FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Training manual

FEED THE FUTURE KENYA

Accelerated value chain development (AVCD) program

Root crops component

Model learning farm for potato producers

Training manual for ware potato farmers

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Model learning farm for potato producers. Guide for ware potato farmers training

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Funded by United States Agency for International Development, the three-year Feed the Future Kenya Accelerated Value Chain Development (AVCD) project program seeks to widely apply technologies and innovations for selected value chains in order to competitively and sustainably increase productivity, contributing to inclusive agricultural growth, nutrition and food security in the country. Focusing on the livestock, dairy, and staple and root crops value chains in 21 counties in Kenya, AVCD aims to lift 326,000 households out of poverty. The potato value chain component, managed by CIP, seeks to expand the seed system, increase production and productivity of smallholder farmers, and support coordination in the value chain by developing farmer institutions to support marketing for member farmers.

FOREWARD

This training manual has been developed for purposes of training ware potato farmers under the USAID-FTF Accelerated Value Chain Development (AVCD) project in potato value chain. The training uses a 'learning farm' approach concept which aims at providing local farmers with hands-on experience in modern potato production technologies by practicing together with the trainers. A learning farm is a designed farm set-up demonstrating modern technologies in production in comparison with the farmers local experiences. This side by side comparison with farmers help in enhancing the learning experience and informing farmers decision making in improving their production practices.

The manual gives a step wise module to be used by the training facilitators working with farmers. The modules provide background information useful during establishment of the learning farm, and the training of farmers. The modules are separated into three different sessions corresponding to different stages of crop development to facilitate practical involvement of the farmers during the training sessions.

The manual has been developed using simple language understandable to farmers and adapted to local context of the project implementation areas. However, many aspects have been generalized as they apply to all potato production activities and most of the recommendations are based on research done or national recommendation from research organizations.

The training modules in this guide covers production activities from site selection to the post-harvest handling of the crop. It also provides indication on how to set up learning farm as a class for farmers training.

The manual emphasizes on farmers' full participation in the whole training process with the trainers only guiding the process. For more details, other resources can be explored.

INTRODUCTION

Learning farm concept

The learning farm training concept has been designed specifically in this case to give potato farmers in the farming community a hands-on experience training with various potato production information and modern technologies. The training module involves combination of theoretical explanation of ideas and practical's in the field over a period of three contacts corresponding to the critical stages of potato crop during the season.

The process of setting up a learning farm involve selection of a farmer in the community/or group who is willing to host the learning farm. The farmer is then subjected to a set of minimum criteria which he/she should meet to ensure that the learning farm will be accessible to the farmers for trainings and reference. The idea is for the farmers to have the feeling of ownership as the host is an ordinary farmer like them.

For the purposes of this project the training sessions for potato production are divided into three section each corresponding to the critical stages in the potato crop development i.e.: planting stage, vegetative stage and harvesting stage

Importance of potatoes

Potato is an important crop in Kenya after maize in terms of production and consumption. It is also a major source of income and employment to many households. Demand is constantly growing with diversified and changing consumption patterns in rural and urban area.

Yields are still low of less than 10 t/ha compared to up to 25 t/ha attained by some progressive farmers. Even with the low yields many farmers still prefer growing potato because of its profitability compared to the alternative crops that are grown in the same area.

Consequently, expansion of production area has been observed as mechanism of increasing production to meet the growing demand. However, this has an adverse effect on environment and ecology.

On that note this manual has been produced to assist extension staff in training ware potato farmers to improve their production through improvement of productivity per unit area as opposed to expansion of production area which has proved unsustainable.

Potato growth stages

Understanding the growth stages of potato crop is important in devising strategies and intervention targeting the most critical growth stages which have impact on improving the yields. This forms the basis of the training modules hence farmers should first understand the different growth stages that potato crop passes before maturity.

Potato crop has five main stages of development which play critical roles (Fig 1). Various interventions for improving productivity can thus be targeted at specific stages of growth.

