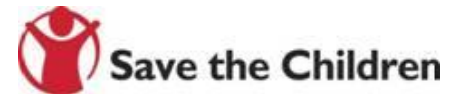


NUTRITION SENSITIVE AGRICULTURE TRAINING MANUAL FOR MODEL FARMERS



I. INTRODUCTION ABOUT THE TRAINING MANUAL.....	3
CHAPTER 1. BASIC NUTRITION EDUCATION.....	3
1.2. Macronutrients.....	4
1.3. Micronutrients	4
1.4: Dietary Diversity.....	5
CHAPTER 2: GENDER AND NUTRITION	7
CHAPTER II: Gender and Nutrition	7
2.1. Key Terms and Phrases Related to Gender	7
2.2. Gender Based Division of labor	8
2.3. Linkages between gender and nutrition	9
2.3. Engaging men for improved maternal and child nutrition	10
CHAPTER 3. FRUIT & VEGETABLE.....	12
3.1 Fruit and vegetable crops importance.....	12
3.2 Fruit crops propagation, production & postharvest handling practices.....	13
3.3 Vegetable crops propagation, production & postharvest handling practices	24
CHAPTER 4. LIVESTOCK PRODUCTION	38
4.1. Importance of animal source foods to human nutrition and health	38
4.2. Livestock production as a business.....	39
CHAPTER 5. BASICS OF AGRICULTURAL MARKETING	58
5.1. Basic concepts of farming as a business and agricultural marketing:	58
5.2: Basics of Business Planning and Marketing Research to produce nutritious foods.....	60
5.3: management of a farming business.....	63
CHAPTER 6. BASIC CONCEPT OF SAVING AND CREDIT TO MODEL FARMERS	68
6.1. Basic concept of savings.....	68
6.2. Importance of Saving to the rural community.....	69
6.3. Basic socio-economic advantages Saving to a person who saves regularly with great vision and discipline:	70
6.4. Types of Saving products	70
6.5. Basic concept of credit.....	72

I. INTRODUCTION ABOUT THE TRAINING MANUAL

Welcome to the Feed the Future Ethiopia Growth through Nutrition Activity Nutrition Sensitive Agriculture Model Farmer Training Manual. This manual is intended to be used as a resource for the training of model farmers to provide specific nutrition sensitive agricultural (NSA) and livelihoods technical advice and support. While promoting NSA, this training manual is also designed for commercial farming where inputs and available technologies are used for the betterment of farmers' food and nutrition security. As such, this manual provides guidance for the trainer on topics to cover, focuses on behaviors that are nutrition sensitive and provides direction to other resources that might be helpful for a trainer to gain additional knowledge.

This manual will help reframe their previous knowledge and understanding of agricultural and extension activities in a more holistic, nutrition orientated approach that helps meet the overall project goals of Feed the Future Ethiopia: Growth through Nutrition, and the Government of Ethiopia's Nutrition Sensitive Agriculture Strategy and the National Nutrition Program. This manual is intended to work in tandem with more nutrition-specific communication that will be delivered through other Feed the Future: Growth through Nutrition messaging and trainings.

Extensive technical resources that provide background to the content of this manual, as well as training cards and government policies already exist; please consult with Growth through Nutrition staff for more information.

About Feed the Future Ethiopia Growth through Nutrition Activity

Feed the Future: Growth through Nutrition is USAID's flagship five-year (2016-2021) multi-sector nutrition and WASH project, which aims to improve the nutritional status of women and young children in the four productive regions of Ethiopia. The project focuses on the first 1000 days, from pregnancy through a child's second birthday, recognized as the critical window of opportunity for a child's growth and development. The project will achieve its objective by delivering nutrition sensitive livelihoods and agriculture activities, social and behavior changing communications on nutrition, water, sanitation and hygiene (WASH) and agricultural related behaviors, utilization of quality nutrition services, utilization of WASH products and services and multi sectoral coordination and capacity to implement the National Nutrition Program and One WASH National Program.

How to Use this Manual?

This manual is designed for a three-day training course in nutrition sensitive agriculture for model farmer. Technical specialty areas including: fruit and vegetable production, rearing of chicken, dairy cattle and fattening, marketing agricultural products, and savings and credit group formation to benefit nutrition. This manual is designed to as a technical supplement to use in addition to Government of Ethiopia education materials covering the topics of nutrition, dietary diversity, gender, adult learning and WASH.

CHAPTER I. BASIC NUTRITION EDUCATION

I.1. Undernutrition and its consequences What is nutrition?

Nutrition is the intake of food and the interplay of biological, social and economic processes that influence the growth, function and repair of the body.

Nutrients are components in foods that an organism uses to survive and grow. There are two types of nutrients: **Macronutrients** and **micronutrients**. **Macronutrients** provide the bulk energy an organism's metabolic system needs to function, while **micronutrients** provide the necessary cofactors for metabolism to be carried out.

1.2. Macronutrients

Carbohydrates provide the body with energy to keep alive, build and repair tissues, stay warm, and move and work.

Proteins provide the body with essential amino acids that have a range of functions: growth and development, repair or replacement of tissues, production of metabolic and digestive enzymes, and production of some hormones.

Fats provide the body with essential fatty acids necessary to build cell membranes and to make hormones. They also help the body to absorb and transport some of the essential vitamins. Fats also provide the body with a concentrated source of energy. Fats are necessary for growth, reproduction, skin integrity, to maintain cells and to use body fat for energy.

Safe and clean water is essential for life and it is very important to get the right amount of fluid to be healthy. The body requires daily adequate fresh water.

1.3. Micronutrients

Vitamins: cannot be made by the body. Some vitamins can be stored in the body so need to be eaten often but not every day (fat soluble vitamins A, D, E and K), while others cannot be stored and should be eaten daily (water soluble B vitamins, vitamin C).

Vitamins: building protein and cells, protecting cells from damage, building bones, protecting vision, metabolising macronutrients, and helping to heal wounds. Without essential vitamins, there are multiple nutritional diseases that can result.

Minerals are a solid, inorganic group of compounds that are like essential building blocks of different types of cells. Essential minerals include iron, zinc, calcium, and iodine among others.

Malnutrition

Malnutrition is a term that includes over nutrition and undernutrition.

Over nutrition results from too much nutrient intake relative to nutrient requirements based on age, gender, physical activity, height, weight, and health status of the individual. In Ethiopia, this is still rare

Undernutrition is, in general terms, an outcome of insufficient quantity and quality of food and frequent episodes of infectious disease.

The most commonly used indicators of undernutrition are:

- **Wasting:** normally the result of **acute or short-term insufficient food intake** often combined with frequent illness. Results in a child who is dangerously thin (i.e. they have a very low weight for their height).
- **Stunting:** normally an indicator of **chronic or long-term insufficient energy or micronutrient intake** although it has many non-nutritional causes such as helminth infestation and frequent or chronic infection. Results in a child who is very short (i.e. they have a very short height for their age).
- **Underweight:** an indicator assessing adequacy of weight-for-age. The causes of which can be short-term or long-term and are difficult to define.
- **Deficiencies in vitamins and minerals** as a result of a poor quality diet. Micronutrient deficiencies can also result from frequent illness which may increase requirement, utilisation or loss of nutrients.

What are the effects of undernutrition?

Short-term

- Both wasting and stunting significantly increase the risk of mortality in children
- Undernutrition increases the susceptibility to, and severity of, infections in childhood

Long-term

- Functional losses in mental development, ability to learn in childhood, and work productivity in adulthood
- Low birthweight infants remain short into adulthood
- Low birthweight infants are also at increased risk of chronic diseases such as diabetes and cardiovascular disease
- Stunted children are at increased risk of becoming shorter adults; for women, being stunted increases the chances of having a low birthweight baby
- Stunted children also perform less well at school and have lower incomes in adulthood

1.4: Dietary Diversity

What is dietary diversity and why is it important?

Dietary diversity is a measure of the number of individual foods or food groups consumed in a given time period. It can reflect household access to a variety of foods and can also act as a proxy for an individual's consumption of adequate nutrients.

Dietary diversification – the consumption of a wide variety of foods across nutritionally distinct food groups – is a commonly food-based approach used to enhance nutrient intakes.

What are food groups?

No one single food or food group contains all of the nutrients that the human body requires for optimal function and good health. The human body requires nutrients that come from a variety of foods. To achieve good dietary diversity, it is important to regularly eat a variety of foods and to consume foods from all food groups.

Staples: Cereal grains such as teff, sorghum, millet, maize, barley, oats, wheat, teff, rice and starchy roots (cassava, potato, sweet potato) are included. Staples are a good source of **energy**.

Legumes and Nuts: ground nuts, beans, chick peas, and lentils. This food groups are a good source of **protein** in addition to energy.

Animal-Source Foods: meats, eggs, dairy and fish are good sources of **protein, fats, and essential micronutrients** (vitamins and minerals). critical for child growth and development in the first two years of life.

Vegetables: green leaf and yellow vegetables including kale, spinach, celery, cucumber, peppers, broccoli, carrots, cauliflower, pumpkin, onion, tomatoes and others. Vegetables provide **essential micronutrients** (vitamins and minerals). They also provide fibre to aid digestion.

Fruits: bananas, oranges, lemons, papaya, avocado, peach, guava, watermelon, sweet melon and many others. They mainly provide energy and **essential micronutrients** (vitamins and minerals).

Fats: cooking oils, oil seeds and avocado. Some foods such as animal-source products (meat, milk, and dairy products like butter and yoghurt) also provide **fat**.

How to get a diversified diet



















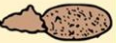

























One should eat a variety of foods at every meal for a diversified diet i.e. at least four or more groups as indicated in the table below

Table: Ways on how to consume diversified meal

SURE programme
Ministry of Health &
Ministry of Agriculture

Eat Diversely!

For good health eat at least 4 different food groups at every meal!

STAPLES	LEGUMES/NUTS	VEGETABLES	ANIMAL FOODS	FATS	FRUITS
Millet 	Lentils 	Kale 	Egg 	Cooking oil 	Mango 
Sorghum 	Peas 	Broccoli 	Fish 	Butter 	Papaya 
Maize 	Broad beans 	Carrot 	Beef 	Sesame Seeds 	Avocado 
Teff 	Chick peas 	Orange sweet potato 	Lamb 	Linseed 	Banana 
Barley 	Beans 	Pumpkin 	Poultry 	Sunflower seeds 	Grapes 
Wheat 	Ground nut 	Cabbage 	Milk 	Pumpkin seeds 	Pineapple 
Oats 		Squash 	Yoghurt 	Avocado 	Guava 
		Tomatoes 			Orange 

CHAPTER 2: GENDER AND NUTRITION

CHAPTER II: Gender and Nutrition

2.1. Key Terms and Phrases Related to Gender

Sex: The different biological and physiological characteristics of males and females, such as reproductive organs, chromosomes, hormones, etc.

Gender: Refers to the socially constructed characteristics of women and men – such as norms, roles and relationships of and between groups of women and men. Gender is the socio-cultural roles assigned to men and women, and is determined by society through various socializing agencies, such as families, peers, schools, and religious institutions. The fact that we are born male or female is unchangeable, however gender roles can and do change over time and across cultures. Women and men learn to behave and work in certain socially prescribed ways that reflect cultural norms and customs.

Gender roles: Refers to what males and females are expected to do (in the household, community and workplace) in a given society.

Gender relations: Refers to social relations between and among women and men that are based on gender norms and roles.

Gender stereotypes: Refer to images, beliefs, attitudes or assumptions about certain groups of women and men. Stereotypes are usually negative and based on assumed gender norms, roles and relations.

Gender equity: Refers to the process of being fair to women and men.

Gender equality: Refers to the state or condition that affords women and men equal enjoyment of human rights, socially valued goods, opportunities, and resources.

Access to and control over resources: One of the manifestations of power imbalances between men and women in any society relates to the disparity in access to and control over resources. This has implications on women's decision making power/ability both within the household as well as in community structures outside of the household.

Access to resources: refers to having the opportunity to use resources without having the authority to decide on the output and the exploitation methods. Access incorporates availability of a resource that includes several components such as geographic or physical accessibility, financial and social accessibility.

Control over resources: refers to having full rights to use resources and authority to decide what the outputs should be and how they should be used. It is the ability to decide when, how and who can use a resource.

2.2. Gender Based Division of labor

The biological differences between men and women do not normally change; people are either male or female. However, the characteristics they are perceived to have, and the roles and responsibilities assigned to them, differ among societies, cultures, and historical periods. To understand the expectations for different genders in our community, we must discover the different roles and responsibilities performed by women and men. Work can be divided into three main categories: productive, reproductive and community.

1) Productive Work

Any work related to production, whether for income or family consumption, is considered productive work. For example, farming or weaving baskets. Usually when people are asked about their job, their response is related to productive work, especially work which is paid or generates income. Both women and men can be involved in productive activities, but for the most part their function and responsibilities will differ according to the gender division of labor. Women's productive work is often less visible and less valued than men's. Women are generally paid less than men for performing same work.

2) Reproductive Work

Involves the care and maintenance of the household and its members, including bearing and caring for children, food preparation, washing, cleaning, water and fuel collection, shopping and family health care. Reproductive work is crucial to human survival, yet it is seldom considered 'real work'. In developing communities, reproductive work is for the most part manual labor intensive and very time consuming. It is almost always the responsibility of women and girls.

3) Community Work

Includes any collective organization of social events and services, ceremonies and celebrations, community improvement activities, participation in groups and organizations, local political activities and so on. Volunteer time is important for the spiritual and cultural development of communities and as a means of community organization. Both women and men engage in community activities, although a gendered division of labor also exists here. For example, men are present and influential in natural resource groups such as water user or forestry committees, women's likelihood to participate in such kind of community groups and influence is minimal.

Hence, women, men, boys and girls are likely to be involved in all three areas of work. In many societies, however, women do almost all of the reproductive and much of the productive and community work. Women's role, as has been noted, includes work in all three of these categories, which is referred to as women's triple work burden. Women's workload can prevent them from participating in development work that men may be able to. Additionally, any disruption in one area of work will affect the other areas. Extra time spent on farming, producing, trainings or meetings means less time for other tasks, such as child care or food preparation and finally rest. For these reasons, especially in agricultural production, it is important to understand the gendered needs of women and men, and cooperate with them for a sustainable livelihood.

2.3. Linkages between gender and nutrition

- Physiological factors augment nutritional vulnerability among adolescent girls and women.
- Selected nutritional requirements (e.g. iron) are higher among women of child-bearing age than among their male counterparts in order to sustain/compensate biological processes including menstruation, pregnancy and lactation. For example, gender disparities are observed with respect to iron deficiency and iron deficiency anemia due regular blood loss during menstruation in girl's post-menarche and premenopausal women.
- Both pregnancy and lactation considerably augment nutritional needs in terms of dietary quantity (e.g. daily caloric needs increase) and quality (micronutrient intake, particularly folate/folic acid, iron and iodine).
- While exclusive breastfeeding is promoted for the first six months of life and continued breastfeeding promoted up to the first two years of life, breastfeeding places an extra time and physical burden on women.
- In many cases, women do not receive support and/or time compensation to help them breastfeed their children, which may contribute to continued low levels of breastfeeding.
- Social norms frequently exacerbate the situation with men (and sometimes male children) receiving preferential access to meat and other nutritious foods. This situation is further compounded if the mother is overburdened with tasks, poorly educated, in poor health, as her ability to provide proper infant and young child feeding is compromised.
- Excessive physical activity during pregnancy is linked with and poor birth outcomes, namely increased risk of: preterm-deliveries, small-for gestational age and low birthweight.

- A major opportunity is missed if nutrition activities addressing women are only initiated during pregnancy. Preconception (pre-maternal) nutrition is critically important for two main reasons:
 - a substantial proportion of pregnancies are unplanned;
 - many birth defects/abnormalities occur during the first weeks of gestation.
- Weight status (underweight and obesity) and micronutrient status (particularly folate, vitamin A, iodine, iron and B12) are among the four key factors that drive preconception nutritional status in women. Underweight during the preconception period impedes weight gain during pregnancy (the main predictor of pregnancy outcomes), increasing the likelihood of preterm delivery and giving birth to small babies. As a result, increased attention to gender can help identify opportunities to reach women earlier, during influential stages of the life-cycle.
- A mother's ability to make decisions within the household and in her community is an important factor for not only for her own nutritional outcomes but also for her children.
- At the family/household level, the heavy workload resulting from the many household responsibilities that women shoulder usually leaves women with little or no time to properly care for their children and themselves.
- Along with unequal gender based resource distribution at the household level, a number of harmful traditional practices such as food taboos for women and girls (especially pregnant and lactating women), early marriage, and violence against women have contributed to the poor nutritional status of the majority of infants, young children and women in Ethiopia

2.3. Engaging men for improved maternal and child nutrition

Although many efforts to improve nutrition and maternal and child health outcomes worldwide have traditionally targeted mothers of young children as their sole beneficiaries, the role and contribution of the father in the well-being and health of both mothers and children has come into increasing focus in recent years, particularly with the Millennium Development Goal focused on gender equality, and now Sustainable Development Goals.¹ Recent efforts to engage men in health have often centered on maternal or reproductive health and addressing the root causes of gender-based violence, but there has been less focus on involving men more in child health and child care, including in nutrition and child feeding issues.

In order to improve the nutritional status of pregnant and lactating women, focus needs to be given to influencing and shifting the knowledge, attitude and practice of husbands and men in the target community. Husbands are the ones who usually have control over household resources and make the decision on how resources need to be used in the family. As they are the bread winners, their main responsibility is to make sure that the family gets the basic necessities. In addition, they have better social networks than women because they have more leisure time to spend in getting together with friends. Thus, reaching and influencing men will have a twofold benefit in that, in addition to getting their

support and engagement to ensure optimal nutrition at their home, they can also use their social networks to pass the knowledge and message to other community influential like religious leaders, community leaders, mother in laws, etc. Husbands are also the household decision makers in many ways and their influence on the nutrition practice of their children and their pregnant and lactating wives is critical

The Barriers and Enablers (Facilitators) for male involvement in maternal and child nutrition

Knowledge: Knowledge of basic nutritional actions and principles

Couple Communication and Decision Making: Men usually feel comfortable talking with their wives about their children's wellbeing. Women also usually communicate about family health and nutrition issues regularly with their husbands. However, decision-making power is largely unequitable within the household, with men having the final say on how resources are allocated including for nutrition and health-related expenses. Both men and women nearly universally view men as the lead decision makers in the household. While men may be more or less receptive to considering their wives' advice, and women may occasionally be able to independently make small purchases, there is a power imbalance that presents a barrier to full involvement.

