BEAN CULTIVATION HANDBOOK

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CGIAR

INITIATIVE ON

Seed Equal

TABLE OF CONTENTS

ACKNOWLEDGEMENT IV
PROJECT BACKGROUND VI
ACRONYMS & ABBREVIATIONS VI
MODULE 1: SITE SELECTION 1
MODULE 2: SEED SELECTION & PREPARATION 2
MODULE 3: LAND PREPARATION 3
MODULE 4: PESTS & DISEASE MANAGEMENT AND CROP MANAGEMENT 5
MODULE 5: AGRO-CHEMICAL USAGE 12
MODULE 6: POST-HARVEST HANDLING 13
MODULE 7: COMMUNICATION SKILLS 17
MODULE 8: NEGOTIATION & CONTRACTING 18
MODULE 9: MARKETING 19
MODULE 10: RECORD KEEPING 20
MODULE 11: FINANCIAL PLANNING 20
MODULE 12: DEVELOPMENT OF BUSINESSPLANS 21

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Disclaimer: The information presented in this manual is for advisory use only. Users of this manual should verify site specific details that relate to their agro-climatic zones from their area agricultural extension officers.


Quality Declared Seed
Field Inspection Guide
Beans

PROJECT BACKGROUND

To address the persistent challenge of limited access to quality agricultural inputs, particularly high-quality seeds in Uganda, a social and behavioral strategy was developed under the CGIAR Seed Equal Initiative activities under work package 6. Though agriculture serves as a cornerstone of Uganda's economy, employing 70% of the labor force and covering half of the national land area. Smallholder farmers, comprising 90% of the farming community, face barriers to accessing quality seeds hindering agricultural productivity and food security.

This activity led by the International Rice Research Institute (IRRI) and the Alliance of Bioversity International and CIAT in collaboration with the Centre for Behaviour Change and Communication (CBCC), focuses on improving seed access in Eastern Uganda, with a specific emphasis on Butaleja District.

We aimed to empower smallholder farmers, women, and youth, enhance seed access and utilization, and contribute to increased agricultural productivity, livelihoods, and food security in Butaleja District and beyond. By implementing evidence-based strategies and fostering collaboration among stakeholders, we aim to create an inclusive and sustainable seed system that benefits all members of the agricultural community.

The project will use key SBC interventions that include strategies for shifting norms, improving adoption, and utilization of quality seeds among smallholder farmers in Butaleja District, with a focus on addressing gender disparities and integrating behavior change communication (BCC). The strategies comprise of:-

Strategy 1: Behaviour Change Communication (BCC) for change in knowledge, attitudes, practices, motivations using multiple channels.
Strategy 2: Capacity Building for Seed Producers and Entrepreneurs
Strategy 3: Social and Market Mobilization
Strategy 4: Advocacy for Policy Interventions
Strategy 5: Gender-Intentional Approaches

The cultivation handbook is one of the communication and training tools to be used during capacity strengthening sessions for farmers to encourage good agronomical practices that result in better yield.

ACRONYMS & ABBREVIATIONS

DAP Di Ammonium Phosphate
GAP Good Agricultural Practices
Ha Hectare
IPM Integrated Pest Management
NARO National Agricultural Research Organization
MC Moisture Content
PHH Post-Harvest Handling
QDS Quality Declared Seed

MODULE 1: SITE SELECTION

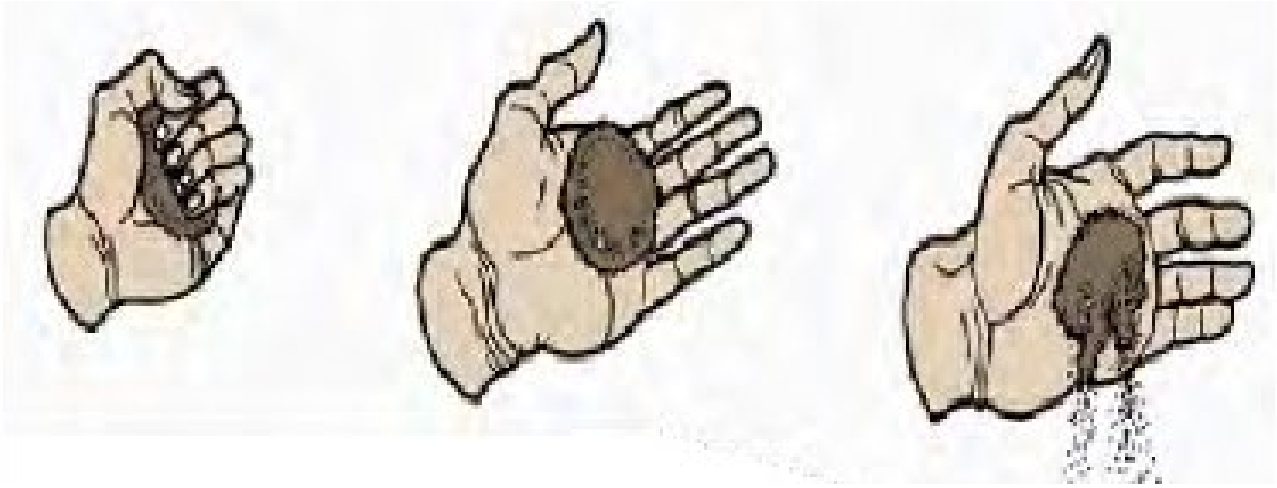
Beans production requires a suitable site that will support optimal bean growth through the life cycle of the crop. To achieve high bean yields, selection of highly productive land is crucial.