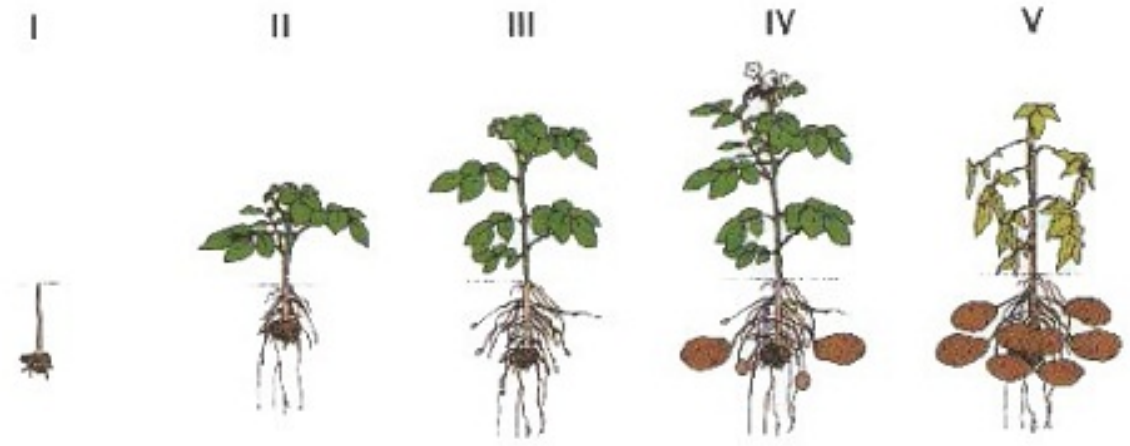

Figure 1. Schematic presentation of different growth stages of potato crop

Stage I: Emergence

First stage after planting when sprouts develop from eyes on seed tubers and grow up ward to emerge from the soil. Root also begin to develop at the base of emerging sprouts.

Stage II: Vegetative growth stage

Leaves and branch stems develop from above ground nodes along the emerged sprouts. Roots and stolons develop at below ground nodes. Photosynthesis begins at this stage.

Stage III: Tuber initiation
Tubers start forming at stolon tips but are not yet enlarging. In most varieties this stage coincides with early flowering.

Stage IV: Tuber bulking
Tuber cells expand with the accumulation of water, nutrients and carbohydrates. Nutrients move from the leaves down to the tubers which enlarge. The leaves start turning yellow.

Stage V: Maturation
Vines turn yellow and lose leaves, photosynthesis decreases, tuber growth slows and vines eventually dies. Tuber dry matter reaches a maximum and tuber skins set.

Session one: At planting

Land preparation and planting

Site selection

Potato crop should be cultivated in open field, not under the shade. The ideal field in which to plant a potato crop, should have a deep, well-drained and loose soil. Naturally loose soils, which offer the least resistance to development of the tubers, are best, and loamy and sandy loam soils that are rich in organic matter, with good drainage and aeration, are the most suitable. The soil should be free from bacterial wilt and nematodes. Potatoes can tolerate a range of soil pH values of 5.0 - 6.5. pH levels lower than 5.0 will produce poor quality tubers and abnormal growth, while high soil pH will cause problems such as common scab.

Crop rotation

History of a field for potato production should be well known. Planting potatoes in the same piece of land season after seasons will encourage the buildup of diseases such as bacterial wilt and other pests in the soil. To prevent buildup of diseases and pests, proper crop rotation is recommended for a period of at least three seasons. During this period, other crops unrelated to potato can be grown. Avoid using tomatoes, black night shade, capsicums (the peppers) eggplant and other known crops from solanaceae family which are alternative hosts to many pests and diseases of potato. Volunteer potatoes in the field can also harbor disease during the break crops and spread the disease later hence should be removed when spotted in the field.

