

ACTION FOR LIVELIHOOD ENHANCEMENT IN NORTHERN UGANDA (ALENU)

AGROECOLOGICAL GUIDE FOR BEANS PRODUCTION Trainer's Guide



November, 2020

ACKNOWLEDGEMENTS AND **DISCLAIMER**

This manual is developed by a consortium consisting of four NGOs (Caritas Switzerland, Advance Afrika, Agency for Accelerated Regional Development, and Gulu Women Economic Development and Globalization) for the implementation of the Action for Livelihood Enhancement in Northern Uganda (ALENU) Project that is funded under the Development Initiative for Northern Uganda (DINU), a government of Uganda programme supported by the European Union (EU) and supervised by Office of the Prime Minister.

The manual formulation process included a review of a number of manuals for which we are indebted, namely:

- Infonet Biovision website: <https://infonet-biovision.org/>
- FiBL 2011. African Organic Agriculture Training Manual. A Resource Manual for Trainers. Beans

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ABOUT ALENU PROJECT

Under the Development Initiative for Northern Uganda (DINU), a Government of Uganda programme supported by the European Union (EU) and supervised by Office of the Prime Minister, Caritas Switzerland has received a grant to implement the Action for Livelihood Enhancement in Northern Uganda (ALENU). ALENU is implemented by a consortium consisting of four NGOs (Caritas Switzerland, Advance Afrika, Agency for Accelerated Regional Development, and Gulu Women Economic Development and Globalization).

Objectives and Results

ALENU is a 40-month action that focuses on improving livelihoods through increased and diversified food production, enhanced market opportunities and better maternal and child nutrition in six districts of the West Nile and Acholi sub-regions. Its **overall objective** is, “to consolidate stability in Northern Uganda, eradicate poverty and under-nutrition and strengthen the foundations for sustainable and inclusive socio-economic development.” And the **specific objective** is, “to increase food security, improve maternal and child nutrition, and enhance household incomes through support to diversified food production and commercial agriculture and through improving household resilience (notably to climate change) and women empowerment. The three main result areas are: **Result 1.1**: Increased production of diversified food; **Result 1.2**: Increased market accessibility; and **Result 1.3**: Improved nutritional status.

Districts and Sub Counties

Agago (Wol and Lokole); Amuru (Amuru and Lamogi); Omoro (Odek and Lakwana); Nebbi (Erussi and Atego); Pakwach (Pakwach and Panyimur); Zombo (Kango and Athuma)

Main Activities

Result 1.1: Increased production of diversified food

Select HHs; develop Family Development Plans; develop seasonal Production and Marketing Plans; set up group demonstration gardens; conduct farmer field school sessions; facilitate outreaches by local government extension staff; organize seasonal agro-input fairs; build capacity of agro-input suppliers; form commodity-based cooperatives; train VSLA Mentor; train Farmer Group (FG) members in VSLA; link SACCOs/ progressive FGs with formal banks.

Result 1.2: Increased market accessibility

Provide FGs with Business Development Services; organize/ promote sub-county farmer markets; facilitate learning visits to model farmers/private sector actors; create added value for commodities; organize a multi-stakeholder platform and annual cross-sector dialogues; achieve progress in certification, quality control, branding and contracting.

Result 1.3: Improved nutritional status

Train VHTs/Health Workers on good nutrition practices, child health, family planning and WASH; empower cultural and religious leaders to sensitise community; increase access to prevention and curative health services; improve nutrition and sanitation practices at HH level; train VHTs on family planning, provide family planning services; conduct annual couples conference and community dialogues on family planning/GBV; conduct community dialogues for out-of-school adolescents on sexuality/ family planning, provide health services; advocate for supplies of FP commodities; facilitate debating clubs and youth peer groups in schools; collaborate with faith-based medical bureau.

Approaches

- **Holistic Family-Centered Approach:** All household members will benefit from a combination of bundled services customized to meet their specific needs, address their vulnerabilities and strengthen their capacities at the collective and the individual level and in view of reducing poverty and malnutrition.
- **Village Savings and Loan Association (VSLA) and Linkage Banking:** Provide simple savings and loan facilities in a community that does not have easy access to formal financial services. Strong VSLAs will be registered at district level and linked to formal financial institutions or federated into SACCOs for better financial inclusion.
- **Farmer Field School (FFS) with Peer-to-Peer Demonstration-based Extension Approach:** Promote practical knowledge among smallholders on improved technologies through participatory, experimental, problem solving and discovery-based learning and hence increase yields, food adequacy and

collective marketing for better market positioning.

- **Market Systems Development (MSD) and Value Chain Approach (VCA):** Make markets work for the benefit of the poor by tackling the underlying causes of market failure and strengthening the functions of market actors as well as the rules and norms that govern the market system.
- **Agro-ecology:** Apply ecological and social concepts and principles to the design and management of food and agricultural systems to optimize the interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system (FAO).

Key stakeholders

Stakeholder	Role
Target farmers and their households	Main beneficiaries, participate in selection of market commodities and peer-extension agents (CBTs, Poultry Paravets, Agroecology Champions, VSLA Mentor and Market Committee Members), various capacity building activities and monitoring and learning meetings
Local Governments	Oversee implementation of activities and align the Action with the district priorities, involved from planning stage and play a major role throughout the implementation as advisors, extension workers, or beneficiaries of capacity building
Community members	(VHTs, cultural and religious leaders, senior women and male teachers, youth Mentors), contribute to changing attitudes and practices, involved at all project cycle stages.
Private sector	Expand market system and offer production inputs (seeds, tools, etc.), loans, services (market information, advisory service, quality control, vet services etc.), transport and, as traders and processors, purchase the products of target farmers and farmer groups
Advance Afrika, AFARD, Gwed-G	Local implementing partners, in charge of implementation based on a mix of geographical and technical division of responsibilities
Caritas Switzerland	Consortium coordinator and donor, ensures independent project supervision, in charge of MEL and quality assurance including capacity building of co-applicants, and the development of a network of strategic contacts with development partners
Ugandan Government	Supervising (OPM) and contracting authorities (National Authorizing Officer/ Ministry of Finance, Planning and Economic Development)
EU	Main donor

Beneficiaries total 35'900 individuals (farmers and their household members, local government officers, community and private sector members, and the staff of implementing partners).