Social and Peer Support: In general, men have limited social support for engagement. Although role models of active fatherhood do exist and have an influence, men who are viewed as too involved are likely to be laughed at or otherwise experience negative reactions from other men. Most commonly, these men are viewed as having been "poisoned" by the influence of their wives.

Cultural and Social Norms around Gender: Local norms present significant barriers to male engagement. There are still traditional gendered division of roles and responsibilities, upholding a dichotomy of men as providers and women as caretakers and nurturers.

Male-friendly MIYCN services: Health centers and community nutrition sites are branded largely as female spaces. Men do not tend to frequent them unless there is a reason their wives cannot attend.

Other Influencers: Mothers-in-law are particularly important influencers both in terms of male engagement and in terms of nutrition and feeding practices more generally.

Key actions of men who are involved in maternal and child nutrition

Financial and Resource Support

- Provides nutritious food (or money for food) for wife during pregnancy/breastfeeding
- Provides nutritious food or supports wife to buy nutritious food for young children in household
- Provides financial /logistical support for seeking health care when needed

Workload Sharing

- Provides childcare when wife is sick or overburdened
- Engages in stimulating activities with the child
- Ensures wife has reduced workload during pregnancy/breastfeeding

Social Support and Health Promotion

- Provides social support/encouragement to wife in breastfeeding or child feeding behaviors
- Offers advice or suggestions (not orders) on child feeding or dietary diversity

Physical Support/Accompaniment

- Accompanies wife/attends growth monitoring sessions
- Accompanies wife/attends child's other medical consultations
- Attends meetings events to learn more about maternal and child nutrition

Communication

- Regularly communicates with wife about children's health
- Consults wife in decisions around household resource allocation

CHAPTER 3. FRUIT & VEGETABLE

3.1 Fruit and vegetable crops importance

Fruit and vegetable crops are diverse crops types with different edible parts, adaptation ecology and growth habits. They are not widely produced and consumed in Ethiopia. However, they have multifaceted importance to improve the livelihood of rural households as described below.

- Fruit and vegetable crops are rich and cheaper sources of vitamins, minerals, fiber, carbohydrate, and protein. Therefore, they play key role in ensuring balanced diet to resource poor smallholder farmers.
- Fruit and vegetable crops provide higher yield per unit area compared to staple cereal crops. They can be produced without tractors and ploughing oxen in homestead simply with hand tools, family labor, and minimum external inputs (without inorganic fertilizer and pesticide). Therefore, fruit & vegetable crops production enables poor rural households to access balanced diet from a small plot of land with minimum external inputs.
- Most vegetables have a shorter growing season compared to staple crops (sorghum, finger millet, maize, etc.). They can be harvested two to three times per year. Therefore, vegetables play key role to mitigate seasonal food shortage. Similarly, some fruit crops such as banana & papaya provide fruit throughout the year. Therefore, they can help to mitigate seasonal food shortage.
- Fruits and vegetables have high market values. The current market price of some vegetables (tomato >10 birr/kg) is higher than most staple crops (maize=4 birr/kg; wheat <7 birr/kg). Similarly, the current market price of some fruits (banana=18 birr/kg) is higher than most staple food crops (maize=4 birr/kg; wheat <7 birr/kg). Therefore, fruit and vegetable crops production enables smallholder farmers to acquire better income subsequently better health service.
- From gender perspective, fruit and vegetable crops are usually grown in the homestead and managed by women. Therefore, they empower women to provide a balanced diet to their families.
- Employment opportunity: vegetable crops production is labor demanding agricultural activity. Therefore, it creates employment opportunity for unemployed citizens.

- Fruits and vegetables serve as raw material for agro- industries, source of export earning & plays vital role for sustainable utilization of natural resources since they provide adequate food and income from a small plot of land.
- Fruit and vegetable leftovers commonly utilized as feed for animals. Flowers of most fruit and vegetable crops are also excellent sources of pollen and nectar for honeybees. Therefore, horticultural crops production supports the livestock sector as source of feed.
- Soil & water conservation: Fruit crops help to conserve soil and water in many ways, such as their leaves and branches intercept rainfall and wind which in turn reduces soil erosion. Their roots, and fallen and decomposed leaves increases infiltration thereby decrease soil erosion and increase water conservation.
- Rehabilitation of degraded lands: Some fruit crops (cactus, custard apple, etc.) thrives in marginal lands which are not suitable for major staple crops production. Therefore, they are useful for gradual rehabilitation of marginal lands.
- Medicinal value: fruits and vegetables contain different antioxidant compounds (vitamin C, Vitamin E, carotenoids, phenols, flavonoids, etc.) which serve as free radical scavengers. Therefore, consumption of fruits and vegetables ensure resistance to our body to many diseases.

3.2 Fruit crops propagation, production & postharvest handling practices

Fruit crops are a group of perennial trees or shrubs that yield fleshy or hard edible fruits. According to their production agro-ecology, they can be classified as tropical, sub-tropical and temperate fruit crops. Fruit crops comprises wide range of plant species and have multifaceted importance to improve the livelihood of smallholder farmers. Their propagation, production and postharvest handling practices are described below.

3.2.1 Fruit propagation

Fruit nursery establishment and management

Fruit crops such as citrus, mango, avocado, guava, etc. require a nursery where rootstocks are raised until they reach the stage of optimum growth for budding or grafting and further after grafting or budding until they are ready for transplanting to the permanent field or are sold. For example, avocado and mango seedlings will reach for grafting in 6 to 8 months after planting and will be ready for transplanting after 5 to 6 months after grafting. In Ethiopia, the demand for fruit crops growing is steadily increasing. However, fruit seedlings are supplied by few government nursery sites, so that they are physically far to most smallholder farmers and supply few number of seedlings compared to the existing demand. Therefore, establishing fruit nursery sites in different areas supports the expansion of fruit production in the country as well as it will be lucrative business to smallholder farmers who are interested to be engaged in fruit seedling supply. Major activities for successful fruit nursery establishment and management are briefly described below.

Nursery site selection.

The following conditions should be considered while selecting a fruit nursery site.

1. The site should have to be flat or with gentle slope in order to easily drain excess water or avoid water logging problem
2. The site should have well drained soil with a depth of up to 1m
3. It should be separated from fruit production field, but as close as possible to major fruit production areas and which was not previously planted with the same fruit crop
4. It should be outside the range of roots and shade of trees, hedges and buildings
5. The site should not be prone to frost and protected from strong wind
6. It should have irrigation water source and be readily accessible by all-weather road

Nursery operations

Nursery operations involves various activities including preparing activity plan, seed collection, seedbed or planting media preparation, seed sowing, potting, pricking-out, shading, watering, weeding, disease and insect pest control, root pruning, application of additional fertilizer or compost or manure, etc.

When to start seedling raising?

The time to start seedling raising depends on when field planting is planned, the availability of viable seeds for sowing and growth rate of seedlings of different species. It is important to allow sufficient time for seedlings to grow to a size where they will survive well in the field, normally 30-45cm height, though this depends on the species and how they will be managed in the field.

Soil or planting media preparation & solarization

The soil to be used for seedling raising should be fertile and drain well. Therefore, collect possibly forest soil or top soil by digging out up to 10cm deep, remove stones and roots by sieving and then mix 2 parts of soil with 1 part of decomposed manure or compost and 1 part of sand. This planting medium should be sterilized through solarization for 3-4 weeks. The purpose of solarization is to kill soil borne pathogens, nematodes, insect pests and weeds. The best time is during the dry season. To solarize the soil, follow the following steps.

- Apply water to moisten seedbed soil or growing medium.
- Cover the soil with transparent plastic sheets for 3-4 weeks (bury the edge of the plastic sheets in the soil to create air tight condition).
- After 3-4 weeks remove the plastic sheet and use for pot filling or plough the soil if it is seedbed. About 2-3 days later, level the soil and sow the seed.



Fig. Soil solarization using transparent plastic

Seed collection and processing

Collect fruits if possible from orchards established for seed production purpose. If not collect fruits from known fruit trees which are free from seed borne diseases and have desirable characteristics at its maturity stage. Extract the seed from the fruit pulp by washing with clean water or by rubbing with ash or saw dust. Then dry them under shade to maintain its viability. The viability of seeds extracted from immature fruit and dried without washing or under sun is very low. Therefore, do not use fruit seeds collected from juice shops.



Fig. Papaya seed extraction, washing & drying process.

Seedbed preparation

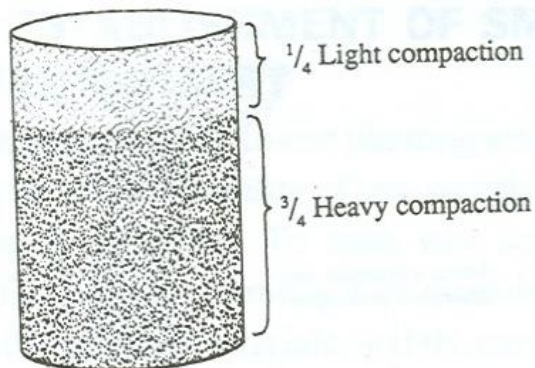
Potted seedlings can be raised on a flat bed, or can be set into a 10cm deep sunken bed. Sunken bed holds seedlings together and helps to conserve water in dry areas. Raised beds are used for raising bare-rooted seedlings. Prepare raised bed with 1.2m width and 5 or more meters length by staking wood with 10 cm height. Then fill it with planting media prepared by mixing 2parts soil, 1part manure or compost, and 1part sand. Finally level the soil applied on the seedbed by hand up to 2cm from the top.



Fig. Raised and sunken seedbeds

Potting or pot filling

Planting media should be moistened and filled to the planting pot to a depth of about three-quarters by pressing. The remaining portion of the pot will be filled loosely up to about 2cm below the top since heavy compaction restricts root development. Before planting the seed moisten the pot by light watering then plant the seed.



Sowing seeds on the seedbed

When raising seedlings in pots, polythene tube that are around 10cm in diameter and 20cm long or deep are widely used. However, the size of pot depends on the species to be grown as well as the length of time the seedlings will wait in the nursery. The bottom of the tube should be open to facilitate drainage and aeration. It also facilitates root development as well as root pruning activity. To sow seedling on raised seedbed, prepare planting furrow at 10cm or width of palm and then place the seed in the furrow at appropriate spacing and depth, then cover the seed with the soil by hand. Cover the seedbed with dry grass as mulch. Then irrigate the seedbed using watering can.

Pricking out: is the process of transferring young and tender seedlings from seedbed into pots. It should be done when seedlings reach a height of 2cm. Pricking out involves the following activities:

1. Water the seedbed and planting pots properly before commencing the operation
2. Take an empty container and fill with water to $\frac{3}{4}$ level.
3. Pullout seedlings gently and immediately put them in the container with water
4. Make a hole at the center of the pot using a stick
5. If roots are too long clip off the tip.
6. Place the seedling in the hole and push the soil around the seedling to hold the seedling and remove air pockets around the root.
7. Water the seedling and construct shade to protect the seedling from dry wind and direct sunlight

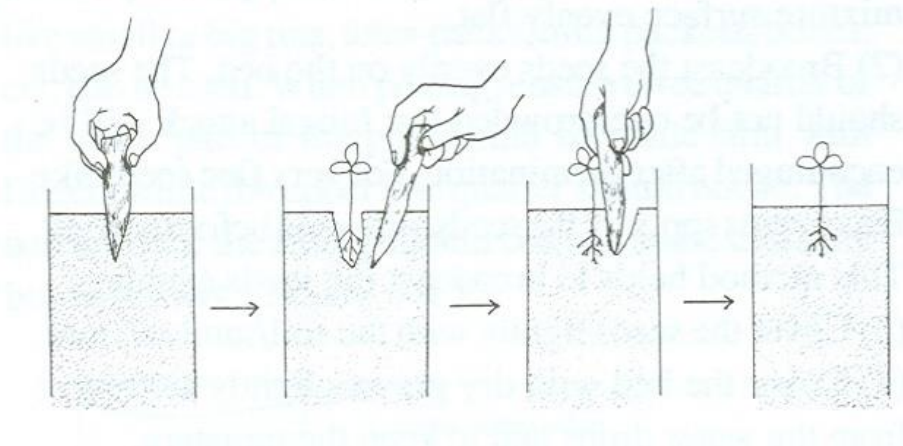


Fig. Young seedling transplanting (pricking out) steps

Watering: the amount of water to be applied depends on the age of the seedling, weather condition and soil type. Frequent irrigation required for young seedlings. On the other hand, when seedlings growth stage approaches to transplanting, reducing the frequency of irrigation is vital to induce hardening. Watering can or a hosepipe with a nozzle should be used to ensure uniform distribution of water.

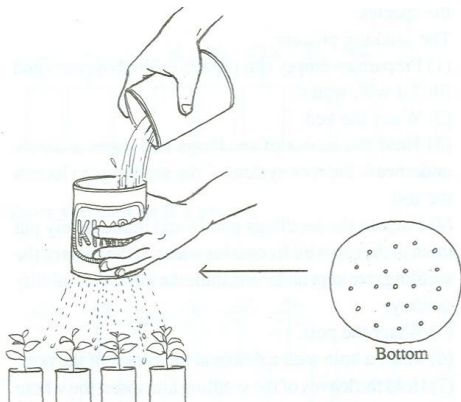


Fig. Irrigating fruit seedlings using locally perforated bottom can

Weeding: weeds compete with seedlings for nutrients, water and light. They also create favorable condition for disease development and insect pest outbreak. Therefore, control them by hand weeding or hoeing the seedbed or pot.

Insect pest control: Insect pests such as termites and cut worms will damage seedling in the nurseries. Their damage can be minimized by putting a thin layer (2-3cm) of ash on the bed or by spraying appropriate pesticides

Disease control: Fruit seedlings are also susceptible to several diseases. However, damping-off and wilt are the most important diseases in nurseries. The occurrence of damping-off is favored by over-watering, high density planting, use of undecomposed manure or compost & damaging the stem of seedling. The effect of this disease can be prevented through use of optimum planting

density, not damaging the bark of the seedling and proper irrigation. Similarly, wilting occurs due to densely planting of seedlings. This can also be controlled by providing adequate space for each seedling.

Fertilizer application: Apply additional inorganic fertilizer or compost or manure whenever seedlings become weak, show yellow color or very slow growth rate.

Root pruning: is cutting of seedlings roots growing beyond the pot. Non-regulating the root system of the seedling affects the survival rate of fruit seedling when it is transplanted on the permanent field. Water the seedling before pruning the root of seedlings. Use sharp knife to smoothly cut out-growing seedlings below the seedling pot (Fig.)



Fig. Root pruning using Sharpe knife.

Seedling Hardening: is a gradual exposing of seedlings to harsh condition to make them strong and be able to adapt to unfavorable environmental conditions when it is transplanted to the field. Seedling hardening should have to be done 2-3 weeks before transplanting. The following practices can be done to harden seedlings.

1. Remove the shade when seedlings reach to the size of transplanting
2. Reduce watering intensity and frequency twice or once per week
3. Prune long roots and rearrange pots to allow more adoption to stress

2.2.2 Propagation methods

Fruit crops can be propagated by seed and vegetative parts (**Table I**).

Fruit propagation by seed

Advantages of fruit propagation by seed:

1. Propagation by seed is an easy, simple and economical method.
2. It enables to develop new varieties and hybrid varieties
3. Fruit trees raised from seed are free from virus and long life.
4. It is the only method to propagate for some fruit crops for example papaya, and the best method to propagate rootstocks.

Disadvantages of fruit propagation by seed:

1. Most fruit crops are heterozygous in nature. Propagation by seed will not enable to get true-type seedlings
2. Fruit trees propagated by seed require longer time to come into bearing compared to those propagated by vegetative means.

3. Fruit trees propagated by seed grow vigorously causing difficulty for carrying out various management activities & harvesting.
4. It may be susceptible to soil borne diseases and moisture stress

Seed collection and processing

Fruit seeds may be obtained from seed orchards, and/ or fruit juice extraction and marketing shops. However, seed collection from fruit juice extraction and marketing shops is undesirable since the maturity and healthiness of the fruit is unknown. Good quality seed is obtained if extracted from matured and ripening fruits. Most fruit species are characterized by having fleshy fruits. Papaya seed production and extraction steps are given below as an example.

1. To produce true to type seed, papaya seed orchard requires 3km isolation or alternatively practice controlled pollination. In controlled pollination method, pollen grains from male parent (staminate or hermaphrodite plant) are used to pollinate the female parent (pistillate or hermaphrodite plant) of the same variety by hand.
2. Tag true to type, and disease free female and male plants in the ratio of 10:1 respectively at flowering for seed production of dioecious varieties. Collect pollen from male plants, mix it and hand pollinate the flower of female plants.
3. In gynodioecious variety two types of plants, hermaphrodite and pistillate in a ratio of 75:25 respectively produced. Hermaphrodite plants are the source of pollen grain both for the hermaphrodite and pistillate plants. Extract seeds only from fruits of hermaphrodite plants to raise true to type plants.
4. Harvest well developed, healthy and mature fruits from healthy female plants in dioecious varieties and hermaphrodite plants in gynodioecious varieties.
5. Cut the mature fruit and separate the seed from the flesh, and immediately clean it either by washing with water or by rubbing with saw dust to remove the sarcotesta layer from the seed. The germination percentage of uncleaned papaya seed is as low as 6% due to the inhibiting effect of sarcotesta layer.
6. Dry the seed under shade
7. From an average size papaya fruit, 200-400 seeds weighing 5-7g can be extracted.
8. The best and simplest papaya seed storage method is mixing the seeds with ash and keeping them in well capped colored bottle.

Propagation by vegetative method

Advantages of fruit propagation by vegetative methods

1. It enables to multiply true-to-type planting materials
2. It enables to multiply seedless fruit crops or varieties eg. banana, pineapple, grapevine varieties
3. Vegetatively propagated plants are usually smaller in size, and come to fruit bearing earlier compared to those propagated by seed
4. It enables to grow more than one variety on a single rootstock/plant
5. Propagation by grafting/ budding method enable the grower to exploit the benefits of rootstocks and scions.
6. It helps to regulate fruit tree growth form

Disadvantages of fruit propagation by vegetative methods

1. Vegetatively propagated fruit plants are short-lived and are not vigorous compared to seedling trees.
2. New variety cannot evolve by this method. Hence it restricts diversity of vegetation.
3. It is expensive, as it requires special techniques.

