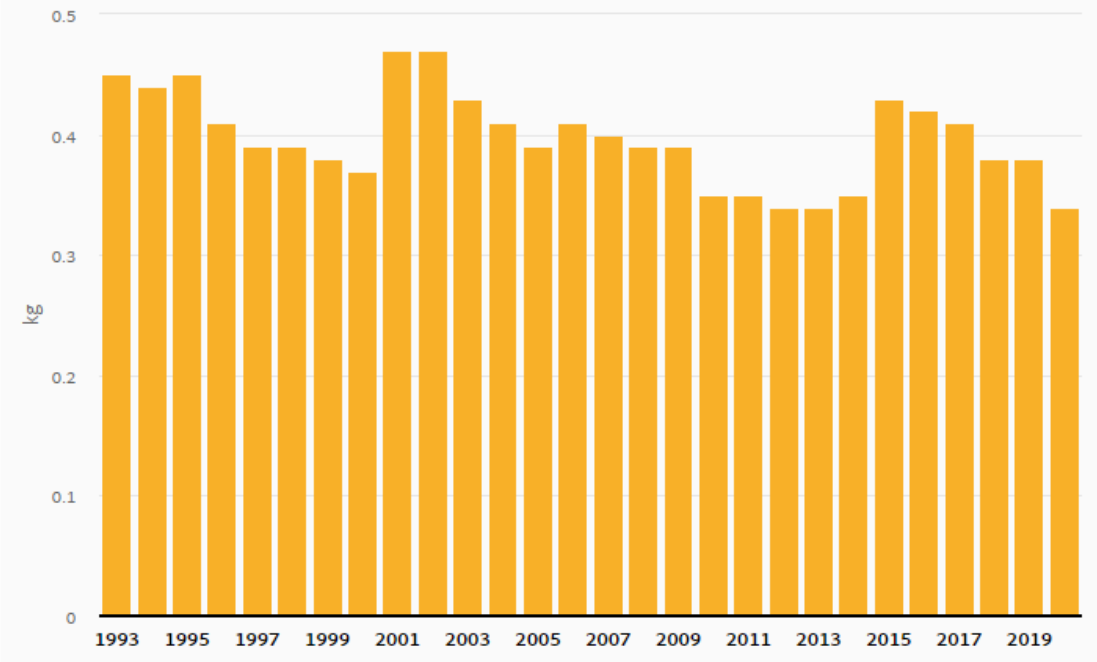

Figure 2: Egg Consumption Per Capita in Ethiopia

Fruits and vegetables

Consumption of fruits such as papayas, avocados, mangoes and bananas are excellent sources of pro-vitamin A carotenoids, vitamin C and minerals and also vegetables such as kale, broccoli,

cauliflower and beetroot also have important source of vitamins and minerals needed for our health. The consumption of fruits and vegetables in general, can help combat multiple nutrient deficiencies and reduced the risk of overweight and obesity. Consumption of fruits and vegetables has been also recognized for its protective benefits against development of coronary heart disease, hypertension and chronic obstructive pulmonary disease.

Fats and oils

This food group contain oils are liquid at room temperature, like the vegetable oils used in cooking. Oils come from many different plants and from fish. Oils contain more monounsaturated and polyunsaturated fats while fats are solid at room temperature like beef fat and butter. Fats are either saturated or trans-fatty acids whereas oils are unsaturated. Fats are concentrated sources of energy. For example, one gram of fat and oil gives 9 kcal unlike the carbohydrate and protein, in which one gram will provide only 4kcal of energy. This fats and oils also help the absorption of fat soluble vitamins such as vitamins A, D, E and K.

b. The 11 Key Messages of Food-Based Dietary Guidelines of Ethiopia

In the food-based dietary guideline of Ethiopia, there are 11 key messages that can help the public for making healthier food choices and also to maintain a healthy lifestyle. The first eight messages help consumers to implement healthy dietary practices, while the rest three encourage the consumers to limit the consumption of certain food groups to stay healthy (Table 1).

Table 1: Key Messages of Food-Based Dietary Guidelines of Ethiopia

Key message	Key Messages for the Public
Key message 1	Diversify your diet by selecting from at least 4 food groups in every meal and 6 food groups every day
Key message 2	Every day, eat 80–120 grams of legumes such as beans, chickpeas, peas or lentils
Key message 3	Eat 100–200 grams of various fruits and vegetables of different colours every day, such as bananas, papayas, kale, carrots and tomatoes
Key message 4	Diversify your diet with 10–20 grams of nuts and oilseeds such as groundnuts, and sunflower or sesame seeds
Key message 5	Add animal-source foods such as eggs and meat (60 grams) and dairy foods (300–400 grams) to your meals every day
Key message 6	Drink 8–10 large glasses of clean water daily
Key message 7	Be physically active for at least 30 minutes a day
Key message 8	Take up to 15–20 grams of fats and oils per day
Key message 9	Limit intake of sugar, sweets and soft drinks to below 30 grams per day
Key message 10	Limit salt intake to below 5 grams per day
Key message 11	Limit alcoholic drinks – both factory-processed and homemade – to no more than 2 glasses per week

c. Classification of nutrients based on their amount needed

Macronutrients

As the name indicates, macronutrients are nutrients needed in large quantities. Basically, this group included water, carbohydrate, fat and proteins. Except water in this group, they provide energy, therefore, most of the time they are called energy providing nutrients. Energy is essential for the body to grow, repair and develop new tissues, conduct nerve impulses and regulate life process. Therefore, human energy requirements depend on the estimated energy expend plus the energy needed for proper growth, and pregnancy and lactation if she is at this physiological stage. As a result, the recommendation for dietary energy intake from food should fulfill the requirements for the attainment and maintenance of optimal health, physiological function and well-being.

Carbohydrate is the major source of energy fuel in the average human diet and supplies at least half or more of the total calorie intake for an individual. In Ethiopia, the contribution of carbohydrate for the total energy of children, women and men were 67.2%, 72.4% and 72.3%, respectively (EPHI, 2013). Grains like cereals and pulses, and roots and tubers are the main source of carbohydrates.

Protein is the major macro-nutrient needed as a source of energy and known as a building block of our body. It is found everywhere in our body and more than 40% of body protein exists in skeletal muscle and more than 25% is found in body organs, but skin and blood are the place for the rest of protein existing in our body. We need protein as it is the source of amino acids, which are needed by our body to synthesize its own type of protein. Protein has many functions to our body. Among them, serving as catalyst in the form of enzyme, messengers in the form of hormone, structural element of our body, immune protector, transporter of other nutrients and serve as acid-base balance regulator in the form of buffer are mentionable. The amino acids are the building blocks of proteins and classified in to two major groups: essential and non-essential amino acids. Essential amino acids are amino acids that can't be made by our body so that we must get them from diet, whereas the non-essential amino acids can be made by our body. Proteins should be consumed in high amount but not as much as carbohydrate. For example, the recommended share of protein for total energy in an adult is between 10-30%. The contribution of protein to the total dietary energy intakes by the Ethiopian children, adult women and adult men were 10.5%, 9.7% and 10.4%, respectively. The major food sources of protein are meat, fish, legumes, eggs and milk and milk products.

Fat is another source of energy and provide more than a fold of energy than carbohydrate and

protein if they are consumed at equal amount, which means taking 1gm of fat gives 9 kilocalories while 1gm of carbohydrate or protein provides 4 kilocalories of energy. Beyond this, it helps for functioning of cell structure and its membranes, serve as a source of fatty acid for cell structure, vehicle for fat soluble vitamins and controlling of blood lipids. In an individual adult, 20-35% of the total energy should come from fat, but in Ethiopia, the share of fat in the women and men was 16.5% and 20.7%, respectively. The major food sources for fat are butter, fats, and oils, fruits such as avocado, nuts and soybeans.

The other macronutrient we must have in large quantities is called water, which covers more than 60% of our total body weights. Without getting adequate amount of water, there is nothing that could be transported in or out of the body, chemical reactions would not occur, organs would not be cushioned, and body temperature would fluctuate widely. On average, an adult consumes just over two liters of water per day from food and drink. According to the "rule of threes," a generalization supported by survival experts, a person can survive three minutes without oxygen, three days without water, and three weeks without food. Since water is so critical for life's basic processes, the amount of water input and output is supremely important.

Micronutrients

Because our body needs vitamins and mineral nutrients in small amounts than macro-nutrients, they are called micronutrients. However, human being should get these micronutrients from food daily since they are not produced by our body, therefore they are essential nutrients. However, they are required in different amounts based on the age, sex and physiological stage. They are important nutrients for growth, immune function, brain development and many other pertinent functions in our body.

The micronutrients (vitamins and minerals) are divided basically into four major categories. These are water-soluble vitamins, fat-soluble vitamins, and macro-minerals and trace minerals. Despite this difference, they are absorbed in similar way in human body and interact each other in many biological processes. Water soluble vitamins are vitamins that are soluble in water. They can't be produced by our body and not easily stored in our body and whenever they are excess, they will be flushed out through urine. This group includes vitamin B and C. Fat-soluble vitamins are not soluble in water, but in oil. Consumption of fat-soluble vitamin source foods is recommended if it is coupled with fat source foods in order to increase the absorption. These

vitamins are stored in liver and fatty tissues in our body for future use. Vitamin A, D, E and k are fat-soluble vitamins and they have different functions.

Minerals in general cover approximately 4% of our body mass. Relatively, macro-minerals are needed by our body in larger amounts than trace minerals. The macro-minerals are calcium, phosphorous, magnesium, sodium, chloride, potassium and sulfur. They have their own functions (Table 2). Trace minerals are also important for our body function properly. Iron, Zinc, iodine and recently selenium are important trace minerals in Ethiopian context.

Table 2: List of micronutrients (Vitamins and Minerals), their functions, sources and consequences of deficiencies

Micro-nutrient	Functions	Major source foods
Vitamin A	• Important for proper functioning of organs and eye	• Dark green leafy vegetables (amaranths leaves, green beans, broccoli, chili greens, kale, lettuce…), red palm oil, yellow fruits, tomatoes, cabbage, pumpkins, orange-flesh sweet potatoes, liver, Egg yolk, apricot, melon, passion fruits, peaches, mango, papaya, carrots, liver, kidney, egg yolk, milk, butter, cheese cream
Vitamin B1 (Thiamin)	• Helps to convert macro-nutrients in to energy.	• Whole grains, meat, and fish
Vitamin B2 (Riboflavin)	• Important for production of energy, functioning of body cells and metabolism of fat	• Organ meats, eggs, milk
Vitamin B3 (Niacin)	• Important drivers for production of energy from diets	• Meat, salmon, leafy greens, beans
Vitamin B5 (pantothenic acid)	• Important for synthesis of fatty acid	• Organ meats, mushrooms, fish and avocado
Vitamin B6 (pyridoxine)	• Important for our body to release sugar from stored carbohydrate for energy production and for production of RBCs	• Fish, milk, carrots, potatoes
Vitamin B7 (biotin)	• Plays an important role in fatty acids, amino acids and glucose metabolism	• Eggs, almonds, spinach, sweet potatoes
Vitamin B9 (folate)	• Important for proper division of cells	• Beef, liver, black-eyed peas, spinach, asparagus
Vitamin B12 (Cobalamin)	• Necessary for proper functioning of brain and nervous system. It is also important for formation of RBC	• Fish, meat

Micro-nutrient	Functions	Major source foods
Vitamin C (ascorbic acid)	• Necessary for creation of neuro-transmitters and collagen, and also the main protein in our skin. Furthermore, it improves the absorption of non-heme iron obtained from plant based foods.	• Citrus fruits, bell peppers, Brussels sprouts
Vitamin D	• For proper functioning of immune system, absorption of calcium and bone growth	• Sunlight, fish oil, milk, mushroom
Vitamin E	• Important for proper immune functioning, and it also serves as an antioxidant, which is important for protecting our body cells from damage	• Sunflower seeds, wheat germ, almonds
Vitamin K	• Important for blood clotting and proper development of bone	• Leafy greens, soybeans, pumpkin
Iron	• Helps in provision of oxygen to muscles and creation of certain hormones.	• Oysters, white beans, spinach
Zinc	• Important for proper growth, functioning of immune system and also for healing of wounds	• Cereals, such as maize; fish, breast milk, meat, beans
Calcium	• Important for proper structure and functioning of teeth and bones, it also helps for functioning of muscle and blood vessel contraction	• Milk, cheese and dairy products, foods fortified with calcium, e.g. flour, cereals. eggs, fish cabbage, broccoli
Iodine	• Essential component of the thyroid hormone, which has a key in normal growth, development and metabolism	• Iodised salt, sea vegetables, yogurt, cow's milk, eggs, and cheese, fish; plants grown in iodine- rich soil
Magnesium	• Assists hundreds of enzymatic reactions	• Almonds, cashews, black beans
Sodium and chloride	• Mainly important for fluid balance and maintenance.	• Salt, processed foods, canned soup

Source: National Institute of Health, Office of Dietary Supplement, 2021

d. Causes and consequences of undernutrition

Even if food and nutrition insecurity affect the whole members of the households in rural setting of LMICs including Ethiopia, the problems are highly affecting children and women at reproductive age. In addition to this, the windows of opportunity "the first 1000 days" encompass from conception to the child celebrate the 2nd year birthday gear the policy makers, development practitioners, researchers and academia working on nutrition problem give priority to mother and children. However, this doesn't mean that other age groups are not affected by these problems. In this regard, our focus in this document will be mother and children. Accordingly, the conceptual framework of under nutrition which is developed by UNICEF classifies the causes in to three major classes: immediate, underlying and basic (**Figure 3**). Considering these major causes, we can understand the multi-factorial and multi-dimensional nature of under nutrition.