Training concept

0.1. Pedagogical approach

The training is based on elements of the FFS approach and adult learning theories. The following elements are important:

- The training should be conducted in a participatory and highly interactive way because involvement and learning are enhanced when participants contribute to the discussion. It is therefore essential that participants are encouraged to share their own experiences before the theoretical material is brought to them.
- Similarly, practical exercises, where participants apply what they learn directly in a demonstration field, will enhance learning.
- The demonstration field should be located on the farm of one of the participants (host farm). All training sessions will take place in this field. The host farmer must look after the field between training sessions.
- The training plan must follow the cropping calendar for the product concerned, so that the farmer can apply what he has learned directly at home (see the proposed training calendar below). Ideally, the participants should meet every week or second week on a learning cycle comprising 8-10 meetings.
- Where appropriate, encourage participants to try different things and make small “experiments”, either at home or on the demonstration field (for example, applying different types of fertilizer) and observe the effect these treatments can have on the crop.
- If possible, the facilitator should visit farmers in their fields to give them feedback on how they implement their crop at home and help them find solutions to the problems they face.

The participatory method and learning-by-doing will create a direct link between the training and the challenges farmers face when implementing new techniques at home. This will enable them to develop their observation and innovation skills and to find solutions on their own to the problems they may face. It is recommended to start each training session with the practical part, before the facilitator gives technical advice at the end of the training sessions.

The training should promote as much as possible a production that includes the principles of agroecology. The general principles of agroecology are described in Chapter 0.2. These general principles can be explained and discussed during the first training session.

Specific aspects of agroecology, such as soil fertility management, crop rotation, pest and disease management, are discussed in more detail in the corresponding chapters and in a separate booklets. They should be explained and discussed during training sessions devoted to these topics.

Recommended structure of a training session:

- 1. Welcome**
- 2. A look back at what has happened since the last meeting.** (10-20 minutes)
In the participant fields: Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any. **In the demonstration field:** Also take a few minutes to observe with the participants what has happened in the demonstration field since the last session. What has changed, how have the plants grown? What disease problems can be seen? Do they find insects, other organisms? How is the soil, the humidity, etc.? Facilitators can ask the participants to focus on aspects related to the topic of the day.
- 3. Introduction of the topic of the day and short brainstorming to identify what the participants know already about this topic.** (10-20 minutes)
For each chapter, some guiding questions are proposed to stimulate the discussion.
- 4. Exercises in the field (2 hours).** Practical aspects of the topic of the day are directly applied in the field by the participants, with the support of the facilitator. The participants shall then apply these techniques at home as well.
- 5. Summary (20-30 minutes):** the facilitator summarizes important aspects of what has been learned during the sessions and gives some more technical advice if necessary.

Recommended training program

Topic	Duration	Timing
1. Introduction – importance of beans production and choice of varieties. What is agroecology?	2-3 hours hours	4 weeks before planting time
2. Land selection and preparation (including soil fertility management)	3-4 hours	4 weeks before planting time
3. Planting	3-4 hours	Day of planting
4. Weeding, staking	3 hours	3-4 weeks after planting
5. Pests and diseases management	2 sessions of 3 hours	5-10 weeks after planting
6. Harvesting and postharvest operations	3 hours	Week 11-20 after planting
7. Record keeping and gross margin calculation	2 sessions of 2-3 hours	Before/during the cropping season. End of cropping season

0.2. What is agro ecological farming?

Agro ecology is farming that aims at feeding a growing population while conserving and nurturing the natural resource base. Agro ecological farmers want to improve food yields for balanced nutrition, strengthen fair markets for their production, enhance healthy ecosystems, and build on traditional knowledge and customs. Their objective is to create stable food production systems that are resilient to environmental perturbations such as climate change and disease.

Agro ecology views farmland as an ecosystem – a complex network in which every living and nonliving component of the system is important and affects every other component, either directly or indirectly. Since farmland provides many services to us humans (such as food production, clean water or biodiversity) we have to take care of it. Key principles of agro ecological farming therefore include:

- Protect the environment and use natural resources efficiently and sustainably;
- Reduce the use of toxic chemicals as far as possible;
- Make use of organic/biological measures and resources, and try to recycle what you can;
- Rather prevent problems (such as pests and diseases) than having to treat them;
- Let nature help you;
- Practice agriculture for the good of people and the environment.
- Concept supports attaining food sovereignty at household

Topics in which agroecological farming differs particularly from conventional farming are especially soil fertility management and pest and disease management¹ Farm plan and design support creating a sustainable agro ecological farming system .

Soil fertility management

Instead of simply using chemical fertilizers to boost crop growth, agroecological soil fertility management considers crop rotations or intercropping with legumes (that can fix nitrogen from the air), the use manure and compost, and beneficial organic matter management to keep soils healthy and fertile. Reducing tillage operations and protecting the soil with a permanent cover helps maintaining the soil fertile and healthy. Some practical guidelines on how to prepare and use soil fertility amendments are given in a separate leaflet.

Pest and disease management

¹ and efficient irrigation, sustainable water use

To reduce the use of chemicals as far as possible, agroecological pest and disease management applies many practices to prevent pests and diseases from building up and creating losses:

- Cropping patterns such as crop rotations, intercropping, or trap/catch/push crops can break pest and disease cycles (and provide numerous other benefits), while anti-parasite crops may scare away (repel) or trap certain pests;
- Use resistant and tolerant varieties (quality seed, seed treatments, ...);
- Strong plants are less susceptible to pests and diseases (soil fertility, micro-climate, weeding, nurseries, effective micro-organisms and the like, ...);
- Introduce and nurture beneficial organisms (habitat, e.g. agroforestry, to enhance diversity);
- Adequate fertilization and irrigation (not too much N or humidity);
- Physical control: traps, enclosures/netting, by hand, scaring away, removing diseased plants,
- Organic pesticides: produced by farmers, small businesses;
- Go regularly to the field and observe thoroughly.
- Support of soil microorganism food web

Some recipes and guidelines to produce and use such measures are explained further-on or in a separate leaflet.

1

Introduction – importance of beans production and choice of varieties

A. Learning objectives

After completing this module, participants will:

- Have an overview of beans production in Uganda
- Understand the benefits of beans growing
- Have reflected on the reasons why they would like to grow beans
- Know the characteristics of different varieties of beans commonly grown in Uganda and be able to choose varieties adapted to the growing conditions of his farm and his production objectives
- Have an idea of timing of critical activities in the beans production cycle
- Understand the principles of agroecology

B. Duration

2-3 hours

C. Learning aids

- Flip chart
- Pens
- different varieties of beans
- the collaborative work on the field will be the most effective learning aid

D. Activities and exercises

Introduction (20 minutes)

The trainer will introduce the topic of the day. He may discuss the following questions with the participants:

- Why is it important for you to grow beans? How will beans production fit within your farms? For which purpose do you want to grow beans (self-consumption, as a source of income)?
- What could be the benefit to grow beans?
- What could be the main problems for you to grow beans? How to overcome

these problems?

- What are the critical timing and activities of growing beans?
- What do you know about agroecology? What does it mean in beans production?

Exercise choosing the right variety (30 minutes)

The facilitator gathers on a table a sample of bean varieties available in Uganda. If possible, he also gathers different bean plant types (erected and bush types) in pots, or pictures of them.

