

Seed Production for AFRICAN INDIGENOUS VEGETABLES



Training Manual

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VEGETABLES

Training Manual

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Introduction

Background

African indigenous vegetables (AIVs) contribute significantly to the food security and nutrition of the majority of people in East Africa. They are a major source of livelihood especially for women who sell vegetable at local market for daily income. The most popular indigenous vegetables grown and consumed in Uganda include: *Amaranthus cruentus* (Doodo), *Amaranthus blitum* (Bugga), *Solanum aethiopicum* (Nakati), *Solanum gilo* (Entula), *Solanum anguivi* (Katunkuma), *Lycopersicon esculentum* (Enyanya entono), *Hibiscus sabdariffa* (Malakwang), *Cleome gynandra* (Jjobyo), *Vigna unguiculata* (Cowpea-Gobe) and *Corchorus spp* (Jute Mallow).

Some indigenous vegetables are scarce because farmers prefer growing vegetables that have commercial value, are easy to prepare, nutritious, and tasty. Those that don't fit the criteria tend to be replaced.

Consumption of indigenous vegetables is low because of limited production and lack of awareness about their nutritional benefits. Production and consumption of AIVs will be enhanced through addressing the issue of scarcity of seed in the AIVs and promotion of benefits of AIV consumption.

About CABI

CABI is a not-for-profit development-led organization supported by a solid scientific research base and a world class publishing service. CABI's mission is to improve people's lives worldwide by providing information and applying scientific expertise to solve problems in agriculture and the environment.

The Good Seed Initiative Project

CABI is implementing the Good Seed Initiative project with support from Irish Aid. The initiative aims to contribute to food and nutritional security and to the livelihoods of smallholder farmers and other actors in seed and vegetable value chains. This is achieved through promotion of consumption of AIVs with high nutritive value to complement staples in diets and improved incomes of smallholder farmers from the production and sales of AIVs and AIV seed.

The project focuses on understanding and improving market demand for AIVs in Uganda through value chain links, building farmer capacity, and promoting AIV benefits.

CABI and partners provide training for farmers on production of AIVs and AIV seeds for home use and commercial purposes. The trainings aim at attaining the following objectives:

- Provide farmers with knowledge of improved agronomy, pre & post-harvest handling, seed production of AIVs, processing and storage.
- Increase accessibility to quality AIV seed.
- Introduce farmers to the basics of AIV farming as a business.

Introduction

Preamble on Vegetable Seed production for the trainer

Production of genetically pure and quality seed requires high technical skill and specialisation. Seed production must be carried out under standard and well-organized conditions. The producer should be familiar with genetic and agronomic principles of seed production.

During seed production, it is necessary to ensure that the seed is true-to type. Genetic purity of a variety can deteriorate due to several factors during the production cycle. The important factors of apparent and real deterioration of varieties are as follows: developmental variations, mechanical mixtures, mutations, natural crossing, minor genetic variation, selective influence of diseases, and technique of the plant breeder. Of these, mechanical mixture, natural crossing, and selective influence of diseases are perhaps the most important causes of genetic deterioration of varieties during seed production, followed by raising the seed crops in areas outside their adoption which may cause developmental variations and genetic shifts in varieties.

Maintenance of Genetic Purity. The important safeguards for maintaining genetic purity during seed production are:

A. Control of Seed Source: The use of seed of an appropriate class and from an approved source is necessary for raising the seed crop. Four classes of seeds, namely: breeders, foundation, registered, and certified seeds, have been defined by the Association of Official Seed Certification Agencies (AOSCA):¹

- **Breeder's Seed:** Breeder's seed is the genetically pure seed produced by the concerned breeder or by an institution and is used for the production of foundation seed.
- **Foundation Seed:** Foundation seed is also genetically pure seed produced from breeder's seed under strict supervision. Foundation seed is the source of registered and/or certified seed.
- **Registered Seed:** Registered seed is the progeny of foundation seed that is so handled as to maintain satisfactory genetic identity and purity, and that has been approved and certified by a certifying agency. This class of seed should be of a quality suitable for production of certified seed.
- **Certified Seed:** Certified seed is the progeny of foundation or registered seed. Certified seed is so handled as to maintain satisfactory genetic identity and purity and that has been approved and certified by the certifying agency.
- **Quality Declared Seed (QDS):** QDS is a seed class created by FAO. It is seed produced from: a) Basic, Certified or Maintainer seed, or b) from QDS seed that has been officially controlled. QDS requires a register of seed producers and a listed variety as part of its regulatory mechanism. Producers of QDS will be identified and encouraged by the NSCS to abide by the Seed and Plant Act and Regulations of Uganda. Regulations will incorporate these players' needs by providing adapted seed classes as Quality Declared Seed and specific National List Page requirements for traditional and participatory bred varieties. National Seed Certification Services (NSCS) will also provide adequate training and licensing in seed quality control so that local farming communities can formally access quality controlled seed from neighbouring licensed seed merchants. Currently QDS is not recognized in Uganda but under this policy provides for its recognition and regulation.
- **Standard Seed:** Standard seed is a recognised seed class in the Uganda Seed and Plant Act 2006. It applies to emergency situations during which there is a shortage of quality seed in the market.

¹Ministry of Agriculture, Animal Industry, and Fisheries. 2014. National Seed Policy Draft 5. Section 1.3.3. 5 pp.

²Sukprakarn, S., S. Juntakool, R. Huang, and T. Kalb. 2005. Saving your own vegetable seeds. A guide for farmers.

Introduction

B. Crop Rotation: Satisfactory intervals between related or similar crops are required to minimise the risk of plant material or dormant seeds remaining from the previous crops, which are likely to cross-pollinate or make admixture with the planned seed crop. Crop rotation, especially with nitrogen fixing crops, improves soil fertility, maintains soil physical condition, and minimises the risk of soil-borne pests and diseases. In practice, therefore, it is good to note the numbers of years since a related crop was grown in the same soil.

C. Isolation: One major factor during the course of seed production is to minimise the possibility of cross-pollination between different cross-pollination crops. Adequate isolation also helps to avoid admixture during harvesting and the transmission of pests and pathogens from alternative host crops. Vegetable seed crops can be isolated by time and by distance.

1. **Isolation by time:** This type of isolation is possible within individual farms of seed multiplication stations. In this system, seed production is arranged in such a manner that the cross-compatible varieties are grown in successive years or seasons provided the rules regarding rotation are applied.
2. **Isolation by distance:** When isolation by time is not possible, then isolation by distance should be followed. Isolation distance primarily depends on how the crop is pollinated. In general, wind pollinated vegetables require more isolation space than highly cross-pollinated (by insects) vegetable crops. Isolation distances also vary according to category of seeds like foundation and certified seeds. The table below gives the isolation requirements necessary for producing foundation and certified seeds.

Minimum isolation distance requirements for vegetable seed crop²

Seed crop	Minimum isolation distance (Meters)		To be isolated by the minimum isolation distance, based on whether it is foundation or certified seed.
	Foundation Seed	Certified Seed	
Amaranthus	400	200	Other varieties and the same variety not conforming to varietal purity requirements for certification. Wild Amaranthus spp.
Pumpkins	800	400	Other varieties and the same variety not conforming to varietal purity requirements for certification, wild Cucurbita spp
Eggplants	200	100	Other varieties and the same variety not conforming to varietal purity requirement for certification

Note:

- Amaranthus is mainly wind pollinated. Minimum isolation distance of 1000 m between varieties is recommended. Keep the crop free from related weeds to prevent cross pollination.
- Eggplants produce perfect flowers, which may be cross-pollinated, but self-pollination is more common. The extent of natural crossing depends upon insect activity. To avoid this, isolate each variety by 20 m or with another tall, flowering crop. Spider plants easily cross-pollinate with each other in open fields.

Icon Key



Question



Ask



Group work



Assessment

²Ministry of Agriculture, Animal Industry, and Fisheries. 2014. National Seed Policy Draft 5. Section 1.3.3. 5 pp.
Sukprakarn, S., S. Juntakool, R. Huang, and T. Kalb. 2005. Saving your own vegetable seeds. A guide for farmers.

Introduction

How to use the Training Guide

This training guide is written for extension workers at different levels of experience. They can use it to train the community knowledge workers/ community based facilitators, lead farmers, and farmers.

Before the session

Be well organised and read through the training guide before starting a session. It will help you to feel confident. Check that you understand what to do. Organise all the necessary materials for the session like the hand-outs, flipcharts, charts, chairs, and training venue.

Beginning the Session

Greet and welcome the participants. Ask questions about the last session. For example, you can ask:

- What did we learn in the last session?
- What did you apply in your seed production that you learned from previous sessions?
- What did you tell your family or community members about the session?

During the Session

Remember to speak audibly and be clear. Pause to allow time for the group to ask you questions. If farmers cannot see the board or picture during an activity, explain what is shown.

During group work, provide the farmers with flipcharts and markers. Write the participants' suggestions, answers and ideas on a flipchart and supplement with the content provided in the guide. Remind your audience that they can ask you questions if they do not understand something.

Ending the Session

1. Check what your audience learned using the questions in the assessment activity.
2. Thank your audience for participating.
3. After each module, ask yourself the following questions and write down your answers:
 - What went well in the session and why?
 - What would I do differently next time?
 - Which part of the session did the learners seem most interested in and why?
 - Which part of the session did the learners seem least interested in and why?
 - Did you manage time well? If not, why?

Reflect on each session in order to find out where you can make changes to improve later sessions.

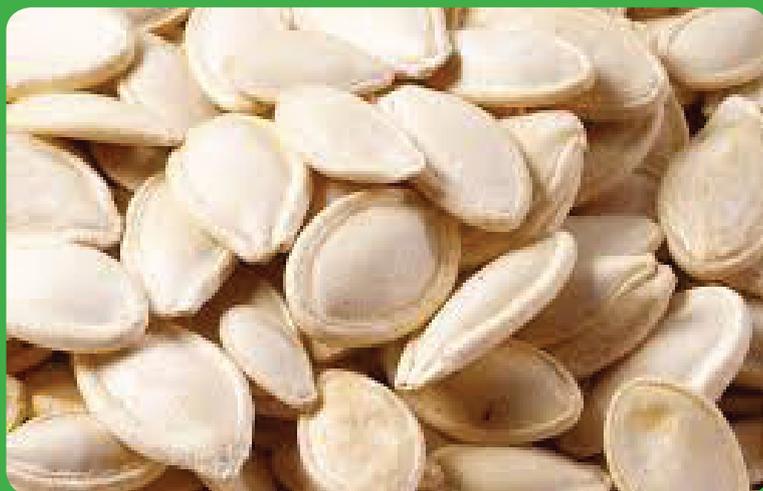
Workshop Training Schedule

Preview the module lessons before planning out the training. Some modules include activities that can be done in one afternoon, others may require longer or may depend on the previous activity. For example, weeding can only take place after time has passed since the planting.

