NARO

Republic of Uganda

Adaptation for Smallholder Agriculture Programme
ASAP
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Investing in rural people

PRELNOR

Beans

Curriculum and Technical Guide for Farmer Field and Business School Facilitators



2018

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ACKNOWLEDGEMENT

This manual is based on training materials developed during the PRELNOR organized write shop meetings. The manual was developed to support Agricultural extension facilitators and Community based facilitators based at parish levels to effectively facilitate farmer learning.

We wish to thank the National Agricultural Research Organization (NARO) led by Nge and AbiZARDI, District Local government staff, Agricultural extension facilitators and breeders of the specific commodities, who were instrumental in the preparation of this manual through technical expertise in the specified commodities, photographs, and in finalization of the text, for which we are grateful. The review of the text by Project Management Unit, DAO's and NARO scientists is also highly appreciated.

The production of the manual is a joint activity between NARO, PRELNOR Project Management Unit (PMU), District Local Government production Staff in the eight project districts of Acholi and Adjumani. The hard work of Otim Godfrey Anyoni, Odama Emmanuel, Alfred Komakech, Walter.O. Anyanga, Lamo Jimmy, Kalule Okello David, Kessime Eunice, Lubadde Geoffrey, Gloria Grace Anguti, Omara Thomas, Kwemoi Daniel and Mercy Namara

in reviewing the publication and the technical editing is highly appreciated.

The support of Kasamba Salim and his team from Real Concepts Ltd in the complex task to provide the illustration and layout for the manual is appreciated.

Finally we acknowledge IFAD and the Ministry of Local Government for funding the development and production of this manual

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Design and layout: Real Concepts


BEANS

INTRODUCTION

Dry beans (Phaseolus vulgaris L.,) cultivated varieties were introduced in Uganda from Latin American as a result of the Spanish and Portuguese trader ventures at the Zanzibar and Mombasa ports about 16th Century. Beans are believed to have been established as a food crop well before the colonial era, although it is not precisely known as to when they first arrived into Uganda. In Uganda, bean yields are estimated at less than 500 kg/ha, much less than the SubSaharan Africa average of more than 770 kg/ha.

Farmers in Northern Uganda still experience low production due to dependence on nature for production, low yielding varieties, lack of quality seed, poor cropping systems. In addition, the existence of other constraints like diseases, insect pests, drought and low soil fertility. Most farmers use cultivars susceptible to these constraints. This manual therefore shall guide Agricultural extension workers and community based facilitators to train farmers so that bean production and productivity is improved in northern Uganda.

Contents of the curriculum

The curriculum consists of training modules divided into units indicating the topics, objectives, contents, methods of delivery and training materials required. A time schedule is allocated for each topic to enable the facilitator to plan appropriately for each session.

Bean Production Technology:

Course content

TIME (HOURS) THEORY	TIME (HOURS) PRACTICAL	TOPIC	OBJECTIVE	CONTENT	METHOD	MATERIAL
30 min	1hr	Introduction	To appreciate bean production	The Economic importance of beans	• Sharing • Group discussion • Practical • Demonstration	• Flip chart • Print out • Brochures
30 mins	45 mins	Record keeping	To be able to keep proper records	Importance of record keeping	• Brainstorming • Group discussion • Demonstration	• Samples of records
15 mins	45 mins	Constraints in bean production	To be able to identify constraints in bean production	Constraints in bean production	• Brain storming • Sharing • Group discussion	• Flip chart • Markers • Pens • Notebooks

15 min	15 min	Varieties of beans	To be able to identify different bean varieties with their attributes	Identification of bean varieties and their attributes	• Brainstorming • Group discussion • Practical • Demonstration	• Variety samples • Note books • Pens
15 mins	20 mins	Seed selection	To be able to select good quality bean seeds for planting.	Attributes of good bean seeds for planting	• Discovery • Group discussion • Practical • Demonstration	• Demo plot • Different bean seed sample
20 min	30 mins	Seed rates	To be able to determine appropriate seed rates and spacing for beans.	Determining the quantity of bean seed for planting by plot size.	• Discovery • Practical • Demonstration	• Demo plot • Bean seeds • Note books • Strings • Measuring tape • Farm tools
30 min	15min	Site selection	To be able to select suitable sites for planting beans	Selection of suitable sites for beans production	• Brainstorming • Practical • Demonstration	• Demo plot • Farm tools • Note books • Pens

