ENGINE: Empowering New Generations to Improve Nutrition and Economic opportunities

A program under the Global Health Initiative and Feed the Future Initiative

VEGETABLES & FRUITS PROUCTION GUIDELINES

Vegetable production through the support of ENGINE at Home garden (left) and at FTCs (right)

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Vegetable and Fruit Production Guideline

Introduction

ENGINE is an integrated nutrition program with the objective to improve the nutritional status of children and mothers. The Livelihood & Economic Strengthening (LES) sub-component of the program supports improved nutrition by working within the context that agriculture has paramount importance to improved nutrition through implementing "nutrition sensitive" or "nutrition friendly" agricultural interventions. Nutrition sensitive agriculture is defined as "Agricultural interventions that involve the design and adoption of cropping and farming systems (crops & animal) which can provide agricultural solutions to the prevailing nutritional problems, or agricultural interventions that will have an impact on nutritional outcomes."

With these prevailing concepts in mind, the LES teams interventions focus on the most vulnerable households within the programs implementation woredas. Special emphasis is placed on those households with pregnant and lactating mothers and children under the age of five. These households will receive targeted support that addresses food availability and access and utilization problems at household level that have an impact on nutrition. At the same time, the LES team realizes that to have a sustainable impact on improved nutrition support needs to be provided to the "wider community" which can be defined as households in the ENGINE program area that may not be food insecure but may sit on the cusp and certainly are part of the broader value chain. The "wider community" will receive training on dietary diversification through agricultural and health extension services focused on health sensitive cooking practices, nutritional education and social behavioral change communication (SBCC). With support to both the wider community and to the most vulnerable households, the ENGINE program will improve nutrition through dietary diversification through demonstrations and training on vegetable and fruit production..

These guidelines are for the use of ENGINE regional nutrition & livelihood officers, zonal coordinators, staff of Woreda Agriculture Office, Development Agents and school teachers involved with school garden sites. Specifically, the information outlined in these guidelines will help field staff advice smallholder farmers and students on the type of crops to be adopted to their specific agro-ecological environments, as well as explain the best conditions for production of different crop types and the subsequent techniques to be applied to grow them satisfactorily.
This manual is intended to be a living document that will be updated by the LES team over the course of the ENGINE program.

The next sections cover implementation procedures, targeting criteria of most vulnerable households, identified Farmers Training Centers FTCs and schools for ENGINE support (annex 1), roles and responsibility of stakeholders (annex 2), basic principles of vegetable and fruit production in a small-scale environment, such as school gardens, FTC demonstration plots and homestead gardens (annex 3), nutrition facts of vegetables and fruits under consideration (annex 4) and inputs dispatch formats (annex 5).

Implementation Procedures

1. Homestead Vegetables and Fruit Production

The homestead garden is the area around the house that is used for a garden to produce various crops. Home gardens are a way to improve micronutrient intake, improve dietary diversity, potentially provide or supplement, women's income and mitigates against seasonality. In addition, homestead production, supported through extension services, nutrition education and agricultural inputs for the poorest segment of the community, can offer substantial improvements in health and nutrition. Evidence indicates that even small-scale homestead production of micronutrient-rich foods, when combined with nutrition education, can have a greater impact on household income and nutrition. Accordingly, ENGINE promotes the practice of homestead production of vegetables and fruits and its consumption targeting two types of households in AGP woredas.

(i) ENGINE supports vulnerable households: selected vulnerable farm households will be identified using a selection criteria (annex 1) and provided full support (explained below) to help them grow nutritious vegetable and to plant fruit trees of high nutritional value for consumption. The program will assist them with marketing techniques for those households that produce a surplus of either fruit or vegetables, or both, to improve household income and create economic opportunities.

(ii) The wider community or households: ENGINE targets productive AGP woredas and households which are producing surplus crops of export value, not necessarily have nutritional value. However, under nutrition rates especially stunting is still very high (above 30%, preliminary ENGINE baseline survey). ENGINE will use the existing extension service, FTCs, and school gardens to promote and transfer agricultural skill for producing fruits and vegetables to food secure or non-vulnerable households. It will promotes the consumption to the wider community through cooking demonstration and nutrition education on the importance of dietary diversification using AEWs and HEWs as part its SBCC interventions. .

1.1 Targeting of most vulnerable households for ENGINE Support (homestead vegetables and fruit production and productive livestock)

The Woreda Agricultural Office, in consultation with ENGINE zonal and regional team, is tasked to select a kebele where homestead vegetable and fruit production will be undertaken. Once the kebele is identified, the most vulnerable households will be selected per established criteria in Annex 1 and through the participation of the community using the community level participatory planning (CLPP) tool of Agricultural Growth Program (AGP). Development agents (DAs) and Health Extension Workers (HEW) will provide guidance and advice to identified households on agricultural best practices, nutritional cooking and consumption at household levels (annex 2).

1.2 ENGINE support for most vulnerable households

Support to the most vulnerable households consists of provision of vegetables seeds, fruit seedlings, and basic hand tools and training. The amount of seed that will be provided to the household depends on the size of plot that would be allocated by the households from the backyard (seeding rate annex 3 Table 1). The size will vary from household to households but will generally be in the range of $50m^2$ to $100m^2$. Crops targeted and promoted will emphasize nutrient content, acceptable for young children, as well as the household's familiarity with production and consumption and adaptability to the agro-ecological conditions. Accordingly, green leafy vegetables such as head cabbage, Swiss chard, kale, root crops such as carrot, Irish potato and sweet potato will be crops under consideration (annex 4). Introduction of orange flesh sweet potato (OFSP), which is rich in vitamin A, pumpkin and green beans will also be encouraged in areas where the crop is expected to perform best and likely to be adopted by the community.

In terms of fruit production, the program will prioritize avocado, mango, papaya and apples based on the agro-ecological environment. Horticulture nursery centers established through Small Holder Horticulture Project support (USAID-MASHAV-MOA) managed and owned by the respective woreda office of agriculture may be the preferred sources of fruit seedling supply since seedlings produced in these nurseries are true to type, disease free and grafted. In order to complement the existing horticulture nursery centers ENGINE will support the establishment of one mini nursery per region. The number of seedling provision per household is expected to be in the range of 5-10 seedlings, but this depends on the size of backyard holdings and type of fruit tree. In order to maximize land use, the households will be advised to plant the fruit trees along the perimeter of their properties. Moreover, intercropping with crops including legumes, cereals and vegetables is imperative to effectively and efficiently utilize the land available between fruit trees.

The program will provide limited type of hand tools for the households that will be used for the cultivation of crops planted in the homestead (annex 3). Due care should be given in the provision of hand tools through identification of felt needs rather than a blanket approach. Basic hand tools for consideration are spades, fork, pick ax and watering cans in areas where irrigation is practiced for homestead crop production.

Availability of water to irrigate crops during the long dry season is vital and needs to be considered seriously for the support to have sustainable impact. Vegetable production necessitates both day to day activity and follow-up, hence a lot of time commitment. So, households that will be involved in the homestead horticulture crop production may require an able work force to maintain the gardens properly.

1.3 Organizing Targeted Households into Groups

Targeted households will have to individually carry out their economic activities supported by the program. Nevertheless, households targeted for homestead production of vegetables and fruit will be organized into a group of their interest. The group of 10 household heads is the recommended size, mainly from a management standpoint. The Woreda cooperative offices are expected to play the major role in organizing the groups. The group formation will follow the AGP group formation principles and guideline. Group formation facilitates service provision such as training, input supply as well as marketing to further lay the ground for economic path whereby the group transits to association or a cooperative, or is linked to existing financial service providers. The providers may include rural savings and credit cooperatives or micro finance institutions to start saving and consequently access financial services to sustain their livelihood endeavors. It should be noted that households targeted for homestead vegetable and fruit production will also receive productive livestock so that they will have animal source foods as part of their diet.

