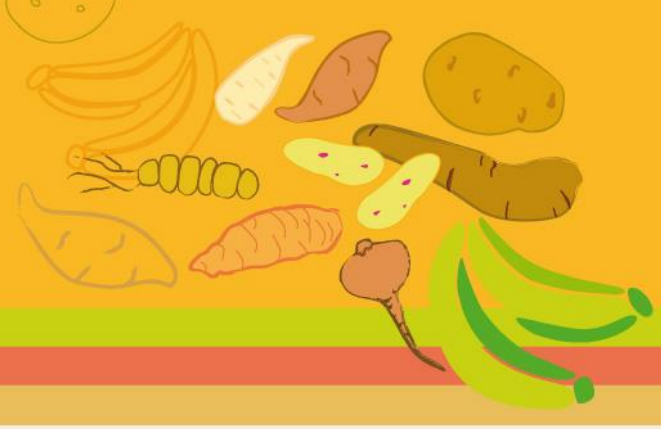
RESEARCH PROGRAM ON Roots, Tubers and Bananas

CGIAR



Training Report:

Capacity Building in Agronomic Practices, Waxing and Relative Humidity Storage Technologies for Shelf-life Extension of Fresh Cassava Roots

Extending the shelf-life of fresh cassava roots for increased incomes and postharvest loss reduction

Expanding Utilization of Roots, Tubers and Bananas and Reducing Their Postharvest Losses

RTB ENDURE

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European Commission

IFAD
Enabling poor rural people to overcome poverty

A broad alliance of research-for-development stakeholders & partners

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CIP Centro Internacional de la Papa

Bioversity International

CIAT Centro Internacional de Agricultura Tropical

cirad Agricultural Research for Development

IIRR

IITA Research to Nourish Africa

NARO

Kyambogo University knowledge and skills for service

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Expanding Utilization of Roots, Tubers and Bananas and Reducing Their Postharvest Losses (RTB-ENDURE) is a 3 year project (2014-2016) implemented by the CGIAR Research Program on Roots, Tubers and Bananas (RTB) with funding by the European Union and technical support of IFAD. http://www.rtb.cgiar.org/endure

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a broad alliance led by the International Potato Center (CIP) jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute for Tropical Agriculture (IITA), and CIRAD in collaboration with research and development partners. Our shared purpose is to tap the underutilized potential of root, tuber and banana crops for improving nutrition and food security, increasing incomes and fostering greater gender equity, especially among the world's poorest and most vulnerable populations.

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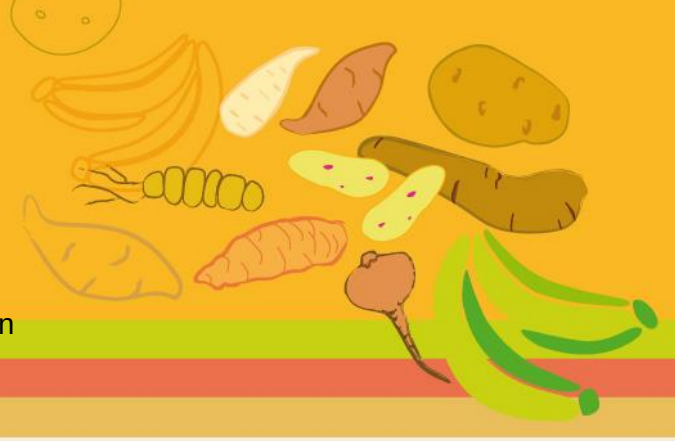


List of Acronyms

CIAT	International Centre for Tropical Agriculture
IIRR	International Institute of Rural Reconstruction
IITA	International Institute for Tropical Agriculture
LA	Latin America – South to South Collaboration
MT	Metric Tons
NARO	National Agricultural Research Organisation, Uganda
NaCRRI	National Crop Resources Research Institute, - Namulonge, Uganda
NARL	National Agricultural Research Laboratories – Kawanda, Uganda
PPD	Postharvest Physiological Deterioration

1. BACKGROUND

Cassava is an important source of food and income in Uganda. Consumption of cassava has been increasing especially in the urban areas. Total consumption of fresh cassava in 2013 was estimated to be 1.32 MT per annum (RTB-ENDURE - Cassava Sub-Project scoping study, 2014). Market demand for fresh cassava in 2013 was estimated to be 309,528 MT per annum and was projected to increase to 387,074 MT in 2018, signifying a 25% increase. New market segments for fresh cassava roots have been emerging for both the niche and mass markets. Fresh cassava was found to be consumed in various forms. According to findings from the RTB-ENDURE Market Study (2015) high-end restaurants had introduced cassava recipes while fried cassava chips were a delicacy in road-side food catering services, a new phenomenon. Further, the study revealed that the most preferred consumption form was in fried form (37% of the study respondents), followed by boiled (35% of the study respondents) and steamed in banana leaves (25% of the study respondents).