4. It will disseminate diseases especially viral diseases.

Most fruit crops are propagated by vegetative means since it enables to multiply true to type planting materials. Fruit crops can be propagated through various vegetative propagation methods such as a) using apomictic seedlings- avocado & mango, b) using rhizomes or corms- banana, c) runners- strawberry, d) suckers- banana, pineapple, e) offsets –pineapple, f) cutting – grapevine, g) layering- apple rootstock, h) budding- orange, and i) grafting- apple, avocado, mango, etc. Some of the most commonly used vegetative propagation techniques are pictorially presented as follow:

Propagation by grafting

Grafting is defined as the art of joining parts of plants together so that they will readily unite and continue to grow as one plant. A graft has two parts – scion and rootstock. Scion is the part of graft combination that becomes the upper or top portion of the plant, while rootstock is the lower portion of the graft combination, which becomes the root system. In most cases the rootstock is raised from seeds. The success of grafting depends primarily on three conditions, such as 1) compatibility of graft union, 2) closeness of fit and 3) cambial contact. In all grafting operations the placing of the cambial layer of the stock in contact with the cambial layer of the scions is very important. For this purpose, both the rootstock and the scion should be the same thickness, so that they match each other, and secondly, the cut should be uniform and smooth, so that when the two components are firmly tied together, there is no free space between the stock and the scion.

There are various techniques of grafting. The most commonly used grafting method, cleft grafting, is described below both in text and picture.

Cleft grafting: in cleft grafting the rootstock is cut at grafting height and then vertical split of 5-7.5cm long is given down the center of the stub to be grafted. The scion is prepared by cutting the end in the shape of a wedge of about 5cm length. The scion should be 7.5-10cm long having at least 2-3 buds. Then the scion is inserted in the split of the rootstock. It is described pictorially as follows

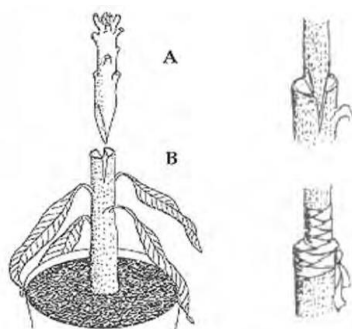


Fig. cleft grafting

Propagation by budding:

T-budding, patch and chip budding methods are widely used to propagate different fruit crops. The application procedure of the most commonly used budding method, T-budding, is described both in word and picture here below.

T-Budding: is the most common and popular method for the propagation of citrus fruits. The most optimum time for budding is when the rootstock is growing actively and the bark separates easily from the wood. A T-shaped incision is made through the bark at 15-20cm height of the rootstock. The shield piece (bud) is cut out from the bud stick by passing the blade of the knife under it so as to remove a shield-shaped patch of bark about 2.5cm long and just slightly wider than the bud. The bud is then slipped into the T-cut on the rootstock and tied with polythene tape leaving the bud and the leaf stalk exposed. Once the bud has united, the tape is removed and the top of the rootstock is cut back. If the budding is practiced in the rainy season, it is better to use inverted T-budding instead of T-budding to prevent seeping of rainwater into the cut of the rootstock. This budding method is presented pictorially as follows.

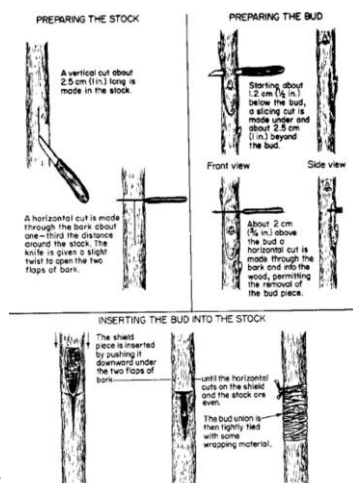


Fig. T-Budding

Basic steps during fruit crop propagation by budding or grafting

1. Identify the ideal agro-ecology to establish nursery site for the intended fruit crop.
2. Select the nursery site. The following conditions should be considered for nursery site selection: a) flat or gentle slope for draining excess water; b) light to medium textured soil with 1m or above soil depth and rich in organic matter; c) be outside of the fruit production field, but close to production area; d) near to source of irrigation water; e) not prone to frost; f) protected from strong wind; g) accessible.
3. Prepare the seed bed (sunken seed bed or raised seedbed). A raised seed bed is preferred in high rainfall areas to facilitate drainage, while a sunken seedbed is preferred in areas that have water shortage and in areas where cold weather is common. The size of seedbed is usually 1.2m wide and 5-10m long.
4. Prepare potting soil mix for those to be raised in plastic pot. You can make suitable potting soil by mixing one part of sand, one part of soil, and one part of compost or animal manure.
5. Collect mature and healthy fruits from rootstock mother trees. Extract and dry seeds under shade following appropriate procedure for each fruit crop.
6. Plant seeds at appropriate depth and planting time. Consider the position of seed during planting for early and proper germination. Always keep part of the seed attached to the peduncle to the lower side when sowing.
7. Cover with grass mulch.
8. Water at regular intervals.

9. Cultivate, weed and apply fertilizer. When you apply fertilizer there should be adequate soil moisture. Otherwise young seedlings will dry-up due to moisture stress as a result of osmosis.
10. Protect plants by controlling pests and diseases. Excessive irrigation will result in damping-off problem.
11. Graft/ bud when the rootstock seedling thickness reaches pencil size using twigs/buds from known fruit trees and standard grafting/budding tools (Fig. 1).
12. Continuously monitor and eliminate suckers/ shoots emerging from the rootstock
13. When the grafted rootstock and scion are well united, gradually loosen the tying material.
14. Harden the seedling.
15. Transplant to the permanent field.

Table I: Fruit crops propagation methods and techniques

Crop	Propagation method	Propagation techniques
Avocado	Vegetative	Grafting; but layering, cutting & budding can be used
Banana	Vegetative	Suckers, corms/rhizomes & plantlets (tissue culture)
Sweet orange	Vegetative	T-budding, but cutting and air-layering can be used
Mango	Vegetative	Grafting, but cutting, layering & budding can be used
Pineapple	Vegetative	Slips (side sucker) and micro-propagation
Papaya	Seed	Seed extraction from healthy trees- hermaphrodite
Guava	Seed/ vegetative	Seed, but budding-patch budding, layering can be
Apple	Vegetative	Grafting
Peach	Vegetative	Budding
Pear	Vegetative	Budding
Plum	Vegetative	Budding
Passion fruit	Seed/ vegetative	Seed is the simplest but also 3-5 node stem cutting
Grape vine	Vegetative	Stem cuttings

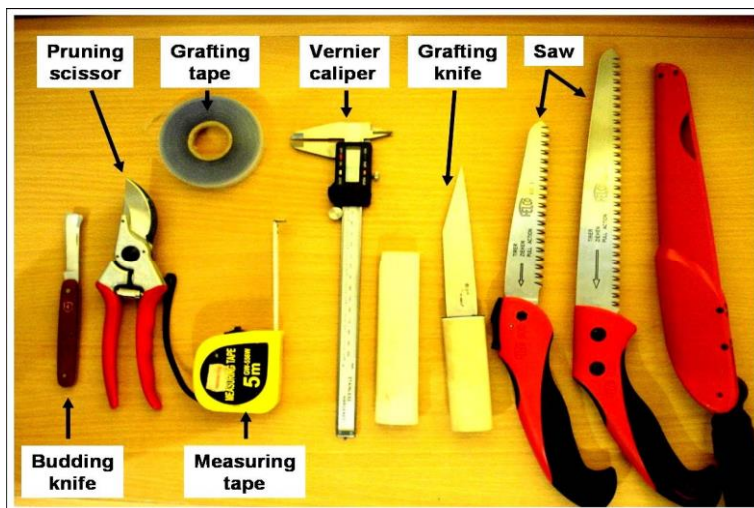


Fig.: Fruit propagation tools

3.2.4 Fruit postharvest handling practices

Fruit maturity indices Fruits need to be harvested at their physiological maturity stage (**Table 4**). Harvesting immature fruits leads to shriveling, mechanical damage, and quality deterioration. Over-mature fruit are poor quality and have a very short shelf life. The maturity of a fruit can be identified by observing fruit shape, color and size, flesh firmness and texture, and number of days between flowering and fruit maturity.

Table 4: Maturity indices of major fruit crops

Crop	Maturity indicators
Papaya	Yellow stripe appears on mature fruit
Avocado	Fruit size and smoothness of fruit skin
Mango	4-5 months after flowering & fruit color change to yellow or pink
Banana	Fruit angle disappear and fruit color will change from green to yellow
Orange	Fruit color will change to orange yellow
Pineapple	Base of the fruit color will be changed to yellow or light brown

Harvesting time and tools

Fruits are naturally highly perishable commodities. They have to be harvested at the coolest times of the day, either early in the morning or late in the afternoon. To reduce mechanical damages, they have to be harvested using safe harvesting tools (Fig.)

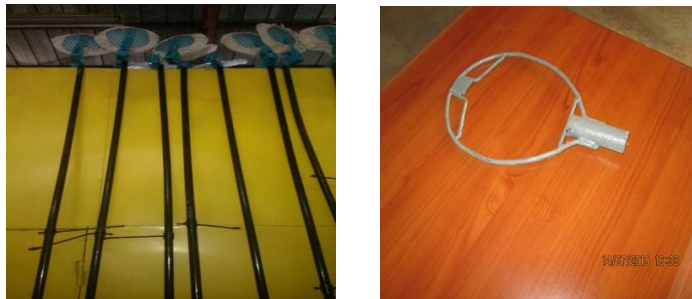


Fig. Fruit harvesting tool prepared by Melkassa Research Center

Fruit postharvest loss prevention practices

1. Harvest fruits at its maturity stage
2. Protect harvested fruit from direct sunlight
3. Avoid mechanical injury during harvesting, transportation and storage
4. Effectively control insect pests and diseases
5. Wash & grade harvested fruits according to their size and ripening stage
6. Use safe packaging material (ventilated plastic box)
7. Store in ventilated and cool conditions (cool chamber) (Fig.)
8. Cleaning and wrapping by polyethylene sheet individual or group of fruits
9. Process using solar drier (Fig.)



Fig. Cool chamber



Fig. Solar drier



3.3 Vegetable crops propagation, production & postharvest handling practices

Vegetables are herbaceous plants cultivated for their edible root, bulb, tuber, stem, leaves, flowers, seed or fruits. It comprises wide range of plant species and has multifaceted importance to improve the livelihood of smallholders. Their propagation, production and postharvest handling practices are described below.

3.3.1 Vegetable crops propagation

Propagation methods

One of the bottlenecks of vegetable production in Ethiopia is inadequate supply and higher price of vegetable seed. Most of the vegetable seeds available in the market are imported from abroad. However, Ethiopia has suitable agro-ecology to produce seed/ planting material of both warm and cool season vegetables. For example, the seed/planting material of onion, tomato, pepper, cucurbits, lowland pulses, eggplant, sweet potato, etc. can be produced in mid- and low-altitude areas. Similarly, the seed of cabbage, carrot, Swiss chard, lettuce, and beetroot can be produced in the highland areas of the country. The seed setting of these cool season vegetables is highly influenced by planting date. For example, the best planting date for beetroot, cabbage and Swiss chard seed production at Ankober is in mid-July. On the other hand, the best planting date for carrot seed production in the same area was found in early March. Different vegetable crops planting material multiplication methods and techniques are indicated in **Table 5**.

Table 5: Vegetable crops propagation methods and techniques

Crop	Method	Isolation distance (m)
Cucurbits (cucumber, pumpkin, water melon, etc.)	Seed (cross pollinated)	500 – 1000
Cole crops (head cabbage, cauliflower, broccoli, kale, etc.)	Seed (cross pollinated) Seed to seed & head to seed method for head cabbage- require low temperature for flowering (highland areas)	1500 -3000
Tomato	Seed and stem cutting but seed is widely used. Self-pollinated	50
Egg plant	Seed, self-pollinated	50- 100

Pepper	Seed, self-pollinated	250- 400
Potato	Vegetative, tuber & stem cutting	5-20
Carrot	Seed (seed to seed & root to seed methods) cross pollinated. Produced in the highland areas	100
Beet root	Seed (seed to seed) cross pollinated. Produced in the highland areas	1000
Onion	Seed (seed to seed & bulb to seed methods)	1000
Garlic	Cloves	-
Sweet potato	Stem cuttings (15-20cm)	-
Lettuce	Seed- self-pollinated. Produced in the highland areas	50

Key activities for vegetable seed production

1. Identify the ideal agro-ecology for seed production. Cool season vegetables such as cabbage, carrot, cauliflower, beet root seed production ideal site is in the highlands. On the other hand, the ideal site for warm season vegetables seed production is in the low and mid altitude areas.
2. Identify the best planting date. Flower initiation and seed setting of some vegetable crops is highly influenced by temperature- vernalization at a particular growth period. Therefore, identify the best planting date or season for quality seed production.
3. Select fertile land, which is free from soil borne diseases, and was not planted with the same crop but different variety in the previous year.
4. Isolate the selected seed production field from other fields planted with the same crop of different varieties by distance, time and physical barrier.
5. Prepare fine seedbed and remove weeds before sowing.
6. Use foundation seed from known source for certified seed production.
7. Sow the seed at appropriate seed rate.
8. Apply all necessary management/agronomic/ practices (fertilizer, cultivation, weeding, irrigation, pest and disease management, etc.) as per recommendation.
9. Rouge out off-types and diseased plants before flowering, and at flowering and maturity stages.
10. Harvest, dry, and thresh or extract seeds appropriately.
11. Store the seed under optimum storage condition to extend the viability of the seed.
12. Collect seed from reasonable number of plants to minimize the effect of inbreeding on the next generations

Seed extraction and processing from vegetables bearing fleshy fruits (eg. Tomato)

1. Collect completely ripen tomato fruit from a healthy plant
2. Cut each collected tomato fruit into half at its equator and gently squeeze out the jelly-like substance that contains the seeds
3. Put the jelly or pulp and seeds into a container for fermentation; if your plan is to process seed from one or few tomato fruits, add a little water to enhance the fermentation process.
4. Loosely cover the container and place in a warm place for 1-2 days and stir it daily

5. A layer of fungus will begin to appear on top of a mixture after a day. This fungus not only eats the gelatinous coat that surrounds each seed and prevents germination, it also produces antibiotics that help to control seed-borne diseases such as bacterial spot, canker, etc
6. After fermentation, fill the seed container with water. Let the contents settle and then decant the water along with pieces of tomato pulp and immature seeds floating on top. Viable seeds are heavier and will settle to the bottom of the container. Repeat the process until the water becomes clear and clean seeds remain at the bottom of the container
7. Pour the clean seeds into a fine mesh to drain-out available water and transfer the seed on paper towel or newspaper
8. Dry the seed under shade
9. Breakup the clumps into individual seeds, label and store for later use

Vegetable nursery site establishment & management

Vegetable production is gradually expanding in many parts of Ethiopia. However, the seed of most vegetable crops is imported. It is expensive and not readily available in rural areas. In addition, there is no commercial vegetable seedling suppliers. Use of seedlings either bought or raised by the farmer himself minimize wastage of expensive seeds. Production of good quality vegetable seedlings is essential for improving yield and getting quality produce. In addition, vegetable seedling raising and supply is a profitable business for smallholder farmers interested to be engaged in quality vegetable seedling raising and marketing business.

Nursery site selection criteria

The following conditions have to be considered as guiding criteria while selecting a site for vegetable nursery establishment.

1. The nursery site should be established in areas where vegetable production is widely practiced
2. It should be located in areas with fertile soil, near to irrigation water source, and with all-weather road to easily transport seedlings for marketing too
3. The site should be on gently sloping area and far from long trees for good drainage and air circulation.
4. The nursery site should be far at least 50m from vegetable farms to avoid spread of pests and diseases
5. The site should not be previously planted by the same crop in order to avoid the problem of soil borne diseases and pests including parasitic weeds.

Nursery operations

Vegetable seedlings can be raised on seedbed or seedling raising containers. They can be raised either under in-door condition (plastic tunnels & nets) or under open field condition. In Ethiopia, smallholder farmers raise vegetable seedlings on seedbeds and under open field condition. The following practices deals on how to raise healthy and vigorous vegetable seedlings on seedbed and open field condition.

1. To raise healthy seedlings in a seedbed, allocate a land in the field that is sunny and have good drainage
2. Use healthy and certified seed from a reliable seed source

3. Plough/ dig the field for fine seed bed preparation
4. Disinfect the nursery area by solarization. Burning straw over a seedbed is also a simple and cheapest method for soil sterilization. It is traditionally practiced by smallholder farmers in many parts of Ethiopia. However, it is effective only for the top 4-5cm layers of the seedbed and kills useful micro-organisms and destroys soil organic matter of the seedbed. Therefore, use polyethylene plastic sheet for seedbed solarization.
5. Apply manure or fertilizer and prepare seedbeds about 20cm high and 1-1.5m wide.
6. Sow seed in line about 5cm apart, about 1-2cm deep. Adjust planting depth according to the seed size of each crop. General rule for sowing seeds is to sow seeds 2-3 times their own thickness deep.
7. Cover the seed with a fine layer of soil or compost or animal manure. Be sure that the compost or animal manure is fully decomposed.
8. Mulch the nursery beds with dry grass or straws
9. Water the nursery beds using watering can early in the morning and in the evening till seeds emerged and once per day after seedling emergence
10. Remove the mulch immediately after seedling emergence from the soil
11. Protect seedlings from weeds, insect pests and diseases
12. Protect young seedlings from excessive rain, wind and direct sunlight by constructing shade
13. Harden seedlings by withholding water 4-5 days before transplanting
14. Transplant seedlings. Rules for transplanting are:
 - a. Transplanting should be done as soon as seedlings are about 4 to 8 weeks old, 10 to 15 cm tall and have formed about 3 to 4 true leaves
 - b. The nursery bed should be watered 24 hours before uprooting the seedling for transplanting so that they may not suffer from desiccation and minimize root damage
 - c. The seedlings should be dug up not pulled up
 - d. When the seedlings are uprooted it experiences transplanting shock. Therefore, it is essential to water plants immediately after transplanting and till the plant has recovered
 - e. Always transplant under cool conditions so that plants may establish themselves in the cool weather in the night and may recover from the shock of transplanting before sunrise
 - f. Avoid seedlings which have grown too tall. Such seedlings become weak and may start flowering very early
 - g. During transplanting, care should be taken to protect seedlings against wilting by frequently sprinkling water on them and covering the roots with moist soil or leaves
 - h. Setting the seedlings to a depth of first true leaves when transplanting result in earlier fruiting and larger fruit size in some crops

3.3.2 Vegetable production

Vegetables adaptable to different agro-ecologies

Ethiopia has diverse agro-ecologies with altitude ranging from 110m below sea level to 4620m above sea level. It also has about four distinct seasons per year. As a result, both cool and warm

season or temperate and tropical vegetables can be produced in the country. Different vegetable crops have different climatic requirements. Therefore, it is very important to grow them in their suitable agro-ecology or production season to get better quality and higher yield. Summary of production agro-ecologies of different vegetables and legumes is given in **Table 6**.