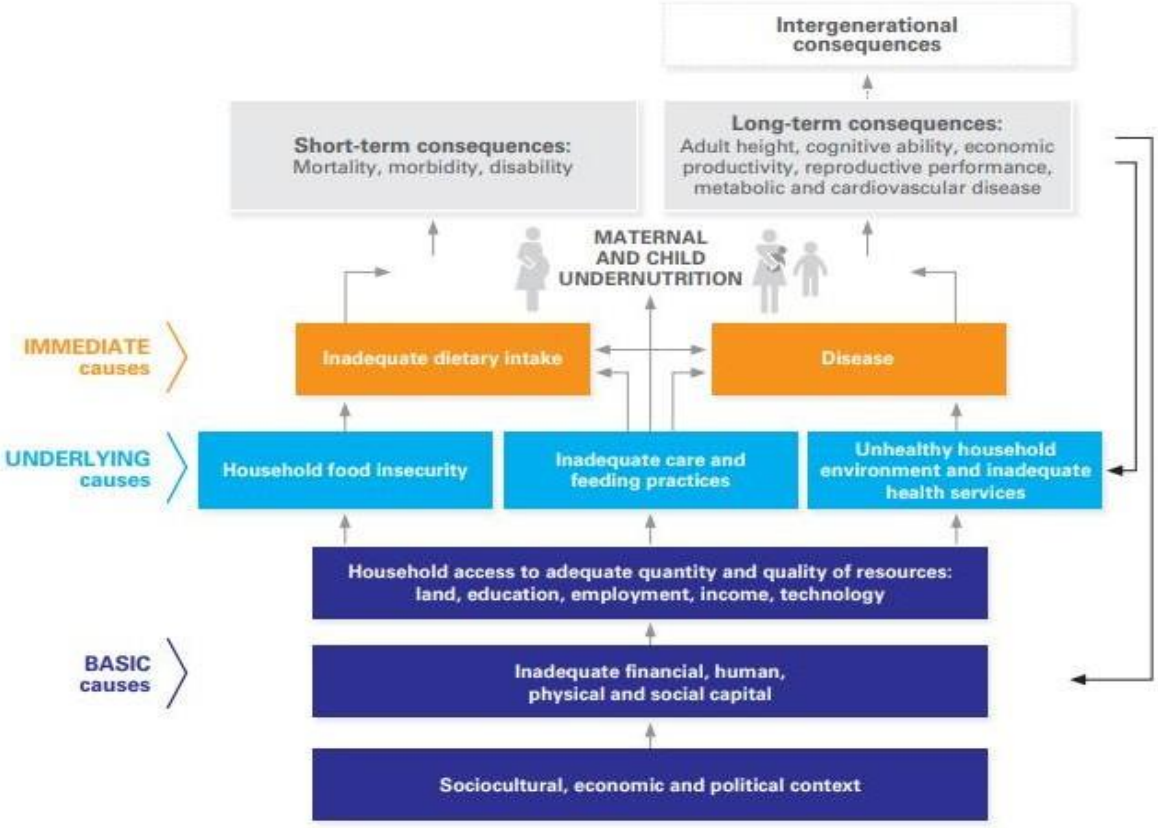

Figure 3: UNICEF conceptual framework of the determinants of maternal & child under nutrition

Inadequate dietary intake and diseases are the immediate causes of under nutrition. It happens at individual level. Inadequate intake includes taking small amount and diversified diet as a result, an individual will not get adequate amount of energy and nutrients needed for healthier life of individuals. Diseases contributed to under nutrition by decreased food intake and absorption, alteration of metabolism, and increment in nutritional requirements.

The underlying causes of under nutrition include food insecurity at household level, inadequate care and feeding practices for mothers and children and unhealthy environment at household level which include water and sanitation (WASH) and inadequate health services.

The basic causes encompass political, cultural, financial and environmental factors and it is broader in cover and its solution needs sub-nation, nation and international level interventions.
All these three causes of under nutrition will lead to two forms of outcome both in children and mothers. The consequences are short term such as morbidity, being disabled and if the worst comes death. On the other hand, the long-term consequences include being shorter adult, less intellectual ability, less productive and reproductive performance, metabolic and cardiovascular disease and the cumulative of these consequences pass from generation to generation if it is not broken somewhere in the vicious cycle of under nutrition (**Figure 4**).

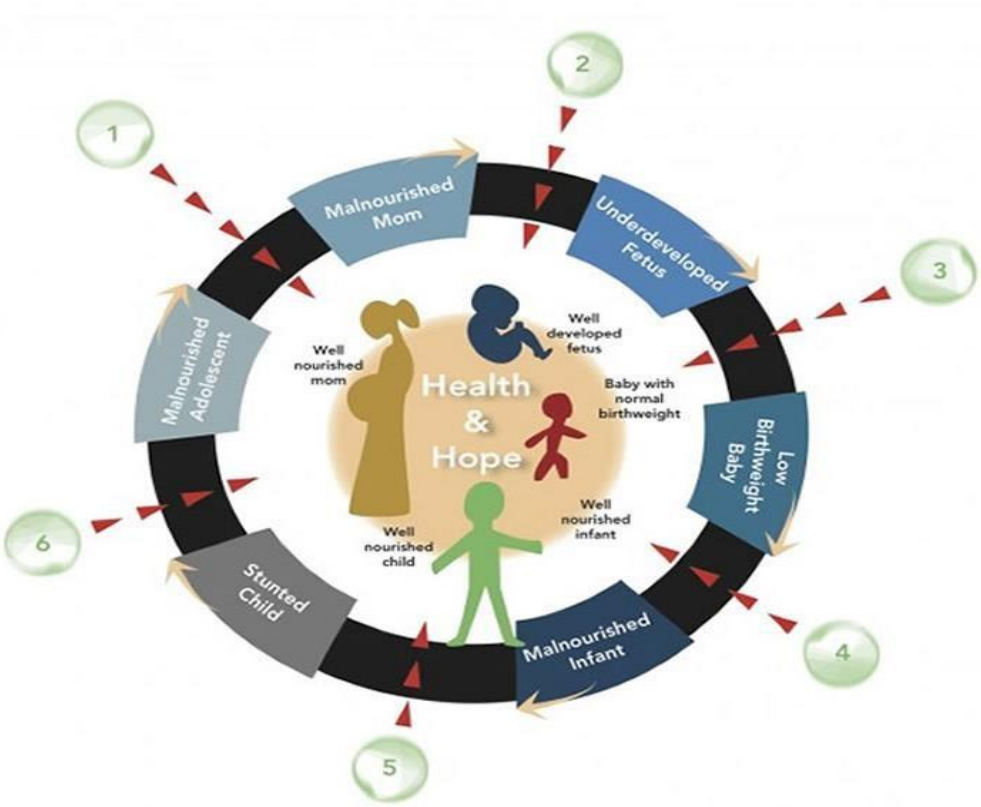

Figure 4: Intergenerational cycle of under nutrition

i. Stunting

Stunting is defined as being short in length/height for age (height-for-age *z* score less than −2 standard deviations [SDs]) and caused by multiple factors. These include being living in households with unprotected drinking water source, unavailability of toilet, large family size especially in high number of children, being a child of older and or illiterate and or farming mother, being a child born in caesarean section (CS), having low birth weight, not received measles vaccination, not receive vitamin A supplementation in the last 6 months, born of mothers not received antenatal and or postnatal care, born of illiterate father, living in rural areas, not exclusively breastfed, inappropriate complementary feeding practices, living in households with food source from own production, living in food insecure and poor households, children born of mother practicing food taboo during pregnancy/ lactation, children who had no colostrum (Figure 5).

ii. Wasting

Wasting is defined as being underweight for the height/length (weight-for-height/length *z* score less than −2 standard deviations [SDs]). It can be caused by many factors. These include living in non-cash producing area, children born of illiterate mother, diarrhea in the last one month, maternal illness in the last one month, child with divorced family, mother's did not take family planning method and or ANC, Children whose mothers had no power to decide how income earned is used, children whose mother had no formal education, low birth weight, Monthly income less than1500 Ethiopian birr and complementary food starting before 6 months significantly associated with wasting (Figure 5).

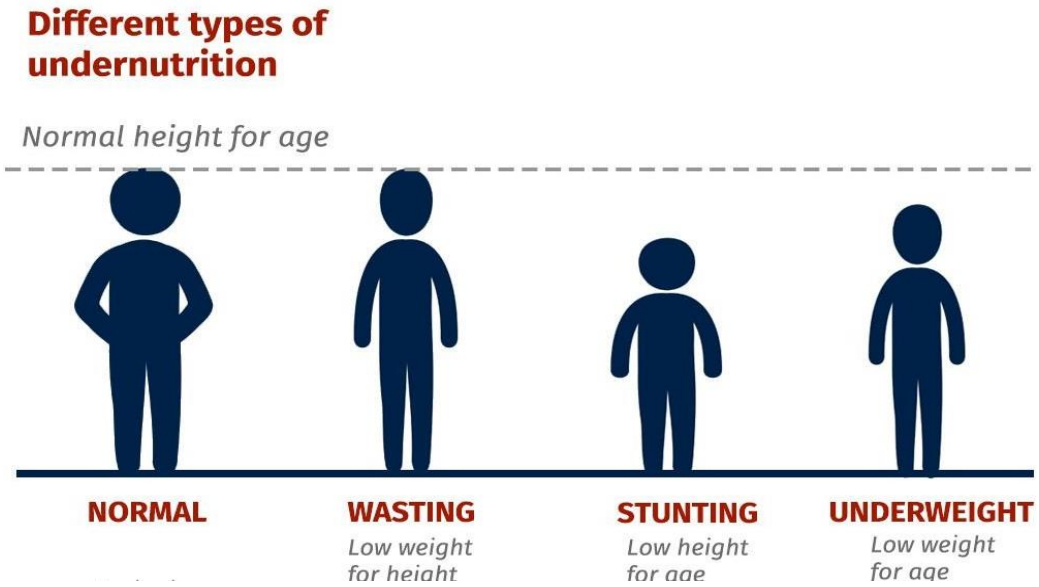

Figure 5: Different forms of under nutrition with the same sex and age

iii. Underweight

Underweight is defined as having low weight for age (weight-for-age *z* score less than −2 standard deviations [SDs]). It can be caused by many factors encompassing being older child, children born of mother practicing food taboo during pregnancy/ lactation, children born of illiterate mother and or father, farming mother, low birth weight, diarrhea in the last one months, born older mother are some of the factors associated childhood underweight in Ethiopian children (Figure 5).

iv. Micro-nutrient deficiency

Micronutrients are important nutrients that are only required in minimal amounts to support the growth, development, organ function, immunity, metabolism, and maintenance of the human body. However, factors such as inadequate intake from diet, poor bioavailability, not meeting the additional need due to disease- related losses or increased need, and extra requirement for physiologically needed groups including pregnancy and lactation period, lead to an invisible form of malnutrition called micronutrient deficiency (MND) or 'hidden hunger'. Because the manifestations of this deficiency problem are less visible shortly, MND has been identified when the condition reaches a severe level and also after the health of the individual is affected seriously. MND is among the important public health problem globally and affects >2 billion people, primarily females, and children. It was also identified as the principal cause of a significant number of maternal and childhood morbidity and mortality. Therefore, its impact on the social, economic, and health status of society and countries is immense. A previous study in Ethiopia on the cost of hunger revealed that the total losses associated with undernutrition are estimated at ETB 55.5 billion or US$4.7 billion for the year 2009. This loss was equivalent to 16.5% of GDP of that year.

e. Malnutrition at global and national level in Ethiopia

Despite a lot of efforts, under nutrition is a global public health problem and affects more than 820 million peoples worldwide in 2018 (UNICEF, 2019). It is also a cause for an immense morbidity, mortality and disability and a route cause for significant proportion of maternal and child morbidity, mortality and disability adjusted life years (DALYs). According to the global report on food security and nutrition in 2019, the number of people affected by under nutrition showed decrement between 2005 and 2015 from 947.2 million to 785.4 million, and then it turned to steadily increase until 2018. However, this is different in Africa and Oceania, where it has been increasing since 2005 unlike other regions of the world (Table 3).

Table 3: Number of undernourished people (millions) in the world and different regions

	Year					
	2005	**2010**	**2015**	**2016**	**2017**	**2018**
World	947.2	822.3	785.4	796.5	811.7	821.6
Africa	196.0	199.8	217.9	234.6	248.6	256.1
Asia	688.6	572.1	518.7	512.3	512.4	513.9
Latin America & the Caribbean	51.1	40.7	39.1	40.4	41.7	42.5
Oceania	1.8	1.9	2.3	2.4	2.5	2.6

Source: FAO, IFAD, and UNICEF, (2019)

Under nutrition remains a public health problem in Ethiopia and the country has lost an estimated 4.7 billion US$ (equivalent to 16.5% of the national GDP) in 2009 due to child under nutrition (CSA, 2017; EPHI, 2013). In under five aged children, the prevalence of stunting, underweight, wasting and anemia was 38%, 24%, 10% and 57%, respectively in 2016 (Figure 6). Additionally, the proportion of 6-23 months old children who met the minimum acceptable diet (MAD) was only 7%. Furthermore, the prevalence of underweight and anemia in women at reproductive age were 22% and 24%. But, overweight and obesity has been increasing in Ethiopia, which accounts 8% of the women and men (CSA, 2017).