Structure your trainings according to the activities and the resources at hand.

Module 1

Seed Production Requirements



Session 1

Farmer-Seed Field Registration Process

OBJECTIVES



1. Understand the importance of registering as a seed grower
2. Understand the process of registering a seed crop for inspection by a seed certification agency

KEY MESSAGE



Seed farmers must know how to identify quality seed to invest in and learn the best farming practices for reproducing quality seed. Farmers doing contract seed production should register with an official seed certification agency and be linked to registered seed companies.

MATERIALS



Registration process chart, flip charts, markers and masking tape.

TIME



30 minutes



Activity 1: Role play

Amos wants to buy seeds as he prepares to plant for the coming season. A friend advises him to get cheap seeds from another mutual friend. His neighbour, John, another farmer, advises him to get his seed from the agro-shop, so he can be sure of the quality. Amos wants to save money so he buys the seeds from the mutual friend and plants. He works hard to take care of his garden but when it is time to harvest he has poor yield. Though he uses the same practices as John, John has better yield.



1. Why do you think John had a higher yield at the time of harvest?
2. What could Amos have done differently?



Activity 2: Discussion

As a seed grower, you must do the following:

- Apply and register with an official seed certification agency e.g. National Seed Certification Services (NSCS) if the variety you are growing is released officially, the certification agency will review your application and send you a reply.
- Prepare a field map showing the location of the seed crop field.
- Use seed of a known variety and source with well-defined descriptors; unique characteristics from other varieties which can be obtained from an official agency like a research station - NaCRRI, Namulonge.
- Register the seed crop for inspection within the recommended time as per seed regulations.
- All contract seed producers must be linked to registered seed companies

Trainer's note

If possible, briefly take the farmers through a sample application process. If you have the opportunity, invite a representative from a seed company or from an official agency to talk about what they look for when inspecting seed.

Inspection schedule:

Phase	Proposed stage of inspection	Factors assessed during inspection
First	At vegetative stage through flowering	<ul style="list-style-type: none"> • Rouge out other crop varieties, off-types, plants of other crop species, diseased and weak plants. • Assess variety purity based on the crop descriptors • Check for presence of noxious weeds.
Second	At maturity of the crop and before harvest	<ul style="list-style-type: none"> • Assess variety purity as specified in the crop descriptor including morphological characteristics such as colour of seeds and pods. • Check disease incidence and pest infestation at maturity of the seed crop. • Check general conditions of the seed crop including estimated expected yield.
Additional	At any time or stage of crop growth	<ul style="list-style-type: none"> • Assess any other aspect that needs to be corrected following previous inspection, e.g. confirm if rouging is done as required, follow-up on the disease or pest situation, correction of isolation.

*rouging (identifying and removing plants with unwanted qualities)



Activity 3: Assessment



1. Conduct the group assessment by asking the following questions:
 - What did you learn in this session?
 - Why do seed crop need to be inspected?
 - How do contract seed farmers benefit from registering with an agency and companies?
2. Emphasise the key message to the participants:
 - **Seed farmers must register with an official seed certification agency and be linked to registered seed companies.**
3. Thank your audience for their participation in the session.

Module 2

Cropping Cycle

Land clearing and nursery bed preparation	1 st Ploughing	2 nd Ploughing	Manure application and transplanting
Week 1	Week 2	Week 3	Week 4-5
Pest and disease management	Weeding	Harvesting Short and long term	Seed production
Week 6	Week 8-10	Week 13-25	Week 18-25

Session 1

What is a Cropping Cycle?

OBJECTIVES



1. Understand the cropping cycle and growth periods for each vegetable.
2. Understand the activities in a cropping cycle season.
3. Understand at what time each activity is to be done during the crop season.

KEY MESSAGE



Before planting a crop, understand the flow of activities related to the growth and harvest of the crop. Know the period they are to be implemented in order to attain maximum yields and quality.

MATERIALS



Cropping cycle cards, vegetable instructor's guide, flip charts, markers and masking tape.

TIME



50 minutes

Trainer's note

Ensure that the groups discuss any one of the following vegetables: African eggplant, African nightshade, green Amaranthus (Doodo), red Amaranthus (Bugga), pumpkin, spider plant, malakwang, nakati and cowpea depending on the region.

Give participants flipcharts and markers. Supplement their contributions with the information on the different cropping cycles.

Trainer's note

Before closing the activity, ask them about the importance of the cropping cycle. Below are answers you can share if participants do not suggest them:

- Using a cropping cycle improves the timelines of crop production and reduces costs.
- It allows farmers to make informed decisions on crops and their sowing season for maximum yields.
- It helps farmers to understand and plan resource needs for the different cropping activities of a given vegetable.



Activity 1: The vegetable cropping cycle

1. A cropping cycle involves seasonal activities from land clearing to processing of vegetable seed. Several vegetables have similar seasonal activities while others differ.
2. What activities do you carry out to grow a vegetable seed from before you plant up to harvesting and processing time?



Answer:

Some of the activities include: Land clearing (land preparation); germination test; selection of quality seed; nursery bed establishment (African Eggplant and African Nightshade); ploughing; harrowing; manure application; transplanting; pests and disease management; weeding and harvesting, processing, and storage.



Activity 2: Drawing a cropping cycle

1. Place participants in groups of five.
2. Select a vegetable to discuss from the above suggestions.
3. Draw a sample cropping cycle and ask each group to do the same for their vegetable.
4. Ask each group to discuss the following about their vegetable:
 - Identify the activities carried out when growing the vegetable and write them in their order of occurrence.
 - Place these activities in the cycle by week
 - What does each activity involve?
 - What is the importance of the cropping cycle?
5. Have groups share their answers with the audience.





Activity 3: Cropping cycle cards discussion



1. Show farmers the African eggplant cropping cycle chart.
2. Show them the first card in the cropping cycle card set.
 - What do you see in this picture?
 - What activity are they doing?
 - In what week should this activity be conducted?
3. Show the next picture.
4. Ask the questions again.
5. Now read the content while showing card 1.

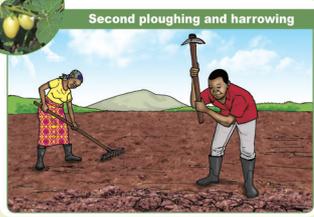
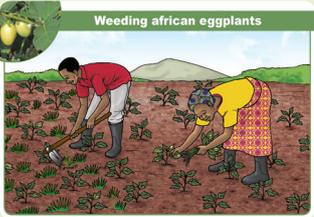
Trainer's note

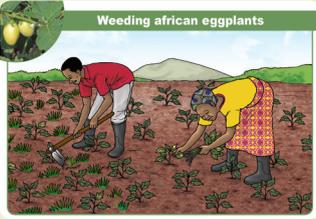
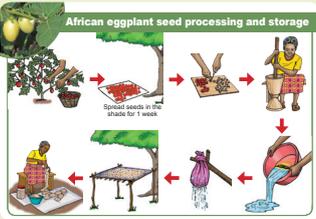
Keep in mind that the days/weeks for an activity differ depending on the location and acreage. A small farm land may take one day to open and harrow while a larger farm may need a week.

To grow African eggplant you need to practice the following activities:

African eggplant cropping cycle

Weeks	Activity
Week 1	<p>Land clearing and nursery bed establishment</p>  <ul style="list-style-type: none"> • Land preparation: Clear or cut all tall grasses. Remove trees to avoid shade, stumps, bushes, stones, ant-hills and any other obstacles from the garden. • A germination test: Test the germination potential of a seed lot. Quality seed should have a germination percentage of at least 85% in 2 weeks. Quality seed is free from disease and foreign matter; has proper moisture content and weight; and has uniform size, colour and shape. • Nursery bed preparation: A nursery bed is a specially prepared portion of land for raising seedlings until they are ready to plant in a permanent garden. Prepare the nursery bed on a flat area that is free of shade, near a water source, and with well drained fertile soils. • Sow the seeds in rows with 15cm-20cm spaces between rows and with 2cm between each plant. Cover the seeds with a thin layer of soil. Manage the seedlings by watering regularly and checking for signs of pests and diseases. Should you find any, take immediate action using the recommended pest and disease control strategy. • 3 weeks after sowing, start to harden the seedlings by gradually reducing the frequency of watering and the amount of shade to prepare them for transplanting.
Week 2	<p>First ploughing</p>  <ul style="list-style-type: none"> • First ploughing is done before the onset of rains to turn plant material into organic manure while also breaking the soil to allow more water and oxygen to enter. • A farmer can use a hand hoe, ox plough or tractor depending on the resources available to the farmer. • If your field has perennial weeds such as couch grass, spear grass, or wandering Jew, you need to spray the field using herbicides like Glyphosate, Round-up, and WeedMaster. Always contact an agriculture extension worker or an agro-dealer for more guidance on herbicides.

Weeks	Activity
Week 3	<p>Second ploughing and harrowing</p>  <p>Harrowing is the processing of breaking soil clods, root up weeds and leveling the field after ploughing .</p> <ul style="list-style-type: none"> • Carry out second ploughing followed by harrowing to obtain a finer tilth. • Remove any trash and other obstacles which can hinder seedling growth. • Also start to harden seedlings in the nursery bed by gradually reducing the frequency of watering and the amount of shade. This will prepare them for transplanting.
Week 4-5	<p>Manure application and transplanting</p>  <ul style="list-style-type: none"> • The seedlings should be ready for transplanting in 4-6 weeks when they have 4-7 true leaves. • The recommended plant spacing for eggplant is 1m between rows and 1m between plants. For seed crops, keep eggplants 100m away from related plants of the same family like tomatoes. • Water seedlings adequately before transplanting. • Transplant seedlings in the cool hours of the day, preferably in the evening. <ul style="list-style-type: none"> • Where inorganic fertilizer (NPK 17:17:17) is used, it should be applied 1 month after transplanting. Subsequent applications should follow after 2 months. • If organic manure is used, it is applied at transplanting. <p>Note: Make sure the roots of seedlings are not damaged in the process of transplanting.</p>
Week 6	<p>Management of pests and diseases</p>  <p>This is the process used to control pest and disease problems while minimising risks to people and the environment.</p> <ul style="list-style-type: none"> • Pest and disease management should be a continuous effort. • Both organic and inorganic pesticides can be used to control pests and diseases. • It is recommended to always seek advice from an agriculture extension worker on pest and disease identification and management. <p>Note: The farmer should monitor the field to ensure quick action is taken in case of outbreak of pests and diseases.</p>
Week 8-10	<p>Weeding and thinning African eggplant</p>  <p>Weeding is the removal of unwanted plants from a garden or an area.</p> <ul style="list-style-type: none"> • Timely weeding will lead to increased yields because it will minimize competition for nutrients, moisture and light between the African eggplant and weeds. • Weeding will also reduce pest and disease infestation at the early stages, which will again lead to increased yields. <ul style="list-style-type: none"> • Weeding should be done as soon as weeds emerge and especially before the flowering of weeds. This will reduce the spreading of the weeds. • Thinning is done at the time of weeding. During thinning the less vigorous, off-types or relatives and diseased plants are also removed.