2. Demonstration of Agricultural Practices and Cooking

Demonstration of agricultural production of vegetables and fruits, coupled with cooking practices using these crops will reach the wider community in order to create awareness and the possibility of dietary diversification at household levels. Farmer training centers (FTCs) and schools are the preferred venues for demonstration activities. ENGINE will technically, materially and financially support selected FTCs and schools interested in producing vegetables and fruit crops through organized demonstration events in their respective vicinities.

2.1 Selection of FTCs and Schools for demonstration of Vegetables and Fruits: -

FTCs and schools will be selected as per the criteria establish for the same (Annex-1) by the Woreda Agricultural Office and Woreda Office of Education respectively.

The size of plot to be allocated for the demonstration of vegetables and fruits per the FTCs and schools should be in the range of 500- 1000m^2 that is a minimum of 200m^2 for vegetables and a 300m^2 for fruits.

The amount of vegetable seeds and fruit seedlings to be provided to FTCs and schools will be as per the respective institutions' proposal, which should be further based on the plot allocation per crop within the limits of total plot size allocated for the demonstration purpose. (Seeding rate and spacing annex 3 Table -1)

Schools requesting to implement the program; depending upon availability of funds, will be provided with basic tools to run the school garden. Since FTCs are expected to receive capacity building support from the Agricultural Growth Project (AGP), ENGINE will not provide support of hand tools.

2.2 Organizing Demonstration Events on Agricultural Practices and Cooking

ENGINE will demonstrate improved agricultural technologies and cooking practices of vegetables and fruits twice per cropping season in the targeted woredas. However, if planting is carried out using irrigation during the off-season demonstration events can be done on the frequency of production. The demonstrations are expected to be carried out as follows:

- When the crops are well established and ready for demonstration of improved farm technologies to the wider community. The period of demonstration varies from area to area, but it is preferred to be undertaken during times when major farm operations of the communities are low.
- When the crops are maturing (ripening) to demonstrate cooking practices to the wider community. The period should be similar to the above and can be achieved by planning the planting date appropriately to fit to the slow season of specific areas.

2.3 Linkage to Markets: -

In order to sustain the demonstration at FTCs and school garden, vegetable crops produced at these sites need to be marketed before the crops spoil. The income from the sales should be used for subsequent production and demonstration. The respective Woreda Agriculture Office and schools are responsible to plan ahead of time on method for selling crops. ENGINE Regional

Nutrition and Livelihood Officers and Zonal Livelihood Coordinators will facilitate marketing linkages in their operational area. Possible marketing channels could be farmers in the vicinity, local markets, cooperative unions, private vegetable assemblers and traders in the order of importance. As much as possible ENGINE promotes local markets in order to improve the consumption by households in the area.

Homestead vegetable and fruit production is predominantly intended for consumption at household level to improve diet diversity – particularly among children and mothers. In areas where vegetables are cultivated during the off-season using irrigation, a staggered planting scheduled will be encouraged to spread the harvest availability over a longer period of time for own consumption and sale of the surplus. Households targeted for homestead vegetable and fruit production will be advised to prioritize household consumption over sale.

Once the harvest surpasses the needs of the households, small holder farmers should be linked up to marketing outlets. Considering ENGINE's objective, will be advised to use income generated from the sales of the surplus produce to address nutritional problems such as purchasing animal products that are not available in the household. Whatever is left from the sale of the produce, after fulfilling nutrition requirements, most be saved and invested to expand production and build asset that will enable them to move to a level of economic status of AGP participants. The saving could be initiated as a group that will transit to a sort of cooperative or joining existing saving and credit cooperatives or microfinance institutions in order to access financial products.

The nutrition education and social behavioral change communication (SBCC) interventions of ENGINE is expected to bring about a behavioral change in consumption habits of the targeted households and the community at large.

3. *Establishment of Mini-Nursery (Mother Clone Garden)*: -

The program will set up two mini nurseries in Oromia Region and one in the three remaining program regions to meet the ever growing demand of improved and true-to-type planting materials of vegetables and fruits. It is also expected that farmers in the regions will have dependable access to planting materials year round to grow the crops for consumption and marketing.

ENGINE will provide financial, material and technical support for the establishment of the mini-nursery. The nursery is owned and managed by the respective Woreda Agricultural Office.

Once the nurseries are established and start producing planting materials, they can easily cover running costs from sales. Basic requirements to select the nursery site include:

- The nursery should be set up on level ground with good drainage.
- The nursery site should have a reliable and uncontaminated water supply available. .
- The soil of the nursery site must be ideal such as sandy loam, clay loam and hummus for the germination of seeds and seedling growth and development.
- To avoid duplication, mini-nurseries to be established through the support of ENGINE should not be in the same zones with nurseries established by the Smallholder Horticulture Project of USAID- MOA-MASHAV.
- The mini-nursery is expected supply a number of Woredas in their geographical areas with improved fruit and vegetable planting materials.
- The Woreda Agricultural Office should assign a full-time nursery manager so that the nursery will be managed adequately and sustainably.
- The nursery managers will be trained in management and horticulture production in cooperation with Smallholder Horticulture Project of USAID-MOA-MASHAV. The training will be in both theoretical and practical aspects of nursery management.

Annex 1 (a): Targeting Criteria to Select Most Vulnerable Households/Individuals

Basic Criteria to select Most Vulnerable Households	Possible Source of information
Household should be member of the community/kebele	Kebele record and community
Female headed household	Kebele record and community
Youth or child headed household	Kebele record and community
Women in reproductive age, pregnant and lactating mothers	Community
Poor household with above three months of food gap (based on wealth ranking)	Community
Orphan & vulnerable children (OVC) through their caretaker	Kebele record and community
People living with HIV (PLHIV)	Kebele record, Health facility record and referral mechanism
Households with productive age family member (lactating and pregnant women) and inadequate access to food	Health facility record and community
Disabled person who do have family labor	Community

Households with children less than 2 years of age, pregnant and lactating mothers, relatively large family size	Kebele record, Health facility record and referral mechanism
Landless households willing to form a group for off-farm activities	Kebele record and community
Willing to form or join a group of common interest based on the type of interventions organized through AGP	Individual consent
Physically able to do on-farm activities, and	Community & individual consent
Who do have plot of land for on-farm activities. A minimum of $50m^2$ and a maximum of $100m^2$ for homestead gardening.	Kebele record and community

Annex 1(b) Selection Criteria for FTCs and Schools

	Farmers Training Centers (FTCs)	**School Gardening**
1	Functional at least for 2 years	Functional at least for 2 years
2	Access to water for irrigation or deep wells preferable	Access to water for irrigation or deep wells, spring, etc. is mandatory
3	Suitable soil type for horticultural crops preferable	Suitable soil type for horticultural crops (vertisol) or black soil not recommended
4	Accessibility or location of the site suitable for demonstration	Adequate plot area without drainage problem, a minimum of $500m^2$ and a maximum of $1000m^2$.
5	Adequate plot area without drainage problem, a minimum of $500m^2$ and a maximum of $1000m^2$.	Active parents and teachers association (PTA)
6		Willing to work with HEW and DAs
7		Market availability for the produce, preferable
8		Elementary or secondary schools (not nursery schools)

Annex 2: Roles and Responsibilities of Different Stakeholders to undertake ENGINE Program.

In order to improve nutrition, agriculture has a paramount importance through implementing "nutrition sensitive" or "nutrition friendly" agricultural interventions. Nutrition sensitive agriculture is defined as "Agricultural interventions that involve the design and adoption of cropping and farming systems (crops & animal) which can provide agricultural solutions to the prevailing nutritional problems, or agricultural interventions that will have an impact on nutritional outcomes." To implement interventions planned under the livelihood sub-component of ENGINE, an attempt is made to specify the role and responsibility of the main actors as follows:

The livelihood team based in the country office (Addis Ababa) shall oversee, advice and supervise the implementation of activities planned under the livelihood and economic strengthening sub-component of the ENGINE program. As this document is a living document, the team is also responsible to update it, based on lessons learned in the course of implementation.