Site Selection

Beans production requires a suitable site that will support optimal bean growth through the life cycle of the crop. To achieve high bean yields, selection of highly productive land is crucial.

The recommended site for beans planting should have the following;

a. Deep fertile well drained and aerated, sandy loams or loamy soils
b. An optimum soil pH of 5.8 to 6.5. Beans are highly sensitive to acidic soils (pH < 5.2)
c. Signs of soil fertility such as presence of indicator plants eg elephant grass, Guinea grass (Panicum maximum), Commelina sps
d. For steeply sloping areas consider contour hedgerows and terraces along the contour to stabilize the soil and minimize the runoff.



Deep loam soil makes a ball that breaks on slight

Soil Testing

It is essential to assess soil health before any soil management operations are implemented. Constraints such as soil acidity and soil nutrient deficiency can lead to significant reductions of crop yields. The soil pH and nutrients levels can be determined by conventional soil analysis in addition to observation methods of crops growing in the field.

Soil testing is an essential crop management decision-making tool that enables one to:

a. Determine acidity and alkalinity levels (soil pH);
b. Identify any soil nutrient deficiencies;
c. Estimate optimum fertilizer requirements for target yields;
d. Estimate the optimum cost of fertilizer needed and the returns

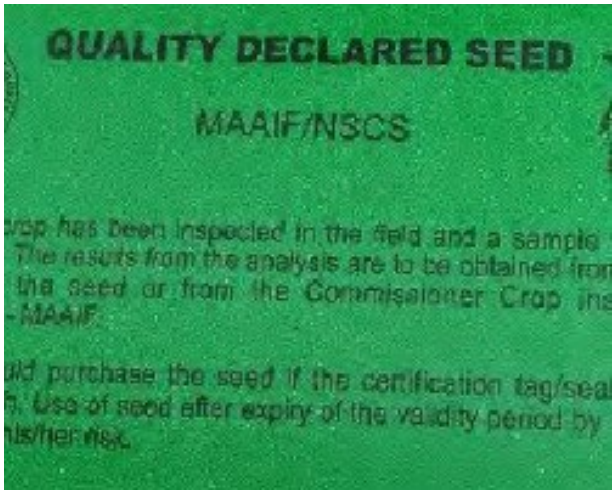
In the field, a soil testing kit can be used or soil samples can be taken to recommended laboratory for further analysis.



Tools for taking soil samples

MODULE 2: SEED SELECTION & PREPARATION

High yield begins with good quality seed, it is therefore important to select well developed, mature, uniform seed of sound vigour. Farmers should always buy seed from certified seed companies or use Quality Declared Seed usually produced by farmer groups (Community Seed Multipliers).





Attributes of quality beans seed

a. Uniformity
b. High germination rate > 85%
c. Well dried to 13% moisture Content
d. Purity 98%: Ensure all seeds are of the same variety
e. Clean: not mixed with foreign matter like stones or dirt, or other seeds
f. Not damaged, broken, shriveled, mouldy, or insect damaged
g. Not rotten or discoloured faded
h. All non-conformity should not exceed 2%

A detailed criterion for determining seed quality



Discoloured and shrivelled beans



Beans seed infested by weevils



Quality beans seed good for planting

MODULE 3: LAND PREPARATION

Land preparation involves; bush clearing, removal of tree stamps, termite mounds, and ploughing. Beans require a fine seed bed for uniform and proper growth of roots to absorb the available soil nutrients. Well prepared seedbed reduces on the number of weeding times.



The process of preparing furrows for bean planting using a string to ensure that rows are straight

Planting

Planting should be done on the onset of rains. For long rain seasons, farmers may delay planting by two to three weeks to avoid too much rainfall during pod filling stage which may lead to rotting of pods and reduction in yields. Early planting takes advantage of the nitrogen flush effect which is the release of accumulated nitrogen in the soil during the dry season.

Normally, the first season is dominated by planting in March up to Mid- April and harvesting in June-July; while the second season is from mid- August to December, depending on the area and variety.

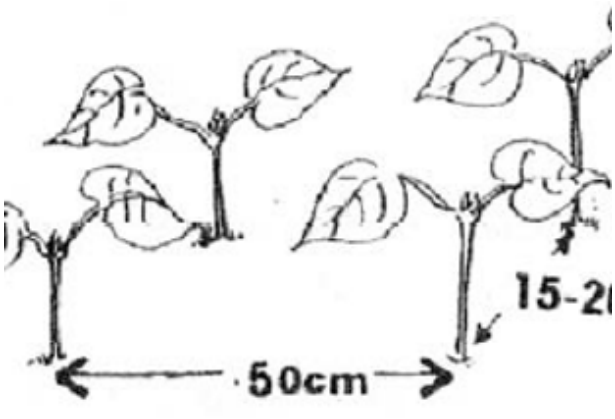
Spacing & Seed Rate (Population Density)

Plant in lines (rows) in order to achieve optimum plant population and also ease field operations such as weeding, scouting for pests and diseases, spraying 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 50cm x 10cm for sole crop with one seed per hole, or a spacing of 50cm x20cm and two seeds per hole.