30 mins	1hr	Land preparation	To be able to prepare land suitable for planting beans	Different methods of land preparation for beans	• Brainstorming Practical • Group discussion • Demonstration • Group discussion • Sharing	• Hand tools, • Ox plough • Tractors • Demo plot • Note books • Pens
15 mins	40 mins	Crop rotation	To be able to design a crop rotation program for beans	Planning crop rotation for beans	• Discovery • Sharing • Practical • Demonstration • Group discussion	• Demo plot • Note books • Pens
15 mins	30 mins	Planting beans	To be able to plant beans using different methods and recommended depth.	Different methods of planting beans.	• Discovery • Practical • Demonstration	• Demo plot • Bean seeds • Strings • Rhizobium

40 mins	1 hr	Soil fertility management and fertilizer requirements for beans	To be able to manage soil fertility in bean fields. To be able to identify suitable fertilizers for planting beans	Soil fertility requirements for beans Integrated Nutrient Management for beans Types of fertilizers required in bean production	• Brainstorming • Group discussion • Practical • Demonstration	• Demo plot • Organic fertilizers • Inorganic fertilizer • Soil conditioners • AESA sheet • Pens • Notebooks
30 mins	1 hr	Weed management	To be able to manage weed infestations in beans.	Methods of weed management in beans	• Brainstorming • Practical • Demonstration	• Demo plot • Weed specimens • AESA sheet • Pens • Notebooks

20 mins	1 hr	Disease management	To be able to manage the different diseases in beans.	Methods of disease management in beans	• Brainstorming • Practical • Demonstration	• Demo plot • Diseased samples in the field • Fungicides • AESA sheet • Pens • Notebooks
20 mins	1 hr	Pest management	To be able to identify and control different pests of beans.	Identification of different pests of beans Methods of pest management in beans	• Brainstorming • Practical • Demonstration	• Demo plot • Insect box • Spray pumps • Samples of chemicals for pest control • Pens • Note books • Flip charts • Attendance sheets • AESA sheet • Posters

20 mins	1 hr	Harvesting beans	To be able to determine time of harvesting beans.	Time of harvesting beans	• Discovery • Sharing • Practical • Demonstration	• Demo plot • Tarpaulin • Transport
15 mins	30 mins	Postharvest handling	To be able to handle beans after harvesting.	Postharvest handling methods in beans	• Discussion • Practical • Demonstration	• Tarpaulin • Bags • Transport
20 mins	1 hr	Drying beans	To be able to determine the appropriate moisture content for beans.	Methods of drying beans Determination of the required moisture content of beans	• Brainstorming • Practical • Demonstration	• Drying yard • Tarpaulins • Moisture meter
30 mins	1 hr	Threshing beans	To be able to thresh beans appropriately.	Methods of threshing beans Methods of cleaning beans	• Discussion • Practical • Demonstration	• Bean threshing • Tarpaulin • Mats • Winnower / blowers • Packing bags

25 mins	30 mins	Packaging	To be able to package beans appropriately.	Suitable methods of weighing and labelling (packaging beans)	• Discussion • Practical • Demonstration	• Samples of packaging materials • Weighing scales • Flip charts • Markers • Notebooks • Pens
30 mins	1 hr	Storage	To be able to store beans appropriately.	Different methods of Storing beans	• Discussion • Practical • Demonstration	• Stores • Silos • Bean seeds
30 mins	1 hr	Marketing beans	To be able to market profitably beans	Marketing beans Profitability analysis for beans	• Discussion • Practical • Demonstration	• Flip charts • Markers • Pens • Notebooks • Calculators