1. *Save the Children Regional Office livelihood officers and zonal coordinators*

- Provide technical advice on the production of nutritious vegetables and fruit trees including crop types and variety selection, agricultural input determination and cultural practices to be applied to program implementers and target beneficiaries whenever required.
- Facilitate training for trainers on the guidelines to pertinent staffs of the Woreda Agriculture Office. The trainers are expected to train the DAs and other key players engaged in vegetable and fruit production/demonstration such as teachers, members of the parent associations and kebele development committee who will then train students and target beneficiaries. The objective of the training must be to improve skills and increase knowledge.
- Facilitate experience sharing visits of DAs to best performing FTCs, Schools and Homesteads in livelihood activities within the region.
- Oversee the overall livelihood and economic strengthening activities including vegetable and fruit production, and marketing of surplus produce of school gardens, FTCs and target beneficiaries
- Encourage and advice the consumption of vegetables and fruits at household level.
- Advice, support and promote savings from the sale of produce and assist in identifying institutions that provide credit to beneficiaries. Access to credit to beneficiaries is essential to expand and develop their production base and to become sustainable.

- Assist target beneficiaries, FTCs, schools and DAs to identify market outlets of farm produce and advise them to undertake value chain analysis on major vegetables and fruits for sustainability of the program objectives.

2. Woreda Agricultural Office

- Select Kebeles and FTCs in consultation with ENGINE regional team where livelihood activities will be undertaken
- Oversee the proper application of farm practices of vegetable and fruit tree demonstrations, and production at the FTCs, schools and homesteads;
- Continually upgrade DAs capacity through training on improved agricultural technologies so that program implementers and direct beneficiaries are advised and trained on the job to improve and boost productivity and production;
- Help investigate and identify dependable agricultural input suppliers such as certified planting materials suppliers and market outlets for the produce of FTCs, schools and targeted households;
- Organize vulnerable households targeted for ENGINE support in to groups and link them to financial service providers;
- Advise on the agricultural calendar:
    - To avoid waste due to a surplus of produce in the markets.
    - To avoid seasons/conditions that favor crop diseases and pests.
    - To get price advantages when market supply of particular produce is relatively low (To maximize niche markets). Help in identifying financial institutions that provide credit and link program implementers to acquire credit so as to expand and develop their production and processing activities etc.

3. Development Agents (DAs)

- Provide hands-on training on cultural practices of vegetables and fruits production to target vulnerable households , school teachers, students and parent association members involved directly in school gardens demonstration activities periodically; continually upgrade their knowledge on new and improved agricultural technologies relevant to the production and productivity of the commodities grown;
- Closely advise and monitor farm activities of target vulnerable households and school gardens;
- Advise targeted vulnerable households and other program implementers on the type of crops and cultivars to be grown in the area and determine the planting materials (seeds) and other input requirements based on the crop type, land size, agronomic practices;

- Advice the wider community on the importance of diversified diets for the household in general and for children and mothers in particular;
- Help schools and FTCs to prepare field days to demonstrate farm activities as well as cooking practices to the wider community, and advise them to undertake the events during the appropriate time of year;
- Assist program implementers and target beneficiaries in identifying credible input suppliers and link them to market outlets for their produce;
- Help program implementers and target beneficiaries in identifying and linking up with financial organizations that provide credit for farm activities;
- Promote close collaboration of DAs with health extension workers posted in their duty area, specifically to assure that harmonized nutrition messages are passed to the smallholder farmers.

4. *Students, teachers and parent association members involved in school garden activities*

- Carry out farm activities effectively and efficiently as per the advice and guidance provided by DAs and agriculture experts of the Woreda;
- Attend training to be conducted by DAs and others on crop production, marketing, financial management, etc.;
- Keep in touch with DAs regularly and seek advice on agronomic practices and other issues related to the production, demonstration and marketing of vegetable and fruit crops;
- Assign students to work in the garden on a daily basis, and design a mechanism to control and monitor regularly proper application of farm activities;
- Plan the vegetable and fruit garden operations properly so that the produce is supplied to the market on a regular basis throughout the year; care should be taken not to oversupply the markets with produce at a given time in order to avoid waste of produce and minimize financial loss;
- Revolve the income obtained from the sale of the produce to sustain the school gardening activities,
- Undertake demonstrations on agronomic and cooking practices
- Organize skill transfer events to families of students;
- Students are expected to promote and assist their families and neighbors in the production and consumption of vegetables and fruits;
- Exert maximum efforts to establish dependable markets for produce and explore creditors to acquire financing of farm operations and assure sustainability.

5 *Target Households*

- Allocate the minimum size of land specified in the guideline for homestead production of vegetable and fruits;
- Undertake vegetable and fruit production as per the guidance and advice of DAs;
- Attend training to be conducted by DAs and others on production, nutrition, storage, processing, cooking, marketing of vegetables and fruits;
- Consume vegetables and fruits produced in the gardens to improve nutritional status of the family in general and children, pregnant and lactating mothers in particular and as well as market surplus produce to strengthen economic status of the household;
- Purchase animal source foods that are not available in the household from the from the sale of produce of vegetables and fruits;
- Sustain the homestead production of vegetables and fruits from the sale of produce of vegetables and fruits;
- Initiate and build up savings from the sale of produce, and invest to expand vegetable and fruit production to further strengthen the economic status of the household;

  Obtain credit from financial organizations that offer loans to diversify economic activities aimed at improving healthy and sustainable economic status for the household.

Annex 3 Basic Considerations and Agronomic Practices for the Production of Vegetables and Fruit Crops

These guidelines highlight fundamental principles and practical approaches for small-scale production of vegetables and fruits and will not attempt to cover all the techniques applied in vegetables and fruits production. Most of the techniques explained here are compiled from various sources and have been adapted and practiced widely, including in Ethiopia.

1. Basic Considerations

1.1 Site Selection

As best as possible, sites for gardening must be on level ground, very near to water sources, and visible from FTC offices, class rooms and homes. They should also be accessible for field staffs and others to visit.

1.2 Seed Sourcing

Concerted efforts and due care should be given for seed sourcing. There are three basic considerations in sourcing horticultural seeds:

First, they must be selected from good stock and true to name; seeds should be good, strong, and plump, full of life and gathered from healthy plants; and they must be fresh.

Second, buy seeds from farmers who make a point of growing and testing their own seed.

Third, buy seed from several farmers and weed out to the ones which prove, to be the most reliable, once out planted.

Another good plan is to purchase seed of any particular variety from the firm that makes a leading specialty of it; in many cases these specialties have been introduced by these firms and they grow their own supplies of these seeds; they will also be surer of being true to name and type.

2. *Vegetable Seedling Production and Nursery Management* [1]

A nursery is a place where optimum conditions and care for vegetable seed germination and development are given until such time that seedlings are strong enough to be transplanted in the field for production. Some of the advantages of growing seedlings in the nursery include:

- Intensive care: Seedlings normally are well cared for and protected from animals, weeds and pests in the nursery beds.
- Cost reduction: The amount of seeds required for raising seedlings in the nursery is lower than sowing directly in the field. In the field, seedlings need to be thinned to maintain optimum plant density, resulting in a waste of seeds and seedlings.
- Opportunity for selection of vigorous seedlings: Nursery beds provide an opportunity to select vigorous, disease-free and uniform seedlings.

2.1 Nursery Site Selection

The following factors need to be considered to select a nursery site.

- Proximity to the field where seedlings are planted: A nursery needs to be near fields in order to minimize transport cost of seedlings, avoid damage of seedlings arising from long distance transport and reduce the chance of transmitting diseases and pests.
- Slope of land: It is preferred to have a nursery on level ground with good drainage. This helps reduce the costs associated with conservation measures such as terraces construction which protects soil from erosion on sloppy land.
- Water supply: A reliable and uncontaminated water supply should be available in the nursery site. The water supply could be from boreholes, natural streams, wells and irrigation canals.
- Ideal soil type: The nursery must be located on good quality soil for production of vegetable seedlings.