Spacing of bean plants depends on the soil fertility, plant type (growth habits), and cropping pattern. Optimum plant population is critical because:

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

The seed rate varies depending on the seed size but on average, the rate is between 25-30 kg of seed per acre giving a plant population of approximately 80,200 plants per acre.



Recommended spacing between plants



Beans planted in lines

Intercropping

- Whereintercroppingispracticed,ad- justthespacingas-perrecommenda- tion.Bushbeanscanbeintercropped withmaize,sorghum,coffee,cassava orbananahowev-er,thebeansdonot grow very well when over shaded.
- Variousplantspacingcombinations can be used in an intercrop.



Beans - maize intercrop

Planting Depth

The speed at which seed germinates and emerges out of soil depends on planting depth, soil moisture and temperatures. Beans are best planted at the depth of 5 cm and lightly covered with a layer of soil. Deeper planting may lead to delays in emergence and low or poor germination. On the other hand, surface planting may lead to poor germination as the seed may not obtain sufficient moisture needed for emergence and it also exposes the seed to rodents and other vermins.

Methods of Planting & Related Equipment

Traditionally, farmers in Uganda use hand hoes. For ease of work, farmers should work in teams of three people; one for digging holes, second person placing fertilizers and covering it with a thin soil layer and the third person placing seeds and final covering.



Working in teams at planting

Basal Fertilizer Application

In case of poor soils, farmers should apply basal fertilizer (organic and or inorganic) at planting. Use only recommended fertilizers especially after testing your soils.

Follow recommended application rates e.g. 50kg of DAP per acre (one bottle cup per hole) depending on initial soil fertility status, use crop specific fertilizers (blended fertilizers) where available. Beans require modest amounts of nitrogen because of the symbiosis with Rhizobium bacteria that transform atmospheric nitrogen into nitrates available to the plants. After planting, inspect your field 3 to 4 days after germination to ensure that a healthy crop is produced. Any gaps in the row as result of seed failing to germinate or other seedling damages should be addressed immediately by gap filling.



MODULE 4: PESTS & DISEASE MANAGEMENT AND CROP MANAGEMENT

This module focusses on management practices during beans crop growth and includes; staking climbing beans, weed management, soil fertility management and pests and disease control.

Staking of Climbing Beans

The practice of providing climbing crops with support is known as staking. Climbing beans grow vertically and thus need support and this helps the plants to grow faster, healthier and help to reduce disease attack especially anthracnose, the plant accesses enough light and produce higher yields. Staked beans can be harvested over a more continuous period compared to bush beans. Staking is usually done on crops planted in rows with the stakes placed between the crop rows. Staking should be done 2 weeks after germination when the plants start forming tendrils for climbing.

Weed Management

Effective weed control is a prerequisite for high bean yields. Beans, being low-growing plants, struggle to compete with weeds. Early control of weeds recommended at 2-3 weeks after planting is extremely important, because the root system of the plant develops at this stage and some weeds secrete chemical inhibitors which limit plant growth. It is also recommended to weed 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. Control of weeds can be by mechanical and or chemical means.

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 harvested grain



Poorly weeded beancrop



Well weeded beangarden

Common weeds in bean fields

ANNUAL WEEDS		PERENNIAL WEEDS	
Blackjack		African lovegrass, Bristy foxtail	
Wandering jew		Coach grass	
Gallant solder		Nutsedge grass	
Goat weed		Spear grass	
Devil's horsewhip		Tick-berry	
Wild finger millet		Oxalis	

Chemical control- This method of weed control either speeds up, stops, or changes the weed's normal growth patterns. This in turn causes the leaves, stems and roots to dry out. Herbicides are very effective if used properly. Farmers using herbicides need to know the type, the correct dosage and stage to apply the herbicide.

Improvement & Management of Soil Fertility

Plants need nutrients and water to grow and give good yields. Most of the nutrients come from the soil and hence soils have to be fertile to sustain plant yields.

A fertile or healthy soil should:

a. Be deep enough and well drained
b. Have good structure, texture and well aerated for proper root development.
c. Have a favourable soil reaction (i.e. degree of acidity and alkalinity pH range 5.5 to 6.5 for most crops)
d. Have a good supply of both available and reserve plant nutrients
e. Be able to store soluble nutrients
f. Contain sufficient organic matter >2%

Support a wide range of micro and macro organism(fauna and flora)

Signs of nutrient deficiency in beans:

NUTRIENT	ROLE	DEFICIENCY SIGNS	
Nitrogen	Contributes to the green colour of the plant;is directly involved in photosynthesis;	Lower leaves become yellow and eventually die. Youngleavesmaybelighter green than normal. Growth is stunted, few flowers de- velop and pods fill poorly.	
Phosphorous	Promotes early root formation, and growth in young plants and improves quality of grains, and water-use efficiency	Beans usually take long to display symptoms of P deficiency. By the time a visual deficiency is recognized, it may be too late to intervene. Symptoms include small, dark green upper leaves that turn purplish and later die. Plants are stunted with thin stems and the number of flowers, pods and seeds are reduced, while seed and fruit development is poor or absent	
Potassium	Increases crop yield, water use efficiency and disease resistance. It also improves grain quality and regulates the opening and closing of stomata	The tips and edges of older leaves appear burnt or scorched, and poor filling of pods. The leaf midrib usual- ly remains green. Deficient plants stay small and weak, and their leaves later fall off. The pods are poorly filled	