Land preparation

Land preparation for potato should aim at producing deep, loose seedbed with minimum of clods. Potato requires loose soil to maximize their growth, bulking potential and consequently yields. It is thus recommended to plough the soil to a depth of 30cm. This can be done by hoes, tractors or animal drawn ploughs. Proper ploughing has several positive aspects which include; improving soil conditions, reducing weeds, pests and diseases, and prevention of soil erosion.

Figure 2. Well prepared land ready for planting

Soil fertility management and erosion control

Fertilizer and manure application

Prior to planting a potato crop, it is advisable to have the soil tested to determine the level of macronutrients and the pH value. Conventional practice in Kenya has been to apply fertilizers at standard rates, irrespective of crop history or soil type. Proper nutrition is crucial in determining potato yield and quality, as well as the potato plant's ability to withstand pest, environmental, and other stresses. The most common fertilizer combinations in Kenya include: Diammonium Phosphate (DAP), NPK 17:17:17, NPK 23:23:0. General recommendation for fertilizer application for potatoes indicate that 500 Kg (DAP) should be applied in one hectare. Thorough mixing of fertilizer and soil is recommended to prevent scorching of the sprouts with fertilizer.

Well decomposed manure can be used at a rate of 5-10 tonnes per hectare. Heavy fertilization of potato with nitrogenous fertilizer should be avoided because it encourages excessive foliage growth, delays tuber growth and may produce tubers with hollow hearts.

Soil erosion management

Potato cultivation usually involves intensive soil tillage throughout the cropping period, which often leads to soil erosion. Slope planting of potatoes can result in higher runoff and soil loss than on fallow plots. Therefore, potatoes should be planted along the contour. A lot of runoff and soil loss is also much after potato is harvested and the land left bare without any ground cover. This leaves soil exposed to different forms of erosion.

Planting cover crops provide vegetative cover for soils susceptible to erosion. Cover crops can be used in association with potatoes to: protect your soils from erosion, improve soil fertility and structure, prevent nutrient leaching, provide a source of N (if legumes are used and improve pest management (e.g. weeds and nematodes).

Seed selection and planting

Seed and variety choice

It is important for farmers first to choose potato varieties that meet their preferences. The quality of the seed potato is also very important to ensure a

good production. A good crop starts with good seed. Quality of potato seed is determined by:

1. Variety: the seed should be of the right variety and not be mixed with different varieties.
2. Health: the seed should be free of seed borne diseases (hence the need to know crop history of the seed).
3. Physiological age: the seed tuber must be at the optimum stage of physiological development at the time of planting.
4. Physical defects: it should be free of internal and external damages.
5. Tuber size: it is best if of 'medium' size (30 to 60 g).

The dormancy period of the potato varieties frequently used varies between 70 and 100 days. Seed tubers with short and strong multiple sprouts are extremely important for a high yield. Development of the sprouts is primarily affected by the light intensity. If the tubers are well exposed to diffuse light, the sprouts will be slow in growth, colored and sturdy. Seed tubers held in the dark will develop pale and long sprouts that are easily broken off. Long sprouts will deplete the seed tuber, which would also shrivel. Seed tubers with short, firm sprouts can be transported to the field with a minimal risk of sprout injury.

Figure 3. Left: Well sprouted seed potato with multiple firm sprouts. Right: Seed potato tuber with single long and weak sprout

Note: Only certified or seed from a reputable supplier should be purchased and used.

Planting

Potatoes can be planted in two ways;

1. Planting in such a manner as to leave the field quite flat, with this one to two hilling will be required.
2. Planting can also be done in pre-made beds with this method only one hilling might be required.

Seed Potato tubers are planted by placing them in rows. For ware potatoes, the rows should be spaced 75 cm apart, for seed potato crops the row to row distance should be reduced to 60 cm to encourage individual plants to produce more tubers of smaller size. In both cases, the tubers in a row should be a placed at 25 - 30 cm distances depending on the size. Place seeds at the planting points with their sprouts facing upwards. Ensure that seed of same size category are planted together in one area, this will result in uniform crop which will facilitate better management.