2.2 Nursery management

2.2.1 Soil preparation: The nursery beds should be prepared well, leveled with fine soil to enable root systems to spread easily for optimum capture of nutrients and water so as to grow and develop satisfactorily.

2.2.2 Sowing: Seeds should be planted on well prepared seed beds, and thinned or transplanted. In order to have uniformity for small seeded crops, it is advisable to mix the seed with fine soil or sand before sowing, then plant in rows for ease of management. Care should be taken to avoid sowing too deep; each crop has a recommended depth for sowing.

2.2.3 Mulching is_covering the seed bed around plants with dry organic materials such as grasses, hay, and weeds (before they produce seeds). The best material for mulching is of a light color to reflect the rays of the sun. Mulching is good for conserving moisture in the soil by reducing evaporation, protecting the soil from water and wind erosion, reducing incidence of weeds and maintaining soil temperature.

[1]Nursery-management.blogspot.com/

Figure 1 Seed bed mulched with grass straw

2.3 Seedling Management

- Shading: Shading is needed to protect young seedlings from damage due to high heat and heavy rains. Shades can be polythene nets or grasses. The shades must be removed one to two weeks before planting seedlings in the field to allow them to adapt to the field conditions.
- Watering: The nursery bed should be watered with fine streams of water until the seedlings are well established, after which watering should continue periodically until the seedlings are transplanted. It is advisable to irrigate in late afternoon or early evening.
- Thinning: This practice is carried out to regulate plant density. During thinning, weak, diseased and abnormal seedlings are pulled out to give healthy seedlings the chance to grow and develop well. This practice is normally carried out when seedlings form a few true leaves.
- Weeding: This practice is carried out manually whenever weeds emerge.
- Disease and pest control: This practice is done continuously from germination to transplanting. It is usually done by physical means such as picking by hand, rouging infected plants and shacking, etc. but chemicals may be used when deemed necessary.
- Hardening off: Seedlings ready for transplanting should be hardened off in order to adapt to the field conditions. This process involves removing shade cover for gradual exposure of transplants to higher or lower temperature and the high light intensity prevailing in the field for 1 to 2 weeks prior to transplanting.
- Transplanting: This is the removal of seedlings from the nursery seed beds and transfer to the field for growth to maturity. The nursery beds must be watered before the seedlings are lifted out to allow the roots to retain plenty of soil. The field where the seedlings will be out planted must also be irrigated before seedlings are transplanted so that planting holes can be opened up easily and the seedlings easily fixed. Cloudy weather or late afternoon is preferred for transplantation.

3 Land preparation for planting

Methods of field preparation must take in to account soil conservation, environmental protection & efficient use of water resources.

3.1 Tillage

The field should be tilled or plowed with due care. Roots of previous crops, lumps & stones should be removed from the field. Care needs to be taken to avoid too much disturbance of soil layers so as to reduce bringing up poor quality layers (sub-soil) to the surface, and to minimize wind and water erosion. Normally, the roots of most vegetable crops are shallow and can extend up to 60 cm in depth. So, depth of tillage should coincide and/or take into account the size of the roots of different crop types to only allow the root systems to spread into the soil smoothly and obtain plant nutrients and water for the crop. The soil should also be fairly loose and fine to ensure proper germination.

3.2 Characteristics of common soil types [2]

3.2.1 Clay soils are characterized by their ability to retain moisture and harden the soil. If a particular soil contains too much clay, it is likely to damage crops by preventing water and nutrients from reaching the root systems, causing water logging and suffocation, and hindering the growth of the roots of crops. These types of soils require adequate drainage systems to grow vegetable crops. They are not normally recommended for vegetable production if other soil types are available.

3.2.2 Sandy soils are characterized by very low water retention capacity. They permit water to easily trickle down into the soil and drain quickly. Sandy soils are good for root growth and circulation of air. These types of soils are good for vegetable production provided water is available to irrigate frequently in order to keep the soil moist for the plant to grow and develop.

3.2.3 Sandy clays are soils with roughly similar proportion of clay and sand. They are characterized by having the quality of moderate soil moisture retention capacity and good permeability to the growth and development of roots of crops. These types of soils are good to grow vegetables but require regular checking of soil moisture for timely watering.

3.2.4 Humus is a decomposed organic matter resulting from the death and decay of plants, animals and microorganisms over a long period of time. They are rich in soil nutrients and good in retaining soil moisture. These types of soils are very good for the production of vegetables.

3.2.5 Loam soils consist of sandy, clay and humus in about equal proportions. These soils are known to have a high level of plant nutrients, including nitrogen. These types of soils are very good for the production of vegetables and are therefore recommended to all types of vegetables to grow.

[2] FAO (2010) GAP working paper series 13: GAP on horticultural production for extension staff in Tanzania, training manual.

3.3 Common seed bed types

There are several types of seed beds used for direct planting and seedling production of vegetable crops. Some of the common seed beds include flat beds, sunken beds, raised beds, ridged beds etc.

3.3.1 Flat beds: These are suitable in areas where the land is plain with adequate drainage and are also easy to set up.

3.3.2. Raised beds: These are commonly used type of seed beds. They are easy to maintain and suitable to drain excess water, especially during the rainy season or when water logged soil conditions are expected.

3.3.3 Ridge beds: These are mainly used for root crops; known for draining excess water out of heavy soils during the rainy season.

3.3.4 Sunken seedbeds are used in areas of prolonged dry conditions to conserve moisture.

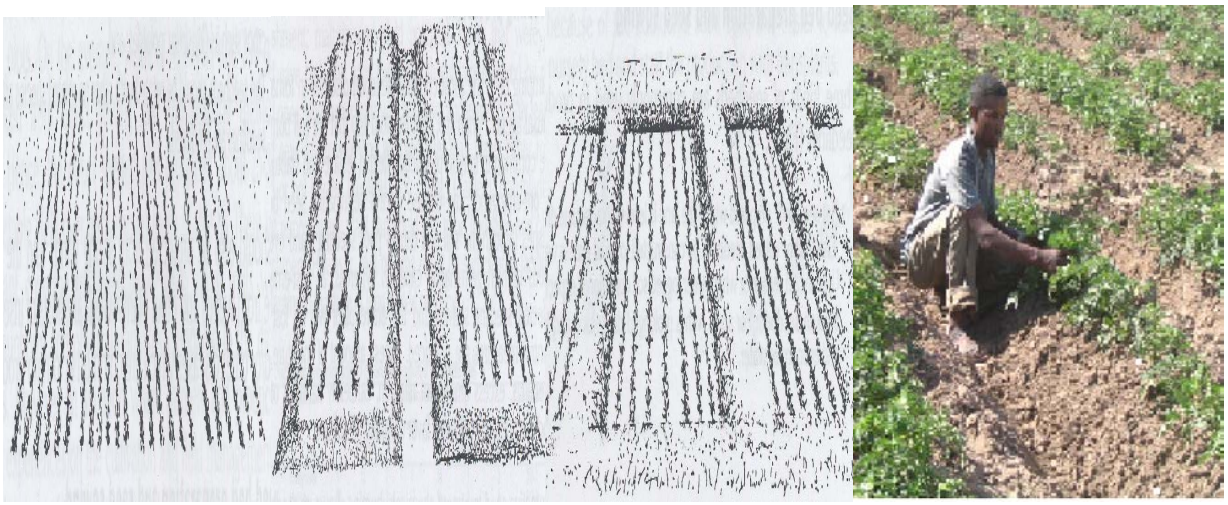

Figure 2: Flat, raised, sunken and ridged seedbed (from left to right respectively)

4 Seedbed design/layout

In most instances, raised type of beds are practiced and recommended. They are easy to maintain, productive and good to improve the soil. The size and number of beds vary depending on the availability of land, labor, and financial and material resources and purpose. The width of a bed should not exceed more than 1 – 1.5 meters to avoid walking and kneeling on the beds. The length can go up to 10 meters or above depending on the purpose and availability of

resources. The shape of the beds is preferred to be rectangular for ease of management, but depending on the available land, other shapes can also be used.