NUTRIENT	ROLE	DEFICIENCY SIGNS	
Calcium	Used in cell division and formation, nitrogen metabolism, translocation of carbohydrates from leaves to fruiting organs and increases fruit set	Stunting in stems, flow- ers and roots. Leaves are curled or cupped with black spots and yellow margins. Pods wilt and seeds fail to develop.	
Magnesium	Used in chlorophyll production, improves utilization and mobility of phospho- rus, activates many plant enzymes and influences earliness and uniformity of maturity	Older leaves have yellow- ing between leaf veins; but veins stay green	
Boron	Is an essential in protein and carbohydrate metabo- lism., seed and cell wall for- mation and for germination of pollen grains and growth of pollen tubes.	Stems abnormally thick- ened, longitudinal splitting of epicotyl, death of grow- ing points and inter-vienal chlorosis on middle aged leaves.	
Iron	Needed for chlorophyll formation, plant respiration, formation of some proteins, and enhances N fixation rates.	Yellowing occurs between the veins of the newest growth. The veins will remain green except in extreme cases.	
Manganese	Involved in photosynthesis and chlorophyll production and helps to activate enzymes involved in the distribution of growth regulators within the plant.	Stunting and yellowing between veins of young leaves. Leaves gradually turn pale-green with darker green next to the veins.	
Zinc	Important in seed forma- tion. Plays a role in chlorophyll, carbohydrate and starch production, and aids plant growth hormones and enzyme system	Younger leaves first become mottled and show intervein- al chlorosis, with browning of the older leaves. when deficiency is severe, the area between leaf veins will become light green and yellow near the leaf tips and outer edges. A general downward curl of the leaves also occurs and pod set will be poor. Plants tend to be stunted due to shortening of the internodes.	
Molybdenum	Aids in the formation of nodules supports nitrogen metabolism, pollen viability and seed production	Early deficiency symptoms are similar to nitrogen deficiency. Affected plants become stunted and lack vigour. Leaves may turn brown along the margins. Deficiency leads to poor nodule formation.	

Soil fertility management

Beans grow well on fertile soils but where soils are deficiency in nutrients, the use of fertil- izers is encouraged.

Soil fertility can be improved through use of:

- Organicmanure
- Inorganicfertilizer
- Other soil amendment practices

Organic manure

These are decaying organic matter or humus derived from plant and animal residues. They include: farm yard manure, compost manure, green manure and organic mulches. Organic fertilizers maintain soil structure, improve water holding capacity and improve aeration in addition to providing the majority nutrients for plant growth.

Application of organic manure

In one acre, use 2 to 4 tons of manure, it should be applied during ploughing and should have decomposed for at least 2 to 3 months. Planting should be done after two to three weeks from the date of manure application.

Compost manure

Crop residues and organic household wastes are left to decompose for two to three months, after which the compost is ready for use.

The compositing process

Requirement: dry plant materials, water, ash, green plant materials, animal droppings and top soil Steps

a. Making the base: Find a shady area, dig a pit for the compost or use the wooden box design and make a bed with twigs or stalks
b. Chop the materials and heap the layers; sprinkle water to help the heap rot; add animal droppings from chicken, goat cow; add top soil for insects and worms; add green plant material; sprinkle with ash for potassium, and water. Repeat the layers 3 or 4 times and cover with soil and dry grass to keep the compost moist.
c. After 3 weeks, turn the heap layer by layer (this helps the rotting process). After another 3 weeks, the compost will be ready.

Application of compost manure

- Using a small container to a size of 3 spades, or a half basin,
- distribute the well decomposed manure in the field evenly
- and hallow/dig it up, so that it mixes well into the soil and plant after 2 to 3 weeks

Benefits of composite manure

- It's cheap to make because of the readily available raw materials
- It improves soil texture, water holding capacity and nutrient up-take
- Gradually release of nutrients for a period of time

Inorganic fertilizers

These are manufactured fertilizers which rapidly provide/release nutrients to the plant. The inorganic fertilizers provide specific nutrients, which are lacking in the soil. Examples of in- organic fertilizers include DAP, UREA, MOP, NPK, TSP, blended fertilizers to cater for specific crop needs.

Fertilizer is supplied in form of Nitrogen (N), Phosphorous (P) and Potassium (K). For the solid particles, mineral fertilizers can be of many different sizes and shapes: from granules, pellets to fine powder (dust), but also available in larger compacted granules that release nutrients slowly.