Weeks	Activity
<p>Week 13-25</p>	<p>Harvesting African eggplant</p>  <p>Harvesting is the process of gathering mature fruits from a crop in the garden.</p> <ul style="list-style-type: none"> • African eggplant is ready for harvesting 60-90 days after transplanting. • Harvesting can continue for 4-6 months at one week interval. • African eggplant is harvested by picking the mature fruits.
<p>Week 18-25</p>	<p>Harvesting and processing African eggplant seed</p>  <p>Step 1: Hand pick and collect ripe (red or yellow) fruits in a container.</p> <p>Step 2: Place the picked fruits under shade for 1 week.</p> <p>Step 3: Slice the fruits into 4 parts using a knife.</p> <p>Step 4: Put the fruits in a mortar and lightly crush them using a pestle. Avoid using too much force as this can destroy the embryo within the seed which will lead to seeds being unable to germinate the following season.</p> <p>Step 5: Fill a container with clean water and add the crushed fruits. Squeeze gently to detach the seed from the freshly part of the fruit. Gently remove the floating fruit skin and seed and then tilt the container to allow any other floating seeds to pour out. The quality seeds will remain at the bottom. Repeat the washing several times with fresh water until all the flesh and skin are completely removed.</p> <p>Step 6: Place the washed seeds in a paper or cloth bag or in cotton cloth and hang in the shade for about 24 hours to remove excess water.</p> <p>Step 7: Place the partially dried seeds on a flat plastic surface like a tarpaulin which is raised off the ground and not under direct sunlight. Loosen any clump of seeds and stir 2 to 3 times daily so that seeds dry uniformly.</p> <p>Step 8: Remove any freshy parts left behind and package the seed in clean container or material. Store the seed in a cool,dry and well ventilated place raised from the ground surface .</p>



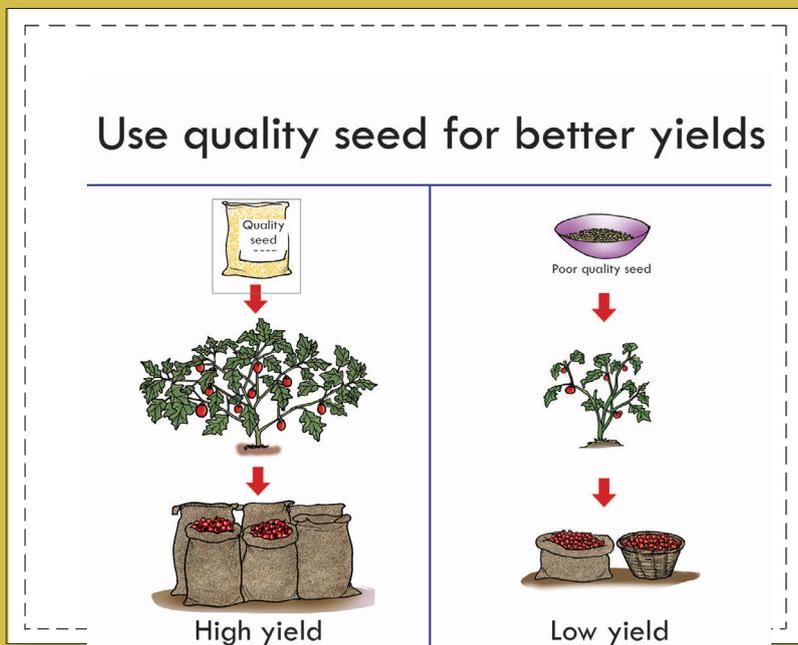
Activity 4: Assessment



1. Conduct the group assessment by asking the following questions
 - What are some of the activities involved in growing vegetable seed?
 - Why is it important to carry out each one of these activities if you want quality seeds?
2. Emphasise the key message to the participants:
 - Before planting a seed crop, understand the flow of activities related to the growth and harvest of the crop. Know the time they are to be implemented in order to attain maximum yields.
3. Explain to participants that in the next modules we will go into detail on each of the activities they have discussed.
4. Thank your audience for their participation in the session.

Module 3

Seed Preparation



Session 1

Use Quality Seed

OBJECTIVES



1. Understand the importance of using quality seed
2. Understand the characteristics of quality seed

KEY MESSAGE



Seed produced for sale to other farmers should be of high quality. To achieve good quality, seed producers must use quality foundation seed or certified seed. Good quality input seed is also important for attaining high yields.

MATERIALS



Flip charts; markers; masking tape; vegetable instructor's guides; quality seed chart; and sample seed labelled 1 and 2. **Sample 1:** processed and clean quality seed (clean, packed, and stored seed). **Sample 2:** poor processed seed, broken, rotten, and different colour and/or mixed seed.

TIME



40 minutes

Activity 1: Importance of using quality seed

1. To grow any AIVs, use seed of a recommended variety if available or seed from a genuine source. Quality seed is a fundamental requirement for high crop production. Home processed seed can also be of good quality if it is well processed and stored.
2. What are the benefits of using quality seed?
 - What are the characteristics of quality seed?
3. Using quality seed ensures:
 - Lower seeding rate
 - Higher emergence, usually above 85%
 - Vigorous seedlings
 - More uniform plant stand
 - Faster growth rate
 - Better resistance to pests and diseases
 - Uniformity in maturity
4. Quality seed should be of uniform size, colour and shape. It should also be free of foreign matter such as weed seed, chaff, and should be pest and disease free. Quality seed can be bought from officially certified and registered agencies or inspected seed suppliers.
5. Show participants the “Use quality seed for better yields” chart.
6. Ask them what they see and re-emphasize the key points of quality seed.



Activity 2: Identifying quality seed

1. Divide participants into groups of not more than 10 people. Give each group samples of the different types of seed and give them 5 minutes to discuss.
 - What are the characteristics of each of the samples provided?
 - Which seed sample do you consider to be quality seed?
 - Which seed sample do you consider to be poor seed?
 - How would you rate the seed samples in terms of quality seed (rate them: very good, good, or bad).
 - Where can you find quality seed in your area
2. Let the group members present the key points of their discussion. Use the information below as a guide.
 - **Quality seed:** Should be a variety pure with a high germination percentage, free from insect pests and pathogens (Disease causing agents) with proper moisture content and weight. Even in cases where there are no released varieties, it should be pure landrace.
 - **Sample 1:** Good quality seed: uniform size, colour, and shape and free of foreign matter. It should have an official seed certification stamp and will be sold by registered and certified seed dealers. This is quality seed because it is inspected, verified and certified.



Trainer's note

If it is not possible to gather samples of quality seed, an alternative is to invite a seed dealer to interact with participants. They could also help re-emphasize the key issues related to quality seed.

For Vegetable production, farmers can use any seed as long as it is quality seed. For seed production however, farmers MUST use only foundation seed or certified seed from research institutes or certified seed companies.

- **Sample 2:** Good quality home saved seed: uniform size, colour and shape. Free of foreign matter and well processed and stored. It is good seed that has been developed at home. Home saved seed that is processed using recommended practices may be safely stored for three to five years³.
- **Sample 3:** Poor quality seed with different sizes, colour, and shape. It also has weed seed.
- **Bad seed:** This is seed with all the bad characteristics of poor quality seed.



Activity 3: Assessment

1. Conduct the group assessment by asking the following questions
 - What did you learn in this session?
 - Will you use quality seeds? Why or why not?
 - How can using quality seeds help you produce quality vegetables and seeds?
2. Emphasise the key message to the participants:
 - Use good quality seed in order to ensure high yields in AIV production.
 - Use only foundation seed or certified seed for AIV seed production
3. Thank your audience for their participation in the session.

Seed treatment⁴

Seed treatment refers to the application of fungicide, insecticide or a combination of both to disinfect or dis-infest seed from seed borne pathogen or storage pests. There are several pre-sowing treatments which are used for vegetable seeds and these include application of pesticides for the control of seed or soil-borne pathogens. The following types of seed treatment are followed for treating vegetable seeds

- **Seed disinfection:** This refers to the eradication of fungal spores that have established within the seed coat or in more deep-seated tissues. For effective control, the fungicidal treatment must penetrate the seed in order to kill the fungus.
- **Seed disinfestation:** Seed disinfestation refers to the destruction of surface-borne organisms that have contaminated the seed surface. Fungicides applied as dust, slurry, or liquid have been found effective.
- **Seed protection:** The purpose of seed protection is to protect the seed and young seedlings from organisms in the soil which might otherwise cause decay of the seed before germination.

^{3 & 4} Rashid, M.A and Singh, P, D. (2000). A Manual on Vegetable Seed production in Bangladesh. AVRDC-USAID, Karshaf Printer (Pvt). Ltd

Session 2

Germination Test

OBJECTIVES



1. Understand the importance of conducting a germination test
2. Understand how to conduct a germination test

KEY MESSAGE



Conduct a germination test to check seed for viability and germination potential before planting.

MATERIALS



Vegetable instructor's guide, handout on steps for conducting a germination test, seed varieties, good sample seed, bad sample seed, cotton cloth, water, a cup, flip charts, markers and masking tape.

TIME



40 minutes

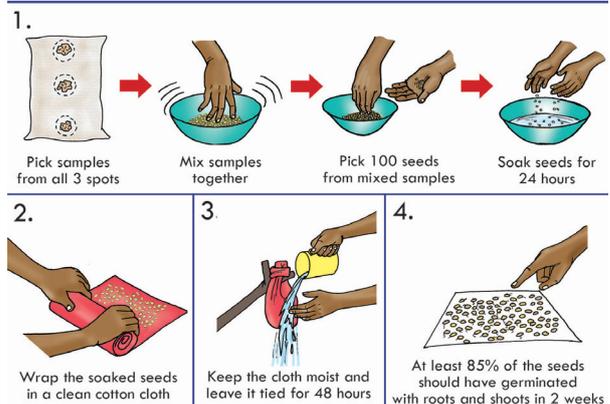
Activity 1: Importance of conducting a germination test



1. Before sowing, test seed for viability and germination potential by conducting a quick germination test.
 - What is the importance of conducting a germination test?
 - Has anyone done a germination test before?
 - How did you do it?
 - Was it helpful in anyway? How or how not?

2. A germination test helps determine the germination rate of a seed lot, which indicates how that seed will perform in the field. This helps the farmer plan better for seed requirements.
3. Show participants the chart showing how to "conduct a germination test". Read through the steps and inform the participants that they are going to conduct the test in two groups; each with their own seed.