SUMMARY INFORMATION ON BEAN PRODUCTION TECHNOLOGIES

Importance of beans

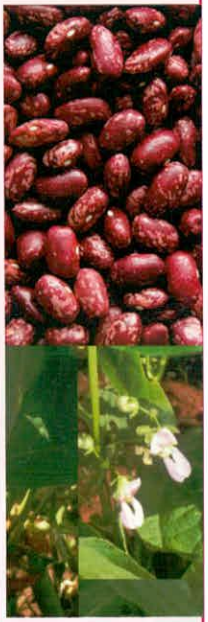
- Source of food and food security
- Household income (domestic and export markets)
- Improving and sustaining soil fertility
- Fodder and fuel for cooking
- Source of nutrients e.g zinc, calcium, iron, folic acid, dietary proteins, e.t.c

Constraints in beans production

- Pests and diseases
- Knowledge gaps in production
- Post-harvest losses
- Climatic changes
- Declining soil fertility
- Poor access to quality seeds

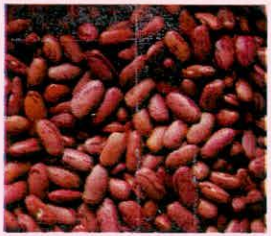
Beans varieties

	Brief Attributes			
	NABE 15 (Bush) 	NAROBEAN 1(Bush) 	NAROBEAN 2 (Bush) 	NAROBEAN 5C (Climbing) 
Maturity	60-75 days	60-75 days	60-75 days	85-95 days
Yield	0.6-1 t/acre (1.5-2.5 t/ha)	0.8-1.2 t/acre (2-3 t/ha)	0.8-1.2 t/acre (2-3 t/ha)	1-1.4 t/acre (2.5-3.5 t/ha)
Others	Disease and waterlogging tolerant	Disease & drought tolerant, rich in zinc & iron, short cooking time	Disease & drought tolerant, rich in zinc & iron, short cooking time	Disease & drought tolerant, rich in zinc & iron, short cooking time
Other varieties	Brief attributes			

	NABE 18	Narobean3 (yellow Beans)	NABE 16	NABE 17
				
Maturity	Maturity (63-78 days)	58-68 days	65-75 days	58-75 days
Yield	Yield (2000-2500 kg/ ha)	1500-2000kg/ha (600-800Kg/ acre)	High yield (2000 - 2500 kg/ha)	Yield (2000 - 2500 kg/ha)

Others	• Released 2012 • Bush • Large seeded • Dark seed colour preferred in northern Uganda (Purple mottled) • Northern Uganda Market • Resistant to anthracnose , BCMV, ALS & tolerant to Root rot diseases	Disease & drought tolerant, rich in zinc & iron, short cooking time	• Released 2010 • Tolerant to bean anthracnose • Suitable for all regions • Spacing 50 x 10 cm • Best suited for lowmid altitude area	• Released 2012 • Bush type (indeterminate bush) • Tolerant to anthracnose , BCMV, ALS • Best suited for lowmid altitude area

	NABE 19	NABE 20	NABE 21	NABE 22
				
Maturity	Maturity (60-70 days)	Maturity (58-70 days)	Maturity (58-70 days)	Maturity (58-70 days)
Yield	Yield (2000-2500 kg/ha)	Yield (1600-2200 kg/ha)	Yield (1500-2000 kg/ha)	Yield (1500-2000 kg/ha)
Others	• Released 2012 • Bush type (indeterminate bush) • Resistant to anthracnose , BCMV, ALS, and tolerant to most of other diseases	• Released 2012 • Bush (indeterminate bush) • Market class quality (Kanyebwa type) • Resistant Tolerant to anthracnose , BCMV, ALS, and most of other diseases • Best suited for low mid altitude area	• Released 2012 • Market class quality (Kanyebwa type) • Bush type (determinate bush) • Tolerant to anthracnose , BCMV, ALS, and most of other diseases • Best suited for low mid altitude area	• Released 2012 • Bush type • Dark seed colour preferred in northern Uganda Market (Purple with white mottles) • Resistant to anthracnose , BCMV, ALS, and tolerant to root rots and most of other diseases • Best suited for low mid altitude area