Table 6: Production agro-ecologies of major vegetable and legume crops

Agro-ecology	Altitude (masl)	Rainfall (mm)	Vegetables	Legumes
Dry Kolla	500-1500	< 900	Cassava, sweet potato	Mung bean & pigeon pea
Moist Kolla	500 – 1500	900-1400	Kale, cucurbits (pumpkin, watermelon, squash), sweet potato, cassava, ladies finger (okra), Eggplant, pepper, tomato, onion	Mung bean, cowpea, pigeon pea, Soybean, haricot bean
Dry Weyna Dega	1500-2300	<900	Kale, pumpkin, sweet potato, cassava, carrot, beet root, Swiss chard, lettuce, eggplant, pepper, tomato, onion	Haricot bean, cowpea, pigeon pea, chick pea, lentil
Moist Weyna Dega	1500-2300	900-1400	Potato, cabbage, carrot, lettuce, Swiss chard, kale, pumpkin, shallot & garlic	Snap bean, field pea, pigeon pea, soybean, fava bean
Wet Weyna Dega	1500-2300	>1400	Potato, cabbage, carrot, lettuce, Swiss chard, kale, pumpkin, shallot & garlic	Snap bean, field pea, pigeon pea, soybean, fava bean
Moist Dega	2300-3200	900-1400	Potato, cabbage, cauliflower, Swiss chard, lettuce, beet root, carrot, shallot & garlic	Fava bean & field pea
Wet Dega	2300-3200	>1400	Potato, cabbage, cauliflower, Swiss chard, lettuce, beet root, carrot, shallot & garlic	Fava bean & field pea

Improved vegetable production practices & technologies

The productivity of vegetables is very low in Ethiopia. This is partly attributed to farmers' inadequate use of improved production technologies and practices. Use of improved varieties and recommended management practices such as spacing, fertilizer rate, irrigation intervals, and pest management practices enables farmers to produce higher yield and healthy food. Recommended production practices and technologies vary by agro-ecology, fertility status of the farmland, and climatic condition. Therefore, refer to the agricultural extension manual prepared for each locality. If such type of manual is not available refer **Table 7**.

Table 7: Recommended varieties and management practices of major vegetables

Crop	Varieties under production	Spacing	Seed rate/ha
Potato	Milki, Moti, Bubu, Belete, Dancha, Kulumsa, Hundee, Araarsa, Gudanie, Gabbisa, Bulle, Chala, Mara Charre, Gera, Gorebela, Guasa, Jalenie, Degemegn, Zemen, Bedasa, & Zengena	75cm x 30 cm	15-20q
Sweet potato	Tola, Ma'e, Jari, Birtukanie, Berkume, ADU, Balo, Ordollo, Kero, Tulla, Kulfo, Dimitu, Temesgen, Beletech, Belela, Awassa-83, Dubo, Falaha, Kudadie, Damota, Bereda, Guntutie, Koka 6, Koka 12, & Ogan Saga	100cm x 30cm	33,000 cuttings
Cassava	Qulle & Kello	100cm x 90cm	
Tomato	Rainbow, Galila, Bridget, Shanty, Irma, Chali, Cochoro, Miya, Lakku, Sirinka I, Mersa, Woyno, Bishola, Fetane, Metadel, Eshete, Melka Shola, Melka Salsa	100cm x 45 cm	0.3(3-4*kg)
Garlic	Kuriftu, Qoricho, Bishoftu & Tseday	30cm x 10cm	10-15q
Onion	Rosy, Caramelo, Sweet Caroline, Red Passion, Sivan, Jamber, Nafis, Neptune, Nasik Red, Adama Red, Melkam (Pusa Red)	30cm x 10 cm	3.5-4(7kg)
Shallot	Minjar, Yhera, Negele, Huruta	30cm x 10cm	15-20q
Pepper	Melka Shote, Melka Awaze, Oda Haro, Melka Zala, Capsi, Spicy, SCH-925, Supreme, Serenade, Melka Dima, Melka Eshet, Markofana,	60cm x 40cm	0.75 -1kg
Cabbage	K500, Oxylus FI, Victoria FI, Rotonda FI, Thomas FI, Lucky FI, landini, Copenhagen market	60cm x 40cm	0.35kg
Carrot	Nantes, Samson	25cm x 5cm	0.5kg
Beet root	Detroit Red	35cm x 10cm	
Lettuce	Tesfa,	30cm x 25cm	1.7kg
Swiss chard		40cm x 25cm	0.7kg
Cauliflower	Snowball	60cm x 40cm	0.25kg
Cucumber		60cm x 50cm	2.5kg
Pumpkin	Local	1.5m x 1m	5kg
Water melon		2m x 2m	
Eggplant		60cm x 50cm	1kg

Source: MoA- Ethiopia, Irrigation agronomy guide

**stands for direct sowing seed rate*

1. **Vegetable production site selection**

- Have to be far from trees and house shade
- Have to be flat in topography, and free from stones, roots or tree stumps
- It has to have sandy loam soil with at least 1.5m soil depth
- It has to have adequate and quality water for irrigation

2. **Land preparation**

Land preparation refers to making the soil suitable for sowing or transplanting of vegetable crops in the field. Till the land one month before planting. The soil should be fine, moist

and firm to provide better germination and excellent medium for subsequent growth. Prior to sowing, the field should be levelled and worked to obtain a fine textured soil free of clods and debris. Enough of well decomposed farm yard manure or compost should be mixed thoroughly in the soil.

3. **Bed preparation**

Most vegetables are growing on beds. Bed preparation facilitates cultivation operations like sowing and transplanting and later in the intercultural operations. The width of a bed should not be more than 1.2m and the length 5m or more. This width facilitates weeding and watering without trampling the bed. The bed is kept raised about 15 cm high so as to provide proper drainage of excess water and the level of the bed surface is also made slightly raised in the center with a little slope on the two sides. Such raised bed is preferred for areas with high rainfall and clay textured soil. On the other hand, for dry areas and sandy soil, sunken bed is more preferred and helps to conserve soil moisture. The space/path between two beds is 50cm. Planting on flat beds is undesirable vegetable production practice.

4. **Direct sowing/ transplanting**

Vegetables propagated by vegetative parts such as potato (tuber), sweet potato (stem cuttings), and garlic and shallot (cloves or bulbs), etc are directly planted on the production field. Some vegetables which are propagated by seed such as carrot, beetroot, radish, pumpkins, etc. have to be directly sown on the production field. Watermelon, squash, cucumber, snap bean, garden pea, etc. are also usually direct-sown on the production field. On the other hand, most vegetables propagated by seed (cabbage, cauliflower, lettuce, tomato, eggplant, pepper, onion, etc.) requires seedling raising in the nursery site and transplanting practices. Seedling raising and transplanting saves seed cost and enables a farmer to maintain recommended plant population in the field, and improves quality and productivity. For vegetables to be direct sown, use recommended seed rate both while drilling in row or broadcasting. Maintain proper spacing between growing seedlings by thinning-out weak seedlings and leaving more vigorous seedlings.

5. **Transplanting**

Irrigate the nursery bed to facilitate seedling uprooting without damaging the roots. Transplant in the evening to reduce the effect of high temperature on the young seedlings due to high transpiration when its root system does not start absorbing moisture. Irrigate the field immediately after transplanting.

6. **Irrigation**

Over-irrigation leaches soil nutrients and causes soil borne diseases. Under-irrigation makes the plant unable to absorb soil nutrients, become weak and less productive. Therefore, follow appropriate irrigation practices as recommended. However, the amount of water to be applied and irrigation frequency depends on the weather condition, soil type, and crop type, and growth stage. The source of irrigation water must be free from disease-causing organisms and parasites, not polluted with chemicals and heavy metal and far from toilet sewage. The source of irrigation can be rainwater harvested from the roof, or water from hand dug wells or rivers and streams. The irrigation method can be furrow, or drip or pitcher depending on the availability of water.

If using the furrow irrigation method, furrows should have very little slope, so that the water does not carry away the soil and seeds. The water should run slowly, without

becoming stagnant or damage the furrows. The water should not touch the plant directly and it is better to water in the mornings.

7. **Soil fertility management**

Vegetables are heavy feeders of nutrients. Therefore, they need a judicious supply of nutrients including micro-nutrients. The most feasible method for soil fertility management is an integrated approach, primarily using organic fertilizer (compost, manure, vermicompost, etc.), cropping practices (crop rotation, intercropping with legumes, etc.), and inorganic fertilizer. Use the recommended rate, application method and time for efficient use of the applied fertilizer and normal growth and development of the crop. Vegetables prefer soils with high organic matter. Therefore, preparation and application of compost or manure improves yield and quality of vegetables. Materials and key activities for compost preparation are described as follows.

Materials required to prepare compost

- Any organic matter except seed of parasitic weeds such as striga
- Tools to dig pit and transport raw materials of the compost
- Water and watering can
- Top soil or matured compost from other batch
- A 2m long Stick to check the temperature of the compost.

Key steps for compost preparation

- Select a suitable site, not too close to house or sources of drinking water. Compost produces a liquid that can contaminate nearby shallow wells or ponds.
- Collect all available organic materials that biodegrade readily. Chop any coarse material to enhance its decomposition process
- Decide how big to make the pit or heap. The pit can be as wide as possible but its depth is not more than 50cm. Heaps can be 2m wide and 1-1.5m high. Generally, it is not smaller than 1m².
- Spread small branches and other coarse materials such as maize or sorghum stover to a depth of 10-15cm in order to facilitate air circulation and drain excess water in wet areas
- Spread different organic materials in layers. Make a layer of organic material about 5-15cm thick and then spread a thin layer (1-3cm) layer of soil or ash on top (Fig. 4.9).
- Add more layers of organic material and soil or ash until you have used up all the materials you have or until the pile is high enough
- Push the long stick at the angle all the way into the heap or pit. This stick is used to check the temperature of the pile as it heats up and cool down. Using stick helps air get in to the heap.
- Cover the heap with dry grasses or crop residues. In cold, highland areas, cover the sides of the heap with soil. This helps keep the temperature inside high and minimize moisture losses.
- Let the heap decompose for about 3-5 weeks. During this time the heap or pit content will get smaller. Pull out the stick to check the temperature of the contents. If it cooled down, the compost needs turning. Always keep the compost moist. You can discard household washing water on it.

- When the pile cools down, turn and mix the compost (after about 3 weeks in Kolla and Weyena Dega zones and about 5 weeks in Dega zone). Repeat the turning and mixing operation once or twice. Compost normally matures in 2-3 months in the Kolla, 3-4 months in the Weyena-Dega, and 3-5 months in Dega zones.

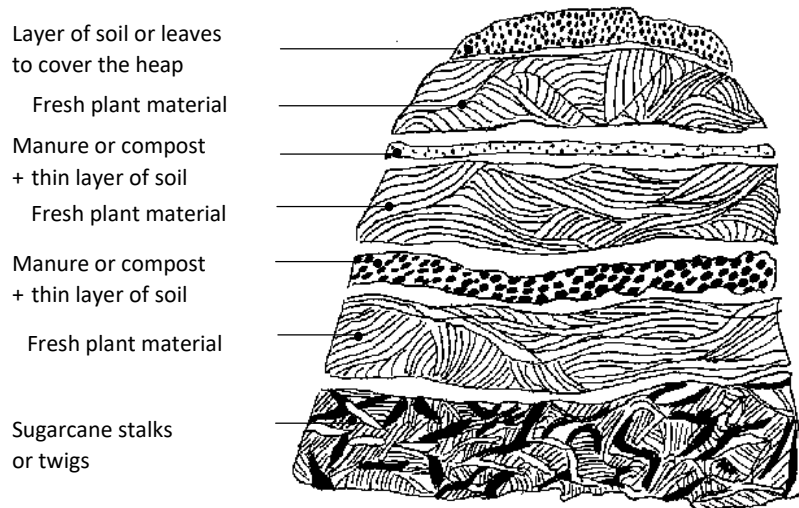


Fig. Components of compost (Inckel, et al, 2002)

How and when to apply compost

Apply compost at time of ploughing: spread compost on the field, then plough it under. Never leave freshly spread compost on the surface. Dig or plough it in right away. Otherwise, if it is exposed to the sun or rain, valuable nutrients will be lost. For growing crops, you can apply small quantities under the crop in the row. You need about 30 kg of organic compost for every 10 square meters of garden. A 1-metre -high compost heap provides approximately 70 to 90 kg of compost.

8. **Cultivating/ ridging/ earthing-up**

Ridging is piling up the soil close to the base of the plant. This is very important especially for root and tuber crops. It can be done a number of times, depending on the length of growing season of the crop. It helps to control weeds, insect pests and diseases; improves soil aeration; preserves moisture; and helps to stand upright and make plants more resistant to the wind and their own weight.

9. **Mulching**

Mulching is covering of the soil with organic matters like grasses and crop residues or with artificial materials like plastic sheet. Mulching is done to prevent loss of soil, loss of moisture, to increase soil temperature, inhibit weed growth, adds organic matter if the mulching material is organic matter, and reduces fertilizer loss

10. **Staking & fruit pruning**

Some vegetable crops such as tomato, eggplant, pumpkin, etc have weak and herbaceous stems. As a result, they fail to stand upright especially during fruit setting stage. This situation causes favorable condition for disease and insect pest attack. This problem can

be tackled by tying their herbaceous stem with sticks as staking. In fruit bearing vegetables, fruit pruning improves the size and quality of fruits.

11. **Weed control**

Weeds are unwanted plants in a vegetable production field. They can easily establish and flourish and compete with the crop for water, soil nutrients, light and space and ultimately have direct impact on yield and quality of the produce. They also harbor insect pests and disease causing micro-organisms. Therefore, they must be effectively controlled to obtain quality and higher yield. Direct seeded crops like carrot, peas, beans, okra, etc. are more vulnerable to weed competition. Weeds can be controlled through an integrated approach of cultivation, mulching (compost, black plastic, dried grass, etc.), use of clean seed, crop rotation, relay cropping, hand weeding, hoeing, herbicides, etc. Critical period for crop-weed competition in different vegetable crops such as potato, cole crops (cabbage, cauliflower, kale, etc.), solanaceous vegetables (pepper, tomato, eggplant, etc.), onion & garlic, and root vegetables (carrot, beet root, etc.) are 30-50, 30-40, 35-40, 20-30, and 20-30 days after planting, respectively. Therefore, it is very important to give due attention for weed control at these periods. Herbicides are effective to control weeds. However, it will cause environmental pollution, kill beneficial insects and microorganisms, residual and resistance problems.

How do you know the quantity of herbicide required? This can be calculated using the following formula. $Quantity\ of\ commercial\ product\ of\ herbicide\ (kg\ per\ ha) = \frac{recomended\ dose\ of\ herbicide}{a.i\ of\ herbicide\ formulation} \times 100$. This will help farmers not to buy extra herbicide.

How do you know the amount of water required to mix and spray the pesticide? This can be calculated by using the following formula. $Quantity\ of\ water\ required\ per\ unit\ area\ (l) = \frac{water\ required\ for\ 1ha \times area\ to\ be\ sprayed}{10000}$.

12. **Insect pest control**

Vegetables are susceptible to insect pests and insect pests cause enormous yield loss and quality deterioration. For example, aphids cause serious yield loss on cabbage and other vegetables while thrips causes very high loss on onion and garlic. Integrated pest management such as the use of resistant varieties, crop rotation, trap crops, color traps, collecting and killing, barriers, etc. can be followed to control/ manage/ insect pests.

13. **Disease control**

Vegetables are susceptible to different types of diseases. Most of these diseases can be effectively managed by planting disease resistant varieties, planting during the ideal growing season, controlling weeds and insect pests (sucking insects transmit virus), proper irrigation (wilt), planting at the right space, using healthy planting material, collecting and using crop residues for compost preparation, etc.

3.2.3 Fruit production practices & technologies

Fruit crops adaptable to different agro-ecologies

Ethiopia has diverse agro-ecologies with altitude ranging from 110m below sea level to 4620m above sea level. Therefore, the country has an opportunity to produce and supply tropical,

subtropical and temperate fruit crops. Different fruit crops have different climatic requirements. Therefore, it is very important to grow them in their suitable agro-ecology to harvest higher yield and quality fruit (**Table 2**). **Table 2: Suitable agro-ecologies for major fruit crops production**

Agro-ecology	Altitude (masl)	Annual rainfall (mm)	Fruit crops
Dry Kolla	500-1500	<900	Cactus, Annona (<i>Gishta</i>) & Zizyphs (<i>kurkura</i>)
Moist Kolla	500-1500	900-1400	Guava, mango, papaya, banana, pineapple, passion fruit
Dry Dega	Weyna 1500-2300	<900	Guava, papaya, mango, grapevine, avocado
Moist Dega	Weyna 1500-2300	900-1400	Avocado, apple, peach
Wet Dega	Weyna 1500-2300	>1400	Avocado, apple, peach
Moist Dega	2300-3200	900-1400	Apple, peach, plum, pear
Wet Dega	2300-3200	>1400	Apple, peach, plum, pear

Improved fruit production technologies

Recommended fruit production practices and technologies varies by agro-ecology, soil fertility status of the farmland, climatic condition, etc. Therefore, it is important to refer to the agricultural extension manual prepared for each locality. If such a manual is not available, refer to the fruit production technologies and practices given in **Table 3**.