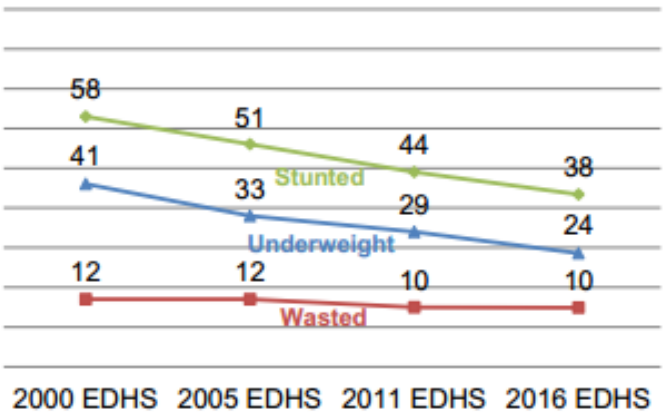

Figure 6: Trends in nutritional status among 6-59 months of Ethiopian Children

Chapter two assessment questions

1. Define food-based approach, dietary diversity, food security, nutrient dense foods, nutrition security, micronutrient deficiency (hidden hunger) and nutrition-sensitive interventions
2. Explain minimum meal frequency, minimum diet diversity and minimum acceptable diet
3. Explain the six food groups the food and dietary guideline of Ethiopia classifies food.
4. Mention iron, vitamin A, calcium and vitamin D rich foods that are commonly consumed in Ethiopia?
5. What are the immediate, underlying ad basic causes of malnutrition in Ethiopian context? Explain the major issues considered for calculating the cost of hunger study in Ethiopia?
6. How do you explain the intergeneration life cycle of malnutrition?

3. Gender and Nutrition

Gender is a term referring to the characteristics of women and men constructed by society through their norms, roles, values and the relationship built for women and men. It differs from society to society and it has dynamic nature and these characteristics are usually observed in social institutions such as families, schools and religious institutions. In general, gender role assignments activities to be carried out by males and females. For instance, food preparation in our society is assigned to females and eating more amounts for males unlike females, the so called quality diet, which are of the negative gender stereotypes that reflect the assigned negative assumption given related with being female.

Gender & nutrition can be considered as two sides of the same coin. Gender is the cause &

consequence of hunger & malnutrition. Gender inequality is associated with higher levels of acute and chronic under-nutrition. The ultimate nutritional benefits of increased incomes are determined by who controls the income and how it is distributed within the household. Women typically spend a higher proportion of their income on food and health care for children than do men. Women are in a unique position to reduce malnutrition, one of the largest threats to public health in the world.

3.1. Key facts about malnutrition and gender

1. Malnutrition is the single largest contributor to disease in the world.
2. Vulnerable women are at greater risk of malnutrition than men and more girls die of malnutrition than boys.
3. Almost five million children under the age of five die of malnutrition-related causes every year in the developing world.
4. Dependence on mostly staple foods and lack of crop and dietary diversity can contribute to malnutrition.
5. Social and economic inequalities between men and women often stand in the way of good nutrition.
6. Many women in developing countries cultivate, purchase and prepare much of the food eaten by their families, but they often have limited access to information about nutrition.
7. Poor women, especially those in female-headed households, tend to have less access than men to income, credit and other financial services and other resources needed to improve food security.
8. Women require two and a half percent more dietary iron than men, and women need more protein than usual when pregnant and lactating.
9. In many societies, men and boys are given priority when meals are served. This can contribute to under nutrition in women and girls.

3.2. Why gender matters

Despite their vulnerability to malnutrition, women are in a unique position to improve nutrition in their households. They are responsible for growing, purchasing, processing and preparing most of the food which is consumed. Yet vulnerable women, especially those in female-headed households, frequently have limited access to nutrition information and the resources they need to improve food security, such as income, land, equipment, financial services and training.

Gender matters because initiatives to improve nutrition cannot achieve lasting success without taking into consideration the social, economic and biological differences between men and women and, in particular, the gender inequalities which stand in the way of good nutrition.

Most often, women are more affected by and suffer from nutritional deficiencies compared to men, due to women's reproductive biology, low social status, poverty, and lack of education. They are also disadvantaged as majority of the developing countries including Ethiopia has socio-cultural traditions and there is also a disparity in household work patterns, which may increase the women's chances for being malnourished. Therefore, addressing women's malnutrition has a range of positive effects because healthy women can fulfill their multiple roles such as generating income, ensuring their families' nutrition, and having healthy children, more effectively and thereby help advance countries' socioeconomic development.

Production and preparation of food are often the responsibility of women in many African countries in general and Ethiopia in particular. Hence, their less or lack of knowledge on production, specifically the nutritious food and also the preparation of nutritious diet can make considerable effects on the health and nutritional status of the entire family. But women have less power on resources and decisions in their households in many developing countries including Ethiopia. Therefore, empowering women in different aspects for decision and promotion of gender equity and equality is crucial to ensure the proper implementations of nutrition sensitive agriculture.

Chapter three assessment questions

1. Explain the difference between sex and gender
2. Why females are more disadvantaged nutritionally in countries like Ethiopia?

4. Nurturing Nutrition Sensitive Agriculture

4.1. Why nutrition sensitive agriculture in Ethiopia?

The main aim of nutrition sensitive agriculture (NSA) is to maximize the positive impacts of the agricultural interventions on food systems in general and on nutritional outcomes in particular while minimizing any unintended, negative consequences of agricultural policies and interventions for the consumer. NSA is a food-based approach focusing on availing, accessing and consumption of diverse, safe and nutritious foods of plant and animal source food through the year, and sustaining agricultural systems at the heart of overcoming malnutrition and its consequences.

4.2. Interplay between agriculture and nutrition

The link between agriculture and nutrition is bi-directional, which means agriculture contributes for improving nutritional outcomes, and well-nourished workers can also contribute for improving the agricultural productivity. In countries like Ethiopia, where agriculture is the mainstay of the economy, agricultural production is one of the important means of achieving food and nutrition security. In this regard, irrigation expansion has been regarded as a promising approach to ensure food and livelihood security in the face of climate change and population growth in Ethiopia. Although the current coverage of irrigated lands out of the total cultivated lands is estimated to be between 4-5% in Ethiopia, it has twofold effects on nutrition. On one hand, irrigation can enhance yields and incomes of smallholder farmers as they can produce two to three times a year. On the other hand, irrigation is commonly associated with production of high-value horticultural crops mainly of vegetables, fruits and spices. These crops can improve the food and nutrition security, and the health status of the beneficiary households through different pathways including 1) a production pathway, 2) an income pathway, 3) a water supply pathway, and 4) a women's empowerment pathway mentionable. Figure 4 presented the framework that shows the role of irrigation for the transformation of agricultural livelihoods through pathways of food production, agricultural income, water supply, and women's empowerment, which can ultimately lead to changes in child and maternal nutritional outcomes.

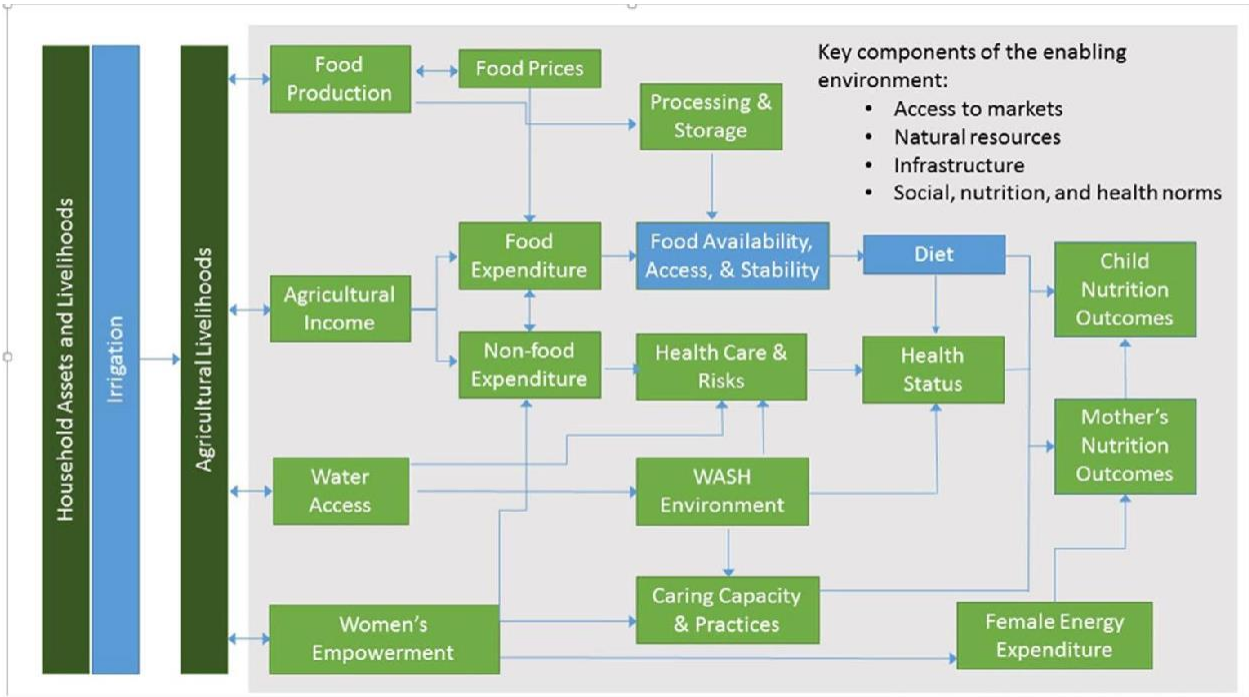

Figure 7: The Pathways from Irrigation to Nutrition

4.3. How do we make the agriculture system nutrition sensitive?

Nutrition sensitive agriculture practices should consider the following 10 outcomes (FAO, 2017).

1. Incorporate explicit nutrition objectives and indicators into their design, and track and mitigate potential harms.
2. Assess the context at the local level, to design appropriate activities to address the types and causes of malnutrition.
3. Target the vulnerable groups and improve equity through participation, access to resources and decent employment.
4. Collaborate with other sectors and programs, for instance agriculture and health sectors can integrate for nutrition sensitive agriculture extension.
5. Maintain or improve the natural resource base.
6. Empower women.
7. Facilitate production diversification and increase production of nutrient-dense crops and small-scale livestock.
8. Improve processing, storage and preservation to retain nutritional value and food safety, to reduce seasonality and post-harvest losses, and to make healthy foods convenient to prepare.

9. Expand market access for vulnerable groups, particularly for marketing nutritious foods.
10. Incorporate nutrition promotion and education.

4.4. Interventions that make agriculture and food system nutrition sensitive

There are different interventions within the food system to make agriculture more sensitive. According to FAO (2017), about 20 interventions are encompassed. The existing NSA interventions being implemented by ICRISAT/PASDEP, which is introduction of nutrient dense crops such as bio-fortified orange-flesh sweet potato in the community irrigation systems of the intervention areas fit with one of the NSA intervention identified in the FAO document. However, the national nutrition sensitive agriculture (NSA) training manual developed for agricultural development agents prioritized the intervention and customized to Ethiopia rural agricultural production system for it implementation and grouped them into 10 Nutrition Sensitive Intervention Approaches for improving the Nutrition of the community. Thus, we customized it to this training manual as well.

1. Diversified food production and consumption to improve nutrition

Increasing the availability and affordability of diverse foods is the aim of diversification. This should be coupled with sustainable intensification which is aimed to improve agricultural productivity and environmental sustainability at the same time. Yet, globally and also specifically in Ethiopia, the production couldn't meet the production of adequate amounts of nutritious foods necessary for healthy diets. The principles of sustainable intensification and diversification can be used from national and regional level with the farming system to the backyard garden. In this case, the availability and affordability of diversity of food can be achieved to meet good nutrition.

- A large scale diversification that can be implemented at national and regional levels or at commercial oriented production system, can help to increase the availability of diverse foods in large and niche markets and also can help also to reduce prices of nutritious foods.
- Integrated farming systems such as legume-based cropping systems (e.g.:- crop rotation and intercropping) support both diversification and sustainable intensification of production.
- Improving the attention on production of horticultural crops, considering their contribution

for healthier diet promotion and also their role in hidden hunger and diet related NCDs.

- Diversification strategies on a small scale in subsistent farm households in order to increase their access at their home level. In this regard, home gardening and perma-gardening which emphasis on production of nutrient-dense varieties of vegetables and fruit trees and small-scale integrated farming systems (e.g. mixed crop-livestock aquaculture) is important to improve diet quality and raise levels of nutrition for producing households.
- Complementary activities that include high-value crop farming, beekeeping, mushroom production, milk production, and involving in community fish ponding in order to increase the access and also improve the livelihood by selling it.
- Criteria for crop and varietal selection should go beyond yield and nutrient content has to get attention so that nutrient dense crops and species can be produced.
- Market-based approaches should be considered through multiple chain approach in order to stimulate and boost diversified production.
- Access to assets and inputs (e.g. land, water and seeds) and support for household food processing and preservation capacities are crucial requirements of these strategies.

2. Biodiversity for food and nutrition

In order to ensure dietary diversity and assuring nutrient adequacy, biodiversity has a crucial role. In this regard, eating from different food items/groups have got a great attention, yet, the differences in the nutrient composition among different foods and also at the variety /cultivars/breeds has less attention. For example, taking the white maize we usually cultivate in the farm households in Ethiopia is quite different from yellowish quality protein maize (QPM), both in terms of protein quality and also the protein contents. And this has a great implication in the nutritionals status of individuals that are consumed this different type of maize. Moreover, there is a huge loss of biodiversity at global level, due to environmental degradation, industrialization and urbanization. Thus, efforts that can improve the protection of biodiversity and prioritizing genetic resources for development of new nutrient dense, pest-resistant, climate-smart varieties has tremendous role for combating malnutrition problem in Ethiopia and globally at large. In order to do this, the following activities are important:

- Identifying available resources, selection and production of high yield and also nutrient dense resources that can help to address specific type of malnutrition problem through available nutrient dense resource in a cost-effective and locally acceptable way.