Pathways between seed beds are very essential for working on the beds comfortably. Normally 50 to 100 cm between beds would be enough to allow people to work and pass goods through easily.

5 Application of Compost

Application of inorganic fertilizers and pesticides are not recommended for home gardening considering that, in most cases, backyard soils are rich in organic matter (if not, compost or manures could be used instead). USAID regulations will not allow procurement of inorganic fertilizers and pesticides unless a waiver is obtained with adequate justification. Therefore for production of vegetables at homestead, FTCs and schools, we recommend use of compost, manure and integrated pest management. It has to be noted that if households, FTCs and schools intend to use inorganic fertilizers and pesticides, they can do so but ENGINE will not cover the expenses related to these inputs.

Composting [3] is a natural conversion of organic matters from animals and plants into humus by earthworms and microorganisms. Humus is rich in important plant nutrients such as nitrogen. It is a natural fertilizer that improves the nutritional content of the top soil and enhances the growth and development of plants.

Most materials which are organic in nature can be used to make compost. These include weeds, straw, leaves, animal manure, animal and fish bones, kitchen waste, wood ash, feathers, soil, cotton clothes etc. Compost is normally made in a pit or pile in the field. The making of compost is easy.

- Dig a hole. The depth and width of the hole depend on the area to be planted.
- Put organic materials indicated above in to the whole regularly. Don't use plastic materials, metals, glasses, wire, and synthetic fabrics.
- Turn the compost every few weeks to allow air to circulate.
- Keep it damp by watering it regularly.
- When the color of the compost becomes dark or looks like soil, it is ready to use (3-6 months).

[3] Catholic relief services-United states conference of catholic bishops (2008): Homestead gardening, a manual for program managers, implementers and practitioners.

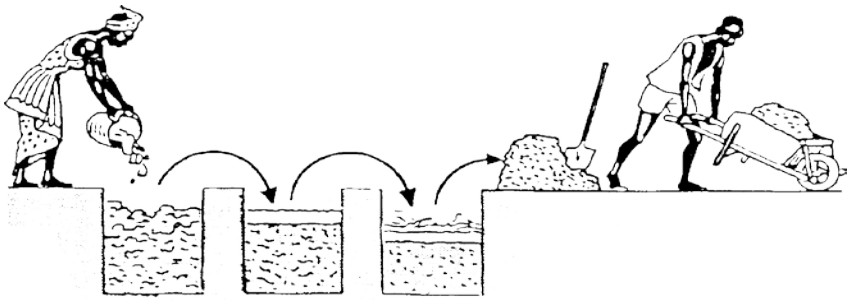

Figure 3: Process of compost making

Manure is natural (organic) fertilizer composed of livestock or chicken dung. It is an excellent source of plant nutrients. It is applied on the soil when it is dry and crumbling.

6 Sowing and transplanting

6.1 Direct seeding

The seeds for direct planting are normally large and sown at a distance recommended for the size of the mature plant. It is advisable to use sticks, pegs and strings to measure distances between plants and rows. Make furrows at a depth of about 3 to 4 times the diameter of the seed to be sown. Add a little compost or manure in the furrow, drop the seeds, cover it with soil and press down lightly.

Water gently and keep it wet. Be sure that the distances between plants and rows are according to the recommendations. If the distance between plants is narrow, thin them out when the height of the plant is about 10 cm and if on the other hand, the distance between plants is wider than recommended, replant to fill the gaps when the plant fully germinates and become visible. Examples of types of crops for direct seeding include carrot, beet root, Swiss chard, and potato. .

6.2 Crops to be transplanted

Seeds for crops requiring transplanting are generally small. Consequently, these seeds are usually sown mixed with sand or fine soil. To sow, make furrows in the nursery beds a few centimeters deep and sprinkle the mixed seeds roughly 10 to 15 centimeters apart and then cover it with fine soil very lightly. Water seeds moderately to moisten the soil before and after sowing. Continue moderate watering daily in the morning and afternoon. When the seeds germinate, cover them with mulch to reduce evaporation, to regulate soil temperature and to reduce weed infestation. When seedlings produce two leaves or more, harden them off for a week or two by exposing them to the sun and the weather on a daily basis. When they are about 10 cm tall, transplant them, respecting the recommended distance between plants and rows. Transplanting should be carried out when it is cool. Water the holes moderately before and after transplanting. Mulching the plants keeps them cool and moist and reduces weed competition. Examples of types of crops to be transplanted include onion, pepper, lettuce, kale, and tomato.

Figure 4. Seedling appropriate for transplanting (left) and over matured seedling (right) which is not recommended for transplanting

7 Propagation and some agronomic practices of fruit production

7.1 ***Propagation*** is the reproduction or multiplication of plants through seeds or cuttings. Fruit trees can be propagated either by sexual or asexual means [4].

7.1.1 Sexual reproduction occurs when a male germ cell (pollen) fertilizes a female germ cell of the same species to produce a fruit with seeds. When the seeds germinate, the new tree will inherit characteristics of both its parents. It will not be true to the variety of either parent from which it originated. Most plants that are reproduced sexually will acquire characteristics that lie somewhere in between that of the two parents.

7.1.2 Asexual and vegetative reproduction are two methods of propagation asexually.

7.1.3 Rooting or taking cutting is the simplest method of propagating fruit trees asexually or vegetative. A piece of stem from the parent plant is cut off and inserted into soil. The roots will then grow from the buried portion of the cutting to become a plant. This method can work for some plants, but is not commercially viable for most fruit trees. Another rooting technique of propagation is known as **layering** which is rooting a piece of wood that is still attached to the parent plant and continues to get obtain and water from this parent. The new plant will be cut only after the roots are grown successfully.

[4] Fruit tree propagation: en.wikpedia.org/wiki/Fruit tree propagation.

7.1.4 Grafting is the most common and widely used method of reproducing fruit trees which entails grafting or budding of desired cultivars on to a suitable root stock. This involves taking a cutting (scion) from a desired cultivar and physically joining it onto the root of different but closely related cultivar or species so that the two parts grow together as one plant. Grafting is preferred over rooting because it reproduces a new plant of desirable quality as well as provides desirable characteristics of the root stock. The root stocks are selected for characteristics such as tolerance to soil borne diseases, growth vigor, hardiness and compatibility with the scion. There are two most common grafting techniques employed widely:

- **Whip, tongue, or bench grafting:** With this technique, a sloping cut is made in the rootstock with a tongue pointing upwards and making a similar or matching cut in the scion cultivar with a tongue pointing downwards. The scion and the rootstock will then be joined together with a maximum contact of the cambium layer s and bind with polythene tape and seal with grafting wax.
- **Bud grafting:** This is another form of grafting where only the bud is used rather than a scion with several buds like whip or tongue or bench grafting technique indicated above. There are two types of budding: T-budding and chip budding. Budding normally involves cutting a slice of bud from the parent cultivar, cutting a similar piece in the rootstock and making a little lip at the base to slot the scion into and joining the two together and binding. The scion will grow in to a shoot, which will then develop in to the desired fruit tree.

Figure 5: Grafting of mango 1) mango scion bud stick, 2&3) cleft grafting, 4) wrapping of union, 5) grafted mango seedling covered with plastic hat, 6) mango seedling after hat removal, and 7) top working of old mango tree

7.2 ***Pruning*:** Fruit tree pruning controls growth, removes dead or diseased part of the wood and stimulates the formation of flowers and fruit buds. The objectives of pruning are to:

- Remove dead, broken, damaged or diseased branches. Damage of branches may occur as a result of wind damage, fruit weight and diseases and insect injury.
- Remove branches that are densely crowded and shaded and bear only few fruit buds. Prune upper branches shorter to prevent shading of lower branches.
- Remove branches that bend to the ground.
- Control tree size, like spreading branches too high.
- Provide light penetration. Penetration of light (sun) is essential for the buds of fruits to develop and fruits to mature properly and uniformly.