The facilitator asks the participants to discuss (either in groups first or directly in plenum) the following questions:

- Which of these varieties / plant types do you know, how do you call them?
- Which one have you already grown, eaten? Which one do you prefer and why?
- What advantages and disadvantages do you know from these varieties / plant types?
- Which variety would you choose to grow for which purpose

The exercise can be closed by a degustation of the different varieties!

Summary by the facilitator (30-60 minutes)

- The facilitator summarizes the discussion by explaining the importance of growing beans.
- He may briefly present the critical stages of growing beans (see Table 1) and point out the training program, which will be following the growing cycle of beans, so that participant can apply directly at home the content of each training session.
- He summarizes the main principles of agroecology and point out that these principles will be addressed in specific sessions during the whole production cycle
- He explains which varieties of tomatoes are more adapted to an agroecological production and why.
- The group may also decide which variety of beans will be planted on the demonstration plot.

E. Content

1.1. Overview of beans production in Uganda

- Beans are a major food crop in the world and they are grown in most parts of Uganda and form an integral and important component in the nutrition in all households.
- It is successful in areas where rainfall is moderate to light during the latter part of the growing season.

- There is increasing production and demand of beans at domestic, regional and international levels to encourage and promote beans production in Uganda.
- There are many varieties grown in the country, with many of them improved to suit specific requirements in the market.
- Since beans belong to the botanical family Leguminosae (Legumes) they play also an important role as Nitrogen fertilizer. Beans have the ability to transform atmospheric Nitrogen fixing it in the soil in a form that can be taken up by plants. Hence they will improve the fertility of the soil.
- They can be grown on small plots of land and are good for intercropping.

Why grow beans?

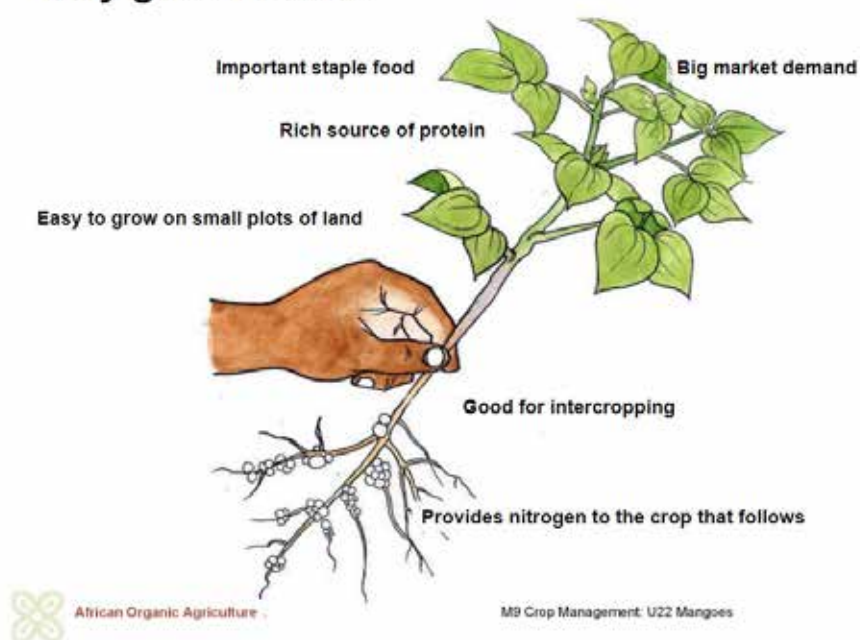


Figure 1: Summary of importance of growing beans (Source African Organic Agriculture)

1.2. Uses of Beans

Beans have very many uses among which, the following:

- Beans are a cheap source of protein, carbohydrates and micronutrients mostly B vitamins, iron, calcium and zinc in human diet.
- Beans can be successfully dried, stored and consumed or sold on the market generating a source of income for farmers.
- Beans are an important inclusion in crop rotation because they contribute to soil replenishment through Nitrogen fixing in the soil providing it to the following crops.
- Beans can be successfully intercropped with other crops like maize or cassava.
- Selected bean varieties are valued for different characteristics, in terms of tolerance to diseases and pests ;
- Some varieties are valued for they economise fuel needed in cooking

•

1.3. Types and varieties of beans grown in Uganda

Common beans (*Phaseolus vulgaris*) can be differentiated into:

Dry beans and green beans

- Common beans can be grown as dry (shelled) beans or green beans (also called French or haricot beans).
- The green beans are the unripe pods of common beans. Green beans have fleshy pods and should be harvested before the seeds are fully developed.
- Varieties suitable for shelling usually have larger seeds and bigger pods and the shelled seeds can be eaten either fresh or dried.

Determinate beans and indeterminate beans

Two types of beans can be distinguished, depending on their growing pattern

- **The determinate beans:** known as bush beans: they grow approximately up to 50 cm and can be grown without support. The main stem terminates into flowers. Once these flowers form pods and ripen, the plant goes into senescence and dies.
- **The indeterminate beans:** known as climbing or runner beans are usually grown on a trellis and can easily grow 3 meters high or more. They produce flowers and when pods are harvested by picking, the branches of the mother plant are capable of flowering again and producing more pods later. Because of the bigger plant volume, they have a higher yield potential than bush beans.

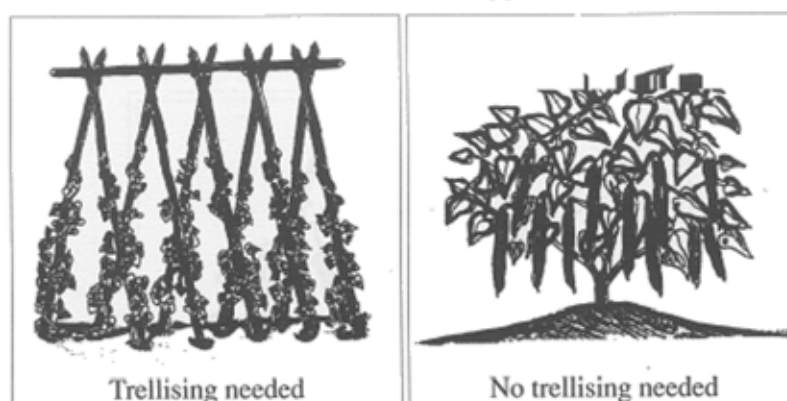


Figure 2: Bean types

Common varieties include K20, K131, K132, NABE 4, NABE 16, NABE 17 and all these are determinate types. On average, the yields for the short varieties (K131, K132) is between 500 and 700 kg/acre, while that of improved varieties (NABE and NAROBAN series) is up to 1,000 kg per acre under good weather and practices.