- Implementation of community-level initiatives to support the saving and exchange of seeds and eco-system to enhance availability and accessibility of genetic resources and strengthen local food systems and empower indigenous people (e.g. smallholder seed enterprises, community-based natural resource management, reforestation, promotion of micronutrient-rich forest foods).
- Use of market-based approaches through establishment of short supply chains.
- Raising awareness on the importance of bio-diverse foods for nutrition and incorporating in the existing extension systems.
- Interventions should also take into account the importance of improving knowledge and appreciation of indigenous peoples' food systems and diets and their implication for nutrition and environmental sustainability.

3. Introduction of bio-fortified crops for improving household nutrition

Bio-fortification is a process of increasing the density of vitamins and minerals in a crop through plant breeding, transgenic techniques, or agronomic practices. The objective of bio-fortification is not to promote increased consumption of staples but rather to substitute consumption of nutrient-poor varieties with nutrient-rich ones. Hence, bio-fortification is best promoted as part of a broader portfolio of sustainable, food-based approaches to nutrition. Bio-fortified staple crops, when consumed regularly, will generate measurable improvements in human health and nutrition (Bouis and Saltzman, 2017). It is also identified as a feasible and cost-effective means of delivering micronutrients to populations that may have limited access to diverse diets. However, introduction of bio-fortified crops in to a certain farming system needs critical identification of the nutrient/s deficiency in the farming households. For instance, vitamin A deficiency was identified as absolute problem of the farming community in many parts of southern Ethiopia. This calls for the introduction of vitamin A fortified crops, which are known and consumed in the specific community. For this purpose, Orange Fleshed Sweet Potato has been recently considered as a viable crop to widely produce in Ethiopia (Figure 8). It can provide yields in poor soils and can withstand droughts. In this regard, ICRISAT/PASDEP NSA intervention has invested much to see the effect of OFSP adoption on production and consumption after introduced in selected areas of Oromia, Amhara and SNNPRS. This activity is one of the enabling environments that have been stated in the FAO NSA manual.

Figure 8: Orange-flesh sweet potato introduced to Welmel Tiqa irrigation Scheme in Harena Bulik district of Bale Zone in Oromia region to address the observed vitamin A deficiency at population level.

4. Good Agricultural practice (GAP) and food safety for nutrition

Good Agricultural Practices (GAP) is a set of practices for produce farmers to reduce the risk of microbial contamination related to food borne illnesses on their farms. In these practices, the environmental, economic and social sustainability can be addressed for on-farm processes and result in safe and quality food and non-food agricultural products. Food safety refers to the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use. Safe food is free from hazards – i.e. any biological, chemical or physical agent in food when consumed orally either by a human or an animal does not cause health risk to consumer.

Chemicals hazards are identified by the presence of harmful substances that can be found in food naturally or unintentionally added during production and processing. Some chemical hazards include naturally occurring chemicals, such as fertilizers, sanitizers, synthetic and non-synthetic pesticides/herbicides/fungicides, equipment lubricants, cleaning agents, etc. Exposure to higher levels of aflatoxin which is produced by aspergillus fungus increases risk for cancer and neural tube defects in children. Aflatoxin can be produce both in pre-harvest and post-harvest time. Corn, nuts such as peanuts, oil seeds such as cottonseed, as well as copra, the dried meat of coconut, is some of the commodities with greater risk of aflatoxin

contamination. Pulses and sorghum have lower risk. Animal feeds, such as hay and straw, might be contaminated during pre-harvest or drying stages resulting in aflatoxin contaminated animal products.

Physical hazards are foreign objects that are found in food products. They are either naturally found in the specific item, such as stems in fruit, or not normally part of the food item, such as hair or plastic, screws, glass, staples, wood, jewelry, insects, etc. Unnatural physical hazards are generally more dangerous to health, whereas natural physical hazards can be harmless.

Biological hazards are characterized by the contamination of food by microorganisms. Found in the air, food, water, animals, and in the human body, these incredibly tiny organisms are not inherently unsafe – many provide benefits to living things. Despite this, foodborne illness can occur if harmful microorganisms make their way into the food we eat. There are several types of microorganisms, each of which can negatively impact health: bacteria, viruses, and parasites. Illnesses can range from mild cases of diarrhea/vomiting to life-threatening cases involving hospitalization and in some cases death. Examples include viruses, bacteria, parasites, and fungi. Fresh animal-source food, vegetables and fruits are at highly exposed to food safety hazard. Produce that is not cooked (raw) is therefore considered to have higher risk for pathogens than those fruits and vegetables that are cooked. Children and women at reproductive age, more specifically pregnant are at greater risk that will be affected by food safety problems.

GAP focuses on the best practices to be used for producing agricultural products to ensure the quality and safety of the final product. Food quality and safety standards are systematic preventive approaches to food safety that aim to protect public health and improve accessibility of nutritious and safe foods. Risks related to food safety and hygiene can be controlled at various points of the supply chain through:

✓ Promote proper application, frequency and amount of agricultural inputs

✓ Promote integrated pest management;

5. Food handling practice for improved nutrition

Food handling includes all the steps from farm to plate that harvested plant and animal

produces passes through the supply chain. Food loss can include loss in nutritional value, economic value and/or food safety. Food loss can take place at primary production level and at post-harvest (handling and storage), processing, and distribution and consumption stages in the agricultural, livestock, fisheries or forestry food supply chains.

Post-harvest handling, processing and storage contribute to: maintaining a secure supply of food (and thus of nutrients) throughout the year; preserving the quality of harvested raw material as it moves along the food supply chain from the producer to the market; reducing losses; and making fresh produce available in local markets as well as in distant locations. Food storage helps to maintain food quality over an extended period until its final use, permits its deferred use (on an annual or multiannual basis), guarantees the regular and continuous supply of raw materials for processing and helps to balance the supply and demand of agricultural products, thereby stabilizing market prices. At the household level, storage contributes to food security and nutrition by offsetting seasonal scarcity. Although crops have the highest nutritional value when consumed in the fresh state, food processing contributes to nutrition by extending the shelf-life of raw materials and by enhancing the safety and retaining the nutritive value of many foods. Furthermore, it enhances the palatability of food and saves time for cooking and food preparation at the household level.

In order to have proper food handling practices, the following activities should be done:

- Crops must be harvested at an appropriate stage of maturity if their quality is to be maintained throughout their post-harvest life.
- Good post-harvest handling, supported by appropriate transport and logistical operations, including efficient cold chain infrastructure, is critical to maintaining the quality of food as it moves from the producer to the fresh produce market.
- Strengthening the capacity of smallholders and small entrepreneurs, in particular women, to store, preserve, process and package foods can help secure a year-round food supply that can improve nutrition and income generation.
- Promote on techniques to optimize the shelf-life and nutritional quality of foods processing techniques like soaking, malting, sprouting, and fermentation of grains and pulses can enhance their vitamin, mineral and protein content and

bioavailability.

- Promote appropriate cooking techniques (avoid overcooking, over drying, and prolonged sun exposure to retain nutrient content of the produce)

6. Women empowerment for nutrition

Women's empowerment refers to improving the social, economic, political and legal strength of women so that they gain power and control over their own lives. Women's empowerment and gender equality are at the nexus of the agriculture, nutrition and health sectors. Women control on resources and income flows have positive impacts on nutrition because they are more likely to be directed towards food, education, health and care. Gender-based inequalities between men and women have a strong impact on the population's nutritional status when women do not have access to family income or other resources (land, credit, information, etc.) or are not empowered to make decisions on their use and distribution. Furthermore, women's workloads (in fields, fetching water and fuel wood, domestic chores, etc.) can result in reduced time for child care, breastfeeding and food preparation. Moreover, heavy workloads can have a significant impact on pregnant women's health and nutritional status, increasing the chances that children are born with low birth weight (< 2500g) and become stunted adolescents and malnourished adults. This process is called the inter-generational cycle of malnutrition. Gender equality and shared care responsibilities positively influence food security and nutrition as well as agricultural production. Designing and implementing gender-sensitive interventions in agricultural and rural development and the food system, which address unequal gender relations and empower women, are major factors contributing to the success of program to improve nutrition. These may include:

- Ensuring access to productive resources (land, agricultural inputs, and extension services for female headed, trainings…)
- Introduction of time and labor-saving farming technologies
- Male involvement in household care practice
- Women involvement in the house hold budgeting and income.

7. Income generation for improved nutrition

Income generation for nutrition refers to strategies aimed at leveraging the potential of agriculture and food systems to generate income, while maximizing the likelihood that the income is spent on buying nutritious foods and accessing nutrition-enhancing services known as the "income pathway from agriculture to nutrition". Ensuring regular and decent incomes for consumers is essential to achieve good nutrition, as it allows not only purchase of healthy foods, but also access to health care and education services. However, an increase in household income does not necessarily lead to improved nutrition. Several mediating factors need to be considered, such as: the amount of change in, and stability of, household income; intra-household income distribution and control; the role of market prices; household preferences and other determinants of purchase. With increasingly commercialized agriculture and food systems, income becomes more important for nutrition than own food production. It thus becomes important to integrate nutrition objectives and components into interventions whose primary objective is to generate income (e.g. agriculture commercialization programs). Thus, the following income generation activities should be done:

- Value addition practice (fruits, vegetables, roots, etc. processing)
- Caged poultry production
- Seed and seedling multiplication
- Off farm activities (wage labor, pottery, petty trade…)
- Fattening and dairy farming practice
- Horticulture and spices
- Bee keeping
- Fishery/aquaculture

8. Agricultural market linkages for improved nutrition

Agricultural marketing is one of the most important activities that help to reach the agricultural products to consumers. It also helps to balance food deficits and surpluses across countries, facilitating the availability of food and contributing to price stability. In a

context of urbanization, rise of the middle class and increased industrialization and globalization of the food system, the way that food is sold to consumers is changing. Supermarkets and fast food restaurants, for example, are rapidly spreading in developing countries and particularly in urban areas. Therefore, looking at trade through a nutrition lens is becoming important to maximize nutritional benefits. Thus, promotion and sustainability increase the availability, and affordability of diversified nutritious foods for household consumption to improve nutrition. This can be achieved through the important contribution of development agents and local administrations, which include: facilitation of farmers' access to market information, creation of market linkages for agricultural products, enhancing the purchasing power of low-income groups through income generation, facilitation of access to fresh foods for consumers, safe packaging and transportation of perishable food items, and promoting the nutrient dense food in local market.

9. Nutrition-sensitive social protection

Nutrition-sensitive social protection seeks to reach the nutritionally vulnerable, to incorporate explicit nutrition objectives and indicators and to promote strategies that enable households to access healthy and sustainable diets as well as health care. Safety nets and social protection schemes can play an important role in improving nutrition and addressing the social and economic determinants of malnutrition. Social protection instruments can assist households in protecting their food entitlements as well as minimizing negative coping mechanisms in the event of a shock – e.g. reducing food intake or pulling children out of school. Moreover, social protection helps families to increase their consumption and to access more and better food, while also helping to develop their productive asset base which is critical for sustaining good nutrition in the long term and facilitating access to health care and services.

Social protection helps families to access nutritious food, while helping to develop their productive asset base which is critical for sustaining good nutrition in the long term and facilitating access to health care and services through:

- Social assistance schemes designed to support the nutrition of vulnerable groups. Food transfers in kind can be maximized by adding nutrition education component, and by ensuring high nutritional quality of food baskets. This can include provision

of nutrient rich foods (e.g. animal-source foods, fruits and vegetables), fortified flours and bio-fortified staples.

- Consumption of nutritionally dense selected foods for prudent use of cash transfers on participation in health or nutrition education programs Social assistance schemes designed to support transfers of productive assets, which can integrate provision of "nutritionally interesting" assets such as dairy cows, small ruminants, poultry, fish or nutrient-rich seeds (i.e. fruits and vegetables).
- Promoting local procurement for social assistance programs, such as for school meals or food distribution, can improve nutrition for both consumers and poor producers.
- Social insurance schemes, including health insurance, targeted weather-based insurance for crops and livestock, maternity protection and employment insurance also contribute to protecting basic pro-nutrition assets against shocks and crises.
- Promoting Self-help saving groups

10. Nutrition education and behavior change communication

Nutrition education and behavior change communication to community can be delivered using multiple SBC approaches are more effective than just using one. The more frequently and consistently individuals practice the desired behaviors, the higher the outcome of behavior change. Therefore, the more frequently the DAs contact and visit farmers and their families, the more likely they will find instances of behavior change in their locality. To realize the SBC, the following points should be addressed:

- Conduct appropriate knowledge, attitude and practice gap assessment.
- Conduct selection of relevant target groups, determinants and activities
- Promoting of appropriate SBC interventions to overcome barriers of behavioral change
- Implement relevant and appropriate behavioral change principles and approaches.

4.5. Nurturing nutrition sensitive agriculture in irrigation systems

When the smallholder rain-fed agriculture system is transformed to irrigated farming, there are substantial changes in overall income, productivity, crop diversity and hence nutrition status of farm households. Irrigated farming may be usually associated with high value marketable commodities which could enhance the overall income of the family. In this regard, care should be taken to ensure that the household level improvements in incomes are properly transformed to improvements in household nutrition security. Therefore, nutrition profile assessments are required at local levels to examine the apparent intakes of energy and other nutrients at household and population levels. Once, the most deficient nutrients at population levels are identified, appropriate nutrition-sensitive interventions can be introduced in association with irrigation farming systems. The following nutrition sensitive agriculture interventions can be considered in irrigated farming systems.