Conduct a germination test



Trainer's note

The germination test results will take more than 3 days. Inform participants that you are going to demonstrate the different steps. After the demonstration, divide participants in groups and have them conduct the test. Do not explain to the groups that one sample is bad seed. They need to realize that it's necessary to conduct the test to determine if seed will germinate or not. This will help them understand that they reduce on production costs and losses if they do a test.



Activity 2: Conducting a germination test

1. Divide participants into groups. Provide them with two different samples of seed to conduct the germination test.
2. Ensure that one sample consists of good seed and the second sample a fairly bad seed or very bad seed.
3. In their groups, provide participants with a handout on the steps of conducting the germination test for the vegetable.
4. Ask them to conduct the first few steps together and decide on where to keep the seeds for close inspection and watering until the final day.
5. Groups should select teams of people per day that will water and inspect the seeds. Ensure that every member participates in the whole process.

Steps for conducting germination test:

- Get representative samples of seeds from the top, middle and bottom of the seed bag.
 - Mix the sample seeds and count 100 seeds to use for the test (for small seed quantities, farmers can count 20 seeds).
 - Put the seeds in a container of water for 24 hours.
 - Drain off the water and wrap the seeds loosely in the soaked cotton cloth to create a bag holding the seeds.
 - Tie the cloth bag to a stick. Tilt the stick to encourage drainage from the cloth bag. Keep the cloth moist by watering 3 times a day. Leave it tied for 48 hours.
 - Untie the cloth bag and count the number of seeds that have fully germinated after 48 hours (both the shoot and roots have emerged).
 - If 85 of the 100 seeds or 17 of the 20 seeds or more have both the shoot and roots emerged within 2 weeks from the start of the germination test, then it is quality seed which can be used for planting.
 - If the percentage is slightly less than 85 of the 100 seeds, increase the seed rate at planting. If the percentage is less than 40%, discard the seed. Do not use the seed because it will have poor yields.
6. Ensure that the groups discuss their findings from the test during the assessment. Inform them they will be setting up a nursery bed in the next session using the good seed.



Activity 3: Assessment

1. Conduct the group assessment by asking the following questions:
 - What 2 things did you learn in this session?
 - Why do farmers carry our germination tests?
 - What might happen if you do not test your seeds?
2. Emphasise the key message to the participants:
 - Conduct a germination test to check seed for viability and germination potential before planting.
3. Thank your audience for their participation in the session.



Session 3

Nursery Bed Preparation

OBJECTIVES



1. Understand the importance of a nursery bed
2. Know how to set up a nursery bed
3. Understand how to manage seedlings in the nursery bed

KEY MESSAGE



A nursery bed provides seedlings with conditions resulting in fast and uniform emergence. Seedlings also requires water, air, warmth and an environment free from diseases and insect pests, which can be easily attacked in a nursery bed.

MATERIALS



Vegetable instructor's guide, nursery bed chart, hand out on setting up a nursery bed and caring for seedlings, demonstration garden, hoe, wheel barrow, animal manure, dry grass, seeds, sticks, measuring tape, flip charts, markers, and masking tape.

TIME



1 hour

Activity 1: Importance of a nursery bed



1. A nursery bed is a specially prepared garden where plants are propagated and grown to a size which can withstand stress, at which point they can be transplanted.
 - Which AIVs have to go through a nursery bed?
 - What are the advantages of a nursery bed?
 - How do you select the site for a nursery bed?
2. Supplement their ideas with the following information.
 - African eggplants and African nightshade grow best when propagated in a nursery bed and then transplanted into the main garden. African nightshade can also be propagated by direct seeding just like all the other AIVs except for African eggplant.
 - A nursery bed makes it easier to take care of young seedlings in a small area.
 - Since only vigorous, healthy and uniform seedlings are transplanted, this could result in higher yields.
 - It's easy to protect the seedlings from pests and diseases
 - When selecting a site for a nursery bed, ensure that it is not near drainage channels, not on a slope, and should be near a clean source of water.

Trainer's note

This section only applies to African eggplant and African Nightshade vegetables.

Trainer's note

Take participants through the steps of making a nursery bed. Select volunteers to conduct the activity in the demonstration garden. They should monitor the nursery bed until the seedlings are ready to be transplanted. Provide them with a hand out on how to set-up a nursery bed and how to care for the seedlings.



Activity 2: Setting up a nursery bed

1. Show participants the chart on nursery bed preparation.
2. Ask them what they see and supplement with the information below:
 - The nursery bed should be raised at least 20cm from the ground.
 - Recommended width of 1metre by any length depending on where you want to plant.
 - Loosen the soil for easy penetration of roots.
 - Add well decomposed manure to the soil before sowing the seeds: 1 wheel barrow of manure and 2 wheel barrows of loam soil.
 - To sow seed, make drills 15cm apart and 2 cm deep. Sow the seed and cover with a thin layer of soil.
 - Apply mulch and water through the mulch. Continue watering to keep the soil moist. It is preferable to water in the evening. Seeds will germinate 10-14 days after sowing. Remove mulch from the seedlings and put it between rows.
 - Set up a shade over the nursery bed. The shade should be 1m high. Ensure that the nursery bed is facing away from the sun. The shade roof should be made out of light materials to allow sunshine to reach the seedlings.



Activity 3: Managing the seedlings in the nursery bed



1. To ensure vigorous and healthy seedlings, certain conditions need to be in place.
2. What key conditions do you need to put in place to get vigorous seedlings from your nursery bed?
3. Supplement their contributions with the following notes.
 - A farmer should water the nursery bed twice every day (early morning and evening)to ensure that the seedlings get sufficient water.
 - Keep the nursery bed free of weeds to avoid competition with the seedlings for nutrients.
 - Monitor the garden for pests and diseases and manage them early using organic methods of control or recommended pesticides.
 - Prepare the seedling for field conditions by reducing the watering and gradually removing the shade a week before transplanting.
4. Inform the participants that they need to think of a suitable site for planting their seedlings in the next session.



Activity 4: Assessment

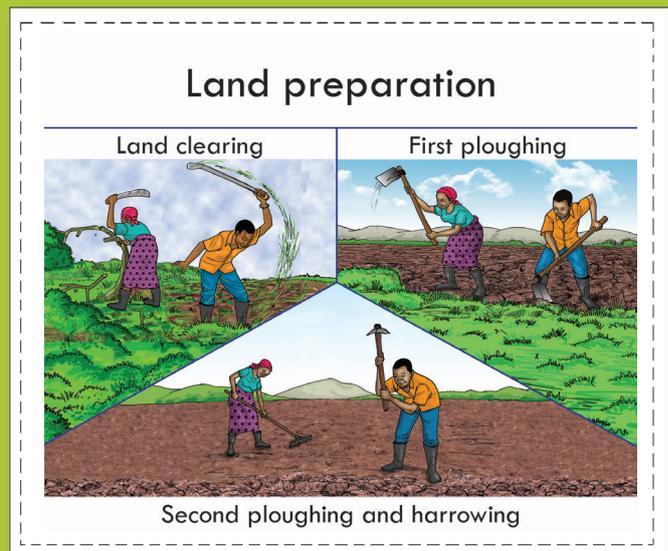
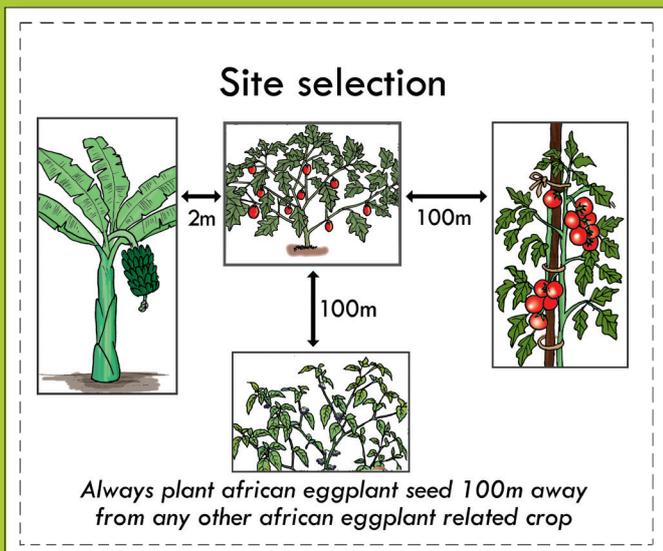


1. Conduct the group assessment by asking the following questions:
 - What is the purpose of a nursery bed?
 - Which AIVs need nursery beds?
2. Ask participants to share one or two things they have learned from this session.
3. Emphasise the key message to the participants:
 - A nursery bed provides seedlings with conditions resulting in fast and uniform emergence. The seedlings also require water, air, warmth, and an environment free from diseases and insect pests.
4. Thank your audience for their participation in the session.



Module 4

Site Selection and Land Preparation



Session 1

Site Selection

OBJECTIVES



1. Understand the qualities of a good site for seed vegetable production
2. Select a good site for seed production

KEY MESSAGE



The site you choose for your seed vegetable garden may influence the amount of yields harvested due to the topography, soil drainage and soil type.

MATERIALS



Vegetable instructor's guide, vegetable chart set, flip charts, markers and masking tape.

TIME



30 minutes

Activity 1: Qualities of a good site for AIV seed production



1. What is a good site to grow seed vegetable?
 - Show participants the chart on site selection.
2. What do you see in the picture?
 - Seed vegetables grow well on flatland, lowland and upland if terracing and raising of beds is practiced to control soil erosion.
3. In lowlands, dig channels to drain or divert excessive water. Seed vegetables grow well in lowlands during the dry season (off season).
 - What are some other key things to consider when selecting a site for seed production?
4. List their contributions on a flipchart and supplement with the following information:
 - It should have fertile loam soil
 - Should not have tree shades as some trees have pest and diseases that could damage the crops
 - The soil should not be rocky
 - The soil should be fertile or manure should be added
 - The soil should be well drained
 - The garden should be close to home but should be protected from domestic birds and animals
 - The site should have good access to a water source
 - The garden should not be close to similar crops grown for home consumption, to avoid cross pollination. See worksheets on isolation distances.

Trainer's note

Before the training ensure you have options of sites close to each other to pick from to conduct the activity. It could be in one of the participant's homes or community land.



Activity 2: Selecting a site



1. As a group we need to identify a demonstration site for transplanting/planting our seeds/seedlings respectively depending on the vegetable.
2. Ensure that the group identifies the site and visit it to check for its suitability for seed production.
3. What makes this site suitable for seed production?
 - What may make the site unsuitable for seed production?
 - What do we need to do to improve the site?
4. Plan with the group on when they would be doing the land clearing together.
5. Let them agree on the tools they will need and ensure that they carry them to do the activity.