8 Watering

It is very essential to have a water supply in order to grow vegetables in a sustainable manner. It is particularly important to have dependable water supply during the long dry season to grow vegetable crops all year round and to realize the impact from the project support. Moreover, vegetables are known to consume a lot of water to produce satisfactorily. Availability of water will also help growers to plan effectively when and how much to plant and harvest.

Some tips on watering:

- Water seeds, seedlings and plants gently and moderately.
- Test the soil moisture with a stick every day. If the top 3 to 5 cm of the soil is dry, it is time to water.
- Always water during the morning or evening to reduce evaporation.
- Apply water to the soil to reach to the roots and not to the stem of the plants or leaves.
- Avoid flooding plants by giving too much water. Always moderate but regular.

9 Cultivation or Hoeing

Cultivation or hoeing is the turning over of soil, and is practiced to control weeds and improve soil aeration during plant growth and development. A minimum of two to three cultivations during the growing period is deemed necessary. Getting rid of weeds before they produce seed and shade is vital. The roots of weeds must also be taken out of the soil to prevent regeneration. Weeds not only compete with crops for nutrients and water but also transmit plant diseases and attract insect pests, to the detrimental effect of the crop. Hence, weeds must be removed from the seed bed/field periodically throughout the crop growth period. Manual weeding along with

hoeing is essential for good production. Weeds removed /rouged from the field can be used for mulching after they are dried.

10 Crop Rotation

Regular rotation of crops will help maintain the fertility of the soil and reduce plant diseases and insect pests. Each type of crop requires particular nutrients in the soil and moreover, each type of plant is favored and attacked by particular diseases and pests. Hence, planting the same type of crop (mono cropping) repeatedly year after year will deplete nutrients that the plant requires, resulting in substantial yield reduction and increased susceptibility to diseases and insect pests. The main crop families to be included in the rotation [5] are:

Grains: Gramineae	e.g. maize, sorghum, wheat, millet
Solanums: Solanaceae	e.g. potatoes, tomatoes, peppers, chili
Legumes: Leguminosae	e.g. beans, peas
Brassicas: Brassicaceae	e.g. cabbage, cauliflower, radish
Bulb crops: Amaryllidaceae	e.g. onions, garlic, leeks
Greens: Chenoppodiaceae & Comositae	e.g. lettuce, Swiss chard, beet, spinach
Cucurbits:	e.g. pumpkin, cucumber, squash, melon
Umbells: Umbellifaceae	e.g. carrot, sesame

Some rotation hints:

- Change the plant family every planting time.
- Rotate back to the same family in four years.
- Leave the beds fallow for one crop season as part of the rotation to allow the soil to rest.
- Leguminous plants such as beans and peas are good in replacing nitrogen taken by other plants. They can be good combination with other crop families in the rotation.

11 Crop Protection /Insect pest control

Insect pests are devastating unless proper controlling measures are taken on a timely basis. Insect pests and weeds can be controlled and prevented from inflicting damage to vegetables crops by employing good crop management strategies. As far as possible, the use of chemical pesticides must be discouraged for two major reasons. First, they are very expensive and unaffordable and second, they can be very harmful to human beings, livestock and the environment. It is, therefore, advisable to practice different crop management techniques to control pests. Some of the techniques are briefly described below.

[5] FAO (2005) Setting up and running a school garden: A manual for teachers, parents and communities.

11.1 ***Crop rotation***: The preference of pests varies from crop to crop. Rotating crops, therefore, helps to reduce crop damage by pests. Moreover, mono cropping will weaken crops immune system by depleting the nutrients in the soil and exposing them to pest attacks. Crop rotation not only maintains soil fertility but also helps reduce pest prevalence.

11.1.1 Companion planting is the planting and growing of some crops together on the same plot/bed. As indicated in the crop rotation technique, insects can be attracted by some crops and repelled by others. What is more, some crops are susceptible to certain pests while others are either resistant or tolerant to those pests.

This technique will, therefore, help reduce the risk of losing the whole crop to one type of insect pest. Some plants are intentionally planted together with a main crop in alternative rows for their insect repellant and resistant properties.

11.1.2 Inter cropping is growing different crops near to one another. Growing different crops not only helps to utilize available space for more crop production but also limits and reduces the attack of pests to all crops planted. Plants for intercropping are selected on their merits. For example, deep rooted plants will only be intercropped with shallow rooted plants to avoid nutrient and moisture competition. Likewise, broad-leafed crops will be intercropped with narrow-leafed ones, tall plants with short ones, leguminous plants with high nitrogen consuming crops.

11.1.3 Sanitation is required to keep the field/garden clean from weeds, crop residues and other vegetation. This technique will deny pests from host plants to harbor.

11.1.4 Resistant varieties can be planted that are tolerant or resistant to diseases and pests.

12 Harvesting

Harvesting varies according to crop types, varieties, planting time and climatic conditions during the growing period. Hence, the harvesting of major vegetable crops is treated separately and briefly outlined as follows [6].

- Cabbage: Harvesting varies depending on varieties, planting time and temperature during the growing period. Generally, cabbages are harvested when the heads become firm. Split, rotten and damaged heads need to be removed during harvesting. Cabbage will not store for a long period after harvest.

[6] MOA, Ethiopia: Vegetables and root crops extension package, (Amharic).

- Onion: Onions are harvested when 50 to 75 % of the leaves dry and fall over. When the leaves start falling, it is sign that the onion bulbs are mature and ready for harvesting. The harvesting of onions should be completed before all the leaves dry out in order to avoid weight loss and spoilage.
- Swiss chard: Harvesting normally starts between 50 and 60 days after planting by removing outer leaves at regular intervals. The leaves need to be cut above the soil surface without injuring new emerging buds.
- Carrot: Depending on the variety and climatic condition, carrot is normally ready for harvest between 80 and 100 days after sowing. They can also be harvested when the roots reach about 2 cm in diameter. They can be harvested over a period of 30 to 45 days once they are ready. Care need to be taken not to damage roots while harvesting or lifting.
- Potato: Depending on the variety and temperature during the growing period, potatoes will be ready for harvest between 90 and 120 days from planting date. Harvesting can be spread over 60 to 90 days after the crop matures without being damaged. Potatoes are normally harvested when the skin becomes firm and does not tear off easily. If harvested earlier, they will tend to discolor and shrivel.
- Sweet potato: Harvesting of most varieties can start from 100 days after planting. Sweet potato can also be harvested when the color of the leaves change to yellow. The vines must be removed before harvesting. As the skin of sweet potatoes is thin and prone to tearing, care needs to be taken not to damage the roots while harvesting or lifting. Watering should also be stopped once harvesting has started in order to avoid rotting of roots or tubers.
- Mango: Depending on the variety and climate, mango fruits take five to six months to mature after flowering. The mature fruits are normally harvested when they are still hard and green.
- Papaya: Depending on the variety and climate, the papaya tree flowers in about four to six weeks after planting, and fruits are ready for harvesting in another six to eight months. Fruits are normally picked when they are still hard but show a distinct change in the color of the outer skin of the fruit, from green to yellow.
- Avocado: Avocado fruits reach maturity seven to nine months after flowering, depending on variety and climate. The oil content, size and color of fruits can also indicate maturity
- Apple: Maturity of apples depends on variety and climatic condition during the growing period of the tree. The base color of the fruit's skin will change from green to yellow when the fruits mature. The flesh color of the fruit will also change from green to yellow or white when the fruit matures. Fruits can be picked or harvested if the above conditions are observed.