No matter what type of cultivating or hilling implement is used, tillage should not take place in wet soils. Working wet soils results in compaction and clods that will present problems at time of harvest.

Small seed plot establishment

Seed plot technique provides an opportunity to improve the farmers seed stock by purchasing small quantities of quality seed and multiplying it in the cleanest part of the land to get better quality seed for use in the following season. This technique can help in meeting part of the large requirement of healthy seed. The size of seed plot will be determined by the expected area under production the coming season and/or the amount of quality seed a farmer can afford to purchase.

Seed plot should be place on the top most part of the farm. Land should be ploughed well to a depth of 20-30 cm. The seed plots should be made on raised beds of 15 cm high and of width of1.5 m for easy operations from the side of the bed. The length of the bed can vary depending on the size of the land. Fertilizer should be applied based on the recommended rates for potatoes. Application should be on the entire bed and mixed well. Tubers are planted at a spacing of

30 by 30 cm and ensuring that a spacing of 15 cm is left from the edge of the bed before placing the first tuber.

Crop management should be done as for other potato crop including disease and insects' management. However, it should be noted that on seed plot weeding and hilling is done by hand pulling of the weed on the beds then adding soil from the sides to raise the bed to approximately 5 -10 cm height from the initial height.

Figure 4. Seed plot preparation and seed plot planting

Example: calculating seed plot size and number of tubers needed for 1 ha.

The size of the seed plot will depend on the seed needs for the area expected to be under production the coming season. Before setting up a seed plot one needs to first determine their seed requirements depending on their preferred spacing as discussed above in planting.

Assuming 1 ha of land requires 2000 kg/ha (2 ton per hectare) of seed. An average sized seed tuber weighs 50 g/tuber. Then this will mean 40000 tubers are required for 1 ha.

At multiplication rate of 10 then you need to plant 4000 tubers. (The principle of seed plot technology is to maximize on numbers of seed sized tubers hence the spacing is reduced to 30 cm by 30 cm).

4000 tubers will require (0.09 X 4000) = 360 m2 Hence a farmer will require 360m2 of land to produce enough seed for 1 hectare using approximately 4 bags (50Kg) of seed.

Session two: Target vegetative stage

Crop management

Weeding and hilling

Two important operations after germination of potatoes is weeding and hilling/ridging. Weeds compete with the potato crop for light, nutrients and water. If weeds are not reduced, crop yields can be severely reduced. The presence of weeds in a potato field can also increase disease levels on potato by allowing the aphid populations to survive in times the field is not cropped to potatoes.

In potato, weeds are controlled while hilling is being done. Hilling is the operation whereby soil is moved from in-between the potato rows towards the stems of the emerged potato plants thereby forming a uniform ridge. Hilling is important to allow the potato plant to produce many tubers; in the absence of hilling the plant simply produces less tubers and more above-ground stems. Potato crops are usually hilled twice: The first time some 4 weeks after emergence, while the second hilling then takes place 6 to 8 weeks after emergence. Avoid hilling when the canopy is closed.

Hilling up is done initially by loosening the soil around the potato plants, and piling it up
around the plants. The height of the ridges after the first hilling up should be around 30 cm. For the second hilling up, remove soil from the furrows and pile it up around the plants. You should do this more carefully to avoid damaging the plant roots. The height of the ridges after the second hilling up should be about 60 cm.

Hilling in a potato crop is essential for the following reasons:

- In the stage of tuber initiation, the stolons that are not underground will not develop in tubers but into stems
- Tubers that are not sufficiently underground are exposed to light which triggers the formation of a green pigmentation of the skin. Tuber greening causes the accumulation of solanine, a toxic component that may cause food poisoning. Solanine is not destroyed by cooking, not even by frying in hot oil. Consequently, potatoes with pronounced greening or with signs of damage should not be eaten.
- High hilling allows tuber development without deformation in a loose soil and protects from excessive humidity
- High ridges provide better protection from insect pests, e.g., the potato tuber moth
- Ridging also contributes to weed management

Care should be taken to avoid damage on potato plant root system and also causing lesions on the roots and tubers, thus increasing the risk of disease.