1.4. Production practices of beans

For proper growing of beans, there is need to closely agree and follow a weekly activity plan with the farmers. Here below is an activity plan that will be found useful to the farmers for proper timing and planning of activities

Table 1. Growth stage of beans and critical activities

WEEK	GROWTH STAGE	CRITICAL ACTIVITIES	RECOMMENDATIONS
-4	Nil	Site selection and 1st digging	Bury as much vegetation as possible.
-1		2nd digging and field cleaning	Remove/align any excess trash in the field. DO NOT BURN.
0	Germination after 5 days	Planting Determine germination rate	Select good seed for planting Plant the seed 3-6 cm deep
1		Gap fill	Make sure there is one seedling in each hole
2	The plant has a bud and 5-7 leaves	First weeding Monitoring for pests and diseases (Cutworms, bean fly)	Take care not to damage the plant roots Remove the wilted plants
3	Vegetative growth, growth	Monitoring for pests and diseases (Cutworms, bean fly, aphids, Common bean mosaic)	Spray with organic concoctions where necessary Phytosanitation
4	Maximum vegetative growth	Monitoring for pests and diseases (flower and pollen beetles, leaf minors, aphids, Angular leaf spot)	Phytosanitation Reduce movement in the field
5	Flower initiation	Second weeding if necessary, but should NOT be done at the time of flowering Look out for flower and pollen beetles, leaf minors, aphids, Angular leaf spot	Minimize movements in the garden
6	Flowering continued	Look out for flower and pollen beetles, leaf minors, aphids and Angular leaf spot	Avoid movements in the garden

7	Pod formation starts	Field monitoring for leaf and pod eating caterpillars like the African bollworm as well as diseases like anthracnose	Keep away animals and limit movements in the field. Spray with organic concoctions.
8	Pod growth	Field monitoring for leaf and pod eating caterpillars like the African bollworm as well as diseases like anthracnose	Keep away animals and limit movements in the field. Spray with organic concoctions
9	Physiological maturity starts		Guard against thieves Reduce movement in the field, keep the field clean
10	Physiological maturity,	None	Minimal activity
11 - 12	Ripening and onset of pod drying	Field monitoring pests and theft	Prepare for harvesting
13	Semi dry pods	Harvesting	Cut the bean plants at ground level, leaving the root crown in the soil

2

Land selection and Preparation

A. Learning objectives

After completing this module, participants will:

- Understand the factors to consider in selecting a suitable site for bean production
- Understand how bean plants interact with other plants and how to plan crop rotation considering spatial and temporal arrangement of bean plants.
- Learn the best practices of land preparation for bean production
- Know how soil fertility should be managed and how to prepare compost and manage manure (can be addressed in a separate session » see separate leaflet for Activities and exercises and content)

B. Duration

3-4 hours

C. Learning aids

- Group Demonstration garden
- Hand hoes, pangas and axes
- Strings and measuring tape

D. Activities and exercises

If relevant: Look back at what has happened since the last meeting. (10-20 minutes)

Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.

Introduction and practical selection of the land for the bean plot (1 hour)

This activity should take place directly in the area where the bean plot will be implemented

1. The trainer introduces the topic of the day. He then asks the participants and discuss with them the following questions, possibly directly in the area where the bean plot will be implemented:
 - How would you choose an appropriate site for growing your beans?
 - Which aspects would you look at or take into consideration?
2. Based on the discussion, the participants are asked to list the criteria on a flip chart.
3. The facilitator asks then the participants to choose the right location to implement the bean plot and justify their choice. Alternatively, they can assess the plot that has already been selected using the criteria that have been discussed.

Exercise: preparing the land for bean sowing (1-2 hours)

The participants, together with the facilitator, will practically prepare the land for bean sowing.

Optional: Exercise soil fertility management and compost and manure management

see separate leaflet «Soil fertility management» can also be done in a separate session)

Facilitator's summary (30 minutes)

The facilitator (or a participants) sum up important points of land selection and proper land for beans production based on the aspects presented in the sub-chapter E. Content below.

E. Content

2.1. Conditions for growing of beans

Rainfall

- Beans require a moderate well-distributed rainfall (300-400 mm per crop cycle) but dry weather during harvest is essential. Prolonged dry conditions or extreme wetness are harmful to beans.
- In excessive rains, the beans will have more vegetative growth and if heavy rains persist during pod formation, the pods will be filled with water and no seeds.

Soil

- Beans grow in most soils but prefer loamy soils with moderate to high fertility.

Site selection for bean production

The land selected for growing beans should be fertile and free draining with no periods of prolonged water logging (3+ hours after rain). They can be grown along river or stream banks, valleys or on hill tops so long as the land is free draining. They should normally come after other crops but not on virgin fertile land as the nitrogen level will be so high and the beans will tend to grow more leaves than the grains.

Crop rotation

- Beans are an important crop in soil conservation because they can add nitrogen to the soil during their growth.
- It is advisable to plant beans after any cereal crop to replace the nitrogen used by the cereal (heavy feeder).
- Beans should be grown in a rotation sequence of legume, cereals, root crops to reduce the risk of depleting the soil of specific nutrients and also to break disease and pest cycles

Intercropping

- Beans are excellent for intercropping with other food crops, such as maize, potatoes, celery, cucumber and can help supply the other crops with nitrogen to a limited degree.
- Longer season varieties of beans can fix higher amounts of nitrogen than short season varieties. Intercropping with chives or garlic helps repel aphids.

Land preparation

- Land preparation should begin at least 3 weeks (21 days) before planting to allow the breakdown of organic matter.
- Deeply plough land at 15-30 cm, dig again after 2-3 weeks to allow for decomposition. A second digging should be done at least a week before planting.
- If the site is very bushy, first clear land by slashing down all plant parts and leave them on the ground, or plough-in the plant residues. This will help the soil to conserve moisture, improve the water-retention capacity, water-infiltration capacity and increases soil fertility.
- If the field was previously covered with weeds like black jack (*Bidens pilosa*) which produce a lot of seeds, then the land needs to be prepared early in the season. This will encourage most of the weed seeds to germinate as soon as the soil gets any moisture. The field can then be lightly tilled down to kill off these weeds.
- If possible, practice minimum tillage
- If possible or relevant, apply soil and water conservation techniques:
 - construct contour bunds and terraces on steep slopes
 - plant cover crops to limit loss of water and soil nutrients

3

Planting of beans

A. Learning objectives

After completing this module, participants will:

- select quality seeds for planting and know the possible sources of quality seed for planting
- sow beans according to the recommended practices including spacing, planting depth and seed rate

B. Duration

3-4 hours

C. Learning aids

- Group demonstration garden
- Hand hoes,
- Strings and tape measure
- Bean seeds

D. Activities and exercises

Look back at what has happened since the last meeting (10-20 minutes)

Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.