13 Storage or Post Harvest Handling

Storage requirements of vegetables vary by crop, however the following points should be considered while storing vegetables.

- They should always be clean, dry and sound. The smallest spot or bruise is a danger center, which may spread to the lot.
- A maintained cool temperature is ideal for storing vegetables.
- Storage area should be kept clean, dry (by ventilation when needed) and paint (by use of whitewash and lime).
- Watch out for rats or other rodents that could be playing havoc with your produce.
- Proper storage will help to maintain the nutritional content of the crops besides prolonging access to, and consumption of, micronutrient-rich foods.

14 Hand tools for Gardening

The most widely used basic farming equipment for gardening include hoes, spades, rakes, machetes, pick axes, watering cans, buckets, strings, stakes, hoses, measuring tapes, knapsack sprayers, barrels for water (water container) and wheel barrows . The following tools are recommended for homestead provision through the support of ENGINE. With respect to schools the schools are expected to submit a proposal within the limit of the budget allocated for the school gardening.

Spade: a tool with a long handle and broad metal blade, used for digging and moving soil.

Fork : a garden tool with a handle and a row of 2-3 metal points at the end, used for cultivation.

Pick ax: a long heavy tool with a curved metal bar and sharp end fixed at a center to a wooden handle, used for digging soil.

Watering can: a metal or plastic container with a handle and a long tube with a metal or plastic rose attached to the end of tube, used for watering garden plants.

15 Garden Protection

Protecting the garden from animal predators is necessary. Local experience is very valuable to protect crops from predators with locally available materials. Fences, hedges, and scary objects are some examples used to protect gardens from predators.

Annex 3: Table 1: General Agronomic Information on Vegetable Production
(Source: MOA, Ethiopia: Vegetables & root crops extension package, Amharic.)

No	Vegetable Crop	Suitable conditions for growth & development			Seed Rate/ha	Spacing/Distance		Irrigation Intervals	Additional Information
		Temperature (Centigrade)	Altitude (MASL)	Rainfall (millimeters)		Between Rows	Between Plants		
1	Cabbage ጥቅል ጎመን	24	Above 2000	400-500	0.4 Kg	50 cm	50 cm	5-8 days	Seeds are generally sown in nursery beds & transplanted when the plant is 10-15 cm tall.
2	Carrot ከሮት	16-24	1000-2000	700-800	4.5-5 kg	20 cm	10 cm	3-7 days	Seeds are sown in nursery beds and thinned out 10 cm apart when the plant height reaches 5-8 cm.
3	Swiss Chard ቆስጣ	13-40	1000 – 2200	400 – 500	15 kg	50 cm	20 cm	4- 7 days	Seeds are sown directly in beds and thinned out 20 cm apart when the height of the plant is about 8 cm.
4	Onion (exotic) የፈረንጅ ቀይ ሽንኩርት	20 – 30	700 -1800	400-600	6 kg	20 cm	10 cm	5 – 7 days	Seeds can be sown directly on well prepared seed bed and thinned out 10 cm apart. It can also be sown on protected nursery bed, thinned out, hardened off and then planted out in the field 10 cm apart when the plants produce 3 to 4 true leaves (about 40 to 50 days from the date of sowing).
5	Irish Potato ድንች	16 -30	1500-2500	750-1000	20 quintals	75 cm	30 cm	7 -10 days	Direct planting on well prepared seed bed maintaining the space between plants/seeds at 30 cm.
6	Sweet potato ስኳር ድንችድንች	25-29	1500-1800	600-700	56,000 pieces of cuttings.	60 cm	30 cm	7-14 days	2/3 of the cutting (seed vine) should be covered with soil. Cutting should have 2 to 3 buds or should be 30 to 35 cm long.

Annex 4: The Role of Vegetables and Fruits to Human Nutrition and Health

Vegetables and fruits are critical sources of essential vitamins, minerals and proteins. Vegetables and fruits help the various organs of the body to function properly and are known to protect our body against various diseases. Vegetables are also low in fat, and are good source of dietary fiber. Absence of vegetables in the diet will affect the proper functioning of the body. For instance, vitamin A deficiency will impair proper vision while iron deficiency anemia. The functions of essential elements obtained from vegetables are briefly described below.

1 Functions of Vitamins and Minerals in the Growth, Development and Health of Humans [7]

- Vitamin A is required mainly for vision, new cell development, maintaining healthy skin, hair and tissues.
- Vitamin C mainly helps human body develop resistance (immune system) against infectious agents. It is also essential for healthy teeth, gum, blood vessels and improves iron absorption.
- Vitamin K is required to maintain the health of the bones and kidneys, and to facilitate normal blood clotting.
- Folate is essential in preventing nerve defects of the fetus during pregnancy. It is also essential for red blood cell development and normal digestion.
- Iron is needed mainly for the production of hemoglobin, the component of the blood which carries oxygen from the lungs to the tissues throughout the body.
- Potassium is an important component of cell and body fluids and helps regulate heart rate and blood pressure. It is particularly vital for proper fluid balance, nerve impulse function, muscle function and heart muscle function.
- Magnesium is essential for healthy bones and teeth, proper nervous system functioning and energy metabolism.
- Copper is required for the formation of hemoglobin, proper iron metabolism and maintenance of blood vessels. It keeps bones, nerves and the immune system healthy and aid in the production of red blood cells. It is also a co-factor for many vital enzymes.
- Calcium is essential for healthy bones and teeth, normal blood clotting, kidney functioning, and nervous system functioning. It also reduces blood cholesterol levels.
- Manganese is essential for production of enzymes necessary for the metabolism of fats and proteins. It also supports the immune system, blood sugar balance and is involved in the bone growth.
- Dietary fiber is essential in lowering blood cholesterol as well as preventing and/or reducing constipation.

[7] www.findlawrence.com/pdf/NutritionHandout.pdf

2 *Nutritional Value of Vegetables for Human Beings:*

Nutritional values of major vegetables are briefly outlined as follows. (Source: USDA National Nutrient Data Base)

- Cabbage is low in calories and contains no saturated fat or cholesterol. It is a very good source of vitamin C and K. It is also known to be rich in minerals like iron, potassium, magnesium and manganese.

- Carrot is very rich in vitamin A and carotenes. Carotenes are changed into vitamin A in the liver. The function of carotene is identical to vitamin A in the body. Carrot also contains minerals including calcium, phosphorus, manganese and potassium which are essential for the proper functioning of various components of the body. Carrot is also known to be rich in dietary fiber, low in calories and free of saturated fat or cholesterol.

- Swiss chard is the store house of many nutrients that are essential for health and prevention of diseases. It is a very good source of vital vitamins like vitamin A, C, K and others which are essential for the proper function of the body. It also has considerable amounts of minerals such as calcium, potassium, manganese, iron and phosphorus each rendering disease prevention and good health advantages. Like most vegetables, Swiss chard is low in calories and free of saturated fat.

- Irish potato is a rich source of starch, dietary fiber and some vitamins and minerals. It has no saturated fat.

- Sweet potato is an excellent source of vitamins and minerals. The tuber is very rich in vitamin A and beta carotene. The body very much requires these vitamins for healthy mucus membranes and skin. They are also essential for vision. Sweet potato also provides to the body with considerable amounts of essential minerals such as calcium, iron, magnesium, manganese and potassium, vital for the metabolism of carbohydrates, enzymes and proteins. The leaves of sweet potato are known to contain more vitamins than the tuber, including vitamins C, K and folates and minerals like iron and potassium. Moreover, it is known to be reach in dietary fiber and free of cholesterol.

3 *Nutritional Benefits of Fruits for Human Beings*:

(Source: USDA National nutrient data base)

- Apple is very rich in essential elements which help the body grow and develop normally. It is low in calorie content and free of cholesterol or saturated fat. It is a very good source of vitamin C which enables the body develop resistance to infectious organisms. It also contains moderate quantities of minerals like calcium, potassium and phosphorus.