	NABE 23 	• Maturity (65-75 days) • Yield (2000-2500 kg/ha) • Released 2012 • Bush • Market Class (Kanyebwa type) • Highly Palatable • Large seeded • Kidney seed shape • Good seed colour • Tolerant to anthracnose , BCMV, ALS, root rots and most of other diseases • Best suited for low-mid altitude area

SITE SELECTION

- The best soil should be well drained and moist throughout the growing season, and with reasonable fertility levels
- Avoid areas that keep standing water for long periods.



LAND PREPARATION

- Prepare a fine seedbed to a moderate depth of 15-20cm
- First ploughing should be at least 3 weeks and 2nd ploughing at least 1 week before planting.



First ploughing	*2nd ploughing*

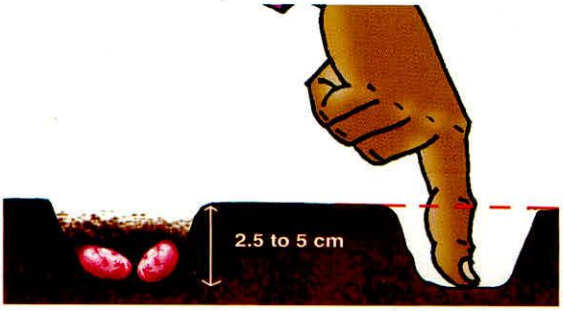
SEED SELECTION

- Select good quality seed and seed dress if necessary (to avoid storage pests and seed borne diseases).
- Choose disease tolerant varieties such as NABE 16, NABE 23, NABE15, NAROBEAN 1, 2,3 & 5C including, to mention but a few.
- Select single variety for planting.

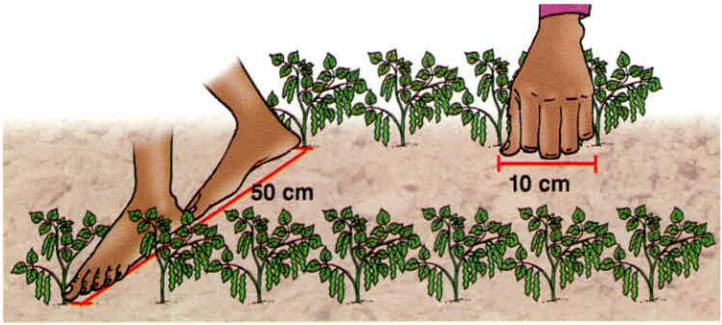


PLANTING/SPACING

- 1 plant per hill is recommended at a spacing of 50 x 10cm. In case of low quality seed, plant 2 seeds per hole and thin to 1 plant.



- Plant at a spacing of 50 × 10 cm for bush beans and 50 × 20 cm for climbing beans in pure stand.



- Use seed rate of 32 kg/acre (80 kg/ha) for bush beans and 16kg/acre (40kg/ha) for climbing beans
- Recommended seed rate is 32-36kg/acre(80-90kg/ha) for bush beans.

WEED MANAGEMENT



First weeding



Second weeding

- Carry out 1st weeding 2-3 weeks after planting depending on initial land preparation.
- Stake climbing beans at this stage as well.
- Second weeding should be done before the start of flowering. This is to avoid flower abortion.

SOIL NUTRIENT MANAGEMENT

- Plant in soil with adequate levels of fertility.
- In soil with low fertility, apply organic manure or inorganic fertilizer (NPK - 40kg/ha) or Urea 46:0:0 (20 kg N/ha) or DAP 18:48:0 (40 kg/ha).
- Rotate and intercrop with cereals and root crops.
- Clean/disease free husks can be ploughed into the soil to improve fertility.