- Irrigation should be used to improve the access to planting materials (seeds, seedlings, cuttings, etc.) of new crops such as fruits, vegetables and related nutrient-dense crops such as Orange-flesh sweet potato. Multiplications of planting materials in irrigation schemes during the dry season can support the production in rain-fed systems and thus contributing to nutrition security.
- Growing 2-3 crops using irrigation and rain-fed systems need to be aptly integrated with crop rotations considering cereals, legumes, root crops and vegetables. This can enhance the availability of several food groups and improve nutrition status in the farm households.
- Irrigation can ensure the availability and productivity of perennial crops such as fruits (banana, mango, apples, avocado, etc.) due to the supply of irrigation water during the dry seasons. In dry agro-climatic zones, irrigation interventions can significantly increase the crop diversifications, productivity and hence income of smallholder farmers thus indirectly improving nutrition.
- Enhancing irrigated commodities value chains should be aptly integrated with improved postharvest handling, marketing and processing of irrigation outputs. This can reduce postharvest losses and enhance incomes due to local level processing and marketing of agricultural products.
- Recently introduced and produced irrigated crops should be aptly integrated with the local

culinary systems through recipe and cooking demonstrations. Proper incorporations of newly introduced crops with the local culinary system can support wider adoptions and disseminations of newly introduced crops.

- As improvements in income may not be easily transformed to nutrition security, proper nutrition extension should be provided. The nutrition extension should be engendered.

4.6. National Nutrition Programs, Policies, and strategies in Ethiopia

4.6.1. National nutrition program of Ethiopia I and II

Ethiopia developed its first national nutrition program (NNP I) for the implementation years between 2008 and 2015 which focused on integrating and coordinating of nutrition-specific interventions to address the immediate causes of sub-optimal growth and development. It has also incorporated the potential effects of nutrition-sensitive interventions to address the underlying causes of malnutrition. It was also aimed to establish favorable environment to execute nutrition interventions.

The goal of the National Nutrition Program II is to provide a framework for coordinated implementation of nutrition interventions in order to end hunger by 2030. The program was developed in step with the government's efforts to realize the Sekota Declaration through the integrated and coordinated implementation of high impact nutrition interventions to reduce malnutrition among children, women of reproductive age, adolescents and the general population. The main interventions under NNP II include optimal breastfeeding, optimal complementary feeding, mitigation and prevention of micronutrient deficiencies, WASH, deworming, food fortification and management of acute malnutrition.

The Government of Ethiopia devised programs and initiatives with set targets that directly and indirectly contribute to the reduction of malnutrition and to ending hunger. These programs include increasing agricultural productivity, promoting girls' education, immunization, integrated management of neonatal and childhood illnesses (IMNCI), water, sanitation and hygiene (WASH), family planning, prevention of mother-to-child transmission of HIV (PMTCT), skilled delivery, delaying of first pregnancy, food fortification, and management of micronutrient deficiencies and acute malnutrition, among others. The interventions that fall under the National Nutrition Program

are grouped into two major categories: nutrition-specific and nutrition-sensitive (FMOH, 2016).

4.6.2. Food and Nutrition Policy (FNP)

The food and nutrition security policy of Ethiopia is inaugurated in 2018 and the objectives of the FNP are to create conducive policy environment to:

1. Improve the availability and accessibility of adequate food to all Ethiopians at all times.
2. Improve access to quality and equitable nutrition and nutrition smart health services to all Ethiopians at all times in all settings.
3. Improve consumption and utilization of diversified and nutritious diet that is compatible with optimal heath and throughout the life cycle.
4. Improve the safety and quality of food throughout the value chain.
5. Reduce food and nutrient losses along the value chain.
6. Improve food and nutrition emergency risk management and resilience systems.
7. Improve food and nutrition literacy of all Ethiopians.

Among the policy implementation approaches included in the FNP of Ethiopia are food-based interventions focusing on food as the primary tool for improving the quality of the diet in a sustainable manner. The policy mentioned in the food and nutrition issues shall be enforced and implemented at different points in the food system including production (bio-fortified crops) in rain-fed and irrigation systems, livestock and fishery products such as milk, egg, meat, honey and fish, processing (solar and simple drying), and consumption (such as porridge enrichment) of nutrient-rich foods.

The policy also promotes the food-based approach as long-term and sustainable approach for ensuring nutrition security by improving availability, accessibility and utilization of safe and nutrient-dense animal and plant foods through improved production (home-based, community-based, school-based and commercial), storage, transportation and preservation (FDRE 2018).

4.6.3. National Food and Nutrition Strategy (NFNS)

Purpose and Use of the Strategy

The national Food and Nutrition Policy (FNP) was endorsed in November 2018 and comprehensively include the issue of food security, food safety, food quality and post-harvest management, and other pertinent issues related to system, that include multi-sectoral approaches and institutional arrangements for food and nutrition governance. The NFNS embraces policy

directions and explicitly put them into strategic objectives, strategic directions, and strategic initiatives. This makes the strategy to serve as a binding national document for the implementing sectors, and defines their roles, strategic actions, and key performance indicators. Different sectors had an input and incorporated their specific roles in the development of nutrition-specific and sensitive implementation programs, guidelines, protocols, and operational plans.

Strategic objectives of the food and nutrition strategy

The development of food and nutrition strategy is systematically built in consideration of the Food and Nutrition Policy (FNP) strategic directions. Accordingly, 13 strategic objectives are formulated for the FNS, and each of them has its own initiatives, actions and key performance indicator, along with lead and collaborating sectors. The first three strategic objectives are formulated to ensure the availability and accessibility of food in a sustainable way, and ensuring the proper utilization of diversified, safe, quality and nutritious food, including the improvement of post-harvest management of agricultural food products. The strategic objectives from 4 to 7, are focus on ensuring optimal nutritional status by using the lifestyle approach, including effective food and nutrition emergency response systems and WASH. The rest six strategic objectives are aimed to support effective food and nutrition governance, food and nutrition literacy, sustainable financing, institutional capacity, evidence generation and an effective nutrition communication system (Figure 9).

Figure 9: Conceptual Framework of Food and Nutrition Strategy

4.6.4. Sekota Declaration

As part of the NNP II, a high-level commitment called the Sekota Declaration was launched in 2015 by government of Ethiopia to end child under nutrition in the country by 2030 as a goal. The declaration is managed under the NNP II, but implemented by sectors. Its aim is to transform the lives of Ethiopian children through integrated community development in agriculture, health, nutrition, education, water, sanitation and hygiene, as well as social protection. The followings are the Sekota declaration key goals:

1. Zero stunting in children under 2 years old
2. 100% access to adequate food all year round
3. Transformed smallholder productivity and income
4. Zero post-harvest food loss through reduced post-harvest loss
5. Innovation around the promotion of sustainable food systems (climate smart)
6. Water, sanitation and hygiene
7. Education
8. Social protection

The roadmap for Sekota Declaration is being implemented in three phases within 15 years period, of them the 1st phase: an innovation phase which was planned to be executed between 2016 –2020. This phase has investment plan with ten strategic objectives and 50 strategic initiatives, which was planned to be implemented in 32 selected woredas of Amhara and Tigray regions, which are known with high prevalence of stunting. The phase also focuses on the implementation of priority intervention packages, which was monitored and evaluated for generating evidences and learning scenarios for the 2nd phase called expansion phase, its implementation is planned to be started in this year (2021) and completed at the end of 2025. In this phase, more nutritionally vulnerable woredas will be reached, which will be further scaled-up between 2026 -2030 at national level for full implementation with evidence-based multi-sectoral interventions.

As part of multi-sectoral interventions, the agriculture sector can contribute immense, and perhaps five out of the ten key goals majorly addressed by this specific sector. For our purpose, we will focus on the contribution of irrigation and introduction of bio-fortified crops to address identified nutrition deficiencies in specific PASDEP/ICRISAT NSA target areas. For instance, the Sekota declaration supports the development and expansion of irrigation schemes through the huge national level investment plan in high potential but with high under nutrition problem woredas. In this way, the use of irrigation will increase the production of crops throughout the year, increase the productivity and income to be generated and increasing the availability of quality water for personal hygiene and environmental sanitation, which is linked with one of the immediate cause (disease) of under nutrition. The other is related with introduction of biofortified germplasm, which may help by introducing climate resilience, food security, pest and disease resistant, high yielding crops, which contribute in reducing the post-harvest food loss and sustaining the food system through climate smart-agriculture.

4.6.5. National Nutrition Sensitive Agriculture Strategy (NNSA) of Ethiopia

Agriculture is the key sector in Ethiopia, plays a gigantic and pivotal role for livelihood of most of the people. It also contributes to reduce the highly prevailing under nutrition problem of the country. Although both the crop cultivations and livestock sectors are dedicated to reduce under nutrition, nutrition sensitive agriculture (NSA) is relatively new to our country and to the sectors as well. But, there was no clear direction documented how the agriculture sectors address the under nutrition problem as one of the signature for multi-sectorial approach in the NNP I. Getting a great attention in the NNP II as one of the strategic objectives in this document, there was a need to embed nutrition in to the agricultural programs, strategies and investments in the agricultural ministries and their affiliates. Therefore, the integration of nutrition in the agriculture ministry's starts from maintaining the quality of land and soil and include provision of improved inputs (seed and fertilizers), agronomic practices (diversification, inter-cropping) and animal husbandry (animal breeding, animal feed and nutrition, animal health care and market), food storage and handling, post-harvest management, marketing, income and consumption or proper utilization of food. But these need clear structure, capacity building and collaborations among the agriculture sectors and between the agriculture sectors and others such as Ministry of Health. As a result,

developing the NNSA was mandatory to implement NSA. So, the NNSA document for Ethiopia was officially released in 2018. The followings are the goal and strategic objectives of the NNSA.

Goal of the NNSA

The overall goal of the NSA strategy is to contribute to improving the nutritional status of children and women by increasing the quantity and quality of food available, accessible and affordable and promoting utilization of diverse, nutritious and safe foods for all Ethiopians at all times.

Strategic Objectives (SOs)

1. To leverage nutrition into agriculture and livestock policies, strategies, programs and work plans at all levels
2. To establish/ strengthen institutional and organizational structures and capacity responsible for planning and implementing nutrition sensitive agriculture
3. To increase year-round availability, access and consumption of diverse, safe and nutritious foods of both plant and animal origin
4. To enhance resilience of vulnerable agrarian, agro-pastoral and pastoral households and communities prone to climate change and moisture stress
5. To ensure women and youth empowerment and gender equality
6. To establish/strengthen multi-sectorial coordination within the agriculture sectors and with signatories of NNP and other development partners (FDRE, 2016)

4.6.6. Vision 2030: Transforming Ethiopian Food System

Concepts and Definitions of Food System

Food system is defined as the sum of actors and interactions along the food value chain—from input supply and production of crops, livestock, fish, and other agricultural commodities to transportation, processing, retailing, wholesaling, and preparation of foods to consumption and disposal. It exists at different scale which include local, regional and global context. For instance, local food systems around the world are very diverse and location specific. In this case, they share some key features, but whenever there is any attempt to change these features results in reflecting their uniqueness due to their cultures owning, economic structures and ecologies of

locations. Evolvement of food systems comes because of the existing external and internal drivers, as well as through feedback mechanisms between these drivers. Climate or health systems are good example for external drivers while productivity gains as a consequence of innovations or from changes in consumer behavior is among the internal drivers (Figure 10).

Figure 10: Food System Overview

Overview of Ethiopian Food Systems Process

The government of Ethiopia has a strong commitment to achieve the sustainable development goals (SDGs) and also is fully committed to achieving the Sustainable Development Goals and has participated wholeheartedly in the UN Food Systems summit. The Ethiopian Food Systems (EFS) process was launched in November 2020 with the objective of defining Ethiopia's vision and pathway for national food systems transformation. The agenda have brought multiple sectors ad institutions to collaboratively chart a course for food systems transformation. The sectors and institutions involved include public institutions, multilateral and bilateral organizations, the private sector, civil society organizations, and universities and research institutes.

In order to formulate the Ethiopian Food Systems (EFS) vision, a couple of multi-stage and multi-sectorial process has been passed and this has been informed by a high-level roundtable discussion and background paper, and followed by three sequential national dialogues. The First EFS National Dialogue, high-level roundtable discussion and the background paper evaluated the

current state of Ethiopian Food Systems and also identified the key challenges that need to be addressed to drive transformation. Whereas, the Second National Dialogue then identified and prioritized key 'game changing solutions' which are 22 in number, in order to address the challenges identified in the previous Dialogue. The last (third) EFS National Dialogue favored the key stakeholders to set together and the EFS vision and declare the Ethiopia's commitment to create a strong and equitable food system publicly. The pathway of EFS follows the footsteps of Homegrown Economic Reform Agenda of the country, aimed to transform Ethiopia from largely agrarian low-income country to an industrialized lower-middle-income country by 2025. The EFS has been also carefully designed to both align with and evolve Ethiopia's existing food systems policy ecosystem and key national programs, such as the Homegrown Economic Reform, the Ten-year Development Plan: the Pathway to Prosperity; Food and Nutrition Policy, the Ministry of Agriculture's Nutrition Sensitive Agriculture Strategy and the Multi-sectoral Food and Nutrition Policy, the Disaster Risk Management Policy (DRM), social protection policies such PSNP5 (Productive Safety Net Program), and the Seqota Declaration and others. It also considered the previous experiences on different plans and programs, including the agricultural and nutrition plans (e.g.:- GTPs I and II, and Agriculture Development Led Industrialization). These all helped to formulate an ambitious vision to transform the Ethiopian food systems by 2030. The vision is designed for a holistic transformation of Ethiopia's food systems from production to consumption that promotes enhanced food safety, nutrition and diets, improved livelihoods, greater land preservation and restoration and greater resilience to shocks and stress. Thus, there is a high commitment and seeking from the Government of Ethiopia to transform the EFS using a sustainable and healthy diet-centered lens that minimizes tradeoffs through calling for strong collaboration across all food systems actors, uniting around a common goal of healthy and sustainable diets for all.