In the demonstration field:

Also take a few minutes to observe with the participants what has happened in the demonstration field since the last session. What has changed, how have the plants grown?

Introduction of the topic of the day (20 minutes)

The facilitator will shortly introduce the topic of the day and the purpose of the

activity. To stimulate the discussion, the following questions can be asked:

- 1) How would you sow your beans?
- 2) How would you select quality seeds?
- 3) Where do you procure your seeds?

Demonstration (3 hours)

The trainees, together with the facilitator will practically sow the beans in the demonstration field of the group. The facilitator must explain all the different activities involved step by step. The knowledge got from the demonstration plot will be used by the trainees in their fields at household level.

Summary (20 minutes)

The facilitator summarizes the main points of the topic of the day

E. Content

Seeds quality

- A good seed source should be identified so as to get good quality seed.
- Seeds should be sorted to remove any seeds that are broken, shriveled, diseased and off-type (different variety). This will improve uniformity in the field after planting
- If you mix up improved and local varieties in the same gardens it is difficult to achieve full potential from the improved varieties because.
- Moreover, the harvested beans are further mixed up after shelling and during further planting. As a result of cross pollination, the characteristics of improved varieties are gradually lost.
- For successful production, it is important that high-quality (certified) seed with a high germination percentage (80 % or higher) be used. This production cost factor is slight when compared to probable yield losses due to disease or poor stand.
- Low-quality seed can cause a poor and an uneven stand, resulting in uneven maturity, harvesting problems and yield losses.
- Using disease-free seed will reduce the incidence of seed-borne diseases such as bean common mosaic virus (BCMV), bacterial diseases (common blight, halo blight and bacterial brown spot) and the fungal disease, anthracnose.

Planting of beans

Bush beans: planting is done at a spacing of 50 cm by 10 cm with 1 seed per hole. This will give optimum yields.

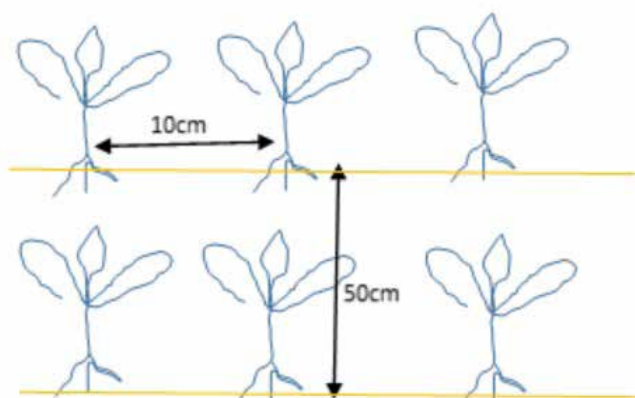


Figure 3: Planting scheme for bush beans (Source: African Organic Agriculture)

Climbing beans: the planting spacing is 50 cm by 15 to 20 cm. At this spacing, the seed rate will be 25-30 kg per acre.

- Depth of planting is 4-6 cm. Deeper planting may lead to delays in emergence and low or poor germination.
- On the other hand, too shallow or surface planting may lead to poor germination as the seed may not obtain sufficient moisture for emergence and it also exposes the seed to rodents and other vermins.
- In case of heavy rain on a slope, seed planted too close to the surface may be carried away in run off.
- Beans are planted during both short and long rain seasons because they have a short maturity period. However, different regions have different planting times which are dependent on the variety.
- On average, however, planting should be done on the onset of rains. For long rain seasons, farmers delay planting by 2 to 3 weeks to avoid too much rainfall during pod filling stage which may lead to rotting of pods and reduction in yields.
- The planting scheme in lines (rows) is the best in order to achieve the optimum plant population and also ease field operations such as weeding, scouting for pests and diseases and harvesting. To ensure line planting, mark out the field using marked strings or line markers following the recommended spacing. For bush beans e.g Nabe 4, Nabe 15, use the spacing of 50 cm x 10 cm for sole crop with one seed per hole, or a spacing of 50 cm x 20 cm and two seeds per hole.



Figure 4: Beans planting scheme in lines

Optimum plant population is critical because:

- High population leads to competition among the bean plants resulting into weak plants and low yield.
- It also provides a favourable environment for growth and hide- out for most bean pests and diseases
- Lower plant population will result into low yields due to reduced number of plants per unit area.

4

Weed control in Beans

A. Learning objectives

After completing this module, participants will:

- Understand the effect of weeds in bean production
- Learn and practice the different methods of weed control in beans
- Understand the importance of correct timing of weed control during bean growth

B. Duration

3-4 hours

C. Learning aids

- Group demonstration garden
- Hand hoes, sickles, pangas

D. Activities and exercises

Look back at what has happened since the last meeting (10-20 minutes)

- **In the participant fields:** Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.
- **In the demonstration field:** Also take a few minutes to observe with the participants what has happened in the demonstration field since the last session. What has changed, how have the plants grown?

Introduction (20 minutes)

The trainer will introduce the topic of the day. He can stimulate discussion by asking the following questions:

- Do you weed at home? How and why? If not, why?

- What is the effect of too much weeds on the bean plants?

Demonstration (2-3 hours)

This training should be practically done in the group demonstration field.

In a first step, the facilitator can walk through the plot with the participants and ask them to identify the weeds that can be found there.

In a second step, the participants, together with the facilitator, will do the weeding. They may not finish weeding their demo plot during this session but will do follow up weeding until the group demo is completed.

The knowledge got from the demonstration plot will be used by the trainees in their fields at household level.

Facilitator's summary (15 minutes)

The facilitator should really remind the trainees about the important of weeding since majority of the farmers tend to ignore this.

E. Content

4.1. Weed control

- Weeds refer to any plant that grows where it is not wanted.
- Because beans are low-growing plants, they struggle to compete with weeds.
- Early control of weeds 2-3 weeks after planting is extremely important, because the root system of the plant develops at this stage and some weeds limit root development and therefore plant growth.
- It is also recommended to do a second weeding at 5-6 weeks after planting to avoid weeds hampering with the harvesting and threshing processes, and not to adversely affect the quality of the crop.
- It is advisable to complete weeding before flowers emerge because weeding a flowering bean crop will lead to:
 - a. Flower fall and loss of yield
 - b. Disturbance to pollination as insects are scared from the flowers during weeding
- During weeding slight ridging of plants will help bean plants withstand attack of bean flies.
- Cultivating beans when the soil is wet encourages spread of soil-borne diseases such as anthracnose and fusarium root rot.
- Shallow tillage is preferred especially in the period before flowering as damage to the roots or the collar of the plant encourages soil borne diseases.
- Mulching with straw and cut grasses helps conserve moisture, promote adventitious root development and enhances tolerance to bean fly maggot damage.