PEST AND DISEASE MANAGEMENT

- Seed dress with Endosulfan (10 ml/ kg) before planting and earth up at first weeding to control the stem maggots.
- Plant resistant/tolerant varieties such as NABE 16, NABE 23, NAROBEAN 1, 2 & 5C to reduce yield losses from angular leaf spot, anthracnose, bean rust and bean common mosaic disease.
- Spray aphids with Dimethoate, ambush or Sumithion to reduce disease incidences.
- Rotate and intercrop with cereals and root crops.

Symptoms of disease attack	Control
Anthracnose 	• Do not use home-grown seed, only certified disease-free seed. • Practice a 3-year crop rotation. Do not cultivate or harvest when plants are wet. • Rogue and destroy affected plants. • Do not spread bean refuse or manure containing bean refuse on land intended for beans in the next three years. • Plant resistant varieties like recently released varieties e.g NAROBEAN 1, 2,3, NABE 15, NABE 16. • Refer to agro dealers for a listing of fungicides and their application methods.

Common Bacterial Blight



- Planting resistant varieties is the best control measure like recently released varieties e.g NAROBEAN 1, 2, NABE 15, NABE 16.

Root rots



- Treatment or sterilisation of soil which may be limited to small areas like screenhouse
- Use or application of farmyard manure, green manure, compost to improve soil fertility (do not use a lot of nitrogen fertilizers as this may aggravate the problem)



- Planting on raised beds or ridges to facilitate proper drainage and good soil aeration.



	• Hilling up soil around the stem to stimulate development of adventitious roots. Deep ploughing of infected plant materials during land preparation and allow the previous crop to decompose well before planting; and practicing crop rotation with a non-host crops such as maize. • Conduct field inspections frequently and apply fungicides at first sign of disease.
Bean Common Mosaic Virus (BCMV): 	• Plant certified disease free seed and resistant varieties if available. Conduct field inspections frequently and apply an insecticide when aphids are first noticed. (Refer to dealers for available insecticides and their application methods).
Angular leaf spot (ALS) 	• Always look out to plant varieties that are resistant to the various biotic stress like anthracnose angular leaf spot, root rots, common bacterial blight, rust, bean common mosaic and bean common mosaic necrotic viruses.



- To minimize the effect of these biotic stresses; i) Plant clean or disease free seed; ii) improve soil fertility; iii) practice crop rotation; iv) rouge or remove infected and damaged plants, v) spray aphids which transmit viral diseases and other fungal diseases using a combination of systemic fungicides and foliar fertilizers; such as Mancozeb, molybdenum (mo) sprays, Benzimidazole, Thiabendozole, Trifloxystrobin and Azoxystrobin.
- Also farmers should avoid movements in the bean field when the plants are wet.

Common bean pest	Control
Bean stem maggot (Bean fly) 	• Management options include; planting within three weeks at the onset of rains to reduce bean stem maggot infestation • Earthling up at first weeding to encourage development of new roots and recovery of damaged plants • Maintain good soil fertility which enables damaged plants to recover • Seed treatment with systemic insecticides e.g., Endosulfan or diazinon (refer to chemical dealers for proper usage and application methods)

Bean aphids (Aphis fabae) 	• Mulching and intercropping may help reduce the effect of aphids and the use of any recommended insecticide as per manufactures recommendations can help eliminate it.
Foliage beetles (Ootheca Mutabilis; O. bennignseni) 	• Insecticide such as chloropyrifos or endosulfan are recommended.
Legume pod borer (Maruca testulalis) 	• Insecticide application using recommended insecticides is the only effective control measure known e.g Dimethoate
Bean weevil (bruchids) 	• Dress the seed with actellic dust or any other chemical recommended by the agro-input dealer. • Proper drying and storage is also essential



HARVESTING

- Uproot the whole plant when mature and spread on a clean surface or tarpaulins until all the pods are dry and crisp.
- Harvest early to avoid weevil infestation, shuttering and termite damage.