Powder
(e.g. singlesuperphosphate)



Crystals
(e.g. ammonium sulphate)



Prills, granules
(e.g. urea, diammonium phosphate)



Supergranules
(urea supergranules)



Liquid fertilizer

Field Pests & Disease Management

Beans are attacked by several pests and diseases while in field. The level of pests and disease incidence depends on the presence of the causing organisms, weather, soil conditions, and the relative resistance or susceptibility of the variety. Management techniques to minimize losses due to pests and disease attack include:

- Biological
- Habitat manipulation
- Modification of cultural practices and
- Use of resistant varieties

Major Bean Insect Pests and their Management

TYPE OF PEST		DAMAGE DONE	CONTROL MEASURES
CUTWORMS Agrotis sp; The larva is dull, hairless brown, or black and hides in the soil near the cut plants.		Larvae feed on roots and base of stem killing seedlings	• Early planting • During primary tillage, dig soil to expose larvae to predators such as birds and ants • Hand pick and destroy the larvae • Apply recommended insecticides such as Thiamethoxam to the ground around affected plants

TYPE OF PEST		DAMAGE DONE	CONTROL MEASURES
BEAN FLY (BEAN STEM MAGGOT) Ophiomyia sp A dults are small shiny black flies with clear wings that reflect a metallic blue colour in sunlight.		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	• Earth up soil around the plant to cover the roots • Plant early • Provide adequate fertilization for plant vigour • Avoid planting beans near cowpea, beans and other leguminous crops • Use resistant varieties developed by researchers • Use treated seed • Use insecticides under severe attack examples include Imidacloprid,Azadirachtin
FLOWER THRIPS Adults are tiny, slim, elon- gated, shiny black and are distinguished from other species of thrips by pale bands across the top of the forewings.		Feed on young leaves, developing flowers and pods causing curling of leaves, flower abortion and scars on pods	• Early planting • Fertility management • Inspect flowers and Use recommended insecticide e,g Dimethoate 40% only when 10 thrips flower are seen, early detection important • Spray with botanicals
APHIDS		They suck plant sap Infest- ed leaves curl under and inward and become severely distorted. Leaves also become mottled due to viruses spread by aphids.	• Early planting • Fertility management • Use bio-pesticides not harmful to natural enemies e.g. neem, soapy water • Monitor crop regularly and apply insecticide if at least 1 in 10 plants is heavily infested • Examples of insecticides include Dimethoate 40%,Azadichtin
FOLIAGE BEETLES OOTHECA SPP	 	Adults defoliate the crop while the larvae feeds on roots causing patches of yellowed plants in the field. Such plants are stunted and may dry up prematurely.	• Fertility management • Crop rotation with non-host plants e.g maize • Plough the field after harvest to expose the dormant adults, eggs and larvae to sun heat • Use recommended insecticide only if 3 plants out 10 are heavily infested or > 30% leaf loss • During flowering stage treat when > 3 beetles per plant seen. • Spray when bees not active Examples include Lambdacyhalothrin + Chlorpyrifos, Betacyfluthrin
PODBORERS	 	Feed on flowers, pods and seeds causing flowers abor- tion, wilting of pods, shrivelled or half eaten seeds and reduced quality of grain	• Crop rotation with non-host plants • Scout the field for the pest and initiate control at an early stage of infestation • Use systemic insecticides e.g Acephate, Dimethoate
POD SUCKING BUGS		Bugs suck on pods causing tiny depressions (dimples), and may cause shrivelling and rotting of the seeds, which lose viability.	• Hand collect and kill when few are seen • Well-timed (45 days after planting) appli- cation of insecticides such as Cypermethrin + Dimethoate

MODULE 5: AGRO-CHEMICAL USAGE

During storage, beans like other grains is attacked by insect pests, moulds, and rodents like rats. Pests form the major problem in a storage especially where good storage manage- ment practices are not adhered to.

Pest Control

A number of pests attack grain during storage and they include; termites, mites, ants, Rhizopertha dominica, pyralid moths, and Sitophilus spp among others. Storage pests can be controlled by physical, chemical and biological methods. Improved storage technolo- gies like the use of hermetic technologies can be used to control pests. Grain infested with weevils when stored in a hermetic storage the insects die due to suffocation.

Fumigation

This is the application of chemicals/fumigants in controlling storage pests of food mainly grains. Fumigants commonly used include; phosphine

Safety measures during fumigation (see safe use pesticides):

- The target site must be enclosed or covered to prevent the gas from escaping.
- Keep fumigants safely and out of reach of ordinary persons. Only licensed persons should carry out the fumigation work.
- Wear protective clothing.
- Wash and preferably take bath after fumigation.
- Aerate the grain and stores after uncovering.



MODULE 6: POST-HARVEST HANDLING

The Market requires supply of quality beans in desired quantities at desired time. Good quality beans attract better market price that help farmers earn high income. Many times, farmers experience high losses of beans from harvesting to marketing. 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 which results in poor quality of the beans. It is therefore crucial for farmers to adhere to good practices to maintain the quality of beans during harvesting and post-harvest handling.

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.