Trainer's note

Remember that when planting African eggplant, plant 100 metres away from any related plant of the Solanum family

Note: An isolation distance of 400m and 200m for Foundation and certified Seed, respectively, needs to be maintained by seed producer



Activity 3: Assessment



1. Conduct the group assessment by asking the following questions:
 - What are the features of a good site for a vegetable seed garden?
 - How can a good site help you produce quality seed?
2. Emphasise the key message to the participants:
 - The site you choose for your vegetable seed garden may influence the amount and quality of seed harvested due to the topography, soil drainage, soil type and proximity (or isolation) to other crops.
3. Thank your audience for their participation in the session.
4. Remind them to come with tools for clearing land in the next session.

Session 2

Land Preparation

OBJECTIVES



1. Understand land preparation and clearing
2. Know when to plough and how many times
3. Understand the benefits of harrowing

KEY MESSAGE



Remove vegetation cover when a piece of land is to be used for seed production. Plough and harrow to obtain small soil particles.

MATERIALS



Vegetable instructor's guide, demonstration garden, flip charts, markers, masking tape, and farming tools e.g. hoes, slashers, axes etc.

TIME



30 minutes



Activity 1: Land preparation



1. What is land preparation and what activities are involved in the process?
 - What is ploughing and when should it be done?
 - What is harrowing and why is it necessary?
2. Share the following answers if participants do not bring them up:
 - Clear or cut all the tall grasses, and bushes. Remove trees, stumps, stones and other obstacles from the field.
 - This will make ploughing and other farming activities easier.
 - Do not burn bushes because burning exposes the soil to erosion and also reduces soil fertility due to loss of nutrients.
 - After clearing land, plough the field for the first time and ensure that the soil has very small debris. (Ploughing is to turn up the earth of an area with a hoe or plough before sowing.)
 - If the field has perennial weeds, spray with herbicides such as Weedmaster, Glyphosate and Roundup. Remember to contact an agriculture extension worker/ agro-input dealer for guidance on herbicide.

Trainer's note

This activity should take place at the demonstration garden. Farmers should come prepared with the farming tools to clear the land. In the next week, the group can meet again to plough the garden.

- Conduct a second ploughing followed by harrowing until the soil makes very small particles. Harrowing is the process of breaking down clod size to assist with field levelling after ploughing.

Trainer's note

Depending on your audience, you could put participants in groups to conduct these activities until the end of the planting season.)

Activity 2: Land preparation demonstration



1. What key land clearing activities do you need to do in the selected demonstration garden?
2. Have the farmers clear the land and plough in preparation for planting/transplanting.
3. Ask the farmers to do the first and second ploughing and harrowing in the week after land clearing if it's not possible to do the demonstration on the same day.
4. Ensure they clear the land, plough and harrow the demonstration plot. In the next session they will be planting seed or transplanting seedlings to their plot.



Activity 3: Assessment



1. Conduct the group assessment by asking the following questions:
 - How does land preparation help farmers with planting activities?
 - What did you learn in this session?
2. Emphasise the key message to the participants:
 - Remove vegetation cover when a piece of land is to be used for seed production. Plough and harrow to obtain small soil particles.
3. Thank your audience for their participation in the session.

Module 5

Planting, Weeding, Thinning and Gap-filling

Weeding and thinning



Weed as soon as weeds emerge

Session 1

Planting Vegetables for Seed Production

OBJECTIVES



1. Understand how to plant and space the vegetables for seed production
2. Understand the seed preparation process
3. Know how to apply manure to the soil

KEY MESSAGE



Plant vegetables at the right time; use manure and correct plant spacing for optimum sprouting and yield.

MATERIALS



Vegetable instructor's guide, plant spacing chart, manure application chart, How to plant chart, manure application handout, how to plant handout per vegetable, basin, mineral water bottle, seeds, flip charts, markers and masking tape.

TIME



30 minutes

Trainer's note

This section covers both the transplanting of seedlings and direct planting of seed in the garden. Adapt according to the vegetable being covered.



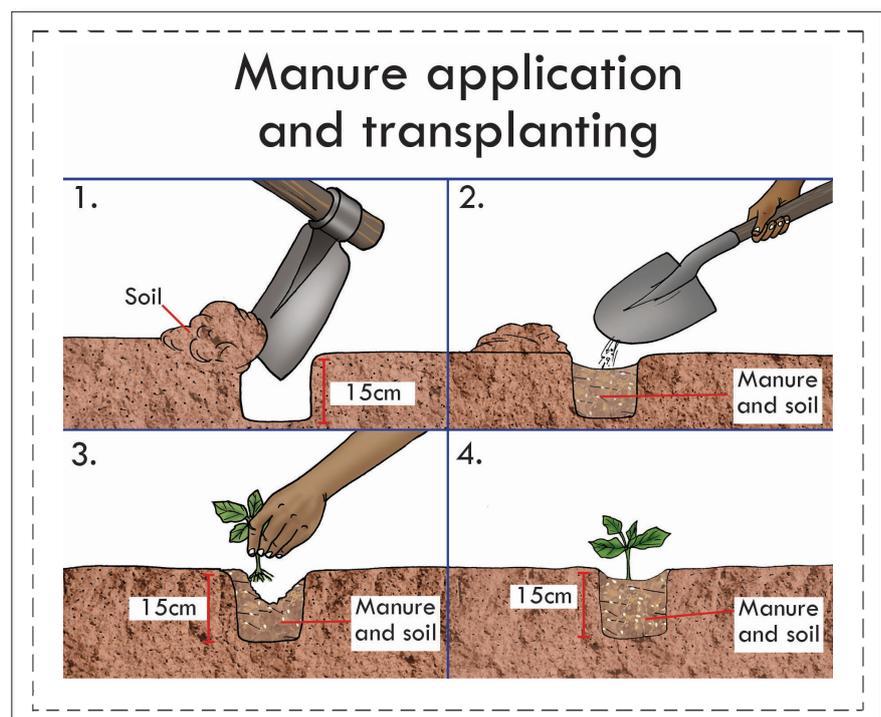
Activity 1: Applying manure



1. Before planting, apply manure to the garden. All AIVs need manure/fertilizers to achieve vigorous growth and high-yield. If plants grow vigorously, they may have a chance to resist some of the pests and diseases.
2. Farm yard manure is a low-cost alternative to inorganic fertilizers and it still helps farmers to achieve higher yields.
3. Farm yard manure is made from animal waste such as cow dung, goat or chicken droppings. If a farmer already has a kraal, it is an easy and cost effective way to use animal waste to make manure and use it in the garden. **Note:** *Never apply fresh animal waste onto the field as this will burn the germinating seed/seedlings*
4. It is good practice for farmers to always collect their animal waste and heap it so there is always enough available to make manure.

How to make and apply farmyard manure:

- Collect animal waste from the kraal.
- Heap the dung in small, knee-height piles and cover with soil or grass. Covering helps to avoid loss of nutrients by heavy rain or sunshine.
- Leave it to properly decompose up to 1-2 months depending on the materials that you use as this will give the best results.
Note: *Decomposition allows for final digestion/ break down of the food consumed by the animals, acids and enzymes produced – (A colour change from Naval green to Black is an indication of well decomposed manure*
- Before applying the manure, mix it with soil.





Activity 2: Transplanting

1. What are some vegetables that need transplanting?
 - The main vegetables that need transplanting are African eggplant and African nightshade.
2. When transplanting the vegetables, manure can be put directly in the hole where you intend to transplant the seedling or around the base of the seedling after it has been transplanted.
 - Manure application is done before transplanting. 10kgs of well decomposed manure is mixed with soil before it is filled directly into the hole in the garden.
 - Dig a hole of 2ft (60cm) wide and 2ft (60cm) deep
 - Fill each hole almost completely with manure using a spade or plate
 - Make a 2cm deep hole in the middle of the manure. This will be for the seedling.
 - Cover the plant with the same mixture.
3. Use the content below for additional information on transplanting African eggplants.



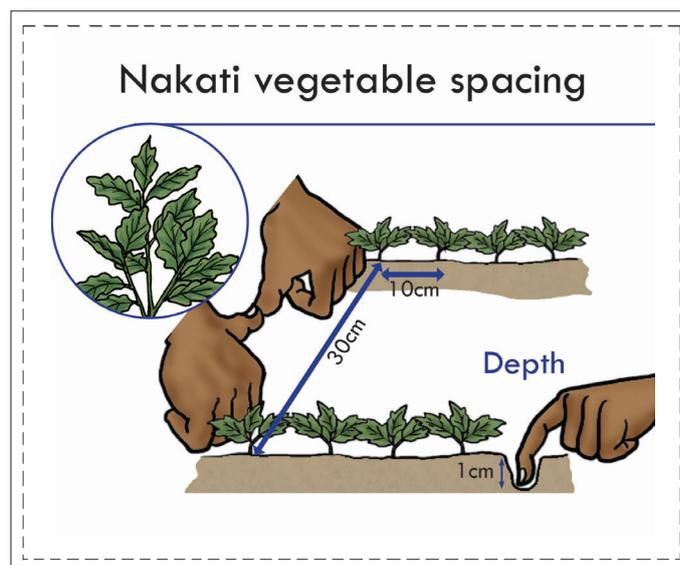
Vegetable	Plant spacing
African eggplant	<ul style="list-style-type: none">• Seedlings are ready for transplanting 1-1.5 months after germination.• Give plants spacing of 1m between rows and 1m between plants. Apply well decomposed manure, about 2 handfuls per hole before transplanting.• Water the bed heavily before transplanting.• Transplant at the onset of rains. The following should be considered when transplanting:<ul style="list-style-type: none">- Make sure that the roots of the seedlings do not break or get damaged.- Use a hand fork to pick out the seedlings.- Transplant in the evening from 3pm onwards.- If the main garden is far, use a basin with water to transfer seedlings.- Keep the garden free from weeds to avoid competition for nutrients.- Application of fertilizer should be repeated one month after transplanting. Use 100g - 120g of fertilizer per plant (NPK (17:17:17) for inorganic fertilizer. For organic manure, spread the fertilizer in a 1 foot circle around the stem of the each plant.

Trainer's note

Below is information you can refer to on plant spacing for different seed vegetables. Use the planting chart and how to plant chart in this section.

Activity 3: Vegetable seed plant spacing

1. Plant vegetable seed at the onset of rains. Farmers who have the capacity to irrigate can grow year round.
2. For transplanted crops, seeds should be sown in the nursery early enough (21-30 days) to ensure that transplanting coincides with the on-set of rains.
3. Plan planting so that harvesting coincides with the dry season.
4. All fields (crops) must be labelled indicating the crop number, variety, date of planting, and class of seed being produced (e.g. Basic, Certified 1, Certified 2, Standard).
5. Keep a record book to indicate all activities related to seed production to ease traceability.
6. Plant in lines to ensure the crop is well spaced and at the same time, it becomes easier to weed and manage the crop.
 - If planted in lines, the recommended plant population is attained and the farmer will plant adequate seed (not too much or too little) for the given area.
7. Some seeds of the vegetables are very small. To avoid pouring too many seeds in the same spot during planting, the farmer can use the following method:
 - Take 2kgs of the vegetable seeds and 8kgs of well decomposed and dry soil/manure to plant 1 acre. Fresh manure will destroy the seed so only use well-decomposed, dry blackened manure (Dry Navel green Manure is not well decomposed) mixed with soil, as this will not destroy the seeds.
 - Mix the seeds with the soil/manure in a big basin.
 - Put the mixture in a large mineral water bottle and make a hole in the bottle top.
 - Plant in lines using a string to make rows.
8. Use a stick to make a 1cm deep furrow following the string.
9. Plant the seeds in this furrow and cover with light soil.