Cassava enjoys a unique position as a convenient food that is easy and fast to prepare. It is in recognition of this fact that cassava has been selected as one of the ten priority crops to assist Uganda transform its agricultural sector through provision of household incomes, employment and food security.

However, despite this growth in demand, both utilization of and income derived from marketing of fresh cassava are being hindered by the rapid postharvest physiological deterioration (PPD) of the roots. Cassava suffers spoilage within two to three days of harvest. The implication is that it cannot be marketed over a long time and distance thereby reducing incomes to growers and traders, leading to less investments and hence low productivity.

To address this challenge, the RTB-ENDURE Cassava Sub-Project also known as “Extending the Shelf life of Fresh Cassava Roots for Increased Incomes and Postharvest Loss Reduction” aimed at introducing, testing, validating and assessing the efficacy of two technologies for increasing the shelf-life of fresh cassava roots, and thereby assisting to increase the value to growers, traders and consumers along the entire value chain. These technologies included high relative humidity storage and waxing.

Both relative humidity storage and waxing of fresh cassava roots are in commercial use elsewhere. However, their applicability and feasibility in Uganda was unknown since these technologies were new. Therefore, the approach used in RTB-ENDURE Cassava Sub-project involved knowledge sharing between the Ugandan research team and its counterpart at CIAT in Colombia, one of the countries where these technologies are being commercially adopted. CIAT has substantial experience in conducting research on PPD of cassava and on how to tackle the issue of the rapid deterioration of the roots by use of suitable varieties, agronomic practices and pre-harvest techniques such as pruning. CIAT scientists and value chain actors in Colombia trained the Ugandan research team in various aspects of high relative humidity storage and waxing, including varietal selection, PPD scoring, and the agronomic and pre-harvest techniques that reduce PPD.

The project team conducted a scoping study and later a detailed market assessment, carried out on-station research on varietal selection (based on PPD susceptibility) and validation of the technologies for shelf-life extension, and established two pilot pack houses in western Uganda. These included one pack house in Kyenjojo district to test a farmer operated business model and another one that was established in Kabarole district to test a trader operated business model. Thereafter, the project built the capacities of both operators and their identified partners and potential suppliers to promote the adoption and adaptation of these shelf-life extension innovations.

This report describes the capacity building process and activities that were done to enable the value chain actors adopt and adapt the pre-and post-harvest practices, and waxing and high relative humidity storage technologies in order to run a successful business enterprise.

2. OBJECTIVE

This training activity aimed at sensitizing and imparting knowledge and skills to all the actors such as farmers, processors and traders involved in operating, supporting or doing business with the pack house managers in Kyenjojo and Kabarole districts. The actors also included extension and NGO staff responsible for and operating in Kyenjojo and Kabarole districts. .

3. METHODOLOGY

As the research team learnt during the training in Colombia (LA), shelf-life extension technologies are effective only if coupled with specific agronomic (e.g., pruning of plants and careful harvesting of the roots) and postharvest practices. Therefore a capacity building plan was developed to provide farmers in Kyenjojo and Kabarole and the trader in Kabarole with the required knowledge on agronomic practices that would enable efficient and effective application of waxing and high relative humidity treatments to fresh cassava roots. The plan also included building the capacities on how to carry out waxing and high relative humidity storage treatments.

The general approach involved the following steps:

1. Preparatory and planning meetings with farmer groups to discuss the purpose of the training
2. Identification and acquisition of land by the group to be used for the practical training
3. Identification of cassava farms with mature cassava owned by the group members
4. Getting buy-in from local government extension officials which would enable them participate and offer administrative support to the actors
5. Training of trainers which necessitated identification of future trainers for both the farmer and trader led models. These would be trained so that they can continue to train others.