POST-HARVEST

- Thresh, winnow and sort by hand the disease stained, off-types or damaged seeds.



- Continue drying seeds for 2-3 more days in good sunshine
- Pack in bags of up to 100kg and place on wooden racks in a well-ventilated, vermin and water proof store, portable silos.





- For seed, treat with Actellic or Malathion dust to control weevils in storage.
- If the beans are for food, mix with ground tobacco leaf powder or Mexican marigold (some farmers use ash and anthill soil)
- Other methods of cultural beans preservation against pests are recommended:- cut onions, garlic, livestock urine, banana juice, red pepper.

Post harvest handling of common beans

- Harvesting: Fresh beans are harvested when the pods are well filled while dry beans are harvested when physiologically mature when leaves are dry.
- Harvesting may be by hand or machinery.



Right stage to harvest fresh beans



Transporting dry beans

- Small volumes are heaped and carried on head or bicycles while large volumes are carried on ox carts or vehicles.

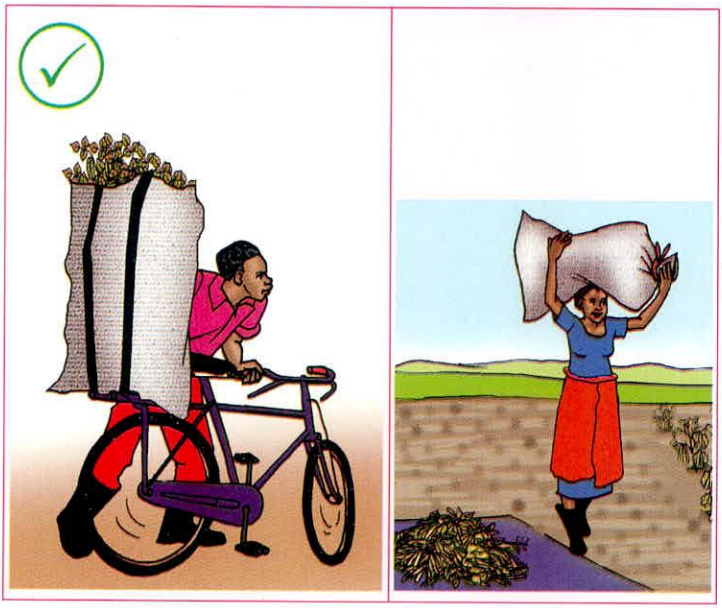
On-farm transport

After crop harvest, it is normally carried in small quantities as head loads, or in animal-drawn carts, wheelbarrows or bicycles. Most of these methods are considered improper because they lead to shattering and spillage.

Large volumes are carried on ox-drawn carts or vehicles.







Drying common beans

- Drying is the process or removing the moisture (water content) from the useful part of the crop. Drying helps to keep the product safe for longer periods.
- The moisture content of grain should be less than 14%, above which mould, insect and mite damage, discolouration (unwanted colour change) and development of off-flavours (bad smell) may occur.
- Drying reduces grain bulk, slows down insect damage, moulds, seed germination and sprouting.
- Drying in most farming communities in the tropics is weather dependent and is often done on bare ground. This results in soil and foreign matter contamination, moulds infection and discolouration of the produce.

Threshing/Shelling

- Gentle beating and use of tarpaulins is recommended.
- Dry pods are threshed to remove the grains. Traditional methods of removing grain involve beating of the dry pods in heaps with sticks.
- The method is considered improper because it results in grains getting broken, bruised or scattered.
- If grains are broken/ bruised entry points are created/ made for insect infestation or microbial infection, and seeds are of low germination. Some of the grains may never be fully recovered from the pods or the cobs. It is easier to handle and treat shelled grain than when it is not.



Cleaning, sorting and grading

Once threshed, the grain must be removed from the chaff (waste) or rubbish. This may be done using traditional winnowing trays by shaking and pouring the grain and its rubbish in the direction of wind flow. The wind carries away the rubbish, while letting the heavy grain to fall on the ground.