Table 3: Recommended varieties and management practices of some fruit crops

Crop	Varieties	Spacing	Fertilizer	Pests & diseases
Avocado	Bacon, Ettinger, Fuerte, Hass, Nabal & Pinkerton	7m X 7m	50kg FYM + inorganic fertilizer	No serious pest & disease
Apple	Anna, Golden Dorsett, Winter banana, Princesa, Granny Smith, BR & Ein Shemer	4m x4m	20kg FYM + inorganic fertilizer	Woolly aphid, powdery mildew
Banana	Poyo, Dwarf Cavendish, Giant Cavendish, William I, William II, Grand Nain, Butuzua, etc.	2m x 2.5m	20kg FYM + inorganic fertilizer	Panama Wilt & cigar end-rot
Mango	Apple mango, Tommy Atkins, Keitt & Kent	7m X 7m	45kg FYM + inorganic fertilizer	Anthracnose, powdery mildew & fruit fly, white scale

Papaya	Solo & Coorg Honey	3m x 3m	25kg FYM + inorganic fertilizer	Anthracnose & powdery mildew, virus
Pine apple	Smooth cayenne, Spanish & Queen	90cmx60cm x30cm		Mealy bug & rootknot nematode
Sweet orange	Valencia, Washington Naval, Hamlin & Pineapple	8m x 4m	25kg FYM + inorganic fertilizer	Scale insect, phermolaria leaf and fruit spot, virus

Sources: MoA-Ethiopia, crop variety register and irrigation agronomy guide

Key fruit orchard establishment and management activities

Crop selection. Select fruit crops that are adaptable to the farmland climatic and soil conditions. Many fruit trees planted by farmers fail to set fruit because they are planted outside their production agro-ecology.

Planting system selection. Determine planting system (square, rectangular, triangular, hexagonal) and spacing between plants and rows based on the growth habit of the variety, soil fertility status of the farmland, and climatic condition of the site. Generally, seek wide spacing and areas with high soil fertility, long growing seasons, vigorous and large cultivars, invigorating rootstocks, and good rainfall or irrigation.

Planting hole preparation. Depending on the species/variety and soil conditions, hole size of 0.6-1.0m both in depth and width is sufficient for most fruit plants. Top soil should be placed in one pile and subsoil in another. The planting hole should then be refilled with a mixture of 50% topsoil and 50% well-decomposed manure or compost. The hole should be allowed to settle for several weeks and then planting can be done.

Planting. The most common season for planting of fruit plants is the start of main rainy season as this allows their fast establishment and vigorous growth. Soil is then removed from the hole, long roots trimmed and the seedling placed to the same depth it was in the nursery. Refill the planting hole with soil, gently compact the soil around the seedling, and water or irrigate the seedling. Planting spot must be raised from its surrounding to facilitates drainage during the rainy season.

Mulch application. Apply mulch around the fruit seedling or tree to protect soil from erosion, conserve soil moisture and reduce weed growth. Mulch can be organic materials such as dried grass or black color plastic sheet. Organic mulch is better than plastic mulch since it improves soil fertility and structure through decomposition, make the soil temperature stable, cheaper, and easily available. The thickness of much must be 5-10cm. Too thick mulch affects aeration and rainwater infiltration. On the other hand, too thin mulch will not conserve soil moisture. Chopping of the mulching material enhances infiltration and their decomposition.

Irrigation. Since fruit crops are perennial crops they require supplemental irrigation during the dry season. The amount of water to be applied and frequency of irrigation depends on the climatic condition, water holding capacity of the soil and age of the fruit tree. Basin irrigation method is the most commonly used irrigation method for fruit crops. Active shoot growth, flowering and fruit setting stages are the most critical stages to irrigate most fruit crops, although moisture

stress is required to induce flowering in mango. Inadequate irrigation result in flower and fruit drop, leaf defoliation, poor quality (less juicy fruit) and fruit crack. Over irrigation aggravate the problem of soil borne diseases, leach soil nutrients, poor root growth, etc.

Fertilizer application. Unlike annual crops, fruit crops mine soil nutrients from specific sites throughout the year and for several years. Therefore, both organic and inorganic fertilizers must be applied several times per year. The rate of application depends on the fertility status of the soil and age of the fruit tree. Fruit trees in general require more nutrients at the emergence of new flushes, flowering and during fruit development. Therefore, fertilizer application time should consider the development/ growth stage of the fruit tree. Fertilizer can be applied by broadcasting, side dressing, ring application and foliar application methods. Ring application method is widely used and foliar application is used to apply micro-nutrients.

Intercropping. Intercrop free spaces between fruit trees. This practice helps to improve income, soil fertility by growing leguminous crops, conserve soil moisture, and control weed emergence.

Weed, insect pest and disease control. Fruits are highly susceptible to diseases and insect pests. Therefore, use integrated pest management (IPM) practice for effective pest, disease and weed management.

Training and pruning. Fruit tree pruning and training is applied to limit tree size, improve light penetration, remove dead, broken or interfering branches, facilitate insect pest and disease control, and control fruit production. However, farmers rarely practice fruit tree pruning. Fruit thinning is also important to produce better quality fruit and to manage alternate bearing. More pruning is required in temperate fruit crops (apple, peach, apricot & grape) compared to tropical & subtropical fruit crops (mango, avocado, citrus, guava, etc.). Some fruit crops for example papaya did not require pruning.

There are two kinds of top pruning: heading back and thinning out. In heading back, the terminal portion of twigs, canes, or shoots is removed, but the basal portion is not. In thinning out, the entire twig, cane, or shoot is removed. Therefore, heading back encourage more branch development and compact growth. On the other hand, thinning out encourage light penetration by eliminating unnecessary branches. Pruning is usually done after harvesting in ever green fruit crops but between dormancy or leaf fall and blossoming in temperate fruit crops. Hand pruning shear, lopping shear, saw and ladder are important pruning tools. One of the purposes of pruning is to train fruit trees. In general, there are three fruit tree training types: 1) central leader, 2) open center or vase, and 3) modified leader. Of these, modified leader is the preferred training method. The extent of pruning depends on the age of the fruit trees and bearing characteristics. According to the age of the tree pruning types can be classified in to three: 1) a framework pruning - mainly for fruit tree form and done at early growth stage of the fruit tree, 2) maintenance pruning- mainly done to manage the balance between vegetative and reproductive growth, and 3) rejuvenation pruning- mainly done to bring back declining fruit trees in to production.

Root pruning is also practiced in fruit crops to induce flowering in juvenile or non-flowering fruit trees. Fruit thinning/ pruning is also practiced to improve the quality of remaining fruits (size,

color and shape) by removing small size, diseased and misshaped fruits. Leaf defoliation/ pruning/ is done to initiate dormancy in temperate fruit crops growing in tropical areas.

.3.3 Vegetable harvesting & postharvest handling practices

Vegetable crops maturity indices

The quality and storability of vegetables is affected by harvesting stage. The ideal time to harvest is at maturity stage. Different crops show different signs of maturity in different ways; this is called their maturity index (**Table 8**).

Table 8: Maturity indices of major vegetable crops

Crop	Maturity indicators
Bulbs (onion & garlic)	Leaves color change to yellow and fall down above the top of the bulb (tops go-down)
Tomato	Leaves color change from dark green to light green
Carrot	After 90 days from planting
Sweet potato	Lower leaves turn to yellow and if the root cut and the cut part did not discolor
Leafy vegetables	Harvested at immature stage
Head cabbage	Heads are tight
Cucumber	Harvested 55-60 days after flowering
Potato	Leaves color change to yellow

Harvesting time and tools

Vegetables are naturally highly perishable commodities. They have to be harvested at the coolest time of the day, either early in the morning or late in the afternoon. To reduce mechanical damages, they have to be harvested using safe harvesting tools (Fig.)



Fig. Potato and onion harvester

Vegetable postharvest loss prevention practices

1. Harvest vegetables at its maturity stage
2. Protect harvested vegetables from direct sunlight

3. Avoid mechanical injury during harvesting, transportation and storage
4. Effectively control insect pests and diseases
5. Wash & grade harvested vegetables according to their size and ripening stage
6. Use safe packaging material (ventilated plastic box)
7. Clean and wrap with polyethylene sheet (Fig.). Controlled atmosphere storage
8. Store in ventilated and cool conditions (cool chamber) (Fig. Refer in the fruit section).
Double wall bricks store with *4.5x2.5x0.6 m in length, width & height, 15-20 cm space between double walls & filled with moist sand.*
9. Process using solar drier (Fig. Refer in the fruit section)



Fig. Vegetable wrapping with polyethylene sheet

CHAPTER 4. LIVESTOCK PRODUCTION

4.1. Importance of animal source foods to human nutrition and health

Animal source foods are excellent sources of high quality protein and easily absorbed micronutrients. A small amount of animal source food added to a mostly cereal based diet vastly improves the quality and micronutrient content of that diet, especially for vulnerable populations such as young growing children and pregnant or breastfeeding women. Diets without ASF can be particularly low in vitamin. ASFs, besides having abundant micro-nutrient it help us to increase the absorption of micronutrients from crop-based diets. The nutrients and other compounds in ASF are proven to improve growth and cognitive development in children.

The major contribution of foods of animal origin to human health is through the alleviation of malnutrition caused by deficiencies in micronutrients that contribute to poor growth, impaired mental development and ill health, which, in aggregate, can contribute to poor economic growth of nations. Nutritional and health benefits of milk, meat and egg are summarized below:

Milk

- Milk is a good supply of vitamin A, Vitamin B12, Riboflavin, Folate and Calcium
- Vitamin A is essential for sight and the function of your retina, as well as immune function
- Vitamin B-12 is required for metabolism in every cell in the body! It is particularly important for brain and nervous system function, as well as the formation of red blood cells
- Folate is super critical for red blood cell function, as well as neural development and rapid cell growth –which there is a lot of during pregnancy and infancy
- Calcium is essential for bone growth

- Milk consumption has also been found to stimulate growth factors in the body, particularly milk contains Insulin like growth factor which is important for bone growth

Meat

- Meat is an especially nutrient dense animal source food, and excellent source of protein, Heme Iron, Zinc, and B-Vitamins
- Iron is critical for red blood cell and muscle function as well as many other enzymatic functions. Heme iron in a diet also enhances the absorption of zinc and iron from plant sources
- Zinc is critical for immune function – pregnant women and young children have particularly high zinc requirements

Egg

- Egg contains valuable macro and micronutrients of essential fatty acids, Choline, Vitamin A, Vitamin B12 and Selenium
- Eggs are also a valuable source of choline, which is gaining recognition for its importance in fetal and young child brain development. Among other things, choline is a precursor to acetylcholinesterase – the neurotransmitter

4.2. Livestock production as a business

Livestock production as a business is a market-oriented farm management which is a term used to capture a body of concepts and skills aimed at supporting farmers who have begun to adjust (orient) their farming activities to the opportunities and demands of the market. Livestock management as a business requires skill on farm management. Farm management is all about making decisions on the farm (for more detail refer to the agricultural marketing part of this manual).

4.2.1. Chicken raising

Keeping chickens can make a substantial contribution to household nutrition and food security throughout the developing world, including Ethiopia. It helps diversify incomes and provides quality food, energy, fertilizer and a renewable asset for rural households.

4.2.1. 1. Housing

Housing is essential to protect against predators, thieves to avoid genetic dilution through crossbreeding with unwanted chicken breed, and protect from rough weather (rain, sun, very cold winds, dropping night temperatures) and to provide shelter for egg laying and broody hens. A suitable or comfortable poultry house is also important for efficient production and the convenience of the poultry farmer.

- Depending on the availability of materials, weather and tradition, you will find different types of poultry houses and shelters in tropical regions.
- Choice of chicken house should be based on a rationale involving an estimate of the costs, the durability and the immediate gain of using a house for the poultry.

Sample chicken house made of local materials

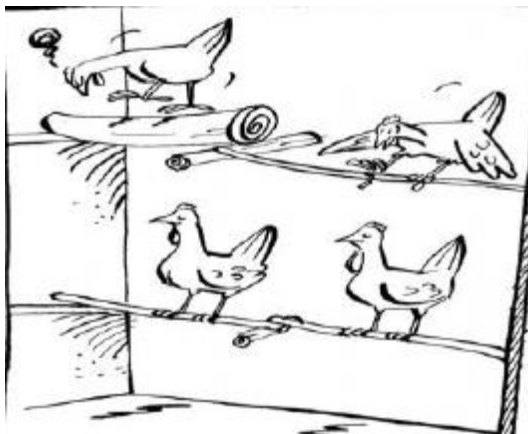


- Fertile, well-drained soil is desired. The area must not get flooded during heavy rains; furthermore, wet floors lead to many diseases.
- Trees and bushes fairly close to the house are beneficial. They serve as a windbreak in the winter, provide shade in the summer and protect from flying predators.
- For security reasons, it is important to have the chicken house near the house.
- The orientation of the chicken house should take into consideration the movement of the sun and the dominating winds, making the house naturally shaded and ventilated at certain times of the day
- The house must be large enough that there is sufficient room for the birds and so that the air inside does not become too heavy with humidity and gases.
- A round or square house of 1.5–2.0 m² will hold 10–12 adult birds.

Important materials that need to be available in the chicken house are perch, nest, feeder and waterer.

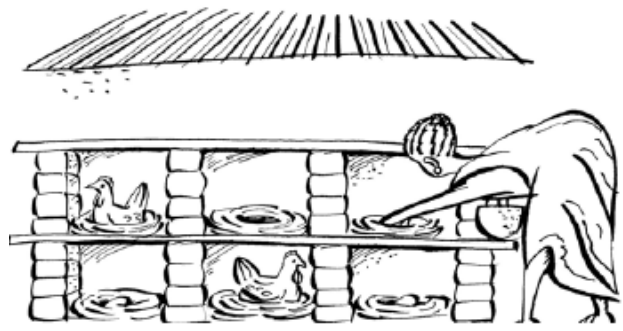
Perches

- Perches are important for chickens to rest during the night.
- Perches are best made of bamboo or round sticks to accommodate the size and structure of the birds' feet. If the sticks are too thick or too thin, the birds may fall
- Sticks used for perches should match the size of the birds' feet



Nests

- Nests should be placed inside the chicken house and preferably above the ground. For laying, you may have a battery of nests where more hens can lay at a time
- There should be one nest for every five hens.
- Nests should be of the right size for the hen to feel comfortable. A nest box will typically measure 30 x 40 x 30 cm.



4.1.1.2. Feed and Feeding

Feeding is essential if you want to increase the production of meat and eggs from poultry. Even small flocks will eventually starve during certain periods of the year, if they are fed only leftovers and the food they find by scavenging. In general, poultry, like other animals, need food containing energy and protein, as well as vitamins and minerals. The need for food will change depending on the age and status (chicken, grower, egg layer, broody hen) of the bird. The cheapest—and also often the best—way to supplement the diet of your poultry is to use local resources.

If your production is based on improved breeds for egg production, different types of commercial diets may be given; usually they are divided into three distinct categories, with decreasing amount of protein:

- Starter's diet: High in protein; from hatch up to 4–6 weeks;
- Grower's diet: Medium in protein; up to 20 weeks; and
- Layer's diet: Lower in protein; hens from 20 weeks on.

How Much to Feed?

Table 1: Supplemental Feed and Total Feed Requirement at Different Ages

Age (weeks)	Approximate Amount of Food Required per Day for a Confined Bird (g dry weight)	Approximate Amount of Supplemental Feed Required per Day for a Scavenging Bird (g dry weight)
1	12-15	10-15
2	15-21	15-20
3	21-35	21-30
4-7	35-50	30-40
8	55-60	30-40
9-27 grower	65-80	30-50
>28 (adult)	100-150 depending on the size of the bird	30-50

How Much to drink?

- Remember to always give free access to water
- For an estimate of chickens' daily water consumption under confined management; adult bird consumes 250ml/quarter of a liter water

Simple Chicken feed mixing and formulating techniques

Mixing and formulating poultry feeds may be based on simple assumptions about the nutritional requirements of the birds and the content of the feedstuffs.

Table 2: Home-made chicken feed for meat and egg type chicken

Feed Ingredient	Proportion in percentage (%)
Maize	55
Noug Cake/ground nut or Sesame oil cake/Soya cake	35

Wheat Middling (Furishkelo)/sorghum middling/millet middling	5
Lime stone	4.5
Salt	0.5
Total	100

Feed Ingredient	Proportion in percentage (%)	Amount of feed ingredient for different amount of feed				
		10KG	25Kg	50Kg	75KG	100Kg
Maize	55	5.5	13.75	27.5	41.25	55
Noug Cake/ground nut or Sesame oil cake/Soya cake	35	3.5	8.75	17.5	26.25	35
Wheat Middling (Furishkelo)/sorghum middling/millet middling	5	0.5	1.25	2.5	3.75	5
Lime stone	4.5	0.45	1.125	2.25	3.375	4.5
Salt	0.5	0.05	0.125	0.25	0.375	0.5
Total	100	10	25	50	75	100

Table 3: Starters Ration Formulation for Egg-Laying Chickens (percentage)

Option one		Option two	
Feed Ingredient	Proportion in percentage (%)	Feed Ingredient	Proportion in percentage (%)
Maize	26	Maize	49
Wheat Middling	27	Wheat Middling	9
Bone and Meat	10	Bone and Meat	7
Noug Cake/Soya cake	13	Noug Cake/Soya cake	24
Vitamin and mineral premix	0.5	Vitamin and mineral premix	0.5
Salt	0.5	Salt	0.5
Crushed sorghum/millet grain	23	Brewery Spent grain	10
Total	100	Total	100

Table 4: Growers Ration Formulation for Egg-Laying Chickens (percentage)

Option one			Option two		
Feed Ingredient	Proportion percentage (%)	in	Feed Ingredient	Proportion percentage (%)	in
Maize	42		Maize	42	
Noug Cake	35		Wheat Middling	16	
Salt	0.5		Bone and meat	5	
Vitamin and mineral premix	0.5		Noug cake	33	
Limestone	2		Salt	0.5	
Brewery Spent Grain	15		Mineral and vitamin premix	0.5	
Alfalfa	5		Lime stone	1	
			Bone meal	2	
Total	100		Total	100	

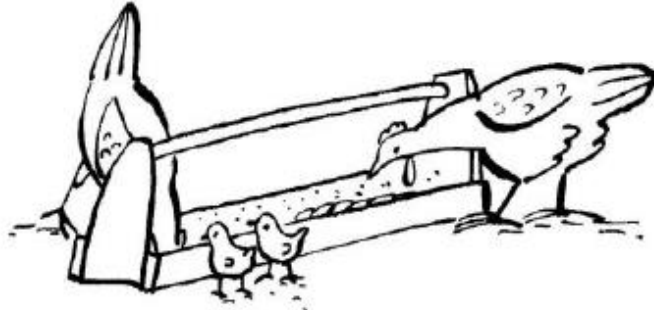
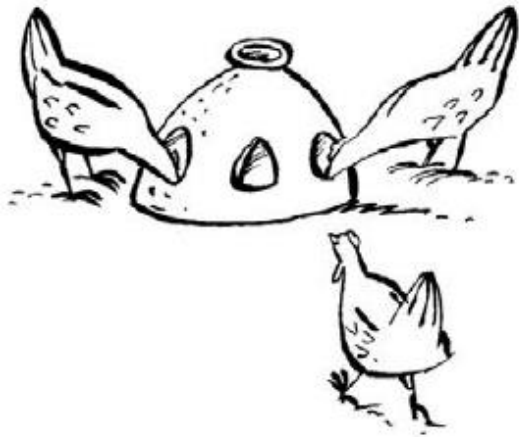
Table 5: Layers Ration Formulation for Egg-Laying Chickens (percentage)

Feed Ingredient	Proportion in percentage (%)
Maize	40
Noug cake	37
Salt	0.5
Vitamin and mineral premix	0.5
Limestone	2
Brewery Spent Grain	15
Alfalfa	5
Total	100

Feeders and Drinkers

- Feeders and drinkers should always be kept clean to prevent spread of diseases.
- They should be big enough for all birds of the same age to feed at the same time.
- A 1-m trough and a 35-cm (diameter) tube feeder are big enough for 20 adult birds to eat and 40 to drink, respectively

Sample feeder and waterer made of local materials and/or procured from the market



4.1.1.3: Disease and Health Management

Diseases are everywhere and will attack birds at all ages, but careful management will prevent many diseases. One sick hen should be isolated in a small shelter away from the others. Birds that are well fed, sheltered in a clean and ventilated house are characteristically healthy.