Practically, capacity building involved the following:

1. Practical hands-on training in new methods of land preparation that involve ridge making in order to enhance productivity and the production of commercial roots that are suitable for waxing and high relative humidity storage
2. Practical hands-on training on cassava planting
3. Practical hands-on training on cassava pruning
4. Practical hands-on training and knowledge sharing on harvesting techniques that minimize PPD
5. Practical hands-on training in washing, disinfecting, drying, waxing, relative humidity storage and packaging of roots for marketing.

The methodology combined sensitization, exposure and field training sessions to provide an opportunity to the trainees to get hands-on experience. Trainees first attended theoretical sessions conducted in a classroom setting. This was followed with practical/physical demonstrations and exposure in the field. Later the trainees were provided with an opportunity to conduct these activities by themselves. Sensitization on the requirements for applying both high relative humidity storage and waxing technologies was done.

After the series of trainings, researchers monitored the activities of trainees, collect and analyzed information obtained from feedback and brainstorming sessions. These were useful in participatory identification of gaps and planning future training programs.

Successful waxing and high relative humidity storage require complementary agronomic practices. The trainings focused on production, harvesting, transportation of roots to the pack houses, handling and packaging of waxed/high relative humidity storage roots. The importance of harmonious group dynamics and strong collective action on the part of smallholders was highlighted.

The training sessions were developed based on the knowledge gained by the Ugandan researchers from the LA capacity building activity on the two shelf-life extension technologies.

For pack house operations, the approach targeted a few selected trainees in the case of the entrepreneur and group members for the farmer model. These trainees constituted the initial pack house labor force. Tables 1 and 2 show the calendar of the training sessions that were conducted, the participants and the content of the different sessions.

Table 1: Training session summary in Kyenjojo, farmer model

	Item	Training 1	Training 2	Training 3*
1	Dates of training	6th and 7th October 2015	9th March 2016	25th November 2016
2	Total number of trainees (M/F)	36 (18M/18F)	40 (18M/22F)	53 (21M/32F)
3	Number of farmers (M/F)	33 (16M/17F)	39 (18M/21F)	52 (21M/31F)
4	Number of extension agents and government officials (M/F)	3 (1M/2F)	1 Female	1 Female
5	Training modules	1. Land preparation (ridging) 2. Planting 3. Pruning 4. Harvesting	1. Disease management 2. Planting 3. Pruning	1. Harvesting 2. Sorting and grading 3. Waxing 4. High relative humidity storage 5. Packaging

Table 2: Training session summary in Kabarole, trader model

	Item	Training 1	Training 2	Training 3
1	Dates of training	23rd March 2016	10th March 2016	25th May 2016
2	Total number of trainees (M/F)	60 (25M/35F)	70 (33M/37F)	65 (28M/32F)
3	Number of farmers (M/F)	50 (20M30F)	66 (29M/37F)	60 (25M/35F)
4	Number of extension agents, traders and government officials (M/F)	10 (6M/4F)	4 (2M/2F)	5 (3M/2F)
5	Training modules	1. Pruning 2. Harvesting 3. Sorting and grading 4. Waxing 5. Packaging	1. Disease management 2. Planting 3. Pruning	1. Pruning 2. Harvesting 3. Sorting and grading 4. Waxing 5. Packaging

NB: * Training was for both farmer and trader models.

4. TRAINING MODULES

4.1 GROUP DYNAMICS AND COLLECTIVE ACTION

This session covered issues of group dynamics and collective action. Participants were introduced to the importance of strong cooperative structures for collective action that are specific to such enterprises. The training covered aspects of rule setting, enforcement mechanisms, sanctioning systems, incentives provision, governance, financial regulations and conflict resolutions. These

rules, regulations and incentives were aimed at assisting the emergence of strong cooperative structures around the following:

1) Planning cassava production schedule to ensure consistent supply of commercial roots to the pack house
2) Collective transfer of cassava production knowledge and methods to the members.
3) Financing: fund mobilization to support production and investment plans
4) Approaches to taking-in new members based on the objectives of the enterprise
5) Gender equity in the distribution of both activities and benefits of production, roots handling and processing at the pack house
6) Scaling-out of the novel technologies by the group to the community at large (farmer-to-farmer knowledge transfer)
7) Group leadership and how members can contribute to the common good of owning and operating a successful business venture.

Capacity and needs assessment of the group took place throughout the project life-span. This assessment was participatory. While Rwibaale Farmers Cooperative (operators of the Kyenjojo pack house) had some level of collective action for production (there was a collective garden and storage facility) this was strengthened to respond to the lack of a concrete plan to expand its production capacity and in the light of the new roles and responsibilities arising from the need to successfully manage the pack house and market the roots with extended shelf-life.