The next step involves the removal of diseased, discoloured, broken or wrinkled grains from the good ones by hand sorting. If not removed some of the foreign matter carry pests and diseases, and greatly lower the market value of the grain.



Storage types and methods

When grain is to be stored for long periods, it must be kept in a storage structure that does not allow wetting or re-wetting, insect attack, rat damage, caking, over heating and/or theft.

The storage structure must protect the grain in good conditions until needed. It is important to store grain for sometime until the market prices get better or increase. The different storage methods used range from traditional units such as tins, drums, baskets, bags that are either kept in granaries, stores or houses.

Packaging

Packaging refers to putting the products in a container of suitable materials that do not allow spillage, contamination, water and any other materials that may lower the quality and quantity of the product. Packaging can also be used in making the product more attractive and acceptable on the market. Packaging materials include bottles, paper bags, polyethylene bags, gunny bags, tins, drums etc.

MARKETING

- Conduct market survey to establish the market requirements in terms of quality, quantity, seasonality, price
- Promote market information and linkages
- Promote bulk marketing
- Encourage contract farming
- Promote local seed business.




Local seed
business
Improved seeds

Value added beans products



No Salt Added Pinto Beans



Black beans



Cooked beans



Bean Spice



Beans flour



Cooked packaged beans



Bean Soup



Make Akara / Nigeria Bean-Cakes Baked



Bean Spice Cake

PROFITABILITY ANALYSIS FOR BEAN

Example: Gross –margin analysis per acre of beans (this is only an example-costs of production vary)

Assumptions: yield = 1,200 kg/acre and expected market price = 2,000/- per kg

Item	Unit	Quantity	Unit cost	Total
Cost of input				
Seeds	Kg	32	3,000	96,000
Tools (hoes)	Pieces	5	8,000	40,000
Tools (pangas)	Pieces	2	3,000	6,000
Pesticides	Litres	4	20,000	80,000
Bags	Pieces	8	1,000	8,000
Total input cost				230,000
Labour costs				
Land preparation x2	Man-day	2 x10	10,000	200,000
Planting	Man-day	4	10,000	40,000
Weeding	Man-day	2 x 10	5,000	100,000
Harvesting	Man-day	2 x 5	5,000	50,000
Drying	Man-day	4	10,000	40,000
Threshing	Man-day	10	5,000	50,000
Packaging	Man -day	8	2,000	16,000
Total labour cost				496,000
Cost of labour and input				726,000
Gross Margin				160,000

Note: Production cost per unit (kg) = $\frac{\text{Total cost}}{\text{Total output (yield)}}$

Profit margin per kg = sale price per unit – production cost

$= \frac{726000}{1200}$

= 605/-

Profit margin per kg = sale per price unit – production cost per unit

= 2,000 - 605 = 1,396/-

Implication: a farmer is getting a profit of shs 1,396/- per kg produce

RISK AND SENSITIVITY ANALYSIS

Risk Analysis for Beans Enterprise

Scenario 1: A decrease in yield of Beans to 800kg/acre and a rise in market price to shs 2,100 kg/

Parameter	Product	Quantity (kg)	Marketing Price (Sh.)	Total (Sh.)
Expected Revenue	Beans	1 acre × 800	2,100	1,680,000
Total Cost				726,000
Gross Margin				**954,000**

Scenario 2: An increase in yield of beans to 1,220 kg/acre and a fall in price to shs 1,300/kg

Parameter	Product	Quantity (kg)	Marketing Price (Sh.)	Total (Sh.)
Expected Revenue	Beans	1 acre × 1,200	1,500	1,586,000
Total Cost				726,000
Gross Margin				**860,000**

Note: **a) In scenario 1 above**, the decrease in yield accompanied by a rise in price will not significantly affect profitability of the enterprise

b) Under scenario 2: A fall in market price will drastically reduce profitability of the enterprise.

A fall in market price has a far reaching effect on gross margin than a fall in yield.

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