Proper chicken health care and management includes anti-parasitic treatment every other 4 months, prophylactic treatment against coccidiosis and regular vaccination program as prescribed by the National Veterinary Institute of Ethiopia (See Annex I: NVI chicken vaccination calendar).

4.1.1.4. Profitability and benefit analysis

Before starting any production, it is important to know the market situation, investment costs, running costs and expected revenue for the different products. In general, the economic outcome, as well as the need for investments and the risk involved in the production, will be very different for improved free-range systems (relatively low risk) and small-scale confined systems (higher risk).

4.2.2. Dairy cattle raising

4.2.2.1. Housing dairy

Experience has shown that dairy cows respond favorably to good management, feeding and hygiene, all of which are possible in a system with suitable housing.

Considerations in Constructing Dairy Housing

- The floor should not be slippery.
- There should be a partition between animals.
- Leave enough space for the animal to get up and lie down easily. Too little space can cause injury, while too much space allows the animal to move across and drop dung and urine on the floor. This makes waste disposal more difficult.
- Conventional dairy cattle housing for feeding and maintaining hygiene.
- The roof must be lick proof.
- Allow for good ventilation.
- Make sure the floor is even and allow sufficient slope to prevent urine and water from flowing toward the animal.
- Build the housing on a well-drained area.
- Make sure there is a walking area; no roofing is required there.
- Remain mindful of space requirements for different classes of dairy cattle
- A milking cow shed needs to be 70 cm wide per cow and 180 cm long
- A feeding trough should be with an internal height of 50 cm and internal width of 60 cm per cow.
- Shade area in the loafing site should be 3 to 5 square meters per cow.
- The length of the feeding trough access per cow must be 0.3 to 0.5 square meters
- The calving (maternity) pen must be 12 to 15 square meters per cow
- Individual pens for small calves should measure 2 meters by 1 meter



4.2.2.2. Feeding of dairy animal

- A normal adult animal should be fed 6 Kg dry and 15-20 Kg green fodder per day.
- Legume and non-legume green fodder should be fed in 1:3 proportion.
- Green fodder should be harvested at 50% flowering stage.

- Surplus green fodder should be conserved in the form of 'hay' or 'silage'
- Conserved fodder becomes useful during summers or when green fodder is scarce



Left: Leguminous fodder, middle non-leguminous fodder and right Commercial cattle feed

- To optimize milk production and to meet the nutrient requirement of animals, balanced feeding is required. Simple feed formulation techniques (See Annex 2: Dairy Ration Formulation)

BENEFITS OF RATION BALANCING PROGRAMME

- Using the locally available feed resources, ration of animals is balanced at a least cost
- Increase in milk production with more fat and solids-not-fat
- Increase in the net daily income
- Improved reproduction efficiency
- Reduction in inter-calving period, thereby increase in productive life of animals
- Improvement in general health of animals
- Improved growth rate in calves, leading to early maturity
- Reduction in methane emission, a potent greenhouse gas (GHG)
- Animals fed only on dry fodder may be provided Urea Molasses Mineral Block as a supplement to the diet, depending upon its availability, farmers can also prepare silage, make bales of hay (See Annex 3: UMT video, Annex 4: Silage making and Annex 5: Belling)
- Fodder should be chopped before feeding to avoid wastage and increase digestibility
- Milking animals should be fed 2 kg of formulated cattle feed for body maintenance and additional 1 kg feed for every 2 liters of milk produced



Cow licking UMB



Cattle feed is prepared from different grains, cakes, brans, molasses, salt, mineral mixture and vitamins.

- Growing animals should be fed 1 to 1.5 kg of compound cattle feed daily

Provide mineral lick

Minerals are essential for proper metabolic functions. Mineral mixture contains all the essential minerals in required quantities. Feeding area specific mineral mixture should be preferred

BENEFITS OF FEEDING MINERAL MIXTURE

- Helps improving growth rate in calves
- Better utilization of absorbed nutrients
- Increases milk production in animals
- Improves reproductive efficiency and reduces inter-calving period
- Increases productive life of animals
- Improves immunity status
- Prevents metabolic diseases like milk fever, ketosis, hematuria etc. which occur around calving period

IMPORTANCE OF DRINKING WATER FOR DAIRY ANIMALS

Water is required for

- Digestion of feed and fodder.
- Distribution of absorbed nutrients to various organs.
- Excretion of undesirable and toxic elements through urine.
- Maintenance of body temperature.
- Normally, an adult healthy animal requires 75 to 80 litres of water daily. Since milk contains about 85% water, for every liter of milk produced, additional two and half liters water is required.

4.2.2.3. Breeding, maternal and calf management

CARE OF PREGNANT ANIMALS

- Adequate health care and nutrition can ensure rapid growth of female calf as well as attaining

- puberty at an early age. Timely insemination of such animals can help them to calve at 2 to 2 ½ years of age
- As foetus develops rapidly during last 3 months of pregnancy, adequate care needs to be taken during this time
- Animals in the last trimester of pregnancy should not be taken far away for grazing, uneven paths should also be avoided
- A lactating animal should be dried within a period of 15 days after the 7th month of gestation
- Pregnant animals should have enough space for standing and sitting comfortably
- Pregnant animals need suitable ration to reduce the possibility of diseases like milk fever and ketosis at the time of calving and also to ensure adequate milk production
- Water should be provided round the clock to pregnant animals with a minimum of 75-80 litres of fresh and clean drinking water daily.
- A heifer after 6-7 months of gestation should be tied with milking animals; and its body, back and udder should be massaged. This will make feeding, delivery assistant and milking let down at ease
- 4-5 days before calving, the animal should be tied in a separate clean and airy area having sunlight. Bedding materials like paddy straw should be spread on the ground for the animal.
- The animal should be kept under observation during the last 1-2 days before calving

NUTRITIONAL CARE AFTER CALVING

- Immediately after calving, the cow has a low appetite and will not eat as much feed as the body may require
- Cow undergoes a lot of stress while calving, therefore, the animal should be given light, palatable, mild laxative ration containing boiled rice/wheat bran, boiled millet or wheat mixed with edible oil for 2 to 3 days after calving. This kind of diet is also helpful in early expulsion of placenta
- In addition, the animal should be given tender green fodder and fresh water as much as it wants to drink, but do not give hot water.
- Ensure the milking cow has constant access to clean drinking water and receives required quantity of mineral lick daily



Calf Management

This management practice takes place in the period between late pregnancy and calf weaning.

- Pregnant cow isolation and the sound feeding of the pregnant cow two months before birth—achieved by supplementing 4 to 6 kilograms of concentrate and providing free choice roughage—are the two most important factors in calf management before birth
- In a first-time pregnancy, gentle washing of the heifer's udder with warm water and a towel for 20 minutes per day will improve milk letdown and future dairying potential

- The calf should receive as much colostrum as possible during the first 3 days (10 to 15 percent of the calf's birth weight). Within 1 hour of birth, a calf should suckle at least for 2 rounds
- Within six hours of birth, the ability of the calf's gut to absorb antibodies decreases by one-third. By 24 hours, the gut can absorb only 11 percent of what it could have absorbed at birth. Also at 24 hours of age, digestive enzymes break down and digest all of the antibodies.
- Calves should be housed individually in facilities which are warm but provide good ventilation.
- Calves should be housed on a surface with adequate drainage and bedded with straw
- Clean nostrils and mouth which helps the calf breathe better and help prevent future breathing problems
- Allow the mother to lick the calf clean which promotes circulation within the calf's body and prepares the calf to stand up and walk

Heifer Management

The feed and management program for replacement heifers (10 weeks to 2 years old) will have a lifelong effect on their productivity. It will determine how young they may be bred; whether they calve early, late or not at all; whether they are good or poor milkers; the weaning weights of their calves; and how long they remain in the herd.

- A ration should provide for adequate growth, but not for fattening. To ensure this, 1 kilogram feed should be provided for a 100-kilogram heifer, which leads to a 40 percent body weight increase and 17 percent milk yield improvement.
- Well-fed heifers reach sexual maturity when they reach 17 months of age and a body weight of about 230 kilograms
- Trace mineral salt and a calcium-phosphorus supplement are recommended on a free-choice basis

Early Puberty

- Puberty is a function of breed, age and weight. In fixed breeding seasons, age typically has less of an effect than weight
- Heifers should weigh 61 percent to 65 percent of mature weight at the start of the breeding season. That means, if the matured body weight of a dairy cow is 450 Kg, at first service, the heifer body weight should be 274.5 Kg to 292.5 Kg.

Dairy Cow Management After Birth

- A calving cow should drink water at a much higher volume than the usual intake. Make the water salty to make it more potable
- Normal fetal membrane expulsion is expected within a couple hours after birth. Lack of expulsion for 12 hours is considered a retained fetal membrane. A nearby veterinarian should be informed if this occurs
- A calving cow should rest in a smooth and well-bedded location
- After birth, feed intake will be compromised for some time, so the cow should be fed the most palatable feed available
- Any sign of disease observed in the dam during or shortly after delivery should be reported to a veterinarian

4.2.2.4. Disease and health management

Animal health plays an important role in harnessing the expected production potential of dairy animals. A diseased animal cannot perform to the expected level. Timely intervention is therefore pivotal in reducing the economic losses due to diseases.

With this aim, the disease and health Part of this booklet is divided into sections which are as under:

General observation of an animal

General observation of certain parameters will guide you in assessing the health status of your animal which will in turn help you in seeking timely advice from a veterinarian. Timely intervention can prevent or drastically reduce the losses due to diseases or other conditions

OBSERVING BASIC HEALTH PARAMETERS

Breathing frequency - (Breathing in + breathing out) is 10-30 times per minute in normal adults and 30-50 times per minute in calves. Observed best from the animal's right flank, seen from behind.

Rumination - Not less than 40 times per minute and 7-10 hours per day

Rumen movement - Two to three per minute, can be felt by pressing lightly on the upper part of the left flank

Appearance - A healthy animal has a shining, smooth and even coat as well as shiny horns and hoofs. Eyes should also be normal without discharge or tears and muzzle moist

Fever - Usually accompanied by rapid breathing, shivering and occasionally diarrhea. Ears, horns and legs are usually cold to touch while body is too warm

If any change is observed in the above parameters or fever seen, consult a veterinarian.

Body Condition Scoring (BCS)

Body scoring is very important in assessing the health status of an animal. A low score may indicate diseases or improper feeding while a high score may indicate a high probability of breeding and metabolic problems.

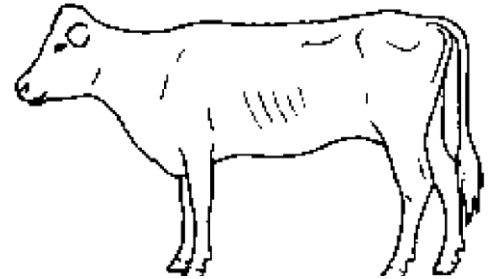
Dairy cattle with body score 1:

- Extremely thin. No fat in brisket or tail docks
- All skeletal structures are visible.
- Dull hair
- May be diseased and survival during stress is doubtful



Dairy cattle with body score 2:

- Thin. Vertebrae, hips and pin bone prominent
- Some tissue cover around tail dock, hip bones and the flank
- Muscle tissue evident but not abundant,
- health may be OK



Dairy cattle with body score 3

- Ribcage only slightly visible
- Fat deposit behind shoulder obvious, ideal condition for calving.
- Fat deposit in brisket area
- Hook and pin bone visible, but not prominent



Dairy cattle with body score 4

- Skeletal structure difficult to identify
- Obvious fat deposits behind shoulder and tail head
- Flat appearance to the top line
- Folds of fat starting to develop over ribs and thighs
- Cattle with body score 4 may have metabolic problems at calving



Dairy cattle with body score 5

- Animal is obese, flat appearance dominates
- Brisket is heavy and bone structure not noticeable
- Tail head and hip bones completely buried in folds of fat
- Back is flat and completely covered by fat
- Mobility impaired by large fat deposits
- Cattle with body score 5 and above have high probability of metabolic and breeding problems



Dry cows and calving cows should have a body condition score of 3.5 (See BCS above). Body scoring would be a helpful yardstick to monitor your dairy cattle care and management.

General signs to observe for in healthy animals during rearing period or at point of purchase

Eyes: bright, clear and not runny (no discharge), crusty or bloodshot.

Nose: cool, moist muzzle, with frequent licking; breathing should be regular and not laboured; beware of discharge, coughing, wheezing or irregular breathing.

Coat: Glossy, clean and un-matted, free of ticks/lice, other parasites or eruptions.

Weight: Average weight for the breed; beware of emaciated or thin animals.

Attitude: Curious, alert and contented; beware of cattle that stand apart from the herd, that

seem disinterested or that show signs of a bad temper.

Mobility: Walking should be easy and free of limps; beware of slow or uneven gaits or hunched positions when sitting; the animal should be able to rise from seated positions with ease.

Udder: Healthy; size isn't necessarily an indicator of a good udder. It should sit forward with prominent milk veins, not sag and not be too meaty. Observe the cow when she walks, the udder should not show too much sideways movement.

Body score: This is an important indicator of the health of the animal. An animal in good health will have a body score between 3-4.

History: It is important to have a record of the detailed history of the animal on number of calvings, recorded milk yield during previous lactation, any specific disease occurrence like mastitis, prolapse of uterus, ROP, dystocia, hypocalcaemia etc.

Age: Though not directly related to health, the farmer should also ensure the age of the animal by referring to its dentition.

Preventative healthcare for dairy cattle

- Carry out routine deworming, fluke treatment (based on endemicity) and get dairy cattle vaccinated against major diseases like Black Leg, Anthrax, FMD, LSD, Pasteurellosis and the likes as recommended by the National Veterinary Institute
- For lactating animals, milk the newly purchased cow or cow with sickness of teat/udder separately and, only after milking all the other animals in the herd
- A calf is tomorrow's cow. From the health point of view, the life of a cattle is divided into two parts; the first 24 hours, and the rest. The first 24 hours of life of a calf is so important that it has a strong bearing on the rest of its life. A calf not provided adequate care in the first 24 hours may succumb to diseases or will always remain weak and an underperformer
- De-worming should be done within 10-14 days of age subsequently on a monthly basis up to the 6th month
- When the animal is 3 months old, contact the veterinarian for vaccination

4.2.3. Backyard Fattening

Backyard sheep and cattle fattening has gained importance to the livestock industry of the Ethiopian. It is becoming popular because of the following advantages: (1) It augments the farmer's income; (2) it requires minimum space for housing; (3) it allows the use of cheap and locally available farm and off-farm by-products which ordinarily go to waste; and (4) it helps meet the immediate demand for high protein foods in the diet of the Ethiopian people.

Fattening sheep and cattle in backyard consist of buying young healthy herds/stocks, feeding them properly and selling them at the proper time.

4.2.3.1. Types of Fattening

4.2.3.1.1. Cattle Fattening

Fattening enterprises in western countries typically take immature feeder animals and bring them to market weight for sale to slaughter. Cattle in these enterprises normally enter the feedlot at well under one-year-old and are fattened for 6 months. Smallholder cattle fattening is also a traditional occupation within some Regions in Ethiopia, e.g. in Harerge Zone of Oromiya Region

where the locally named Harar beef is produced. In most of the Ethiopian farmers tradition, fatten mature and therefore much older animals (5 to 7 years old) for shorter durations (usually 3 months).

4.2.3.1.2. SMALL RUMINANTS

Farmers in the Regions of Ethiopia often fatten a few sheep and goats to sell during feasts and holidays when prices are relatively high. Traditionally, sheep are raised on native pastures and crop residues. Animals, which are to be sold during peak demand periods, may have some supplemental feeding, but this traditionally includes only surplus grains and leftover household food. Forages, grains and concentrates could be used to increase animals' weight and therefore the price they will sell for.

4.2.3.2. *Suitability of the area or locality for fattening*

Fattener of sheep or ox production is sensitive to the changes in the quality and quantity of feed supply. They grow normally well when given the right feed. Adequate feeding is attained through grass pasture, grains, and roughages supplemented with protein, minerals, vitamins, carbohydrates and fats. It will be highly profitable if feeds are available in the locality. Feed ingredients such as rice straw, corn Stover, oil cake, rice bran, wheat bran, brewery byproduct, sorghum bran, millet bran, wild oats, soya cakes and molasses must be abundant. Grass should be enough for the fattener to graze throughout the year. Good quality feeder stock can be obtained from your neighbors, livestock markets and commercial ranches. Those that are well adapted to your area should be selected.