Vegetable	Plant spacing
Nakati	<ul style="list-style-type: none"> Nakati should be spaced at 45cm between rows and 30cm between plants for leafy vegetables when thinning. Nakati requires an isolation distance of 100m away from any related plant.
African Nightshade	<ul style="list-style-type: none"> African nightshade should be spaced at 120cm between rows and 75cm between plants for leafy vegetables when thinning. African nightshade requires an isolation distance of 100m away from any related plant.
Green Amaranthus-Doodo	<ul style="list-style-type: none"> The green amaranthus should be spaced at 45cm between rows and 30cm between plants for leafy vegetables when thinning. Green Amaranthus requires an isolation distance of 400m (foundation seed) or 200m (certified seed) away from any related plant.
Red Amaranthus-Bugga	<ul style="list-style-type: none"> Red amaranthus should be spaced at 45cm between rows and 30cm between plants for leafy vegetables when thinning. Red Amaranthus requires an isolation distance of 400m (foundation seed) or 200m (certified seed) away from any related plant.
Spider plant	<ul style="list-style-type: none"> Spider plant should be spaced at 45-60cm between rows and 30cm between plants for leafy vegetables when thinning. Spider plant requires an isolation distance of 200m away from any related plant.
Pumpkin	<p>Pumpkins are planted by directly sowing the seeds into the soil. Consider the following when preparing a site for the pumpkins:</p> <ul style="list-style-type: none"> Pumpkins require a lot of water, it is therefore important to plant at the onset of rains. The soils should be well drained and deep. Plant a maximum of 3 seeds in each hole. After the seedlings emerge, thin to leave only 2 strong plants. Spacing should be at 3m x 3m or 10ft x 10ft for a plant population of 900 plants per acre. Proper spacing is important because it will ensure maximum growth and productivity. Pumpkins require an isolation distance of 100m away from any related plant. Thinning should be done 2-3 weeks after germination. The frequency of thinning depends on whether germination is low or high. In case of low germination, gap filling should be done.
Malakwang	<ul style="list-style-type: none"> Malakwang should be spaced at 50cm between rows and 30cm between plants for leafy vegetables when thinning. Malakwang requires an isolation distance of 100m away from any related plant.
African eggplant	<ul style="list-style-type: none"> Seedlings are ready for transplanting 1-1.5 months after germination. Give plants spacing of 1m between rows and 1m between plants.
Cowpea	<p>Cowpea are planted by directly sowing the seeds into the soil. Consider the following when preparing a site for the cowpea:</p> <ul style="list-style-type: none"> Plant a maximum of 3 seeds in each hole. After the seedlings emerge, thin to leave only 2 strong plants. For erect/semi-erect varieties, spacing is 60cm x 20cm with two seeds per hill. This requires 28kg per hectare. For Local prostrate variety, spacing should be 80cm x 40cm. Cowpea require an isolation distance of 100m away from any related plant. Thinning should be done 2-3 weeks after germination. The frequency of thinning depends on whether germination is low or high. In case of low germination, gap filling should be done.

Trainer's note

Provide participants with handouts on how to plant/transplant and how to mix manure and have them work on the demonstration garden. As a facilitator, you could also choose to have 2 gardens. One could use good practices and the other could use wrong practices. It will help assess the impact at the end of the season..

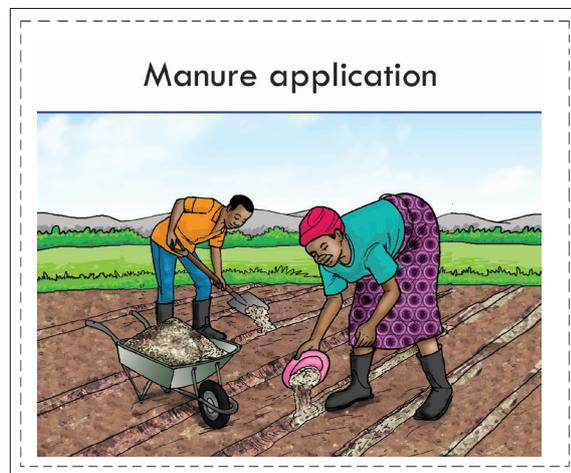
Trainer's note

If you have participants make two gardens to compare, give each group different instructions.



Activity 4: Planting and manure application

1. Divide participants in 2 groups. We shall have two different gardens close to each other.
2. Tell participants: We are going to plant/transplant our seedlings to our demonstration garden. We shall apply manure and use the correct plant spacing using a string.
3. Mix manure with soil
4. Make holes at the correct spacing and apply the mixture
5. Make a hole in the middle of the manure and put the seedling/seed and cover with soil.
6. Plan with the group on when they should be weeding.
7. Let them agree on the tools they will need and ensure that they carry them to do the activity.



Activity 5: Crop registration

This is a quality control requirement in seed production

1. Seed crops should be registered within 10 – 21 days of planting / transplanting
2. Seed grower must keep labels as proof of origin (seed source)
3. Seed grower must fill the registration forms



Activity 6: Assessment

1. Conduct the group assessment by asking the following questions:
 - What 2 things did you learn in this session?
 - What did you like doing best?
 - What will you tell your family and community members?
2. Emphasise the key message to the participants:
 - **Plant vegetables at the right time, use manure and correct plant spacing for optimum sprouting and yield.**
3. Thank your audience for their participation in the session.

Session 2

Weeding, Thinning and Gap-filling

OBJECTIVES



1. Understand the benefits of thinning and gap-filling vegetables
2. Know when and how to weed vegetables.

KEY MESSAGE



Keep your vegetable seed garden free of weeds at all times.

MATERIALS



Vegetable instructor's guide, weeding chart, flip charts, markers and masking tape, cropping cycle.

TIME



1 hour



Activity 1: Weeding, thinning, rouging and gap-filling

1. Show participants the weeding chart.
 - What do you see in the chart?
2. Put participants in two groups.
3. Ask participants to discuss the following questions in groups.
 - Why do farmers weed?
 - What is thinning and why is it necessary?
 - What is rouging and why is it necessary?
 - What is gapping and why should it be practiced?
4. Each group should share their ideas with the participants.
5. Supplement their answers with the information below.
 - Weeding is the removal of unwanted plants from the garden.
 - Timely weeding will lead to increases in the yield. Timely weeding minimizes competition for food and light between weeds and the vegetable.
 - Weeding reduces pest and disease infestation at the early stages which will lead to increased yields.
 - Weeding should be done as soon as weeds emerge and before the flowering of weeds. This will reduce the risk of weeds spreading.
 - Weeding can be done using a hoe, by uprooting with your hands, or by use of selective herbicides.

Trainer's note

Please refer to the cropping cycle for the actual weeding time of each vegetable.

- Ensure that the weeds are not put on the boundaries of the garden but thrown far away from the vegetable garden. Preferably dig a pit and bury the weeds (free of seed) to decompose for manure.
- Thinning is the removal of some plants to make room for the growth of others. Thinning is done during weeding to reduce on the crowding of plants so that they have enough water and nutrients. It also helps reduce the chances of the plants being attacked by pests and diseases, thereby increasing yield.
 - When thinning, save the strongest seedlings and remove excess plants. If some seedlings are removed carefully during thinning, they can be transplanted and used to fill in empty spaces during gapping.
- Rouging is the act of identifying and removing plants with undesirable characteristics from the field. These may include: off-type (different varieties) or sick plants. The major aim of rouging is to ensure varietal purity.
- Gapping is done to replace seeds that did not germinate immediately after germination is complete.
 - Keep the garden free of weeds at all times.

Trainer's note

Assign participants to two groups and identify three sections of the garden. Have group one weed their section, group two should leave their section for weeding later. The third section should not be weeded at all. If you do not have enough garden space, just have the participants weed one section and leave the other. The aim is to observe the effects on the two gardens and compare the yield at the end of the season.

Activity 2: Weeding the demonstration garden

1. Today we are going to weed a section of our garden and the other section will be left to grow on its own until harvest time.
 - Let farmers know they need to do thinning and gapping in the section that they will weed.
 - Inform participants that in their next session, they will be monitoring both gardens for pest and disease infestation.



Activity 3: Assessment

1. Conduct the group assessment by asking the following questions:
 - Why is it necessary to weed?
 - Why is it important to carry out weeding activities through the cropping cycle?
2. Emphasise the key message to the participants:
 - **Keep your vegetable garden free of weeds at all times**
 - **Rouging is critical for seed growers to ensure they produce quality seed that is not mixed with off types.**
3. Thank your audience for their participation in the session.



Module 6

Pests and Disease Management

Pests and disease management



Session 1

Pest Management

OBJECTIVES



1. Know the common pests of vegetables affecting the quality of seed
2. Know the signs and symptoms to look out for.
3. Understand how to prevent and control pest infestation.

KEY MESSAGE



Early intervention is critical to reduce the impact of pest infestation. Monitor your garden for pests through all the stages of the plant's life.

MATERIALS



Vegetable instructor's guide, Pest and disease booklet, pest and disease management chart, exhibits of diseased or pest infested plantlets, handout on pests and diseases plus bio-pesticides, flip charts, markers and masking tape.

TIME



1 hour



Activity 1: Pests identification and management

1. Pests can cause significant losses if not controlled. The pests can directly eat part or even whole plants. In seed production, pests can lead to production of low quality seed.
2. Both organic and inorganic pesticides can be used to control pests.
3. You should scout your garden and seek for advice from the agricultural extension worker as soon as you notice signs of pests in your vegetable garden.
4. Brainstorm with participants on the following questions:
 - What are some vegetable pests you know?
 - How did you identify them or what part of the plant do they attack most?
 - How did you control them?
5. Show participants the pests and diseases chart.
6. Supplement their contributions with information from the pest and diseases guides and flyers.



Activity 2: Assessment

1. Conduct the group assessment by asking the following questions:
 - What 2 things did you learn in this session?
 - How does pest management improve your crop production and quality of seed produced?
2. Emphasise the key message to the participants:
 - **Early intervention is critical to reduce the impact of pest infestation. Monitor your garden for pests through all the stages of the plant's life.**
3. Thank your audience for their participation in the session.