Effects of Weeds on beans

- Weeds reduce yield by competing with the bean crop for minerals, light and moisture especially during the early stages of crop growth.
- Some weeds are alternative hosts of pests and diseases
- A thick growth of weeds in beans makes harvesting difficult.
- The weed seeds and shoots increase labor for winnowing and sorting; they also reduce the purity and/or quality and market price of the beans due to admixtures.



5

Pest and disease management in beans

A. Learning objectives

At the end of the training, the trainees will be able to:

- Know the common pests and diseases affecting beans and their effects.
- Recognize the signs and symptoms of different pests and disease attack in beans.
- Apply the Integrated Pest and Disease management approaches in bean production.
- Understand the critical stages of growth of different pests to target control.

B. Duration

3-4 hours (in 2 sessions)

C. Learning aids

- Demonstration garden,
- Insect bottle,
- Stationery,
- Knapsack sprayer,
- jerrycan,
- basin soap,
- pesticides.

D. Activities and exercises

Look back at what has happened since the last meeting (10-20 minutes)

- **In the participant fields:** Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.
- **In the demonstration field:** Also take a few minutes to observe with the participants what has happened in the demonstration field since the last

session. What has changed, how have the plants grown?

Introduction (20')

The trainer will introduce the topic of the day pointing out what is to be learnt, including the different pests and diseases affecting beans and their control. The trainer should inform trainees that training will be a practical one where the trainees will be taken to the group demonstration for different pest and diseases scouting and identification.

The following questions can be used to stimulate the discussion:

- What main pest and diseases affecting beans do you encounter in your field
- What symptoms of pest attack and diseases have you seen on your beans?
- Which prevention measure do you know to avoid pest and disease attacks
- Which organic treatment against pest and diseases do you know?

Practical exercise (2 hours)

a) How to observe the bean field and the bean plant to detect pest attack and diseases?

The facilitator discusses with the participant how the field should be visited to monitor pest and diseases. Then, he discusses with them how single plants should be observed, which aspects should be looked at. An observation format could be developed by the group.

b) Practical observation of the field in subgroups

Each subgroups of 4-5 participants will observe one or two plants taking into consideration the criteria identified in a. Part of sick plants can be collected. Insects can be collected and placed in bottle. The groups summarize their observations on a flip chart and try to formulate recommendations.

c) Presentation by the subgroups in plenum and discussion




The findings of each subgroup are presented and discussed. At the end of the discussion, the main pests and diseases found in the field should have been identified and possibilities for prevention or treatments discussed.

Summary (20 minutes)




The facilitator summarizes the main findings of the group works and discussions. He presents other important pests and diseases that may affect beans.

On other days, the groups may be doing scouting on their own and will be using the insect bottle to keep the insects and present to the Agricultural officers on the days they visit the groups. The knowledge got from the demonstration plot will be used by the trainees in their fields at household level.




Pest and Disease Management



Pest	Effect	Control
<p>Bean fly (Stem maggot)</p> 	<ul style="list-style-type: none"> • Female fly pierces the young leaves to lay eggs and sucks the exuding sap, leaving yellow blotches on the leaves. • Larvae tunnel into leaves and down petioles to the stem cutting flow of nutrients causing withering and drying • Yellowing of seedlings • Swollen stems and collar of the plant • Stunted growth • Common during moisture stress periods 	<ul style="list-style-type: none"> • Crop rotation • Early planting • Mulch and manure application to strengthen the plant • Avoid planting beans near cowpea, soybean and other leguminous crops, that may be the source of bean flies. • Remove and destroy crop residues and all plant parts with symptoms of damage by bean flies. • Earth up (building up) the soil around the plants to cover the roots at 2-3 weeks after emergence. • Use botanical insecticides such as neem. • Use resistant varieties
<p>Black bean aphid</p> 	<ul style="list-style-type: none"> • Transmit common bean mosaic virus (CBMV) • Reduce yield especially if infestation is during the vegetative phase • They suck plant sap Infested leaves curl under and inward and become severely distorted. Leaves also become mottled due to viruses spread by aphids. 	<ul style="list-style-type: none"> • Crop rotation • Early planting • Chemical use (Dimethoate) (not recommended) • Mixture of cow urine and ash • Conserve natural enemies. They are important in natural control of aphids. • Monitor regularly the crop. • Whenever necessary spray only infested plants (spot spraying). • Use biopesticides that are not harmful to natural enemies (e.g. neem, ashes, soapy water)
<p>Bean weevil</p> 	<ul style="list-style-type: none"> • Yellowing of seedlings • Swollen stems and collar of the plant • Stunted growth • Adult weevils chew the edges 	<ul style="list-style-type: none"> • Crop rotation • Early planting • Collect weevils manually and destroy them • Remove plants damaged by grubs and destroy the weevils

<p>Flower & pollen beetles</p> 	<ul style="list-style-type: none"> • Feed on flowers (petals and pollen), reducing on pod setting 	<ul style="list-style-type: none"> • Clean gardens and burn the stalks after harvest, and crop rotation • Hand-pick and destroy adult beetles to keep the numbers in check. However, care should be taken, since when disturbed, blister beetles can release a liquid that burn the skin.
<p>African bollworm</p> 	<ul style="list-style-type: none"> • Larvae feed on tender leaves and pods 	<ul style="list-style-type: none"> • Early planting • Resistant varieties
<p>Cutworms</p> 	<ul style="list-style-type: none"> • Larvae feed on roots and base of stem killing seedlings • The caterpillar cut through the stem of young plants just above ground level or just below the ground which causes plants to wilt and die. 	<ul style="list-style-type: none"> • Early planting • During primary tillage, dig soil to expose larvae to predators such as birds and ants • Hand pick and destroy the larvae • Remove and destroy cutworms. • Prepare field and remove weeds well ahead (10-14 days) of planting the crop in the field. • Ploughing exposes caterpillars to predators and to desiccation by the sun.
<p>Leaf miners</p> 	<ul style="list-style-type: none"> • The larva makes long, slender, white mines (tunnels) in leaves. • Severely mined leaves may turn yellow and drop. • Severely attacked seedlings are stunted and may eventually die 	<ul style="list-style-type: none"> • Handpick and destroy mined leaves • Whenever necessary spray the crop with local neem extract

<p>Foliage beetles</p> 	<ul style="list-style-type: none"> • Adults chew small round holes in the leaves • Larvae live in the soil feeding on roots or may bore into the stem of the bean plant causing swellings or galls • Plants attacked by grubs of this weevil show stunted growth and may die 	<ul style="list-style-type: none"> • Practice post-harvest tillage to expose the grubs in the soil to the sun heat and to predators. • Rotate beans with non-host plants such as maize or sunflower to break the development cycle of the pest. • Delay sowing, where practicable, to allow the crop to escape from high populations.
 	<ul style="list-style-type: none"> • Infestation starts from the field • Larvae bore into bean seeds leaving them perforated with holes • Destroy bean seeds in store • The larvae feed on the seeds • Adult emerges from the seeds leaving small round holes on the bean seeds. • Can attack pods in the field laying eggs on ripening pods 	<ul style="list-style-type: none"> • Field and store hygiene before and during storage, • Timely harvest (before shattering of pods) • Dry seeds thoroughly before storage • Clean the storage facility prior to storage • Do not store old beans with newly harvested beans • Store beans in air-tight containers e.g hermetic bags/silos • Proper drying • Mixture of pepper dust and ash. • Before storage, treat or mix stored seed with a mixture of plant parts (e.g. neem, & lantana)

Bean diseases if not well managed can cause losses as high as 100%.