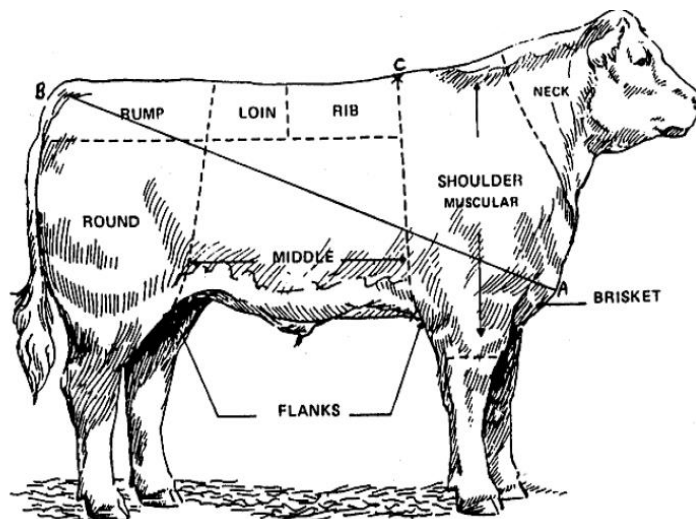
4.2.3.3. *Selection and purchase of fattener bull and ram*

The uncastrated male ox (bull) and the uncastrated male sheep (ram) selected for feedlot should be lean and healthy. This is because they are less expensive for reason of their physical appearance and are capable of responding fast to feeding as well as make good returns better than animals that are well-fed at the purchase time. Such lean animals are principally lay down more of marbling (palatable) fat found within intramuscular areas than subcutaneous fat which no one wants. Ecological zone adapted bull and ram should be preferred for fattening. Purchasing of fattener animals especially for large scale operation should be at the terminal markets, preferably during the middle of dry season, when feed is scarce and farmers willing to let go their animals for lack of feeds. Fattener in a fattening station where feed and water is provided can have sound economic return. Age range of fattener bulls should be between 2 to 2½ years or 180-200 kg weight while fattener of ram should be between 1 to 1½ years 12-15 kg body weight.

TIPS IN SELECTING FEEDER STOCK

- Have knowledge of the relative prices
- Know the weight of the animal
- Estimated weight of animal

$$= \frac{C \times C \times A \times B}{300}$$



- C= Heart girth (measure the circumference behind the shoulder blade)
- AB= Length (measure length from point of shoulder (A) to point of rump (B))
- Know the quality of the animal
- Consider the body conformation and physical appearance of the animal
- Age- Younger animals require longer feeding period. Feed is utilized for maintenance, growth and fattening. Older animals take shorter time for fattening. Preferred age of cattle for fattening is 2-3 years old.
- Sex: Castrated males are preferred than heifers or young females due to their inherent capacity to gain weight, grow faster and easy to manage.
- Disposition- An active yet mild, quiet and easily handled male usually grow fast and fattens easily. Restless, nervous and erratic cattle or sheep waste too much energy
- Constitution- and Vigor: These are determined by the size and quantity of the vital organs. A large feeding capacity, a strong appetite, a large heart girth, well sprung ribs and a wide, depend full-chest show good constitution and vigor
- Breed- Improved breeds gain weight faster with less feed than native animals

4.2.3.4. Fattener housing

There is a general trend to keep the fattened animals in semi-confinement in order to control waste production. More efficient growth rates will be achieved if shade is provided. Solids from manure are either collected daily and stored, or allowed to dry in the feedlot and removed periodically before spreading on fields. Collection of urine is limited to feedlots with a slatted floor. Sheds of the animals should be airy with protection of the animals from extreme temperatures and strong winds. The cattle housing should be facilitated with drinking water for animals. There should be proper drainage system to keep hygiene at the farm. It consists of a built up animal shed and brick soling paddock for animal to move around. Animal sheds should be located with long axis north to south, to get direct sunlight and yet face away from the direction of prevailing winds, whenever possible. Tree plantation can be carried outside the sheds to provide natural shades and these trees will also act as windbreakers.

Dimensions of water troughs will be the same as that of feeding trough and water will be available round the clock. Generally, all the animals feed at the same time in a shed, but not all animals drink water simultaneously. The following figure shows the animal housing layout adopted for this particular fattening station considered in this feasibility study.

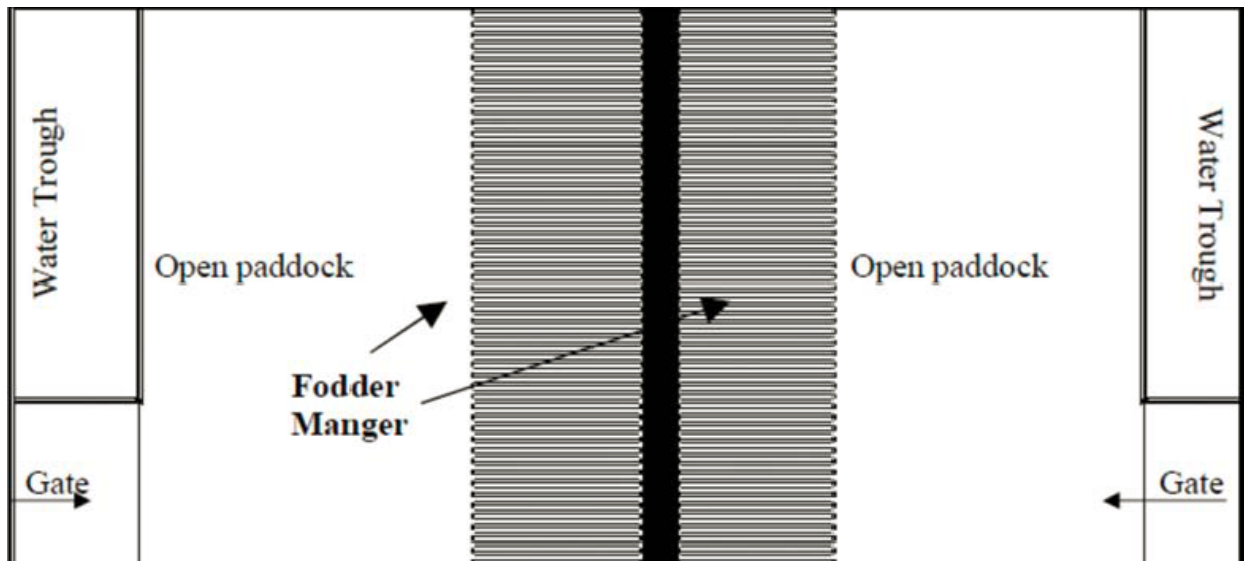


Fig 1: Top view of the proposed fattening station shelter resourced with built-in feeding and watering trough

4.2.3.5. Vaccination and Medication

Vaccination & medication is required to prevent any disease outbreak in the animal herd. Each new animal will be receiving external parasitic treatment against tick infestations and get dewormed with broad spectrum anti-parasitic treatment upon arrival and before putting into the farm. Anthelmintic are used to treat the animals for internal parasites whereas spraying with some disinfecting solution is used to eradicate external parasites. In all the treatment options there is a need to consider drug withdrawal period, recommended time gap between administration of drug and slaughter time of the animal under treatment. In addition, injection mark as a possible cause of carcass condemnation must be considered before making decision on cattle treatment. Vaccination of new batches of cattle and sheep can be done 2-4 weeks after the deworming service. Farm owners can obtain vaccines on payment-base according to prescribed schedule from Ministry of Livestock and Fishery. Farm managers can get their animals vaccinated by the animal health service provider of the extension workers and/or private veterinary practitioners operating in their locality.

4.2.3.6. Feed Requirement

In the selection of feed, the ration should be adjusted to the requirements for fattening cattle or sheep based on the availability of feed materials in the locality. Cattle or sheep can be fattened on all roughage ration or a roughage-concentrate ration. In giving roughage, be sure to give good quality grass-legume mixture in the form of pasture herbage. These should be given in full feeding

Roughage-concentrate ration is the contribution of forage or farm by-products and concentrates. Some common concentrates used are: rice bran, oil cakes, soya cakes, sorghum/millet/corn by-products, byproducts of local drinks; like tela and Areki atella plus salt. These concentrates are cheap and available in many localities. Force-feeding or drenching of this concentrate should be given twice a day.

Common Concentrate Mixtures Used for Fattening


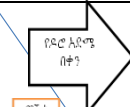
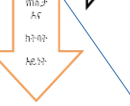










Simple feed formulation samples for fattener bull and ram

Feed Ingredient	Proportion (percentage)	Feed Ingredient	Proportion (percentage)
Oil cakes	60	Oil cakes	50
wheat bran	39	wheat bran	25
Salt	1	Dried chicken manure	24
		Salt	1
Total	100	Total	100

All the green, hay or straw feed that the animal can consume in a day is placed in the feed bunk so that the animal has access to it all the time. Concentrates should be fed twice daily.

Management practices related to feed and feeding of fattener animals

- Newly arrived feeder stock should first be confined and provided with clean and low energy feed
- The feeding area should be always kept clean and drained to ensure proper health and good sanitation
- Always watch for signs of illness such as reduced feed intake, abnormal discharge or unusual behavior. If illness is suspected, ask the help of a Veterinarian
- Water should be available at all times. Ordinary salt should be made available to the cattle and sheep at the rate of 30-50 grams per head daily
- Feeding of concentrate should be increased gradually to minimize the occurrence of rumentis, scouring and bloating
- Mineral supplements and growth stimulants are added to the feed as needed

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CHAPTER 5. BASICS OF AGRICULTURAL MARKETING

5.1. Basic concepts of farming as a business and agricultural marketing:

Back ground

Farming activity in Ethiopia is mostly subsistence in which the activity is not run as profitable venture and much income is not earned to the rural households to fulfill the basic needs including nutritious foods. Hence the traditional way of production should be transformed in to business orientation and this requires improved skill and knowledge in the area of agricultural marketing. Hence, capacitating the rural community in the area of business skill will be worth enough to improve their income from the farming activity and spend portion of income to purchase affordable nutritious foods.

5.1.1 What is farming business?

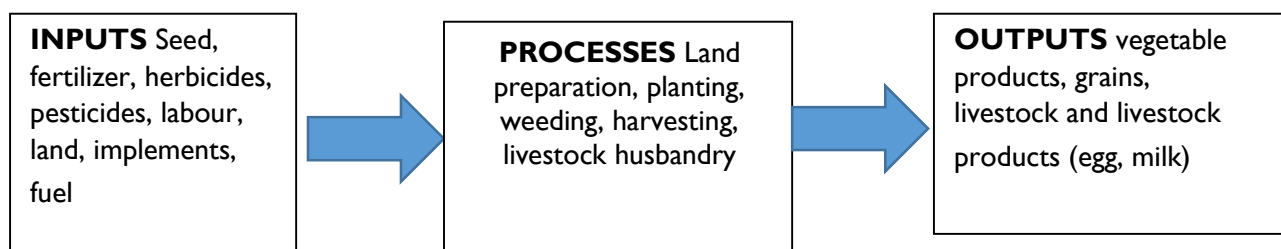
A commercial activity designed to supply agricultural goods and/ or services that are demanded by the market at a profit. In a normal business set-up, a given set of inputs are processed and converted into outputs, which may be goods or services. **a farming business include:**

Inputs: seed, dipping chemicals, fertilizer, pesticides, herbicides, and farm equipment

Processes: activities such as land preparation, planting, weeding, fertilizer application, dipping cattle, fumigation of poultry structures, harvesting, and output marketing.

Outputs: maize grain, flowers, fruits; and livestock and livestock products. These outputs are then sold to consumers at a profit, which is calculated as the difference between the value of outputs and the cost of inputs.

FIGURE 1.1: ILLUSTRATION OF THE FARM BUSINESS CONCEPT



Adopted from Farming as a Family business manual, Zimbabwe Agricultural competitiveness program, USAID.

5.1.2. Key principles of farming as a business:

- Invest resources with a profit motive
- Provide product or services that satisfy customers
- Conform to the laws and standards of the society and government
- Plan continuously, analyze the environment and manage risks
- Keep updated records of the business for planning and decision making
- Establish long term relationship with customers and other stakeholders

5.1.3. Benefits of farming as a business:

Benefits to the Family	Benefits to the Society
Growth in income due to market participation. ¹	Improved consistency in supply of products.
Improved standards of living due to increased income.	Improved quality of products.
Diversity of consumed products purchased using increased income.	Growth of rural-based businesses and employment creation.
Improved nutrition and household food security.	Improved distribution of food and raw material through trade.
Increased productivity and efficiency of the family farm	Growth of productivity and supply base for agro-industry inputs.

5.1.4. Basics of agricultural marketing concepts

Agricultural Market: It is the set of actual and potential buyers of an agricultural product who share a particular need or want that can be satisfied through exchanges and relationships. In simple term; market is a place where agricultural products are bought and sold.

What is Agricultural Marketing?

A management orientation focusing all the activities of production and sales of agricultural products on satisfying customer needs and wants profitably. Involves finding out what your buyers want and supplying it to them at a profit

Option of selling places to small holder farmers/ type of Agricultural markets:

Assembly markets: These are rural markets where farmers and small collectors come to sell agricultural products to larger traders and agro processors

Wholesale markets: located in towns and cities, or in their vicinity

Retail markets: in villages, in small towns and in cities; such as restaurants and hotels, shops, roadside vendors, supermarkets

Rural small holder farmers should be aware of selling options so they can make informed decisions based on market information and product prices.

Demand and supply:

Demand: The amount of a particular product or service which buyers are willing and able to buy at different prices

Supply: The amount which producers and market intermediaries are willing and able to provide at different prices

Understanding the dynamics between demand and supply is important to improve nutrition status of the households because availability of agricultural products has a significant impact on the purchase, consumption and production decisions small holder farmers make when access nutritious foods to fulfill their dietary needs. Every day, households must make informed decisions regarding whether ***it is a wise decision to consume the product at household level; rather than selling or which product they should produce and which to purchase from the market.***

Factors influencing the change in DEMAND of agricultural product:

Price, Income, Consumer preferences, Competing or substitute products, Quality

Factors influencing the change in SUPPLY of agricultural products:

Climate, Production costs, Price, Transport infrastructure

5.2: Basics of Business Planning and Marketing Research to produce nutritious foods

Back ground

Majority of rural households usually produce single crop in subsistence manner, due to many socio economic and environmental constraints; as a result, although they have long time experiences and skills in farming activity, they don't have organized plan to guide the farming activity. To meet the nutrition requirement of the household they might need to run multiple farming activities, in this case the management is not simple and resource mobilization will be difficult to handle easily. Hence effective planning of the farming activities is the most important. The planning should be based on real market information; to be effective and realistic.

5.2.1. Basics of Business Planning:

Business plan: is consolidation document that define the parameters of how a business operates. It is comprising explanation Justification and numerical and financial statistical data.

Uses of Business plan:

- describes what the business will do
- how and where will be done
- how the business will be financed and managed?
- It communicates strategic direction, goals, methods to achieve the goals

Importance of Business plan:

- The real value of creating a business plan is not in having the finished product in hand;
- rather, the value lies in the process of researching and thinking about your business in a systematic way.
- The act of planning helps you to think things through thoroughly,
- It helps to study and research if you are not sure of the facts, and look at your ideas critically.
- It takes time to develop business plan, but avoids costly, perhaps disastrous, mistakes later
- Uses to Measure performance and to guide implementation
- To convince lenders and donors

Business planning: is the process of arriving/developing at/a Business plan

5.2.2. Contents of a simplified Farm Business Plan

Introduction: Description of the business and its goal, skills and advantages of the farming activity

Production planning: detailed resource requirement related with the production, such as labor, raw material etc.

Marketing Plan: The products or services offered, identifies the customer demand and requirements, identifies targeted market, size and location, identifies how you are going to promote/advertise your nutritious food, describes the pricing strategy

Financial Plan: Explains source and amount of initial capital; develops a weekly, monthly and yearly operating budget and expected income for an intended product(s)

Operations: How the business managed on a day to day basis, how will be labor covered by family or hired; rental issues if needed such as land; sources of the equipment and raw material required

Anticipated risks & challenges and mitigation plan: Identifies and plans how to mitigate or minimize the anticipated risks, such as occurrence of disease and pests, natural disasters, theft etc.

Annex II Business plan format attached

5.2.3. Conducting Marketing Research:

Marketing research: is the function that links the consumer, customer, and public to the marketer through information.

Information used to identify and define marketing opportunities and problems; generate, refine, and evaluate marketing actions; monitor marketing performance; and improve understanding of marketing as a process.

The ultimate objective of marketing research is to identify the requirement of customers.

Market Requirements: are reflections of the buyers needs and wants for purchase and delivery. The farmers should know what specific nutrition rich agricultural products required by consumers and produced based on the requirements

Why do we need to know market requirements?

The knowledge of market requirements enables to establish long lasting business relationships with customers. Most of the time market requirements may be taken as obstacles to market entry unless due care is taken about them to satisfy customers.

Some examples of market requirements are:

- Packing/processing requirements, i.e., to what level the product should be processed before its' entry to the market. Usually farm products are not handled with care to maintain the nutrition content
- in the case of potatoes, the degree to which it has to be washed etc. fruits should be handled with crated-at least made from local available materials such as baskets rather than handling them with sacks

Identify Customers:

After identifying the general requirements of markets, producers need to identify particular potential buyers for their produce. For this purpose, they need to get marketing information/data. Marketing data can be collected through different ways like interviews or it can be obtained from official sources like radios, newspapers and official statistics. Marketing data/information can be used for customer identification.

Source of Market information/data:

- market actors, such as Traders and agro-processors, retailers, brokers, consumers/buyers, Unions and cooperatives
- Other workers (DAs)

- Radio and television
- Magazines and newspapers if appropriate for small holder farmers
- Extension
- Farmers

5.3: management of a farming business

Back ground

Just like in other businesses, farmers handle considerable amounts of money in their businesses. Cash money and other material resources must be managed effectively to ensure that it is available for expenses, improvements, and growth of the business. For many farming families, income is both irregular and unpredictable. Therefore, farm business owners have to exercise strong financial management in order for their businesses to succeed and sustained their farming activity. strong financial management and Record keeping on a family farm business translates to using limited financial resources in a way that maximizes income or profit.

4.3.1 Cost Analysis and pricing:

To meet the nutrition need of the household, small holder farmers should produce nutritious foods sustainably on their farm or should earn sustainable income from their farming activity to meet the households dietary need sustainably. Economic uncertainties are a fact in any business especially in agriculture. Hence farmers should do thorough analysis of the cost they incur to produce a farm product and decide its price accordingly to achieve a certain target level of profit. The price the farmers received should compensate the cost incurred and assume a certain level of profit.

Costing

Cost is the entire money required to operate the farm business.

Costing is calculating the total cost required to produce and deliver a product or service.

Cost is an essential basis for pricing of a product or service produced.

Benefits of calculating cost:

- To determine at what price to sell the Product/Service
- To pre evaluate if the business we planned to run will make a profit or loss
- To devise an alternative strategy on how to minimize higher/significant costs
- To budget and plan the resources in hand (material, labor and capital) to use effectively

Type of costs

Fixed costs: costs do not change with the level of production and can be used beyond a single production season. e.g. Land rent, machinery, equipment (plough, axe...etc.), house construction, feeder

Variable costs: costs their level determined by volume of production. these costs increased with an increased production volume and vice versa. (e.g. Raw material, labor, transport, packaging...etc.)