Session 2

Disease Management

OBJECTIVES



1. Know the common diseases of vegetables affecting quality of seed produced.
2. Know the signs and symptoms to look out for.
3. Know how diseases are spread (Water, Wind, Weeds, Animals, Insects).
4. Understand how to prevent and control disease infestation.

KEY MESSAGE



Early intervention is critical to reduce the impact of disease infestation. Monitor your garden for diseases through all the stages of the plant's life.

MATERIALS



Vegetable instructor's guide, Pest and disease booklet, pest and disease management chart, flip charts, markers, and masking tape.

TIME



1 hour



Activity 1: Discussion on disease identification and management

1. Like pests, diseases can cause severe damage to crops if not controlled, and can significantly reduce the quality of seed produced. Some of the diseases are seed borne and if not controlled can be easily transmitted in the produced seed making it poor seed. Ensure that you scout your garden for any infestation and seek advice from the extension worker. You could use both organic and inorganic pesticides to control the diseases.
2. Brainstorm with participants about the following questions:
 - What are some vegetable diseases you know?
 - How were you able to identify them?
 - How did you control them?
3. Show participants the pests and diseases chart.
4. Supplement their contributions with information from the pests and diseases booklet and flier.



Trainer's note

Remember that we have one section of the garden that we weeded in the previous module and another section of the garden that we did not weed. Note that weeds are also pests. You could ask for volunteers to weed the other garden after this session (late weeding). We shall compare the effects of weeds to the vegetables and harvests from the different gardens in module 7.



Activity 2: Pest and disease identification

1. Put participants in 4 groups.
2. Today we are going to scout our two gardens in search of different pest and disease infestations.
3. Provide participants with the handout of different pest and diseases symptoms and control measures.
4. Have two groups scout the weeded garden and the other two scout the garden with weeds.
5. Let them talk about the following questions:
 - What pests and diseases have you identified?
 - What is their extent of infestation?
 - How are they affecting the vegetables?
6. Each group should present some of their findings to the other participants.



Activity 3: Assessment

1. Conduct the group assessment by asking the following questions:
 - How can you go about identifying different pests and diseases?
 - How can you best avoid disease infestation?
 - How can you stop a disease from spreading other plants?
2. Emphasise the key message to the participants:
 - **Early intervention is critical to reduce the impact of pest and disease infestation. Monitor your garden for pests and diseases through all the stages of the plant's life.**
3. Thank your audience for their participation in the session.



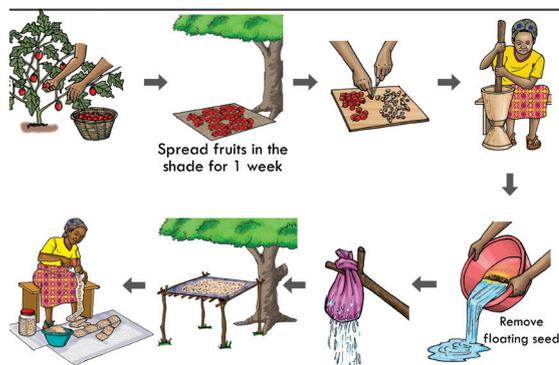
Module 7

Harvesting, Processing and Storage

Harvesting african eggplant seed



African eggplant seed processing and storage



Session 1

Harvesting seed

OBJECTIVES



1. Understand when the AIVs seed crop is mature and ready for harvest
2. Understand how AIV seed should be harvested

KEY MESSAGE



Harvest seed when plants, fruits and pods have reached full maturity to have quality seed. Avoid diseased or rotting plants and fruits.

MATERIALS



Flip charts, markers and masking tape.

TIME



1 hour

Trainer's note

Adapt the section to the vegetable you are training on.

Activity 1: Harvesting seed crop



1. When is the vegetable seed ready for harvest?
 - How should you harvest vegetable seed?
2. Let the participant's brainstorm and share ideas. Supplement their answers with the following:
 - It's important to harvest AIV seed at the right stage of maturity to prevent losses caused by reduced quality. Farmers use different means to determine the appropriate time for harvesting e.g. observing the colour change in fruits, or seeds/pods and testing the hardness (moisture content) of the seed during harvest
3. Use the following information to give specific times of seed harvest per vegetable.

Harvesting periods of vegetable seed

Vegetable	When to harvest	Harvesting method
African nightshade	<ul style="list-style-type: none">• Fruits turn orange, shiny purple• Harvesting starts 17-20 weeks after planting	<ul style="list-style-type: none">• Hand pick and collect the mature fruits
Spider plant	<ul style="list-style-type: none">• Pods turn pale brown• Harvesting starts 17-20 weeks after germination	<ul style="list-style-type: none">• Hand pick pale brown pods OR cut the mature plant at the base
Red Amaranthus	<ul style="list-style-type: none">• Inflorescence turn yellow and seeds fall easily when shaken• Harvesting starts 15 weeks after germination	<ul style="list-style-type: none">• Cut mature plant at the base
Green Amaranthus	<ul style="list-style-type: none">• Inflorescence turn yellow and seeds fall easily when shaken• Harvesting starts 15 weeks after germination	<ul style="list-style-type: none">• Cut mature plant at the base
Pumpkin	<ul style="list-style-type: none">• Mature fruits make a hollow sound when slapped• Pumpkin seed is ready for harvest 28 weeks from planting	<ul style="list-style-type: none">• Pick the mature fruit off the plant. Avoid rotting/diseased fruits.
Cowpea	<ul style="list-style-type: none">• The plant turns a light shade of brown and the leaves start falling off.• Seed is ready for harvesting 50 to 55 days after planting	<ul style="list-style-type: none">• Hand pick the pods off the stalk
African eggplant	<ul style="list-style-type: none">• Fruits change colour to red/yellow• African eggplants should be ready to harvest 60 – 90 days after transplanting.	<ul style="list-style-type: none">• Hand pick and collect the mature fruits
Malakwang	<ul style="list-style-type: none">• The mature plant shows lightly brown pods• Harvesting seed starts 21 weeks after planting	<ul style="list-style-type: none">• Cut the whole plant
Nakati	<ul style="list-style-type: none">• Fruits have fully matured and turn dull red• Harvesting seed starts at 17-20 weeks after planting	<ul style="list-style-type: none">• Hand pick and collect the mature fruits



Activity 2: Harvesting vegetable seed



1. Put participants in 2 groups. Have 1 group harvest vegetable seed from the good garden and group 2 from the unmaintained garden.
2. After they have harvested their crops, have them analyse the following:
 - How much did you expect to harvest?
 - How much have you harvested?
 - Why is the harvest good or poor?
 - What will you do differently next time?
3. Each group should present their findings.



Activity 3: Assessment



1. Conduct the group assessment by asking the following questions:
 - When should you harvest vegetable seeds?
 - What are some of the ways to harvest seeds of different vegetables?
2. Emphasise the key message to the participants:
 - **Harvest seeds when plants, fruits and pods have reached full maturity to have quality seed. Avoid diseased or rotting plants and fruits.**
3. Thank your audience for their participation in the session.

Trainer's note

Remember that we have one section of the garden that we weeded on time, another where we did late-weeding, and a third section of the garden that we did not weed. This is the unmaintained garden.

If you have three groups, each can harvest a different section. If you only have two groups, have them harvest the good garden (weeded on time) and the unmaintained garden to compare.

Session 2

Seed Processing and Storage

OBJECTIVES



1. Understand the best methods for processing and storing vegetable seeds

KEY MESSAGE



Careful processing and storage of seeds will produce quality seed

MATERIALS



African eggplant, water, basin, mortar and pestle, packaged seeds, flip charts, markers and masking tape.

TIME



30 minutes

Trainer's note

Demonstrate how to process seeds or have participants bring in their own equipment and do the sample process

Activity 1: How to process seed



1. What is seed processing?
 - How would you process seeds from plants that give fruits?
 - How about those from pods?
2. Brainstorm with the group and note on the flipchart the different processing methods that people have heard-of or used before.
3. Processing is the method used to take seeds from a plant or out of a fruit.
 - Wet seed extraction (African nightshade, African Eggplant, Nakati), uses the following process:
 - Hand pick and collect the mature fruits
 - Put the fruits in a mortar and gently crush them using a pestle
 - Place the crushed fruits and seeds in an open plastic container. Fill the container with water and stir to allow the pieces of fruit flesh and pulp to float
 - With pumpkin, open the fruit and scoop out the seeds into a basin of water
 - Gently remove the floating pulp and tilt the container to allow more floating seed to pour out. The quality seeds will remain at the bottom. Repeat the washing several times with fresh water until all the pulp is removed and only seeds remain.

- Place the partially dried seeds on a flat plastic surface like a tarpaulin raised off the ground under little heat (not in direct sunlight). Loosen any clump of seeds and stir 2 to 3 times per day so that seeds dry uniformly.
- Normally, drying will take 3 to 4 days but the seeds will be ready for storage at 6-8% moisture content.
- Dry seed extraction uses the following process:
 - Hand pick pods or cut entire mature plants and dry them on a flat surface under the sun. This will take 1-3 days depending on the weather
 - Put the dry pods in a bag and thresh them by gently beating on the bag using a wooden stick
 - Winnow to separate the seeds from the chaff
 - Dry clean seeds in the sun for 1-2 days

Activity 2: Checking moisture content

1. To determine if seeds are properly dry, pinch with fingers or use the salt method to determine the moisture content as follows:
 - Take 20g (3 bottle tops) of salt and 160g (one handful) of seeds.
 - Mix the two together and put in a plastic, glass, or any other transparent bottle and seal completely with a bottle top (you can also use polythene bag without any holes which will need to be tied to make it airtight)
 - Shake vigorously for 2 minutes.
 - Allow to settle for 15-30 minutes.
 - If the walls of the bottle or polythene bag become foggy or cloudy then the moisture content is still more than 15%.
 - Continue drying the seeds.

Activity 3: Seed storage

1. Clean and package seeds and store them in a cool, well ventilated and dry place.
2. Well stored seeds will maintain the quality in size and a high germination capacity with vigour until it is required for use. The main factors determining the storage life of seed are the moisture content and temperature.
3. Seed may be treated to protect it against infestation by insects and infection by seed-borne and/or soil-borne disease causing micro-organisms (plant pathogens) prior to and during germination and seedling establishment. This operation is referred to as seed dressing or seed treatment.
 - The ideal chemical for seed treatment should be:
 - Highly effective against pathogenic organisms and insects.
 - Relatively non-toxic to plants.
 - Harmless to humans, livestock and insects like bees even if misused.
 - Stable for a relatively long period of time during seed storage.
 - Easy to use.
 - Cost effective.

4. Packaging, labelling and sealing:

- Packaging material should be durable, free from defects, and should allow seed to retain viability.
- Treated seeds are packaged in clean bags and containers of various sizes according to the customers demand.
- Seeds of all classes must bear the official label on to each bag or container, which shows the lot number, type of crop, name of variety, class of seed, germination and purity levels and the packing date.
- Containers should be fastened or sealed according to national requirements.