Diseases identification and management

Potential disease problems include bacterial wilt, late blight, viruses, early and other emerging diseases in the country like blackleg (Dickeya spp) and potato cyst nematode (PCN).

Bacterial wilt

Bacterial wilt is a disease caused by the bacterium *Ralstonia solanacearum*. It does not only infect potatoes, but can also damages plants such as chili, tomato,

tobacco and eggplant, as well as several species of weeds. This disease is extremely dangerous, especially in regions where potatoes are cultivated intensively. The symptoms of bacterial wilt infection can be seen on all parts of infected plants. They begin to wilt, starting from the tips of the leaves or where the stems branch out, and then spreading to all parts of the plant. Leaves become yellow at their bases, then the whole plant wilts and dies. When stems are cut a brown colored ring will be visible.

When a tuber is cut in half, black or brown rings will, however, be visible. If left for a while or squeezed, these rings will exude a thick white fluid. A further symptom is fluid coming out of tuber eyes. This can be signified by soil sticking to tuber eyes when crops are harvested. Serious infection causes tubers to rot.

Figure 5. Symptoms of bacterial wilt disease on plant and tuber

On potato crops, bacterial wilt originates from: Soil-bacterial wilt can survive in soil without a host for several seasons, water, seed tubers, rogue potato plants or other crop or weed plants that can host bacterial wilt and potato plant remnants. The disease can spread from field to field or from plant to plant in one field via: Infected seed, water, soil, farming tools and livestock and people. The disease will spread rapidly in the warmer temperatures in storage areas, and will cause tubers to rot. Infected seed can also be a source of the disease in the field.

Currently there in no registered chemical for controlling Bacterial wilt. Management principles for bacterial wilt are as follows:

1. Planting potatoes in soils free from bacterial wilt.
2. Using healthy seed not infected with bacterial wilt.

3. Rotating potato crops with other non-solanaceous crops such as cereals. Good practice is to rotate potatoes with corn, leeks, cabbages or sweetpotato.
4. Removing infected plant debris before planting and clearing weeds away before planting, while plants are growing and at harvesting time.
5. Using composted organic fertilizer not infected with bacterial wilt.
6. Carefully managing irrigation in the field by digging channels that allow water to flow freely from the field. Bacterial wilt will spread rapidly in flooded fields. Also when watering the field, try to make sure water does not flow over the surface of the field.
7. Using water not contaminated with bacterial wilt to irrigate the crop.
8. Cleaning the field by destroying (burning or burying) plants and tubers infected with bacterial wilt throughout the whole season.
9. Cleaning farming tools after use.

Late blight

This is the most important disease, caused by the fungus *Phytophthora infestans*, affecting

potato crop in Kenya. It regularly causes crop failure, infecting plants from the tuber initiation stages up until harvest. Severe infections occur at times of high rainfall, high humidity and low temperatures.

This disease damages leaves, stems and tubers. Early symptoms are small pale to dark green spots appearing on leaves. When infections are still active, spores appear on the undersides of leaves blanketed in what looks like flour. These spores can spread rapidly at low temperatures and high humidity and infect leaves on other plants. This disease acts very quickly. If it is not controlled, infected plants will die within two or three days. When tubers are infected by late blight, their surfaces become brown, irregular and watery. If a tuber is cut open, parts of its flesh will appear brown in color.

Figure 6. Late blight symptoms on underside of a potato leaf, stem and tuber

Sources of late blight are the air, soil, seed and remnants of infected plants. It spreads very
rapidly via air, soil, water and seed. The white powder on the surface of affected leaves can be carried by the wind and spread the disease to other plants.
Late blight management practices must be based on the relationship between the disease and factors that influence its development. Key practices in late blight management are;

1. The use of resistant varieties
2. Routine observations, and
3. Developing management techniques based on these observations.