- Avocado is generally high in monounsaturated fats and calories. They are also rich in essential vitamins and minerals. Monounsaturated fat is very important in lowering bad cholesterol and increasing good cholesterol, thereby preventing heart disease. It also has considerable quantities of vitamin A, E and K. which are essential elements for the normal functioning of the body. Moreover, avocado is reach in essential minerals including iron, magnesium, copper, potassium and manganese.

- Mango is rich in vitamins, minerals and dietary fiber. Vitamins A and C and potassium and copper minerals are available in mango fruit.

- Papaya is very low in calories, has no cholesterol, and is very reach in vitamins and minerals. It is particularly known to be rich in vitamin A and C. It also contains good amounts of calcium and potassium.

Note: - Details on nutritional facts of vegetables and fruits are shown on Annex 4 Table 1 & 2. for reference.

Annex 4 Table 1 Nutritional Value of Some Important Vegetables (per 100 grams)

(Source: USDA National Nutrient Data Base)

	Cabbage	**Carrots**	**Onion**	**Potatoes**	**Sweet potatoes**
Principle	Nut. Value	Nut. Value	Nut. Value	Nut. Value	Nut. Value
Energy	25 Kcal	41 Kcal	40 Kcal	70 Kcal	86 Kcal
Carbohydrates	5.8 g	9.58 g	9.34 g	15.9 g	20.12 g
Protein	1.3 g	0.93 g	1.1 g	1.89 g	1.6 g
Total fat	0.1 g	0.24 g	0.1 g	0.1 g	0.05 g
Cholesterol	0.0	0.0	0.0	0.0	0.0
Dietary fiber	2.5 g	2.8 g	1.7 g	2.5 g	3 g
Vitamins					
Folates	53 mcg	19 mcg	19 mcg	18 mcg	11 µg
Vitamin A	98 IU	16706 IU	2 IU	7 IU	14187 IU
Vitamin C	36.6 mg	5.9 mg	7.4 mg	11.4 mg	2.4 mg
Vitamin E	0.0	0.0	0.02 mg	0.0	026 mg
Vitamin K	76 mcg	13.2 mcg	0.0	2.9 mcg	1.8 µg
Electrolytes					

	Cabbage	**Carrots**	**Onion**	**Potatoes**	**Sweet potatoes**
Sodium	18mg	69 mg	4 mg	6 mg	55 mg
Potassium	170 mg	320 mg	146 mg	455 mg	337 mg
Minerals					
Calcium	40 mg	33 mg	23 mg	10 mg	30 mg
Iron	0.47 mg	0,3 mg	0.21 mg	0.73 mg	0.16 mg
Magnesium	12 mg	12 mg	10 mg	22 mg	25 mg
Manganese	0.16 mg	0.143 mg	0.129 mg	0.141 mg	0.258 mg
Phosphorous	26 mg	35 mg	29 mg	61 mg	47 mg
Zinc	0.18 mg	0.24 mg	0.17 mg	0.33 mg	0.3 mg
Copper	0.0	0.045 mg	0.039 mg	0.0	0.0

Annex 4 Table 2 Nutrition Value of Some Important Fruits (per 100 grams)

(Source: USDA National Nutrient Data Base)

	Apple	**Avocado**	**Mango**	**Papaya**
Principle	**Nut. Value**	**Nut. Value**	**Nut. Value**	**Nut. Value**
Energy	50 Kcal	160 Kcal	70 Kcal	39 Kcal
Carbohydrates	13.81 g	8.53 g	17 g	9.81 g
Protein	0.26 g	2.0 g	0.5 g	0.61 g
Total fat	0.17 g	14.66 g	0.27 g	0.14 g
Cholesterol	0.0	0.0	0.0	0.0
Dietary fiber	2.4 g	6.7 g	1.8 g	1.8 g
Vitamins				
Folates	3 µg	81 µg	14 µg	38 mcg
Vitamin A	54 IU	146 IU	765 IU	1094 IU
Vitamin C	4.6 mg	10.0 mg	27.7 mg	61.8 mg
Vitamin E	0.8 mg	2.07 mg	1.12 mg	0.73 mg
Vitamin K	2.2 µg	21 µg	4.2 µg	2.6 mcg
Electrolytes				

	Apple	**Avocado**	**Mango**	**Papaya**
Sodium	1 mg	7 mg	2 mg	3 mg
Potassium	107 mg	485 mg	156 mg	257 mg
Minerals				
Calcium	6 mg	12 mg	10 mg	24 mg
Iron	0.12 mg	0.55 mg	0.13 mg	0.1 mg
Magnesium	5 mg	29 mg	9 mg	10 mg
Manganese	0.0	0.142 mg	0.027 mg	0.0
Phosphorous	11 mg	52 mg	0.0	5 mg
Zinc	0.04 mg	0.64 mg	0.04 mg	0.07 mg
Copper	0.0	0.19 mg	0.11 mg	0.0

Annex 5 Dispatch formats for Farm Inputs

Save the children ----------Sub- Office

ENGINE- Distribution of Vegetable seeds/ cuttings and fruit trees seedlings to HHs beneficiaries

Zone:_____ woreda:_____ kebele:_____

S/N	Name of HHs	Sex	Land size	Family size	Under 5 Children	Quantity of Vegetables Distibuted to HHs(in grams)									Fruit Trees & root crops cuttings (in numbers)							
						Cabbage	carrot	Onion	Lettuce	BR	Tomato	S.chard	Garlic	Potato	Avocado	Mango	Apple	Sweet potato	Cassava			
																					Total Cost	Signature

Woreda Represntative	Agricultural Extention Worker	Kebele Represnative	Distributed by	Aproved By
Name:_____	Name:_____	Name:_____	Name:_____	Name:_____
Signiture: _____	Signiture: _____	Signiture: _____	Signiture: _____	Signiture: _____
Date: _____	Date: _____	Date: _____	Date: _____	Date: _____
		Stamp		

Save the Children ---------- Regional office

ENGINE- Distribution of mannual farm equipment to HH benificaries

Region:_____Zone:_____ Woreda:_____ Kebele:_____

S/N	Name of HH	Sex	Land size	Family size	Under 5 children	Type of farm equipent distributed (in numbers) hoe	spade	fork	matcheterake	pickaxe	Total cost	Signiture

Woreda Represntative	Agricultural Extention Worker	Kebele Represnative	Save the children Distributed by	Aproved By
Name:_____	Name:_____	Name:_____	Name:_____	Name:_____
Signiture:_____	Signiture:_____	Signiture:_____	Signiture:_____	Signiture:_____
Date: _____	Date: _____	Date: _____	Date: _____	Date: _____

Save the Children _____ Sub Office

Distribution of planting materials of vegetables & fruit trees to Schools

Region:_____ Zone:_____ Woreda_____

S/N	Name of school	Kebele	Quantity of Vegetables Distibuted (in grams)									Fruit Trees seedlings & root crops cuttings distributed(in numbers)					
			Cabbage	Carrot	Onion	Lettuce	BR	Tomato	S.chard	Garlic	Potato	Avocado	Mango	Apple	Sweet potato	Cassava	Total Cost (Birr)
School representative									**Save the Children**								

Name:_____
Signiture: _____
Date: _____

Distributed by
Name:_____
Signiture: _____
Date:_____

Aproved By
Name:_____
Signiture: _____
Date: _____

Save the Children _____ sub office									
Distribution of mannual farm equipment to schools									
	Region:_____		Zone:_____			Woreda:_____			
				Type of farm equipent distributed (in numbers)					
S/N	Name of school	Kebele	hoe	spade	fork	matchete	rake	pickaxe	Total cost (birr)

School Represntative

Name:_____

Signiture: _____

Date: _____

Save the children

Distributed by

Name:_____

Signiture: _____

Date: _____

Aproved By

Name:_____

Signiture: _____

Date: _____