Post Harvesting Handling (PHH)

Postharvest handling practices are activities carried out immediately after harvesting and they include; transportation, drying, threshing, cleaning, packaging and storage. Good PHH practices ensure that the harvested product reaches the consumers in the desired quality and quantity

Transportation

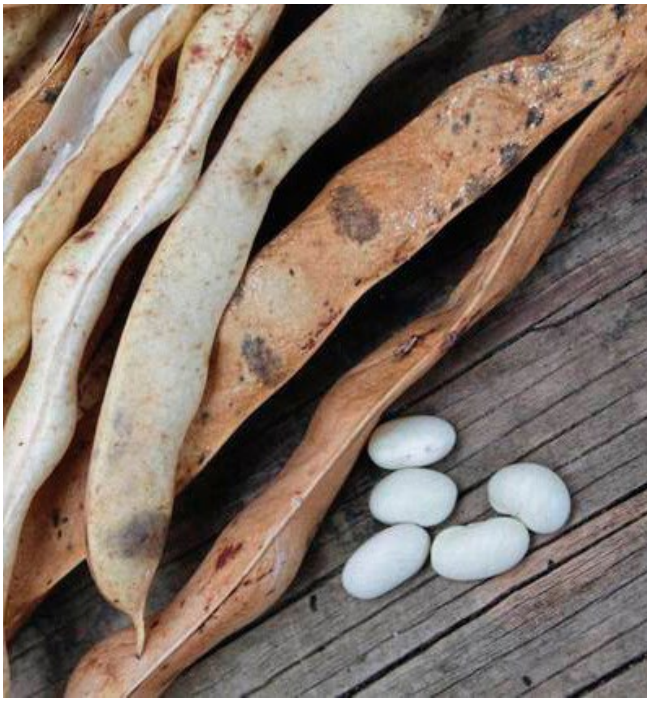
Beans are transported home for further activities to be carried out. Transportation is carried on head, bicycles, motorcycles and vehicles depending the volume of produce.

Drying of beans in the pods

Drying is the systematic reduction of crop moisture down to safe levels for storage. It is one of the key postharvest operations that ensures bean grain quality. During harvesting the moisture content of grain is between 18-24% and this should be reduced to 14% for safe handling.

During drying, the following steps should be observed:

a. Sort the beans to remove weeds and immature pods.
b. Spread the beans loosely on the tarpau- lin, drying rack, drying yard and mat to allow drying of the pods.
c. Dry the beans until the pods can easily open to release the grain.



Drying of beans in the pods

Threshing of beans

This is the process of separating the bean grain from the pods to make grain avail- able for further processes. Threshing can be carried out on threshing rack (fig. xx) that protects the seed from damage, dirt and prevents it from scattering. A threshing rack consists of strips of wood arranged on a platform with a wire mesh that sieves seed from chuff. Grain is collected on the bottom tray or tarpaulin. Scattering of grain during threshing is prevented by the high wooden sides.



After threshing, the grain contains higher moisture content than the standard. It is therefore recommended that grain be dried further to the desired moisture content level. Dry the grain on a clean tarpaulin, plastic sheets, mats and drying yards. Where big volumes are involved, use a drying machine.

Methods and technologies of drying

Sun Drying

Drying is carried out in the open air on tarpaulin, mats, plastic sheets, drying yards and collapsible dryers.

Mechanical drying

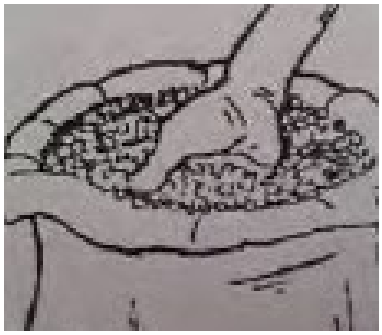
Hot air is blown in the grain to remove excessive moisture under controlled conditions. Hot air is generated using burning fuel, solar, electricity and biomass.

- During drying of the grains, take note of the following precautions to ensure quality.
- Turn the grain regularly to hasten and ensure uniformity of drying especially when using sun drying.
- Keep off animals from beans to avoid contamination of grain with animal droppings.
- Protect the grain from adverse weather conditions by covering the grain with tarpaulin or keeping it under well ventilated facility.
- For mechanical drying, ensure appropriate temperature is maintained through close monitoring of the temperature. and care should be taken not to exceed 400C for bean grains.
- Ensure close monitoring of the moisture content to ensure that recommended standard is achieved.
- Dry the bean grains until required moisture content is attained

Methods of checking moisture content

Traditional methods

- Shaking grain in a tin and judging from the sound made: grain with high MC gives a dull sound compared to the sharp sound made by dry grain.
- Pushing the hand into grain bulk: wet grain offers more resistance to penetration than dry grain. In addition, grain with high moisture content has high temperatures in the middle due to high metabolic rate while grain with optimum moisture content is cold in the middle.
- Biting with teeth: a dry bean is relatively hard and cracks when you bite with teeth while grain with high moisture content is soft, the teeth penetrates when you try to bite
- Salt method: Take a small sample of bean grain mixed with dry salt, put it in a clean dry jar, shake it vigorously for several minutes and allow it to settle. If salt becomes wet and sticks on the wall of the jar, then the grain has high moisture content above 15% and therefore, it needs to be dried further.


Scientific means

Moisture meter: It is the equipment used for measuring moisture content in grain. It measures the percentage moisture content in a given sample. Different types exist on the market depending on the manufacturer.