Challenges and Approaches to Transform Ethiopian Food Systems

Despite the strong efforts that have been made by the government of Ethiopia to improve the food and nutrition security of its citizens, undernutrition remains to be a public health problem in the country. Researches have also identified the persistent challenges that have been observed in the Ethiopian food systems, starting from production to distribution to consumption. The productivity and also the diversity of production are affected by low access to appropriate

agricultural inputs and technologies. The significantly increasing trend in the price of nutrient dense foods within short period of time, make also a challenge to afford healthier diets for majority of the population. Coupled with these, the population growth and intensive agricultural practices has led to soil erosion, land degradation and deforestation. Thus, addressing all the above mentioned issues must be addressed in parallel to reducing the rapidly growing greenhouse gas emissions emanated from agricultural practices and building enhanced resilience to both ongoing climate change and extreme weather events. In order to address these challenges and transform the Ethiopian food systems, five central goals have been identified, which are aligned with the UNFSS Action Track thematic areas (Figure 11).

Figure 11: Systemic challenges to the Ethiopia's Food Systems

To achieve the above goals, the Government of Ethiopia has identified 22 game changing solutions, which are segregated into six clusters: a) Nutrient dense food production; food safety, fortification and rural electrification and appropriate climate smart technologies; b) Supply and value chain development, national food based dietary guidelines and nutrition literacy and awareness creation; c) Integrated policy-making, land reform, and improved government finance provision for agricultural and rural transformation; e) Access to markets, market information, infrastructure and specialization; and f) Managing risk and protecting the poor.

This caught the attention of Ethiopian government to call for all actors and partners to unite and form alliances on the clusters and to support the national efforts to realize the EFS vision. This alliance is believed to be facilitators for policy and program coordination, and they can mobilize

participants, innovation of expertise and also resources. In this regard, all 22 game changing solutions are critical to accelerating food systems transformation and have been designed to both support and evolve existing national policies and programs. Thus, the FBDG of Ethiopia is among the identified game-changing solutions in the Ethiopian food-system transformation plan.

4.6.7. Ethiopian Food-Based Dietary Guidelines

The Food-based dietary guideline of Ethiopia is primarily prepared to establish a basis for food and nutrition, health and agricultural policies and nutrition education programs to customize healthy eating habits and lifestyles. It provide advice to the general public on foods, food groups and dietary patterns in order to fulfill the nutrient demand, promote overall health and also to prevent chronic diseases. This guideline contain a set of science-based easily understood messages accompanied by an image or diagram as an aid to rapidly, accurately and readily understand the message. Inappropriate dietary intake is the single most important causes of malnutrition, which are directly influenced by coupe of factors including food availability at individual and national levels. The social, cultural, economic, ecological and environmental circumstances should be considered to transit to healthier diet through the food-based dietary guidelines. For this reason, FAO highly encourage countries to prepare FBDGs, thus, the FBDG for Ethiopia was developed and its implementation and its use can be executed in different ways.

- Policy and advocacy tool: the guideline can be used as policy advocacy and programmatic tools in order show-up the demands including the need to make healthy food available to the target population by ensuring and maintaining the standard using FBDG recommendations for a healthier diet.
- Educational and capacity development tool: the guideline can be used by the academician development practitioners including health and agriculture service providers and those who are working directly on the community.
- Quality improvement: the guideline can be used by food industry to produce high quality food products and also to consider the key messages related to recommendation on the limitation of sodium, fat and sugar content in their food products.
- Shaping the food environment: the guideline helps to shape the food environment by setting standards for foods offered in public settings (schools, workplaces, hospitals, prisons, social canteens and restaurants).

- Monitoring and evaluation (M&E): the guideline can be used as a monitoring and evaluation tool by organization to track, refine and improve annual plans, and to re-plan as may be needed.

Goal and objectives of Ethiopia's Food-Based Dietary Guidelines

Goal: To reduce malnutrition and diet-related public health problems in the country by developing FBDGs and by promoting a healthy diet among different population groups.

Objectives: The main objectives of the FBDGs are:

1. To provide dietary recommendations for the Ethiopian population two years and older to increase diet quality, including diversity and food safety, for achieving optimal health.
2. To promote broad food-system actions supporting diet quality while being sensitive to sustainability.

Target audiences and scope for Ethiopia's FBDG

The target groups for the Ethiopia's FBDG are two years old and older in Ethiopia's urban, rural and pastoral settings. Children younger than two years are excluded from the target due to the presence of well aligned infant and young children feeding (IYCF) materials with global evidence and the local context. Whereas, the guideline will be used by government sectors, non-governmental organizations (NGOs) and United Nations (UN) agencies, universities and research organizations, industries, schools, professional associations, the media and social workers. Moreover, the guideline is prepared to support national and regional strategies, policies and programs through the multi-sectorial engagement of the Food and Nutrition Policy signatory sectors.

4.7. Food Processing and Cooking Demonstrations

4.7.1. Traditional food processing techniques

Since, plant-based diets are staple foods in Ethiopia; bioavailability of micronutrients is the major concern of micronutrient malnutrition in the country. Thus, traditional food-processing and preparation methods can be used at the household level to enhance the bioavailability of micronutrients in plant-based diets. These methods include thermal processing, mechanical processing, soaking, fermentation, and germination/malting.

Traditional processing methods such as soaking and germination are among the most common traditional household food processing strategies for cereals and legumes. The benefits of these strategies are immense including increment of ascorbic acid content, improvement in the protein digestibility, nutritional profile and cooking time of the crops in addition to the reduction in the amount of anti-nutrients, which are known with affecting the bioavailability of micronutrients, as a result their absorptions in human body. These anti-nutrients are mainly phytate and tannins. The presences of anti-nutrients in the food to be eaten have multiple benefits on human health. For instance, phytate contribute for prevention of kidney stone formation, reduced risk of diabetic-related diseases and serves as anti-cancer agents and also associated with reduced cardiovascular disease. Thus, here we are targeting the nutritionally needy groups suffering with micronutrient, so in this sub-section we focus on the negative impact of anti-nutrients.

Soaking of cereals and pulses

Soaking of cereals and legumes can be as short as 15 to 20 minutes up to longer hours (12 to 16 hours). In farm household's situation, they are usually soaked overnight at room temperature. But this can vary still from crop to crop and cereals to legumes. In this case, legumes and cereals with high outer coats need more time of soaking. For example, a previous case in Sidama area of Ethiopia showed that soaking of maize and chickpea increased the energy, macro- and micro-nutrients, water and oil absorption capacity and reduced the phytate and tannin contents of the flour and the complementary porridge without significant effect on overall acceptability. Soaking is not also limited to reduction of phytate and tannin contents, it is also for reduction of oxalate that inhibit calcium absorption. Because slight roasting improves the acceptability of different dishes prepared from pre-treated or non-treated food items, slight roasting for 5 minutes should be done after drying of the soaked item.

Germination of cereals and pulses

Germination also improves the nutrient quality and digestibility of cereals and legumes by reducing the anti-nutrients such as phytate, tannin and protease inhibitors. It also supports synthesis of hydrolytic enzymes such as starch degrading enzymes (α-amylases) and enhances breakdown of protease resistant prolamins; increases the availability of minerals (iron, zinc, etc.). Once the enzyme α-amylase synthesized, it starts to hydrolyze starch to dextrin and maltose, which reduces the viscosity of thick cereal porridges and enhances their energy and nutrient densities. In Ethiopia,

germination of chickpea and beans for 24 – 48 hours following overnight, or a day soaking period improve the nutrient quality by reducing the anti-nutrient contents. Thus, this technique can be used as cost-effective traditional technique for producing nutritionally quality food for children and women in our rural settings.

Drying of fruits and vegetables

Drying is a process of removing moisture through simultaneous heat and mass transfer and is a classical method of food preservation that provides longer shelf life, reduced weight and volume. It has three main phases: 1st phase, it is a phase in which the drying velocity increases and corresponds to the rise in temperature of the product until it reaches equilibrium. This is the time when the product receives as much heat from the air used to vaporize water; 2nd phase, is a phase in which a constant drying velocity will occur and include the evaporation of the free water on the surface of the product, which is permanently renewed by the moisture coming from inside of the product; and the 3rd phase is the slowing down phase and it corresponds to the evaporation of bond water.

Drying can remove a large portion of the water contained in a product in order to considerably reduce the reactions which lead to deterioration of the products, thus the growth and reproduction of microorganisms that would be a cause for decay can be arrested and it also minimizes most of the moisture-mediated deterioration reactions. It also slows down the action of enzymes that take part in many of the reactions, but does not inactivate them. It substantially reduces weight and volume and consequently minimizes packaging, storage and transportation costs, and enables product storability under ambient temperatures. Fruit drying could play significant role in developing countries like Ethiopia to diversify the economy, reduce imports and meet export demands, stimulate fruit production, generate both rural and urban employment especially for women, reduce postharvest losses, improve farmer's nutrition, develop new value-added products and promote micro- and small-scale rural enterprise development.

Sun drying: it is also called open-air drying and the most ancient method of drying foods and is still in use in many parts of the world. Drying in the sun is cheaper as it has little or no equipment costs and the produce has to spread on suitable surface and allowed to dry in the sun.

However, it has its own limitations and these are exposure to dust, rain and cloudy weather and infestation by animals, thus it requires having a continuous follow up throughout the drying period. Therefore, a food product that is dried using direct sun exposure often have a poor quality and in some cases unhygienic as a result of microorganisms and insects such as flies. This problem might be reduced through applying some transparent meshed cloths. Yet, it requires more space compared to solar drying for drying the same amount of food (Figure 12).

Figure 12: Sun drying of tomato using plastic tray confined with wood cabinet

Solar drying: it is an improved version of sun drying and is said to be an elaboration of sun drying and is an efficient system of utilizing solar energy. Therefore, most of the problems that can be encountered by sun drying techniques could be overcome with it. In principle, it is a method of using the sun's energy for drying, but excludes open air sun drying. It is more effective than sun drying, but has lower operating costs compared to mechanize drying that require energy and technology. Using solar drying technique, the product is protected from rain, insects, animals and dust which may contain faecal materials that alter the quality of the dried product. Additionally, there is faster drying that reduces the chance of mould growth and also there is high chance of removing all possible water from the food, due to higher drying temperatures and this may allow much longer shelf life.

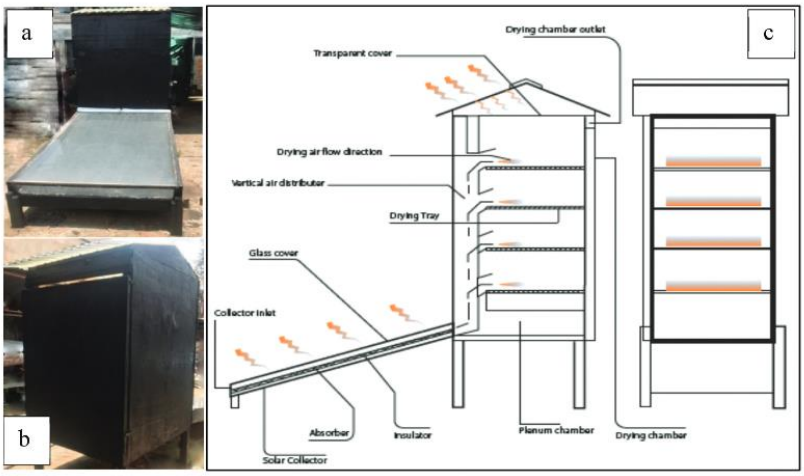

Figure 13: Solar drier, a) front view, b) back view and c) drying diagram of the solar drier

4.7.2. Cooking demonstrations for incorporating the required nutrients to local culinary systems

Development and demonstration of appropriate recipes to address specific nutrient deficiencies

Incorporation of the deficient nutrients to the local culinary system requires demonstration of appropriate recipes. These recipes could be newly developed or adapted to the local food systems. When new food ingredients are incorporated to the local food systems, there could be changes in the tests and colors of the foods. Hence, proper feedbacks should be obtained from the local communities. As previously explained, one of the strategic NSA interventions to address nutrient deficiencies is introduction of nutrient-dense crops which could be bio-fortified or natural crops. For instance, orange-flesh sweet potato has been introduced in Southern Ethiopia to address the severe vitamin A deficiency at community level. Figure 6 below depicted the cooking demonstrations of orange-flesh sweet potato at Offa district of Wolayta in Southern Ethiopia, about Hence, the crop could be aptly incorporated to the local culinary system upon proper cooking demonstrations. During the demonstrations, both couples of farm households were in attendance. Men in male-headed households being the main decision makers for what to produce in their farm plots, winning their trust on the importance of the crop and the recipes is crucial to ensure adoption. Women are mainly responsible in cooking and related household activities. Hence training women on recipe preparations is crucial.

Generally, there are three main steps in undergoing effective cooking demonstrations. The first step is to avail the major ingredients for recipe preparations and demonstrate the food preparation

processes. It is crucial that the participants have observed how the ingredients could be applied consecutively in the cooking processes. There could be discussions followed by questions and answers during the cooking processes. The second step is evaluating the recipes through visual observations and testing. It may be important to compare the new recipes with the already adapted once so that they can score and prioritize them. The third step is collecting feedbacks to accept or reject the recipes. In this stage, the types of recipes that could be accepted for possible adoption and rejected will be listed. The accepted recipes can be widely disseminated upon continued

cooking demonstrations and including this as part of the health and nutrition extension systems. Figure 6 depicted some of the recipes prepared from orange-flesh sweet potato as an important ingredient to address vitamin A deficiency (Figure 14).