Note: Poor methods of processing contribute to rapid seed deterioration, for example: beating harvested fruits and storing them on wet floor.



Activity 4: Assessment



1. Conduct the group assessment by asking the following questions:
 - Name two methods for processing seeds?
 - Why is it important to test the moisture content of your seeds?
 - How can good or bad packaging affect your seed business?
2. Emphasise the key message to the participants:
 - **Careful processing and storage of seeds will produce quality seed**
3. Thank your audience for their participation in the session.

Module 8

Vegetable Seed Farming as a Business

		
Sales	2,400,000	4,800,000
Total Cost	1,383,000	1,964,500
Profit	1,017,000	2,835,500

Refer to the pictorial budget guide to complete the calculations.

Session 1

Farming as a Business

OBJECTIVES



1. Understand what it means to treat your farm as a business.
2. Learn how to keep important farm records.
3. Be able to calculate the cost and profitability of a farm business

KEY MESSAGE



The goal of any business is to create more money from selling than what is spent when buying.

MATERIALS



Cost-benefit analysis tool and instructor's guide, flip charts, markers and masking tape.

TIME



30 minutes



Activity 1: Farming as a business (Faab)



1. Put participants in 2 groups, and ask them to discuss the following questions:
 - Why did you choose to be a farmer?
 - Do you buy inputs for your farm?
 - Do you sell produce from your farm?
 - Do you hope to make money from your farm?
 - What is a business?

2. Invite the groups to share their answers. Supplement their contributions using the following information:
 - Business is simply buying and selling things to make money. The goal of any business is to create more value from selling than it uses up when buying.
 - Every business exists to make money, but there are many factors that can contribute to whether a business is successful or not.



3. In their groups ask participants to draw a successful business and highlight some of these points in the drawings:

- Characteristics of a successful business.
- What do you do to make sure you earn money from your farming business?
- What do you spend your money on?
- What do they think is their goal as a business?



4. Supplement their contributions with the following:
 - A successful business will require land productivity, good labour management, product diversity, good facilities, planning and budgeting, good record keeping or farm activities, access to markets, saving money, etc.
 - A successful farm business will spend its money on good farming practices, farming tools, storage facilities, marketing etc.
 - The farm business earns money by ensuring that they manage their costs and sell their produce at the highest price possible to make a good profit. They also diversify their production, so that they earn income from different avenues.



Activity 2: Planning and budgeting

1. Place participants in small groups. Read this story to the participants and let them discuss the questions below in their groups.

Ritah is a widow who decides to start up a business to improve her financial situation. She has a small garden and a seed company representative tells her she could make more money selling seeds. She decides to start that business and rents a bigger piece of land. She starts clearing a big piece of land to grow eggplants, nakati and pumpkins. To use up all the space, Ritah plants African nightshade as well. She does not want to pay labourers so she does all the work herself. The vegetables only get the last of the rains. Once she has planted, she takes a long time weeding and the vegetables compete with the weeds for nutrients, sun, and water. At harvest time, Ritah has low yields; the vegetables are diseased and stunted, giving her poor quality seeds in small amounts. The seed company does not buy from her because she planted the eggplants along side African nightshade which reduced on the quality of her seeds. She can only sell to individual farmers who give her very little money compared to what she invested.

- After investing all her energy, where did Ritah go wrong?
 - What key things could she have done differently to improve her chances of success?
 - Did Ritah plan and budget? If so how? If not, why do you think she needed to budget?
2. Invite group members to share their ideas.
 3. After the discussion, brainstorm with the whole group the following questions.
 - In a month, what are the key things you spend your money on? Mention the activities in order of priority. List all the items they mention on a flipchart in their order.
 - Ask them: How much money or value do you get from spending on these items? Attach money to the activities.
 - In most cases, you will find that there are things they spend money on that are not necessary or do not add value. You need to explain that they need to do the following:
 - Plan as a family, including father, mother and children.
 - How much income do you bring in from the different activities in a month? These may include the sale of cassava or perhaps the man is also a builder and brings in income from his jobs, or the woman has a small kiosk selling tomatoes, etc.
 - What things do you need to spend on in the month? Let them list all the items including clothes, books, seed, sauce pans, bicycle etc.
 - What are the key things that must happen in the month? Prioritize the activities.



- Draw up a budget and attach money to each of these activities. Do you still fit in the budget based on the expected income? If not, then cut costs. This budget will also help you project what you expect to achieve by the end of that month for the activities you have invested in.



Activity 3: Assessment



1. Conduct the group assessment by asking the following questions
 - What is the importance of a budget?
 - How can planning for investment help you in the future?
 - How can spending without budgeting create problems?
2. Emphasise the key message to the participants:
 - **The goal of any business is to create more from selling than what is spent when buying.**
3. Thank your audience for their participation in the session.

Session 2

Seed Production Record-Keeping

OBJECTIVES



1. Understand the importance of keeping farm records
2. Learn which key information to record

KEY MESSAGE



Farm records help give the farmer an accurate picture of the farm but also provide information needed to make sound business decisions.

MATERIALS



Cost-benefit analysis tool and instructor's guide, flip charts, markers and masking tape.

TIME



30 minutes

Activity 1: Vegetable farming record-keeping



1. Divide participants into small groups and ask them to discuss the following questions:
 - What is record keeping?
 - What type of information is important to record?
 - Why should you keep these records?
2. Explain:
 - Record-keeping is a systematic way of keeping written financial and business information. It is also a way to keep track of transactions.
 - The first step to profitability is good record keeping. Records provide the information needed to make sound business decisions. Poor record keeping can lead to significant losses for a farmer.
 - When keeping records, it is critical to record all money coming IN and OUT of the business. This includes sales income, rent income, storage fees, transport, rent, seeds, investment, personal transactions, crop information etc.
 - You need to record both CREDIT and CASH transactions to ensure you account for everything.
 - Records help measure the level of expenditure and determine the amount spent during the vegetable farming period.
 - They help farmers determine the level of income from the vegetable farming business.



- They help farmers calculate the amount of profit or loss made in a particular period of time.
- They create a foundation that can help farmers to plan, make future budgets and forecast for the next season.
- They help farmers relate cost and benefit when analysing which plants to grow or what to invest in.

Trainer's note

Ensure that the activity is done very fast so that it's effective. Each person should mention their activities in less than 1 minute. The 8th person is supposed to mention all the costs and prices mentioned by everyone, but also give us the total cost incurred by the business at the end.

Trainer's note

Play this game again, but ensure that all the volunteers have a paper and pen to note down activities mentioned by each person. Ask participants to comment on the difference when they use pen and paper.

Activity 2: Game – Record-keeping



1. Invite 8-12 volunteers to help play out this activity.
2. Explain the rules of the game to the volunteers as listed below.
 - Tell participants to imagine they are running a seed production business and they would like to determine the costs for each activity from the previous season in terms of inputs and labour cost and the total cost.
 - Each member is given a cost item for which they need to estimate the cost e.g. planting –UGX 40,000
 - The trick is to remember the cost item and price mentioned by the previous people so that they can calculate the cost of running the business. The last person should be able to mention all the items mentioned by previous people in their order but also give the total cost.
 - Cost items include: buying improved seed, land clearing, ploughing, manure application, weeding, spraying, harvesting, storage, packaging and transport.
 - **The trainer starts:** I bought improved seeds for UGX 20,000
 - **2nd person:** I bought improved seed for UGX 20,000, cleared land at UGX 50,000,
 - **3rd person:** I bought improved seed for...
 - **4th to 8th or 12th person:**
 - By the time the 8th person talks, it will be impossible for them to remember all the cost items mentioned by everyone and add up the costs.
3. What did you learn from this activity?
 - Does this happen in your businesses?
 - What are some of the results of not keeping complete records?
4. The farmer gets incomplete information which gives unreliable results. This can lead to getting an inaccurate picture of the farm business or even making poor farm decisions. It is also important to calculate the profitability for your different vegetables separately so they can be compared. This means separate records of the income you earn and expenses you pay for each vegetable.





Activity 3: Assessment



1. Conduct the group assessment.
2. Ask participants to share what they have learned. You can use the following questions to guide you.
 - What kind of information should a farmer record?
 - How does record keeping help a farming business?
3. Emphasise the key message to the participants:
 - Farm records help give the farm an accurate picture of the farm but also provide the information needed to make sound business decisions.
4. Thank your audience for their participation in the session.

Session 3

Cost Benefit Analysis

OBJECTIVES



1. Understand how to select an enterprise
2. Determine the input and labour costs
3. Understand how to determine the total cost and unit cost of production
4. Determine the profits or losses and compare profitability of 2 crops or more.

KEY MESSAGE



To determine if the business is a sound investment, you need to calculate and compare profits/benefits and costs of a project.

MATERIALS



Cost-benefit analysis tool and instructor's guide, profit analysis chart, 35 pieces of paper trimmed to fit in each pocket, flip charts, markers, and masking tape.

TIME



1 hour

Trainer's note

In this example we are using Nakati grown on an acre. You could use the same process for another crop with the participants. Use the cost benefit analysis tool and the instructor's guide that comes along with it.

Activity 1: Choosing a seed enterprise

1. Every farmer running a business should be able to determine the income and expenses of seed production for different vegetables to determine the profit (or losses) of growing on an acre.
 - In this manual we have discussed the production for 9 indigenous vegetables including African eggplant, pumpkin, African nightshade, nakati, spider plant, red and green amaranthus, cowpeas and malakwang. But this session can be used for any crop, vegetable or commodity.
2. Of these 9 vegetables, which vegetables grow best in your region?
 - Which one of the vegetables looks more promising in terms of profit?
 - Allow participants to discuss their experiences and ideas.
3. Should we try to calculate the costs, income and profit for the vegetables?
4. Agree on one vegetable and place the crop label in the top left corner of the cost-benefit chart.
5. The land size will impact both costs and income for farming; therefore, we need to agree on the average size of land within the community to use for all the calculations.





Activity 2: Assessment



1. Conduct the assessment by asking participants the following questions:
 - How does comparing the costs of different vegetables help you make a business decision?
 - Do you know what vegetable you would prefer to grow? Why?
 - How can competition affect your decision to plant a certain crop?



2. Emphasise the key message to the participants:
 - **To determine if the business is a sound investment, you need to calculate and compare benefits and costs of the project.**
3. Thank your audience for their participation in the session.

Appendix 1: Handouts

- 1. Cropping cycle handout**
- 2. Plant spacing handout**
- 3. Steps in conducting a germination test**
- 4. How to set up a nursery bed and care for seedlings**
- 5. Manure application handout**
- 6. How to plant a vegetable handout**
- 7. Pest and diseases handout with bio-pesticides**
- 8. Budget template**



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