Graincleaning

It is the removal of foreign material and un conforming beans from the normal ones. A number of technologies are employed to clean the grain and they include; traditional winnower and mechanical cleaners (human and motor operated),

Cleaning technologies

- Traditional winnower- Common at small holder farmer level, winnowers of different shapes and material are used to clean the grain. Farmers usually take advantage of the wind so that it can remove some of the light dirt during winnowing. One person can clean 100 kgs per hour.
- Use of screen/sieve- Common at bulking sites and warehouses. A screen/sieve mount- ed on a wooden frame is used for cleaning. It is more efficient than using a traditional winnower. One person can clean 500 kgs per hour. Foreign materials and dirt that are smaller than the screen size pass through. One of its short-comings is that grains that can pass through the screen have to be sorted from the dirt and this increases the la- bour time. On the other hand, foreign material that is bigger than the screen hole size and none conforming grains have to be removed by hand.
- Mechanical cleaners- These are machines that are operated by engines or mortars and have capacity to clean above 1ton/h with automated sorting system based on the qual- ity parameters like colour, size, and shape. They are appropriate for big companies, bulking centers and warehouses where big volumes of grain are being handled.



Traditional winnower



Useofscreen/sieve

Storage

Storage is the process of keeping grain until an appropriate time of use. The primary aim of storage is for quality maintenance, food & nutrition security, seed and better price. Note: Good Storage does not improve grain quality but it maintains it

Storage Technologies:

Various storage technologies (traditional and modern) can be used by smallholder farmers to store bean grain and these include;

TRADITIONAL TECHNOLOGIES	MODERN TECHNOLOGIES
• Mudandwattlegranaries • Baskets • Pots • Jute bags	• Hermeticstorage » PVC Tanks/Silos » Metallic tanks/Silos » Triple/Picsbags • Flatbed Warehouse/Silo • Grain store(Farmlevel)

Hermetic storage is an airtight facility that allows for maximum protection of stored products from insect infestation. It seals off the exchange of oxygen and moisture between the produce and environment

- Advantages of hermetic storage include:
- Eliminates the use of chemicals in controlling storage pests
- Beans can be stored safely for more than12 months
- Stores seed without losing seed viability
- Simple to use
- Affordable by small holder farmers

Where big volumes of produce are required to be stored, a grain store/ bulking centre/ware house is used and good storage management practices are required to ensure grain quality. The type of storage facility depends on volume of grain, purpose and the financial resources.

MODULE 7: COMMUNICATION SKILLS

These are skills that allow someone to understand as well as be understood by others. The basic communication skills are speaking, writing, listening and reading. Below are the high- lights of the Do's and Don'ts in business communication

DOS
Listen to your partner
Acknowledge his/ her point of view
State your position with confidence
Look at your negotiation partner in the eye
Reframe your partners ideas to move towards a solution

DON'TS
Get angry
Reject your partners ideas immediately
Lock yourself in one position
Allow yourself to get self-side tracked



MODULE 8: NEGOTIATION & CONTRACTING

Preparation is the key to successful negotiation! Therefore, the participants must understand the basics of negotiation. Important parts include objectives (what are the results wanted), appreciation (of the negotiating partners and their opinion), interests (of both sides) and the set-up of the discussion.

Role-playing and mock discussions with a focus on negotiation guidelines are once again a useful method of directing the participants' attention to the content conveyed. The aim should be to practice various aspects of negotiations: preparation, clarity of detail, exerting and dealing with pressure, making concessions and admitting problems, and the conclusion.

It is not uncommon to have negotiating meetings ending without any concrete conclusions. Therefore, this step of skilling is where participants are exposed to some of the things to lookout for after or in a negotiation meeting or session. Participants need to ask themselves the questions below:

- What was our objective when we came to the meeting?
- Have we achieved the objectives?
- What deal do we have on the table?
- What are the agreed upon conditions?
- Do we understand the conditions? Can we effectively deliver on the conditions?
- Do we need more time to discuss, think and return with alternatives?
- Do we need another meeting?
- What type of agreement do we have: formal or informal?
- What type of agreement did we want?



MODULE 9: MARKETING

Marketing is the activity, set of institutions, and processes for creating, communicating, de- livering, and exchanging offerings that have value for customers, clients, partners, and so- ciety.

Marketing skills:

- Understanding all aspects of the product and arguments as to why anyone should pick interest in buying this, specifically over other products
- Farmers should go out to the public with the effort to convince as many people as pos- sible to buy the selected product
- Upon return, in a meeting, reports and marketing experiences are shared. Those with higher sales could share best practices and those with lower sales could share what went wrong.



MODULE 10: RECORDKEEPING

Record keeping is the maintenance of a history of one's activities such as financial trans- actions among others. Record keeping is vital as it helps one to stay on top of their tasks, measure progress and achieve career goals.

Farmers can keep the following records; sales book, purchase records, labour records, busi- ness plans, production records, cropping calendar, visitor register, and asset register.

Afterwards, the farmers should be supported in developing suitable templates for their re- spective record keeping by using a participatory approach. Templates are meant to be used at individual and group level, focusing on the selected products and should be updated depending on needs.