Figure 14:Selected recipes prepared out of Orange-flesh sweet potato being incorporated with local food items including sauce (wot) with onion and other ingredients (left), Kocho bread with Enset (second from left), Injera with teff (third), and normal bread with wheat

Recipes for infant and young children

Children aged between 6-23 months should get safe and nutritious complementary foods in addition to breastfeeding. But, whenever this type of complementary foods are recommended in rural poor settings, it is important to consider the food habits of the community, the availability of the food items to be used for preparing nutritious complementary food in the area, and the costs.. Young children of ages 6-23 months should eat at least from 5 diversified food groups out of the following eight every day including breast milk. These include 1) grains, roots and tubers, 2) legumes and nuts, 3) dairy products (milk, yogurt, and cheese), 4) flesh foods (meat, fish, poultry and liver/organ meats) 5) eggs, 6) vitamin-A rich fruits and vegetables, 7) other fruits and vegetables, and breast milk.

The preparation of the recipes for supplementary food to young children should consider the locally available crops either from the own production or markets. For instance, in Wolayta area of southern Ethiopia several crops are produced including cereals like maize and teff, root crops such as cassava, sweet potato, taro, yam and enset; from legumes like haricot bean and chickpea; fruits like, mango, avocado and banana; and vegetables including tomato and kale.

Hence, preparing nutritious complementary food can be made out of these crops although other crops and animal source foods can be accessible in the local market. To prepare cereal based complementary porridge, first we have to pre-treat and mix the cereals with legumes before they are grounded in to flour. During mixing, the blending proportion of cereal with pulse should not be more than ratio of 60:40 if we are intended to prepare 100gm mixed complementary flour. Where it is economically feasible for the household, dried meat, which is called 'Quanta' should be milled with small local grinder and the powder can be added on the porridge while preparing. Similarly, green leafy vegetables can be dried and added on the porridge and can be fed at least 2 or more times per day depending on the age of the child age and breastfeeding status.

The critical practical questions are what, how much and how should be fed to healthy children of age ranges between 6- 11 months and 12-24 months. Hence, the following procedures are worth considering for feeding of children of different age groups.

For 6 - 11 months old children

1. Give soft and semi-solid porridge which is enriched with 2-3 colored foods such as orange-colored fruits and vegetables, green leafy vegetables, legumes including cracked lentil, peanuts and egg. Whenever we prepare porridge, we must add butter or oil and iodized salt, if possible, add milk by replacing some of the water, and also meat, which can be chicken, beef, fish and mutton.
2. Daily, we have to feed our child with nutritious porridge 2-3 times if she or he is breastfed or up to 4 times with an amount equivalent to locally known larger coffee cup. In between, we must also give additional food as snack or 'meksis' in between morning and mid-day, and also between mid-day and late afternoon. In this period, we can feed the child food items such as mango, banana, avocado, boiled and mashed potato or sweet potato or other foods available in our home, but should be presented in a way appropriate for child.
3. If the child gets sick, we must encourage the mother to breast feed and also take time as the child appetite may be lost and try to feed an extra meal since the illness until two weeks after.

12 - 24 months old children

- We can give family food such as soft and thick porridge, which is enriched with 2-3 colored foods such as orange-colored fruits and vegetables, green leafy vegetables, legumes including cracked lentil, peanuts and egg. Whenever we prepare porridge, we must add butter or oil and iodized salt, if possible, add milk by replacing some of the water, and also meat, which can be chicken, beef, fish and mutton.
- Daily, we must feed our child nutritious porridge 2-3 times if she or he is breastfed or up to 4 times with an amount equivalent to locally known 1 up to 2 larger coffee cups. But, we can increase the amount if the child needs more. In between, we have to give also additional food as snack or 'meksis' in between morning and mid-day, and also between mid-day and late afternoon. In this period, we can feed the child food items such as mango, banana, avocado, boiled and mashed potato or sweet potato or other foods available in our home, but should be presented in a way appropriate for child.
- If the child gets sick, we have to encourage the mother to breast feed and also take time as the child appetite may be lost and try to feed an extra meal since the illness until two weeks after.

Chapter four assessment questions

1. Why nutrition sensitive agriculture is important in Ethiopian context?
2. How does irrigation contribute to nutrition positively and negatively in your context?
3. How do we make agriculture nutrition sensitive?
4. Mention some of the actively working nutrition guideline, policy and strategy, with their main purpose?
5. Can you mention some of the traditional food processing and preservation techniques that are commonly used in rural Ethiopia?
6. Can you brief the main difference between sun and solar drying techniques?
7. What is complementary food and how should we practice it appropriately?

5. Water, Sanitation and Hygiene

5.1. Interlink between WASH and under nutrition

WASH is an acronym for Water, Sanitation and Hygiene. Lack or poor access on WASH can affect the nutritional status of individuals in the community, but this may be more devastating in nutritionally needy groups such as women at reproductive age and children. This can create problems on the health of individuals. Such a problem can occur through three direct ways, a)

diarrheal diseases, b) intestinal parasite infections, and c) environmental enteropathy. In addition to these, both mothers and children can be affected while the mothers are forced to go longer distance to fetch water, which is related with fatigue to prepare nutritious food for the family members including themselves, their children and other member of the household. Besides this,

child caring practice can be affected, which is one of the immediate factor for inadequate dietary intake and disease occurrence on children. Thus, it may affect the nutritional status of children.

5.2. Diarrhea

Diarrhea is the cause of mortality for millions of children under five years old. For instance, on average about three episodes of diarrhea are occurring in children per year, which is more occurring in children below two years of age. The effect of diarrhea on nutritional status of individuals, especially children is reflected in three ways: by affecting appetite, affecting absorption of nutrients and also due to increased metabolism. Thus, the nutritional status will be affected, which is linked with weak immunity as a result increase the susceptibility and severity of infection.

5.3. Intestinal parasitic infections

This type of infection is routed due to the contact of contaminated solid with human body in different ways. In such a way, millions of people are affected by roundworm, whipworm and hookworm. Basically, these infections are directly lined with poor sanitation. The eggs and larvae of the worms survive for longer period in the soil and infect humans when ingested through food or water, through the contact of fingers or it may contact the skin especially the leg when the individual walk without shoe in an infected soil especially hookworm. Hookworm can cause anemia in women and children. For instance, the pregnant women suffering with anemia are more likely to have preterm delivery; low birth weight resulted in undernourished children.

5.4. Environmental enteropathy

It is the pathway when the gastro-intestinal tract has huge load of pathogenic organisms and when the normal function is unsteady. Environmental enteropathy is a condition when chronic ingestion of pathogens can cause recurring inflammation and damage to the gut, leading to malabsorption of nutrients. This condition is mainly happening in children between the age of 6 months to two years. Due to the crawling of children in the ground and putting objects and their fingers into their

mouth, whenever this happens frequently, there is a likelihood of ingesting more enteric pathogens, as result the digestion and malabsorption of nutrients in the gut will be affected.

5.5. Interventions for improving the WASH practices

Conceptually, when we are dealing with WASH, we focus on the facilities and services to provision on water, sanitation, and hygiene. Thus, a holistic improvement in the WASH requires the improvement in the facilities and services of the three components. Improvement in the household access to safe, pure, and adequate amount of water for drinking, sanitation, hygiene and small-scale irrigation purposes is regarded as crucial WASH service and facilities. In such a way, improving the access to facilities and services to keep the living environment clean and safe for optimal health and nutrition consequences are the example for improved sanitation. These include ensuring the hygienic separation of human feces from human contact through Pit (VIP) latrine, flush/pour flush connected to sewer system, or septic tanks; pit latrine with slab; and composting toilet. Similarly, the hygiene component can be improved by improving personal hygienic practice principally by promotion of proper hand washing practice. Figure 7 shows the link between sustainable WASH improvements and sustainable child growth and nutrition. Basically, three interdependent WASH interventions should be implemented to improve the nutrition outcomes in general.

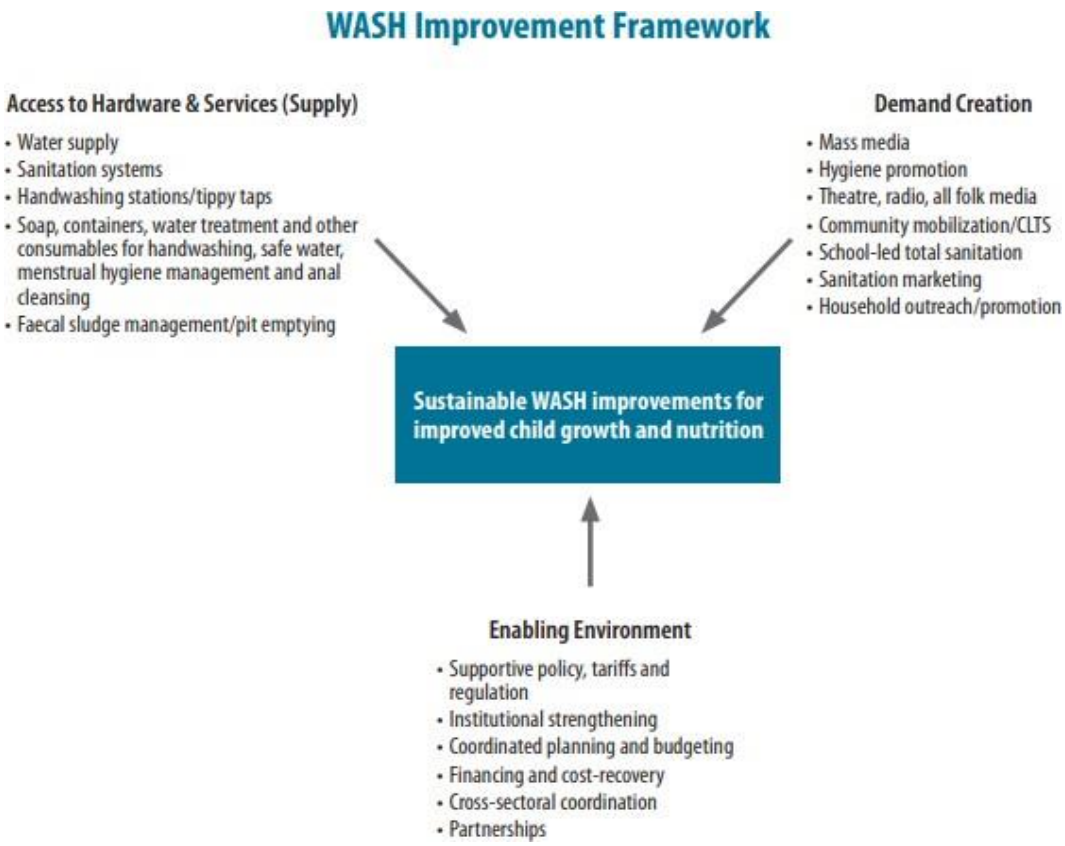

Figure 15: WASH improvement framework

5.6. Hygiene promotion

It is the intervention known with its feasibility to implement nutrition programs including NSA and includes promotion of hand washing with soap and other locally accessible cheap materials such as ash. The concept in this section also extends to food and environmental hygiene.

1. Hand washing at critical times at household level, which include before preparing food or cooking, before eating or feeding a child, after cleaning a child's bottom and after defecation.
2. Food hygiene: there are five key issues to have safe food, which are included in the PAHO/WHO recommendation for making food safe.

a. Keep a clean environment for handling food (including hand washing, cleaning key surfaces and utensils, protecting food preparation areas from insects, pests and other animals).
b. Separate raw and cooked food.
c. Cook foods thoroughly.
d. Store food at safe temperature.
e. Use safe water and raw materials

3. Environmental hygiene: young children start to contact the environment through crawling and walking and putting objects and their fingers into their mouth, which can be a source for their contamination and their illness as a result. Thus, environmental hygiene is critical and needs the following practice for its improvement in the local context.

a) Keeping animals or prepare separate rooms for animals and humans and the food they prepare, and regular cleansing of animal and child feces in daily basis.
b) Keeping food away from disease vectors such as flies, mosquitoes, cockroaches, and rats by covering food.
c) Improving the drainage for wastes, establish protected waste disposal pit.
d) Clean key surfaces which can be contaminated, such as latrines and kitchen floors and surfaces with soap if possible or other locally available disinfectant like ash and water.
e) Prepare safe areas which can be easily cleaned for letting child while they are crawling and playing.

5.7. Sanitation

Animal and human feces should be disposed properly or treated well; otherwise, they can be the source of pathogens and a threat for human health. Thus, cautions should be used during the application of cow dung as a fertilizer for improving the productivity of the crops growing in their farm. Thus, the followings are the recommended interventions appealing to sanitation.

- Engage communities in a process to develop and implement sanitation safety planning to safely manage, dispose of and utilize excreta

- Support sanitation campaigns using social mobilization strategies, such as community- based approaches targeting both household- and community-level improvements.
- Encouraging local social and financial institutions involvement in establishing community latrine.
- Develop communal, public and institutional sanitation services such as establishment of communal garbage pit and latrine.
- Promotion of integrating hygiene practices with sanitation facility improvements by locating a hand washing device with water and soap near a latrine to remind and enable users to wash hands after defecating.
- Promote access to, and use Improved or Shared sanitation facilities.
- Mobilize the community to create an open defecation free village.

5.8. Ensuring water quantity and quality

Access to safe drinking water needs construction or improvement of the supply system and services. This includes piped water on-site, public standpipes, boreholes, protected dug wells, protected springs and rainwater. This should consider the average 15–20 L of water need per person per day for all purpose of the individual.