Disease	Effect	Control
<p>Common bean blight (CBB)</p> 	<ul style="list-style-type: none"> • Drying patches of leaves • Pods are also attacked leading to discolored seeds • Stunted growth • Small water-soaked spots are the first symptoms observed on leaves and appear within 4 to 10 days of infection. • As the spots develop, the center becomes dry and brown. 	<ul style="list-style-type: none"> • Use resistant varieties • Clean planting seeds • Intercropping bean with maize • Use certified disease-free seed. • Plant resistant varieties (e.g. NABE 17'). • Plough under bean debris after harvest. • Practice a 2-3 years crop rotation • Do not work in bean fields when the plants are wet.
<p>Bean common mosaic (Caused by virus transmitted by aphids) – Virus is seed borne</p> 	<ul style="list-style-type: none"> • Cupping and twisting of leaves with a light and dark green mosaic pattern. • Affected plants produce smaller, curled pods and yields are reduced 	<ul style="list-style-type: none"> • Plant resistant varieties • Control attacks of aphids • Remove infected plants from the field • Use certified seeds; • Rogue any plants infected with the virus • Avoid adjacent planting and overlapping bean crop during the rainy season (i.e. only one crop per rainy season)
<p>Angular leaf spot (Fungal disease) – Fungus is seed borne</p> 	<ul style="list-style-type: none"> • Small dark brown spots with angular edges and are often numerous to give the foliage a checker-board appearance. • The spots may join, and cause yellowing and necrosis of the affected leaves. • Can lead to premature defoliation. • The disease is favored by high moisture and moderate temperatures (20-25°C). 	<ul style="list-style-type: none"> • Resistant varieties e.g. K20, K131, K132, • NABEs are tolerant) • Early planting • Crop rotation • Do not work in bean fields when the plants are wet • Plough in debris after harvest

<p>Anthracnose</p> 	<ul style="list-style-type: none"> • Dark brown lesions form on leaves, restricted to the veins on lower leaf surface. • On stems, lesions are elongated and sunken. • On the pods, the fungus produces black, sunken lesions. These lesions penetrate deep into the pods and may c • Cause shriveling of the young pods. Infected seed become discolored changing to yellow through brown to black 	<ul style="list-style-type: none"> • Remove from the field and destroy crop debris after harvest. • Practice a 2 to 3 years rotation. • Avoid workers moving in the field when it is wet
<p>Root knot nematodes</p> 	<ul style="list-style-type: none"> • Stunting and yellowing of plants which wilt in hot weather. • Roots are distorted, swollen and bearing knots of various sizes • Infested roots under severe infestation decay. <p>NB. These knots should not be confused with legume nodules, which are normally small and round, and are attached to the outside of the roots, whereas swellings of root-knot nematodes are within the body of the root.</p>	<ul style="list-style-type: none"> • Maintain fields weed-free. • Uproot and destroy entire plants after harvest. • Amend soil with neem cake or green manure of marigold or sunn hemp. • Maintain high levels of organic matter in the soil • Practice a 2-3-year crop rotation with cereals, maize or grasses.
<p>Root rot (especially common in highlands where the temperatures are low</p>	<ul style="list-style-type: none"> • Yellowing of seedlings • Swollen stems and collar of the plant • Stunted growth 	<ul style="list-style-type: none"> • Crop rotation • Early planting • Plant on gentle slopes

6

Harvesting and Post harvesting handling of beans

A. Learning objectives

After completing this module, participants will:

- be able to identify signs of maturity in the bean crop
- know when to harvest beans
- Learn the different stages of post-harvest handling in beans
- Identify common mistakes during PHH that affect quality and quantity
- Learn basic technologies in PHH

B. Duration

3-4 hours

C. Learning aids

- Demo plot with beans
- (Other gardens around the demo plot with beans at different ripening stages)
- Knife
- Tarpaulin
- Sieve
- Winnowing
- Sticks for threshing
- Bags for packing

D. Activities and exercises

Look back at what has happened since the last meeting (10-20 minutes)

- **In the participant fields:** Take a few minutes to ask participants what they have been able to apply at home since the last session and with what results. Allow participants to share their experiences with each other, highlight their successes and ask questions if they have any.

- **In the demonstration field:** Also take a few minutes to observe with the participants what has happened in the demonstration field since the last session. What has changed, how have the plants grown?

Introduction (20 minutes)

The trainer will introduce the topic and ask the following questions to stimulate the discussion:

- What are signs of maturity in the bean crop?
- What is the correct stage of harvesting? When do you harvest your beans?
- What post-harvest handling operations do you apply?
- What are the common mistakes made by farmers during harvesting of beans?
- Some common mistakes include: harvesting the crop not fully mature
- Using worker and children while not supervised

This can be directly in the field, so that participants can look at sign of maturities directly on the crop.

Demonstration (2 hours)

The participants, together with the facilitator, will harvest the beans. This training should be done at the demonstration sites so that the farmers learn good harvesting practices and replicate in their fields at household levels.

E. Content

- Good quality beans attract better market price for high income.
- It is estimated that farmers in Uganda loose up to 40% of their produce from harvesting to marketing as a result of poor postharvest handling practices resulting in poor quality and many times in loss of quantities of beans harvested.
- It is therefore important for farmers to adhere to good practices to avoid losses during harvesting and postharvest handling.