Example of a farm record:

SEASONAL BEANS CROP CALENDAR													
DISTRICT	OPERATION	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	NOV	DEC
BUTALEJA	Landpreparation												
	Planting												
	Firstweeding												
	Fertilizer application												
	Pesticides												

MODULE 11: FINANCIAL PLANNING

With basic financial skills and better financial planning, smallholder farmers can gain signif- icant farm benefits, increased household income and food security, helping farmers make the most of their farms.
Smallholder farmers should be guided using financial planning tools such as the cash flow and the farm budget.

Example of an annual finances overview.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
REVENUE													
Rice harvest sales	10,000						5,000						
Bean harvest sales												3,000	
Total revenue													
EXPENSES													
Inputs			2000						2000				
Labour	100,000		5000										
Ploughing													
Transport													
Marketing													
Loan payment	10,000	1000	1000			1000	2000	1000	1000	1000		1500	
TOTALEXPENSES													
NETINCOME													

MODULE 12: DEVELOPMENT OF BUSINESS PLANS

The business plan should include all identified stakeholders. At this stage, farmers have iden- tified areas and businesses that will ensure production, productivity and profitability, and specified the time period of the business plan.

Components of a business plan;

Step 1: Description of the business.

This paragraph contains a detailed description of the business and business idea. Explain the background, where the business is coming from and who the initiators are. Furthermore, it should describe the who, why (goals, objectives, etc.), when, where and how of the busi- ness/product, basically this information was gathered in the previous stages. As a rough reference, the leading questions below should be answered in this paragraph.

- What is the name and description of the product/business option?
- Describe the value chain,
- Who are the target consumers?
- What is the importance of the product?
- Why is it different to other products?

Step 2: Analysis of the market and business environment (external factors)

This paragraph is strongly based on the information gathered during the Rapid Market As- sessment and SWOT. Describe the markets, competition and consumption habits as well as the policy environment of the product to be sold. Similar to the above guiding questions may support this step.

- Describe the actual market (e.g. location, products, urban/rural, typical consumers and
- sellers) you are planning to supply.
- What is the number of potential customers per day, month or year?
- What are consumer preferences? Where are potential consumers located?
- Any seasonal fluctuations in demand for product?
- Who are the other actors in similar business – potential competition?
- What is unique about the business so that it can compete against competitors?
- Are political, social and other external environments stable?
- What are the rules and regulations that guide the business?

Step 3: Promotion and marketing plan (internal factors)

After describing the external factors influencing the business, this paragraph focusses on internal factors about the product. This includes aspects of production, post-harvesting, processing etc., but also how it is supposed to be marketed (consider the 6Ps (product, price, place, people, promotion and performance). The market trial session (4.3) could pro- vide some suitable answers here.

- Are there any points standing out in production, post-harvesting, and processing (e.g. decomposable packaging)?
- What is different or special in the whole process? In addition, think "outside the box" e.g., producers are widows; 10% of the income goes to the local school or into environ- mental education services.
- Are there any specific promotional requirements (platforms like newspapers, radio, and network of social media), benefits to the public, partnerships i.e. research, public sector, donors)?

Step 4: Operations and management plan
Use this paragraph to describe how smallholder farmers manage resources such as inputs, human resources, equipment, transports, etc. Take the chance to introduce the governance structure and respective committees. Describe the different tasks, roles and responsibilities of the participants in the process. Administration and management processes for assets and equipment should be included here as well. Keep in mind that this section goes hand in hand with the financial plan – in this section describe the financial aspects, e.g. reimbursement, income distribution and such. However, the actual calculations should take place in the financial plan.

- How to do you manage resources?
- How to deal with risks and challenges?
- Are there any internal policies in place?

Step 5: Financial plan
The financial plan includes all the necessary calculations including investments, costs, (pos- sible) incomes and remuneration, cash flows and if possible, also financial. It is advised to use a mathematical calculation tool, e.g. MS Excel. The financial plan also should be repre- sented in the monitoring and evaluation of the business.

- What are the investment amounts?
- Are there any profitability estimates?
- What sources of funding do you have? In what forms, which amounts for what period?

Step 6: Description of risks and challenges
One good source of information for this section is the SWOT as well as the Rapid Market Assessment. This section describes the critical issues that could affect the business in the short and long term. Respectively, strategies for tackling upcoming issues should be includ- ed as much as possible.

- How will you contribute to the environment?
- Any uncertainties or threats?
- How do you plan to overcome them?
- Do you have a crisis management plan?

Step 7: Gender analysis
This is an informal paragraph about describing gender issues in your business. This includes roles, opportunities as well as gender balances. Make sure to address gender equality, con- sider opportunities for both women and men and women empowerment in business imple- mentation. You might consider including relationships with partners and other stakeholders.

- What are aspects of gender among actors?

Step 8: Executive summary
An executive summary generally provides an overview of a larger document and is one of the first things a reader will look for. Often, the executive summary is the only part decision makers – or in our case partners, traders, etc. will go to determine if action or collaboration is warranted on the business option. The executive summary analyses the situation/problem and recommends a course of action in a complete but brief way. Remember, the people who are reading the summary often do not have much time, so your executive summary must grab their attention and entice them to read through the larger, more in-depth business plan. Such a brief but well descriptive summary of the business plan is used at a later stage to establish further contact with contract partners and customers.


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To learn more about this Initiative, please visit this webpage.
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