Household water treatment (HWT) and safe storage (HWTS) technologies, which is also called point-of-use technologies, include a wider range of devices and methods which are designed to treat water at the household level or institution based including school, health facilities and other sectors. For instance, filtration, boiling, adding bleach, filtration, and solar disinfection are listed as appropriate point-of-use water treatment methods in Ethiopia. Yet the coverage of use of these methods at household level are very low even if it was planned to achieve coverage of 35% by 2020. Its purpose is immense, in some condition when the water is safe at the source; it may be contaminated while fetching, transporting or storing. Practically, water should be stored in our home in clean and washed container, which should have a lid and a narrow neck or spigot to prevent or reduce contamination. If the container doesn't have spigot, then we can use cleaned candle, which should be used only for this purpose and placed also in the cleaned area not on the ground. If possible, it can be stored in bucket with tighten fitting lid and helps for pouring it easily

without contamination. Studies in Ethiopia show the positive impact of Solar Disinfection (SODIS) and chlorination of water in reducing diarrheal diseases episodes in rural children.

Chapter five assessment questions

1. How does poor WASH links with malnutrition occurrence?
2. What is the specific role of intestinal parasite for the occurrence of malnutrition?
3. Explain environmental enteropathy dysfunction? How do we improve WASH in Ethiopian context?
4. Explain the five PAHO/WHO recommendation for making food safe

6. Further Readings and Links to Resources

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Annexes

Annex A: Aggregated food groups from the questionnaire to create HDDS

Q. No.	Food group	Examples	YES=1 NO=0
1	Cereals	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + *insert local foods e.g. maize or wheat porridge or paste*	
2	White tubers and roots	white potatoes, white yam, white cassava, or other foods made from roots	
3	Vegetables	pumpkin, carrot, squash, or sweet potato that are orange inside + *other locally available vitamin A rich vegetables (e.g. red sweet pepper)*, dark green leafy vegetables, including wild forms + *locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach*, other vegetables (e.g. tomato, onion, eggplant) + *other locally available vegetables*	
4	Fruits	banana, avocado, mango, papaya, strawberry, orange, lemon, orange, strawberry, passion fruit, pomegranate, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + *other locally*	

		available vitamin A rich fruits, other fruits, including wild fruits and 100% fruit juice made from these	
5	Meat	liver, kidney, heart or other organ meats or blood-based foods, beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects,	
6	Eggs	Eggs of chicken, and culturally acceptable others	
7	Fish and other seafood	fresh or dried fish or shellfish	
8	Legumes, nuts and seeds	Chickpea, soybean, broad bean, peas, lentils, sesame, linseed, peanut, haricot bean, etc	
9	Milk and milk products	milk, cheese, yogurt or other milk products	
10	Oils and fats	oil, fats or butter added to food or used for cooking	
11	Sweets	sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes	
12	Spices, condiments and beverages	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages	

Annex B: Diet Diversity Questionnaire (open recall method: for individual or household level)

Please describe the foods that you ate or drank yesterday during the day and night, whether at home or outside home. Start with the 1st food or drink eaten in the morning.
Write down all food and drink mentioned. When composite dishes are mentioned, ask for the list of ingredients. When the respondent has finished, probe for meals and snack not mentioned.

Breakfast	Snack	Lunch	Snack	Dinner	Snack

Eg: tea, maize porridge	Maize bread	Teff injera with lentil, peas sauce, onion, oil	Maize bread	Maize bread	Milk

For household level, please consider all foods eaten by members of the household, and exclude foods purchased from outside and also eaten outside home.

Annex C: Information for production diversity

C1) Types of crops grown during the last meher (kiremt) season.

Types of crops during the meher season by plots [a]	*Area coverage of the plot during the last meher season (ha)* [b]	*Estimated yield (quintals) per plot* [c]	*Estimated proportion for household consumption** [d]	*Estimated proportion for sale** [e]	*Why do you sel part or majorit of your products (more than one answer is possible)?* [&f]	*Renting status (ow use, rente in, rented out)* [g]	*Type of water source for prodn:* [h] *1) Rain-fed 2) irrigation*
A1.							
A2.							
A3.							
A4.							
A5.							
A6.							

*The optional answers for this question are: 1) All the product (90-100%); 2) The majority of the product (50-90%); 3) Half of the product (40-45%); 4) Some of the product (10-40%); 5) None at all (<10%)

[&]The optional answers for this question are: 1) I cannot store the product for long; 2) I have produced more than I need for consumption; 3) To get money for purchase of other food commodities; 4) to get money for other non-food expenditures; 5) Others (Specify)---------

C2) ***Types of crops grown during the last irrigation season***

Types of crops by plots during the belg season [a]	*Area coverage during the last Belg season (ha)*[b]	*Estimated yield (quintals)*[c]	*Estimated proportion for household consumption**[d]	*Estimated proportion for sale**[e]	*Why do you sell part or majority of your products (more than one answer is possible)?* [&f]	*Renting status (own use, rented in, rented out)* [g]	*Type of water source for prodn:* [h] *1) Rain-fed 2) irrigation*
P1.							
P2.							
P3.							
P4.							
P5.							
P6.							

*The optional answers for this question are: 1) All the product (90-100%); 2) The majority of the product (60-90%); 3) Half of the product (40-60%); 4) Some of the product (10-40%); 5) Not at all (<10%) [&]The optional answers for this question are: 1) I cannot store the product for long; 2) I have produced more than I need for consumption; 3) To get money for purchase of other food commodities; 4) to get money for other non-food expenditures; 5) Others (Specify)---------

C3) List the types of edible crops collected/harvested from the wild during the different seasons?

Types of edible wild plants [a]	Estimated yield collected per year (kg) [b]	Major seasons of collection (Months)[c]	*Estimated proportion for household consumption*[d]*	*Estimated proportion for sale*[e]*	*Why do you sell part or majority your products (more than one answer is possible)?* [& f]	Remarks
P1.						
P2.						
P3.						
P4.						

*The optional answers for this question are: 1) All the product (90-100%); 2) The majority of the product (50-90%); 3) Half of the product (40-45%); 4) Some of the product (10-40%); 5) None at all (<10%) [&] The optional answers for this question are: 1) I cannot store the product for long; 2) I have produced more than I need for consumption; 3) To get money for purchase of other food commodities; 4) to get money for other non-food expenditures; 5) Others (Specify)---------

Annex D: Food security information (HFIAS Scale)

	HFIAS Questions	**Response 0-No, 1-Yes**	**Frequency codes: 0-Never; 1-Rarely (1-2 times); 2-Sometimes (3-10 times); 3-Often; (>10 times) during the past 4 weeks**
01	In the past four weeks, did you worry that your household would not have enough food?		
02	In the past four weeks, were you or any household member not able to eat the kinds of food you preferred due to the lack of resources?		
03	In the past four weeks, did you or any household member have to eat **a limited variety** of foods due to lack of means to buy them?		
04	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?		
05	In the past four weeks, did you or any household member have to eat a **smaller meal** than you felt you needed because there was not enough food?		
05	In the past four weeks, did you or any other household member have to eat **fewer meals** in a day because there was not enough food?		

07	In the past four weeks, was there **ever (a day when there was) no food** to eat of **any kind** in your household because of lack of resources to get food?		
08	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?		
09	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?		

Annex E: Maternal nutrition knowledge assessment

1	How do you make more nutritious the complementary food you make for your baby?	
	1) I will prepare the porridge from flour of different food items	0= No 1= Yes 2= I don't know
	2) I will prepare the porridge from flour of pre-treat cereals and legumes	0= No 1= Yes 2= I don't know
	3) I will prepare the porridge from flour of cereals only	0= No 1= Yes 2= I don't know
2	If you prepare the complementary food from different food items? Please ask the type of foods and tick the group	
	a) Cereals	0= No 1= Yes
	b) Pulses	0= No 1= Yes
	c) Orange coloured fruits and vegetables	0= No 1= Yes
	d) Other fruits	0= No 1= Yes
	e) Dark green leafy vegetables	0= No 1= Yes
	f) Energy rich foods (oil, butter, etc)	0= No 1= Yes
3	If you prepare from pre-treat cereals and legumes, what type of pre-treatments you apply? Please tick if all applies	a) soaking
		b) germination
		c) fermentation
		d) roasting
		e) Others, specify

4 Eating diversified food at adequate amount during pregnancy and lactation is beneficial for both the mother and fetus/child	0= No 1= Yes 2= I don't know
5 Please observe the pictures, which of the following pictures of porridge you think is more nutritious?	1= Thin porridge 2= Thick porridge 3= I do not know

1) Thin Porridge 2) Thick porridge

6 Inadequate nutrition during pregnancy can be the cause of miscarriage and/or preterm birth	0= No 1= Yes 2= I don't know
7 What are the signs that could be observed in undernourished individual?	
a) Weakness and inability to accomplish activities properly	0= No 1= Yes
b) Easily and seriously ill	0= No 1= Yes
c) Weight loss or thin or skinny	0= No 1= Yes
d) Short for age in children	0= No 1= Yes
8 Why someone or people become undernourished?	
a) Not getting enough food	0= No 1= Yes
b) Not getting adequate amount of nutrients	0= No 1= Yes
c) Suffering with disease and not eating adequate amount of food	0= No 1= Yes
9 How should we do to prevent someone from under nutrition problem?	
a) Giving more diversified food	0= No 1= Yes
b) Feeding frequently enough amount of food	0= No 1= Yes
c) Getting treatment	0= No 1= Yes

Annex F: Dietary diagnosis/ profiling over the last one week

	Household composition data sheet					
Number of family members during at least 3 months						
		Male [a]		Female [b]		Total [c]
C1	Less than 6 months of age					
C2	Between 6 and 12] months of age (ref. child)					
C3	Between 12 and 24 months of age (ref. child					
C4	Between 25 and 36 months of age (ref. child)					
C5	(3, 5] years of age					
C6	(5, 7] years of age					
C7	(7, 10] years of age					
C8	(10, 12] years of age					
C9	(12, 14] years of age					
C10	(14, 16] years of age					
C11	(16, 18] years of age					
C12	(18, 30] years of age					
C13	(30, 60] years of age					
C14	> 60 years of age					

Food Id	Foods consumed either by the whole family or individuals		How much in total for the whole family in 1 week	
	Food type	Yes/No	Quantity	Unit code
C	Cereals			
C1	Teff			
C2	Wheat			
C3	Barley			
C4	Maize			

Food Id	Foods consumed either by the whole family or individuals		How much in total for the whole family in 1 week	
	Food type	Yes/No	Quantity	Unit code
C5	Sorghum			
C6	Millet			
C7	Rice			
C8	Others (specify)			
P	Pulses			
P1	Chickpea			
P2	Faba beans			
P3	Lentiles			
P4	Haricot beans			
P5	Grass pea			
P6	Ground nuts			
P7	Others (specify)			
RC	Root crops			
RC1	Potato			
IC2	Sweet potato			
IC3	Cassava			
IC4	Yam/Taro			
IC5	Others (specify)			
IC6	Fruits and vegetables			
IC7	Leafy vegetables (Gomen lettuce, etc)			
IC8	Tomatoes			
IC9	Onion			
IC10	Pepper			
IC11	Mango			
IC12	Avocado			

Food Id	Foods consumed either by the whole family or individuals		How much in total for the whole family in 1 week	
	Food type	Yes/No	Quantity	Unit code
IC13	Banana			
IC14	Watermelon			
IC15	Others (specify)			
IC16	Oils and spices			
IC17	Oil			
IC18	salt			
IC19	Sugar			
IC20	Livestock products			
IC21	Egg			
IC22	Milk and milk products (Cheese, Yoghurt)			
IC23	Meat (beef or lamp)			
IC24	Fish			

Annex G. Key Informant and Focus Group Discussion Questions

1. What are the commonly grown crops/ agricultural produces in the area in belg and meher seasons? Which of these crops commonly consumed? And commonly sold in the market? Why you sell them? (Potential respondents: Fathers, mothers)….. KII and FGD
2. Is there any changing trend in the types of crops grown in your area during the meher and Belg seasons since the last five years? How? Explain why?
3. What are the commonly prepared food recipes prepared in the area? What are the ingredients to prepare these recipes? What are the proportions of these ingredients? (mothers, women volunteers) ……FGD
4. How do you explain the food security status of the households at different months/agricultural activity periods (pre-planting/land preparation, after planting, pre-harvest and post-harvest) of the year? please ask also the periods for different agricultural activities. (fathers, elders, DAs)….KII

Months	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Food security status*												
Causes of food insecurity												

Coping strategies#												
What are the main types of recipes and ingredients during the different months												

*The optional answers for food security status are: food secured, mildly food insecure, moderately food insecure and severely food insecure.

#The optional answers are: 1) Reducing the amount and frequency of meal; 2) Less costly food items; 3) Livestock sale 4) Go for other income generating means (e.g. labor, migration, collecting and selling forest products etc.); 5) Relief/aid; 6) Go for credit; 7) Remittance; 8) Others (specify)

5. In which months of the year are the food prices are getting higher?

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec

Why and how? (Fathers, mothers, volunteer mothers)…KII and FGD

6. What are the less costly food items (commodities) that are consumed during the food in-secured periods? (volunteer mothers, mothers, Das)….KII and FGD
7. Do you know nutrition sensitive agriculture? How do you understand by NSA? Do you practice it in your area? (fathers, mothers, volunteer mothers)….KII and FGD
8. Have you or your family member ever got a nutrition training? If yes, who gave the training (e.g. CHW)? What were the training topics? Who from the household are mainly trained in nutrition? Why? Do you think that nutrition training can make a difference in the nutrition status of the family and agricultural system?
9. What types of nutrition trainings do you think are important? Why?