6.1. Bean Physiological Maturity:

- stage when the crop has achieved maximum growth (usually 58-120 days) after planting depending on the variety grown) and has the following indicators
- Bean leaves turn yellowish with mature veins
- Shading of leaves in some varieties occurs
- Seed texture hardens
- Seed colour becomes more pronounced

- Pods harden, becomes light brown

6.2. Harvesting

- Harvesting is the process of removing the plant from the garden after it has achieved full physiological maturity.
- To ensure quality, harvesting should be carried out on time to avoid losses and deterioration of quality.
- Beans are harvested at different physiological stages depending on the intended use.
- When it is for fresh eating, it is harvested when the pods are tending to yellow.
- If it is meant for dry grains, the whole plant is harvested when it has dried and achieved full physiological maturity.
- Most varieties of beans will mature in 58 – 120 days depending on the variety planted.
- Harvest when most of the pods (roughly 80%) are fully mature and have turned yellow, and the rest of the pods are dry.
- Do not leave the beans to dry completely in the fields to avoid loss due to shattering, pests, diseases, rain and thieves. They develop diseases and lose quality.
- Complete cutting of the plant is advised other than harvesting individual pods which is labor intensive. Farmers are discouraged from uprooting the plants during harvesting as the root area should remain and rot in the soil to provide organic matter and slow depletion of soil nutrients.
- In order to prevent contamination of the seed with pathogens, seeds for propagation must only be taken from healthy plants and dried under optimal conditions. Bright sunlight has a certain disinfecting effect. Therefore, beans must be turned regularly during drying to benefit from the sunlight. Optimal germination conditions help the young plants overcome early infestations.



6.3. Postharvest handling and storage



- Drying is done in pods before beans can be threshed.
- If you start threshing right after harvesting, you will damage the seed because it is still soft due to the high moisture content.
- Test the moisture of the seed before threshing using your teeth.
- Dry the beans on a tarpaulin or papyrus mats but not on put directly on the ground as this will affect the quality.
- Chase away chicken and other animals to

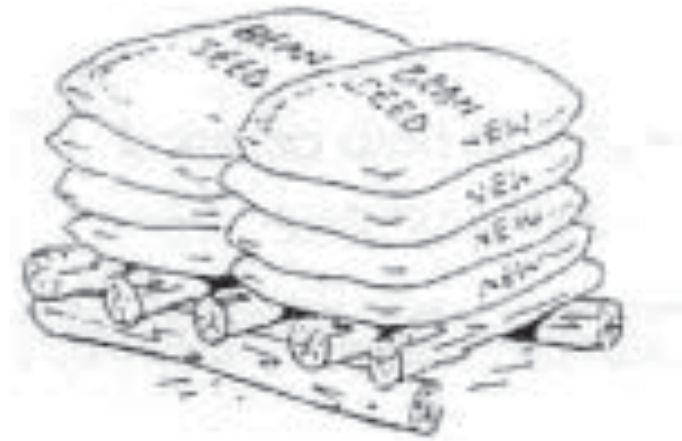


- avoid damage to the drying beans.
- Remember that both beans that are too dry and those that are too wet can easily be damaged during threshing.
- When the seed is threshed it must be dried a second time. It is important to protect the seed from rain, insects, animals and dirt.
- Threshed seed should be dried on mats, tarpaulins or plastic sheets.
- Winnow to remove chaff, dust and trash from seed.
- After winnowing, sort to remove shriveled, diseased, broken seed and seed of other varieties/colors before packaging for storage.



6.4. Storage

- Storage is an important component of beans production.
- The beans should be stored in gunny bags when at the right moisture content (13%) in a well-ventilated room, free from rain and the bags placed on a high platform, at least 30 cm off the ground.
- Close all holes that might allow rats into the store and periodically check the store to ensure the beans are not destroyed.
- For prolonged storage, mix the beans with red pepper powder or ash to prevent them from attack by storage pests.



7

Record keeping

Activity 1: Introduction to record keeping

A. Learning objectives

After this session participants will:

- Be aware of the importance of record keeping and be able to record costs and income of the target crop.
- Know how to calculate the gross margin in order to assess the profitability of a crop and find out ways of potential improvements.

B. Duration

2-3 hours

C. Learning aids

- Flip charts,
- markers,
- calculator.

D. Activities and exercises

Introduction

The trainer will introduce the topic of the day. He will stimulate the discussion by asking the following questions:

- Do you know how much profit you generate with the target crop the last season?
- Do you know which expenditures are most important in the production?
- Do you know if your costs were higher or lower than your income?

Practical exercise

1. The facilitator asks the group to list all the expenses and costs (means of production and labour) they had for the target crop during the last crop year (or other crop). Producers are invited to mention them from memory. Do not forget the value of family labour and the costs of paid labour. The facilitator records the costs mentioned by the producers in the table below (on a flip chart).

2. Once the production costs are listed, the facilitator asks the group about the income: What have you done with the harvest product? Did you sell the entire production or only part of it? How much did you earn from the sales? Do you still have a remaining stock, how many bags/kg? The facilitator writes the cash income or the value of the production (in case of no cash value) in the table under part B. Income.
3. The facilitator explains how to compute the gross margin, which is total income minus the total costs. Then he asks the group whether the production of this crop is profitable or not (see if the gross margin is positive or negative).
4. The facilitator asks who wants to try to keep a record for the target crop during this season. The facilitator distributes the above table to the participants. The latter should write down their expenses (materials and labor). At each session, the host farmer could present his data (or in turn). It could serve as starting point for a group discussion on the similarities and differences in the record keeping among the participants. And report on the difficulties faced in filling the table.

Activity 2: Gross margin analysis

A. Learning objectives

By the end of the training the participants are able to:

- analyze the record keeping and the gross margin, and identify how to improve the profitability of the target crop

B. Duration

2-3 hours

C. Learning aids

- Flip charts,
- markers,
- calculator.

D. Activities and exercises

- The host farmer and each participant who recorded his costs and income present them to the group. Before the session, the facilitator can help the producers to copy the table on a flipchart to make it easier to read during the session.
- The facilitator initiates the discussion on the analysis of the results by asking the following questions. What are the reasons for the different figures/results between the producers? What does a positive or negative gross margin mean? What are the factors that influence expenditures and income? If the gross margin is low or negative, which expenditures could be reduced and how? Which price should you sell your products to make a profit?

Table for the calculation of the costs and income for a crop

Name of farmer:		Village/district:	
Date of calculation:			
Time period (season from/to):			
Crop:			
Total field area (ha):			
Total yield (kg):			
	Quantity	Unit cost (Ushs)	Total (Ushs)
A. Production costs (input)			
Materials			
Seed	3 bags	600	1800
Organic fertilizers:			
- Manure			
- Compost			
Mineral fertilizers:			
- NPK			
Pesticides:			
Packaging bags			
Labor (Person-days)			
Soil preparation	2 man days	2000	4000
Manure application			
Planting			
Weeding/ Hilling up 1			
Weeding/ Hilling up 2			
Dehaulming			
Harvesting			
Threshing			
Transport			
Total production costs (a)			
B. Income (output)			
Sales			
Home consumption*			
Remaining (storage)*			
Others*			
Total income (b)			
Gross margin (b - a)			
Profit per acre (Gross margin divided by field area)			

*Convert in monetary: kg multiplied by market price.