Pricing:

Price is a monetary value charged for a product or service to cover the total cost incurred (fixed and variable cost) and the profit intended to earn per each unit of the produced product/service. And pricing is the process of setting the price for the product or service a business venture produce.

Pricing is an important decision in business operation, cause the profitability and sustainability of the business depend on how accurate decision made about the price of the product the business produced

Markup is the level/percentage of profit a business desired from a product or service the business produced. For example, if a farmer incurred a total cost of 6 Birr per Kg to produce a kilo of Avocado and assumes to earn 20% mark up the calculation will be as below.

Total cost: 6 Birr

Mark up: $20\% = 0.2 \times 6 = 1.2 \text{ Br}$

The selling price = Total cost + markup; $6 \text{ Br} + 1.2 \text{ Br} = 7.2 \text{ Br}$ and the gross income is 1.2 Br

The general formula for price setting is:

Price = costs of good produced/unit + operating costs/unit + desired profit/unit

Factor to consider in pricing

- The level of competition in the market
- The demand for the product
- The level of production and operation costs incurred
- The psychological consideration of the consumer
- The negotiation skill of the seller and buyer

After thoroughly considering the above mentioned factors, a farmer should initially set the price he/she assumes for his/her produce ahead of visiting the market

Pricing and profit calculation

Profit: a net income earned after covering the incurred total costs and any other obligations (taxes...)

Revenue: the total amount of sales during a specific period (simply out put \times price per unit)

Price: the sum or amount of money or its equivalent for which anything is bought, sold, or offered for sale.

Sales Volume: quantity or number of farm output sold or services rendered in the normal operations of a firm in a specified production period

Total Cost: actual payment of cash or cash-equivalent for goods or services produced (fixed and variable costs)

Simple formula to calculate profit:

$$\text{Sales Price} = \text{Cost} + \text{Profit}$$

$$\text{Total cost} = \text{Material} + \text{Labour} + \text{Transportation... (fixed and variable costs)}$$

$$\text{Revenue} = \text{Price} \times \text{sales volume (quantity farm out put sold)}$$

$$\text{Profit} = \text{Revenue} - \text{Total costs (fixed and variable cost)}$$

5.3.2. Record keeping

Record keeping is the art of collecting useful pieces of data or information on the happenings of a particular undertaking, with the view of processing it in the future (for example, analyzing sales and costs and calculating profits).

Although record keeping is an important activity, many small holder farmers do not keep records of their farming activity. Hence they don't know how much they spent and how much they earned from their farm business/activity. Keeping farm records helps small holder farmers to detect important challenges/problems happening in the farming business and recognize the level of profit they earn from it. Hence keeping farm records is important to run a farm business successfully and sustainably.

Importance of farm business record keeping

- To track individual farm business/activity performance.
- To evaluate farm business profitability
- To establish a basis for pricing of farm products
- To recognize the amount of loan, when it is required and facilitate access to loans
- Records are helpful when farmers seek advice from extension agents
- Records are a good management tool because they provide figures for planning and budgeting.

Note: to be useful farm records must be accurate, neat, and written clearly; be complete; be easy to record; be easy to keep and retrieve; provide necessary information for the family member; be easy to analyze; and be analyzed regularly.

Classification of farm business records

To make farm business record keeping easy to understand and used appropriately; small holder farmers should keep records of their farming activities separately; if they are running more than a single farm activity. For example, if a farmer does poultry and vegetable gardening; the record keeping must be done separately for poultry and vegetable. In general, two types of records will be kept in farm business/activity; which are livestock and crop records.

Table. 3. Common Livestock Records

Record Type	Description
Mating Records	Taking note of female number, male number, when mated, and whether aborted or not.
Birth Records	The date, sex, and weight of offspring; if possible and accessible
Financial Records	Record of income and expense, quantity of sale, amount sold to and name of buyer
Death Records	Date and cause of death, if known.
Health Records	Record of vaccination, dosing, and treatment, health history.

Table.4. Common cropping Records

Record Type	Description
Agronomic and land use Records	Planting dates, weeding, inputs used (for example, quantity and type of seed and fertilizer, chemical), labor usage, land preparation, conservation and other land uses
Financial Records	Record of all financial transactions (income and expense), Quantity of sale, value, and name of buyer
Weather Records	Record of rainfall, temperature, humidity, etc. if possible

5.3.3. Labor management in farm business

Labor is People or machinery performing or required to perform productive tasks in the farm business

Labor is among the most critical farm business resource; especially in small holder farmers farming activity, who want to diversify the livelihood of the family to achieve daily dietary need of the household and improve income from their farming activity to purchase affordable nutritious foods from the market. Hence Organization of labor is one of the critical tenets of successful family farm businesses. Most importantly; when farming becomes a business, family labor may not be sufficient to carry out all farm operations. This necessitates planning for and hiring extra labor; how to allocate the family labor and when to use hired labor. Each farm business is unique and no single approach works for all types in terms of using the available labor; hence the family should decide how the farming activities labor requirement covered; if for example the family owns multiple farm activities, such as poultry, dairy, vegetable and fruit production.

Farm labor requirements

For family farm businesses to succeed and become profitable, access to adequate and suitably

skilled labor is required. Improving the skill level of farm labor is essential to enhance innovation and strengthen competitiveness in the markets. If there is skill gap to operate a farm business in the household, the family should plan how to fill this gap through informal and formal training schemes; from different extension services provided by different government and non-government institutions. Especially if the household decided to assume new farm business activities never been tried before; they should plan to develop the necessary skills required to produce profitably.

Key operations to organize labor for crop and livestock businesses

Livestock:

- breed selection, (special skill required to select breeding animals)
- Cleaning and fumigation of structures
- feeding and watering
- vaccinations
- slaughtering
- marketing

Crop:

- Land preparation
- Planting
- fertilizer application
- Weeding
- Watering, if the production is through irrigation
- Harvesting
- processing, and marketing.

The whole family should participate to thoroughly plan the above labor requirements of the family's farming activity, if they really want to run multiple farming activities to meet diversify dietary need of the household. Each household member should contribute to fulfill labor requirements of the farming activity in the family and decide to hire, if necessary.

CHAPTER 6. BASIC CONCEPT OF SAVING AND CREDIT TO MODEL FARMERS

6.1. Basic concept of savings

There are three general approaches to defining savings:

- (i) savings can be considered as the creation of assets of all types. In this approach, savings can resemble credit, which provides financing for the purchase of assets.
- (ii) the most frequent conception of savings is as a tool for cash flow management, helping the saver bridge gaps of consumption and income with extra liquidity.
- (iii) savings can be thought of as a buffer against risk, a resource—resembling an insurance claim—that can help mitigate the effects of unpredictable crises.

Savings for asset creation

One approach to defining savings may be to describe an individual's savings by the amount and type of assets to be purchased. Capital assets are often expensive: they include housing, land, or machinery for use in a business. Importantly, these assets can eventually be converted into less tangible goods as well. Housing may be used as collateral for debts, land can be rented to others, and capital brings an expected increase in income if used properly. Even more abstractly, each of these assets may bring with it an increase in social stature, credibility, independence, or confidence. Intangible assets range even wider and may include education, health, or community life events such as weddings and funerals.

Savings for cash flow management

Savings need not necessarily involve the accumulation of income over time. Instead, it is possible to think of savings as an instrument to help the poor manage regular expenditures that cannot easily be paid for out of pocket. Whether savings are for known or unknown needs, consumption smoothing may at different times leave account balances high, low, or nonexistent

Savings for risk management

“savings that encompass the necessity of saving to avoid bankruptcy in the face of unforeseen massive expenditures or losses. Expenditures could mean large hospital bills, the need to rebuild a home after a flood, or helping relatives get back on their feet. Losses could be the failure of a crop after a poor rainy season, the failure of a business investment, or the sudden disappearance of a large debtor.

Savings means keeping a portion of your assets in cash or in kind for future use. Save **regularly** in small portions and you will reach your short- and long-term financial goals easily!

- Do you know saving proverbs that encourage savings with in the community?

-
- Where have you been saving your money? Where do the community save their money?
 - At Bank
 - At saving group
 - At saving and credit cooperative
 - At Micro Finance institution
 - At Home



6.2. Importance of Saving to the rural community

Savings mobilization in a given country has basic advantages at three different levels: (i) at individual or household level; (ii) at institution level; and (iii) at national level.

- *At individual (member) level*

At individual level, if a person has proper savings habit, the saving will offer him a combination of security of funds, easily able to access for financing investment and generate return, able to meet any financial obligations related with his/her daily life. Savings assist individuals to skip poverty by drying the root causes and resolve key constraint to poverty reduction by providing resources that allow the poor to invest and pursue new economic opportunities. Helps the poor to manage seasonal liquidity/cash flow shortages, meet planned lifetime events and emergencies.

- *At institutional (Saving and Credit Cooperative (SACCO) level.*

A financial institution (SACCO) that has effective savings mobilization strategies will able to increase its outreach and serve significant number of member-clients within the community. In addition, the SACCO that mobilizes internal savings will become financially self-sufficient; minimize operational expenses, loan loss and cost of funds. Furthermore, the SACCO will easily able to create business linkage with national and international financial institutions which will help the SACCO to improve its service in a sustainable way by getting financial, technical and managerial support. In most cases SACCO's are community based financial service providers owned by the community.

- *At national level*

A country with high level of individual and internal savings; will has high amount of national resources and decrease the need for foreign indebtedness in order to cover domestic investment and consumption demand. Countries with low internal savings rates are forced to borrow from abroad, which results in a debt burden. This clearly shows the importance of internal savings mobilization to sustain economic growth.

6.3. Basic socio-economic advantages Saving to a person who saves regularly with great vision and discipline:

- Savings protect a person from unexpected economic shocks and going without food: a person who faces economic shocks might be forced to go hungry; may expose the person to sickness, and then if the person falls sick, family income drops sharply and they may all go hungry.
- Savings protect a person from selling off something owned: person without saving may be forced to sell some of the vital assets if the worst comes, that may be useful for future income generation.
- Savings protect a person from unnecessary and unplanned borrowings: unplanned borrowing always leads to consume less tomorrow to repay the loan and force the borrower to become dependent on others than relying on him-self.
- Savings inspire a person to have investment motivation and think about doing a business: a person who has saving will become more motivated to start own business and look for business opportunity, become interested for getting business development skill and look for possible financial access to expand his business.

6.4. Types of Saving products

6.4.1. Compulsory Saving:

Compulsory savings are minimum deposits that members agree to save on daily or, weekly or, monthly, etc basis. Compulsory savings are called membership saving, Compulsory savings and need to be saved based on the leverage ratio of the SACCO (3.5:1) Example:

Amount of monthly saving	Share	Compulsory Saving
4.5	1	3.5
9	2	7
13.5	3	10.5
18	4	14

22.5	5	17.5
27	6	21
31.5	7	24.5

Compulsory savings can be withdrawn only if the member quits from membership. Compulsory savings used for lending purposes and get saving interest & dividend. Compulsory savings are used as collateral. For new saving and credit cooperatives it is better to have similar amount compulsory saving, collected at the same day and the amount collected will be deposited in bank saving account immediately or disbursed in the form of loans for members for loan applicants who have got loan approval promised to get loan in the month. The saving and credit cooperative will pay interest as per the bank interest rate paid for saving. The interest rate is calculated starting from the date the member paid and registered on the saving pass book of the member.

6.4.2. Voluntary saving:

Members or none members save voluntary savings based on their interest, and can be withdrawn any time with advance notice. This kind of saving is very important to people who don't have regular income. It helps them to save during harvest time, and by transferring monthly to their compulsory savings account; members will be able to save regularly. In addition, voluntary savings help members to fulfill any immediate financial obligation. This kind of saving is not used for lending purposes and pays lower/no interest /service charge/on saving.

6.4.3. Time Deposits:

Time deposits are collected by saving and credit cooperative when it is needed. Normally time deposits are fixed for some period of time and the depositor can only claim for the amount and interest after the agreed up on time has passed. Higher interest rate is paid for these deposits because the cooperative uses immediately for lending purpose. Time deposits can't serve as collateral for loan.

6.4.5. Share:

Shares are deposits that represent the net worth of the members' equity in the saving and credit cooperative. Shares are normally collected in proportion to a member's compulsory savings at fixed leverage ratio. Members have the right to withdraw share from the cooperative when they have decided to quit membership and usually with drawn the cooperative transactions were audited. It is this share that brings profit and loss to the individual members. When the cooperative become in loss it is the money contributed in the form Shares affected negatively. When the cooperative get profit members will get dividend from the profit obtained based up on their share holdings and participation with in the cooperative.

6.5. Basic concept of credit

6.5.1. Definitions

The way the term “credit “is defined by various authors varies from time to time and person to person. Although the means of explanation differs, the core idea remains the same and applicable based up on situations. Some of the definitions are as follows:

- Credit is some of money which, when added to my savings, makes it possible for me to carry out my project
- Credit can be defined as the money borrowed for short and long period and repaid latter.

Borrowing: Involves obtaining certain amount of Funds to be repaid as specified in the contract

Repayment: is the amount of credit which is scheduled to be recovered at some specified time period

Repayment capacity: refers to the amount available with the farmer after meeting his farm and family needs and obligations to repay the loan.

6.5.2. Credit needs

The need for credit in the case of a majority of farmers arises from the fact that, their surplus out of which saving can be made is low. Besides their income source came from limited period of the year while their various expenses are distributed throughout the year. Credit needs of farmers can be broadly divided in to two types:

- Productive expenses-these encompass purchase of seeds, fertilizers, herbicides, insecticides, irrigation equipment, purchase of livestock, implements and payment made to labor in the case of farming activities.
- Non Productive expense-These categories consist of expenses for marriage, death, serious illness and other social events in the family.

6.5.3. Principles of Agricultural credit

Three R's of Credit

Farmers as a whole will have to borrow at one time or other. Before a farmer borrows money to expand its farming operations, he needs to weigh all other possibilities of obtaining necessary funds. There are three basic considerations before a model farmer decides to borrow:

A. Return from investment

This is an important measure in the credit analysis. The model farmer needs to have an idea about the extent of returns likely to be obtained from the proposed investment. The demand for credit can be accepted only when the borrower will be able to generate returns that will enable him to tide over the costs. The main concern here is that the borrower should be able to generate incremental income when they go for the additional returns from the borrowed funds.

B. Repaying capacity

C. It is the ability of the borrower to clear off the loan obtained for production purposes within the time stipulated by the lender. The loan amount may be productive enough to generate additional income to the borrower, but it may not be productive enough to repay the loan. Hence, the necessary condition here is that the loan should not only be profitable but also have potential for effecting repayment. Then only the borrower has a favorable point on his side.

D. Risk bearing ability

It is the ability of the borrower to withstand the risks that arise due to financial loss. The borrower may satisfy the Lender with regard to returns and repayments capacity, but yet another factor to be fulfilled is risk – bearing ability. It is the ability of a borrower to with stand unforeseen expenditure and unexpected losses of income and still continue the business he is carrying on.

Examine whether the loaner is capable of repaying a loan even in bad years. This calls for assessing his credit worthiness and moral character Small land holding sizes

- Low production due to poor management
- Low price of farm products
- Shortage of water or rain fall
- High cost of production
- Lack of awareness about credit concepts
- Division of credit for consumption purpose

Ways to strengthening repayment capacity

- Organizing and operating farm business to increase profit
- Using improved technology for increasing production or reducing cost
- Adjusting time for loan repayment
- Educating borrowers about concepts and principle of credit

What is expected from borrowers in the process of facilitating credit?

In order to get credit from lending institutions like saving and credit cooperatives, micro finance institutions and banks borrowers should fulfill certain criteria that is expected from them. Among these, the following are the critical ones:

- Knowing the purpose of getting credit
- Carefully understand the type of credit and amount of credit
- Know when to borrow and match with seasonal production period
- Understand the amount interest to be charged on the loan amount
- Understanding the fact that poor in loan repayment will harm the relationship with the lender and future of the organization in accessing loan from others

What will happen if the borrowers fail to pay on time as per their agreement?

- It disturbs the plan of the lending institution
- It prohibits the situation accessing more credit to potential borrowers

- It brings loss to rather than profit to farmers as credit amount increase from time to time

Advantages of timely repayment of credit

- It facilitates the condition of accessing loans to more farmers
- It makes the lending institution profitable and become strong
- It encourages the lender to better service to the rural community
- It enables the farmers to get credit at lower difficulty and low accessibility
- It upgrade economic development of the nation

Annex I. Sample business plan outline for small scale farming activity

1. Full name of the business operator:

2. Address:

Woreda

Town

Kebele

House No.

3. Type of the plan/work/business in which the operator is/to be engaged:

.....

4. Year/Quarter of the plan: from to

5. Work premises at the disposal of the operator:

.....

Specify, if there is any problem:

.....

.....

6. Yearly/quarterly sales plan:

Ser. No. Product/service to be sold, marketed/year

Unit	Quantity	Unit price	Total price	Remark
------	----------	------------	-------------	--------

Total sales

Months during which sales are expected to be high:

.....

.....

7. Equipment currently owned by the operator:

Ser. No.	Type of equipment	Unit of measure	Quantity	Unit cost	Total cost	Remark
	Total cost of equipment					

8. Equipment to be purchased by the operator:

Ser. No.	Type of equipment	Unit of measure	Quantity	Unit cost	Total cost	Remark

	Total cost of equipment					

9. Yearly raw material requirement:

Ser. No.	Type of raw material	Unit	Quantity	Unit price	Total price	Remark
	Total yearly raw material cost					

Source of raw material

10. Other yearly operating expenses (e.g., labor costs, sales expenses, depreciation, taxes, etc.):

Ser. No.	Types of expense	Amount of expense in Birr	Remark
	Total expense		

11. Yearly production/service plan:

Ser. No.	Types of production/service to be	Unit	Quantity	Unit cost	Total cost	Remark
	Total cost					

12. Financial plan:

Capital requirements	Equity	Loan	Total
Investment capital:			

1. Machinery + equipment			
2. Furniture			
3. Business premises/houses etc...			
4. Any other initial and significant outlay			
Working capital:			
1. Salary/wage			
2. Raw material and/or supplies			
3. Rent			
4. Maintenance			
5. Business promotion			
Total:			

13. Yearly profit and loss plan:

Particular (in Birr)	Amount (in Birr)
I Cash Receipts	
II Expenses	
Operating expenses of costs	

Total operating expenses	

Fixed expenses or costs	
Total fixed costs	

V Net farm income _____	