Reducing the spread of the disease can be done through application of contact fungicides which can reduce infection and influence the formation of spores and the spread of rot on the leaves.
Once the crop is infected by the disease it is advisable to use the systemic fungicide.

Viral diseases

A common problem when cultivating potatoes is reduced yield from one generation to the
next. Farmers often consider the cause to be old and degenerated seed potatoes. In fact, this yield reduction is caused by viral infections residing in the seed tubers. These diseases are very varied and display a multitude of symptoms. It is difficult for farmers to gain an understanding of viral diseases because:

1. Their causal agents are tiny and invisible to the eye.
2. Viral infections rarely cause plants to become damaged or die. The symptoms visible, if any at all, are changes in the shape of plants. Consequently, most farmers consider viral diseases harmless.
3. It is difficult to differentiate between symptoms of one virus and another, as they are all very similar. Thorough testing calls for equipment and expense well beyond farmers' reach.

Viral diseases have developed from one generation to the next primarily due to farmers' habit of basing their seed potato selection on the size of the potatoes alone. Generally, viral diseases lead to smaller potato tubers being produced. Consequently, when tubers are sorted and selected for seed, the majority of seed potatoes chosen are those already infected with viral diseases. A key factor when obtaining seed from your own field should be selecting healthy plants for parent stock through positive selection technique.

Despite variations, management principles are nearly the same for all viral diseases. Viruses can be controlled by:

i. Using virus free seed

It is very risky to select seed potatoes based on size alone, as plants infected with viral diseases generally produce smaller tubers. Strict sorting and selection is highly recommended when a part of the harvest will be used for seed.

ii. Destroying plants infected with viral diseases

Plants displaying symptoms of viral diseases must be pulled up, collected and destroyed. Viruses can spread from one plant to another through vectors, so removing infected plants will also remove the source of disease for other plants

iii. Controlling insects that can spread viral diseases

Generally, sucking insects such as aphids, thrips, mites and whiteflies can spread viruses. Therefore, management of these insects can reduce the spread of viral diseases.

Examples of common viral diseases

Figure 7 potato plants showing viral symptoms

Other emerging diseases and pests

With the movement of seed internally and externally there is risk of introduction and spread on new pest and diseases not originally present in farmers' field. Farmers are advised to report any disease or plant behavior that is un common. Some of the recently observed disease and pest include Potato Cyst Nematode and pectobacteria *Dickeya spp.* These two are very destructive and can cause severe damage to potato crop.

Figure 8. Plants and tuber showing blackleg symptoms

Session three: Targeting harvesting stage

Harvesting and post-harvest handling

Dehaulming

It is recommended to cut the foliage of potato crops before harvesting for the skin to set. 10 to 14 days before harvesting is the recommended time for this activity. Dehaulming should be done when the crop is mature by cutting the foliage at the base of their stems. Benefits of dehaulming are:

- To make tubers harden more quickly so they can be harvested sooner. Normally, you can harvest plants two weeks after pruning.
- To prevent diseases spreading from plant stems to tubers. Viral diseases in particular will spread to tubers if stems begin to wilt and dry out. The same occurs to other diseases such as late blight, stem rot and bacterial wilt.

Figure 9. Left: Dehaulming of potato crop before harvesting. Right: Potato tuber harvested before skin set

Harvesting

Determining the right time to harvest is essential for achieving high quality produce. Ware

potato crops are harvested when tubers are mature, and the tuber's skin is firm and cannot be removed by lightly rubbing the tubers with your fingers. Harvest should be done in clear dry weather and not when it is raining.

Timely harvesting can help avoid serious pests and disease damage. Leave tubers on the ground for a while to allow any soil caked on them to dry out and fall off, as soil left on tubers can cause them to rot. Tubers should then be sorted,

separating healthy ones from damaged ones, and big ones from small ones (depending on what the market demands). Do not leave tubers in the field for too long as they may be attacked by pests such as potato tuber moth.

Harvesting methods affect tuber quality. Potatoes can be harvested in two ways, directly by hand or by using a hoe. Harvesting by hand takes longer and is more labor intensive, but will produce good quality, undamaged tubers. Using a hoe is less time-consuming and labor intensive, but some tubers will be damaged in the process.

After harvesting, you should sanitize the field, by gathering and destroying harvest remnants such as plant parts, rotten tubers etc. Post-harvest sanitation is an important part of controlling various pests and diseases, by removing sources of contamination for the next crop.

Certain actions are not favorable for potato tubers and they should be avoided:

- Do not leave the tubers in the full sun for more than the time required to dry (2 hours at most)
- Do not harvest tubers when the soil is waterlogged or during heavy rain
- Do not wash freshly harvested tubers
- Do not throw tubers from a distance but deposit them carefully in a box or in a basket.

Figure 10. Proper positioning while harvesting potatoes to reduce damages

Storage

Spread out harvested tubers in the field or the storage area to dry. Harvesting in the dry season enables you to leave the produce in the field for a long time. In the rainy season, it is best to spread out the produce in the storage area under lights.

Sorting should be done by separating damaged and undamaged tubers and classifying them according to weight. Gather and destroy any rotten tubers.

Packing must be done carefully to avoid bruising tubers. Produce can be sold while it is still in the field, particularly when prices are high and not too many potatoes are available. When the main harvest takes place; farmers must store harvested tubers in a storage area until prices improve. Be careful to avoid any damage when transporting produce from the field to the storage area. Aspects to pay attention to in the storage place are temperature, humidity and air circulation.

a) Storage temperature

If there is only a short period of time between harvesting and planting the next crop, tubers should be stored at high temperatures to accelerate sprouting. If they

are stored for a longer time, then lower temperatures (2°C - 5°C) are more advisable so they do not sprout too quickly.

b) Humidity:

Not too low as this will cause tuber shrinkage and weight loss. Overly humid conditions will increase the risk of disease, condensation and rotting. Tubers will become damp and sprout easily.

c) Air circulation:

Ventilation is necessary to ensure a clean and even flow of air and to regulate humidity. Air flow will be affected by storage practices and whether tubers are stored in piles, kept in sacks or on racks

There are different storage systems for different purposes e.g. seed multipliers or farmers with large quantities of seed to save will require a Diffused Light Store (DLS) while ware potato store for longer period will require a cold and dark storage facility.

Figure 11. Example of an ambient cold store for ware potato storage.

Records keeping

Potato farmers should always record their income and expenditure every planting season. At the end of the season, the two columns containing amounts of money (labor and production costs) are added up. When the produce has been harvested it should be recorded in production records and also all sales must be recorded in income records sheet.

Table 1 Example cost of production record sheet

	Date	Activity	Quantity	Unit cost	Total (Ksh)
1	15/09/16	Purchased seed	8 bags	2,500	20,000
2	20/09/16	Labor: Land preparation	8 men	400	3,200
3					
4					
5					
6					
				Total	

Table 2 Example of production and utilization record sheet

	Date	Variety	Quantity harvested	Retained for seed	Used for food/Donated
	20/12/16	Shangi	100 bags	10 bags	5 bags
	05/01/17	Unica	80 bags	15 bags	1 bag

Table 3 Example income record sheet

	Date	Buyer	Variety	Quantity	Unit price	Total (Ksh)
1	20/01/17	John	Shangi	20 bags	1,500	30,000
2	20/01/17	Baraton	Unica	10 bags	2,000	20,000

3						
4						
5						
6						
					Total	

The farm economic analysis can be done by calculating the profit.

Profit = Total income – total costs of production

- Total income – Total harvest sold (kg) x price (money value per kg).
- Total costs of production – By adding together the labor costs and production costs.


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