Sensitization was done on the importance of self-reliance, business ethics and cost/benefit sharing mechanisms as the best approach to enhance business growth and sustainability. Right from the start, the group was challenged to take initiative and play a leading role in discussing with service providers rather than leaving this to the research team to carry out. A plan to carry out this was proposed, implemented and evaluated over time. Resources that needed to be collectively procured included land for locating the facility and also accessing and equip a water supply point.

Key points of this methodology involved setting up an *ad hoc* committee to lead the negotiations with local government and other service providers. The aim was to facilitate both sense of ownership and also enable business partners acknowledge the fact that they were dealing with a local farmer group rather than a project. This aspect also had the advantage of having realistic costs from service providers.

4.2 LAND PREPARATION (RIDGE MAKING)

Land preparation, including soil preparation and ridge making, is an important aspect in growing fresh cassava roots for waxing and high relative humidity storage. Apart from enhancing the yield of fresh cassava, ridge planting increases the likelihood that the roots will present the characteristic required for the the shelf-life extension treatments, i.e., roots that are medium sized, straight and not too long.

Figure 1: A trainer demonstrates measurement of ridge making

Cassava was usually grown on flat bed and the practice of growing it on ridges was new in the target locations. A practical session on land preparation involving ridge-making was conducted. The distance between ridges was 1.8m. Ridges should be between 40 and 50 cm high. Planting in ridges facilitates harvesting. The roots are easily pulled out of the soil. Ridges have a higher water retention capacity. Current harvesting practices largely contribute to the injuries that the roots are subjected to. Cassava is harvested using a hoe and usually the roots are damaged in the process. Injuries to roots accelerates the on-set of PPD. This problem is more severe during the dry season when the ground is hard. Ridges also increase the topsoil volume per plant and hence lead to a better establishment of the roots.

The gender sensitive training on ridge-making built upon current practices in cassava growing, where both women and men traditionally play a key role in land preparation for cassava growing. Therefore a deliberate effort was made to train women and involve them in the practice of land preparation and ridge making.

Figure 1: Trainees get hands-on experience in ridge measurement

Figure 2 above shows farmers having hands-on experience as they try out what was taught while figure 3 below shows both women and men opening up land. Training was conducted on the group garden where both women and men participated in land opening,and soil preparation. Land was cleared of all grass, brush and trees. The soil was throughly ploughed, which assists growth of “commercial tubers”. Trainees were shown how to carry out these practices and were requested to replicate them in the group garden

Figure 2: Women and men preparing for ridge during the training session

Figure 4 shows both women and men trying out the practise of making ridges on the group garden. This followed the initial training in ridge making and required measurement. The group was tasked with continuing with ridge-making to cover their entire plot. Thereafter each member was tasked with transferring the same technology to their fellows that could not attend.

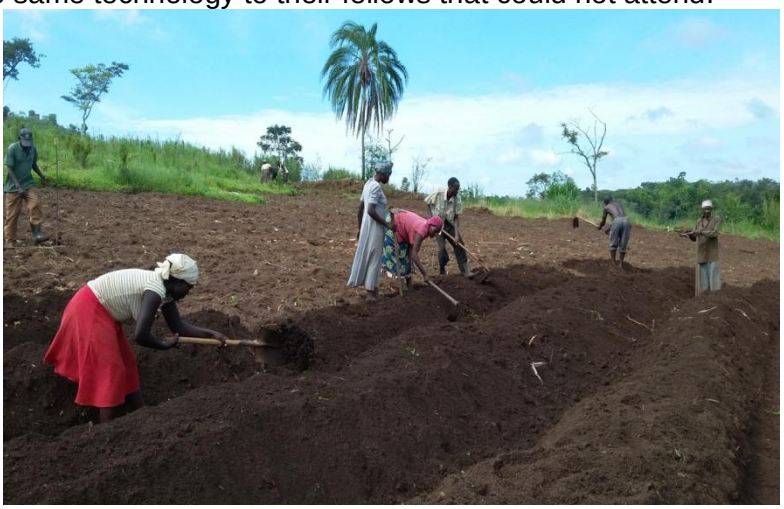


Figure 4: Farmers practising ridge-making

Individual farmers continued to make ridges on their individual plots. Figure 5 below shows one of these farmers who had opened up one acre with ridges.

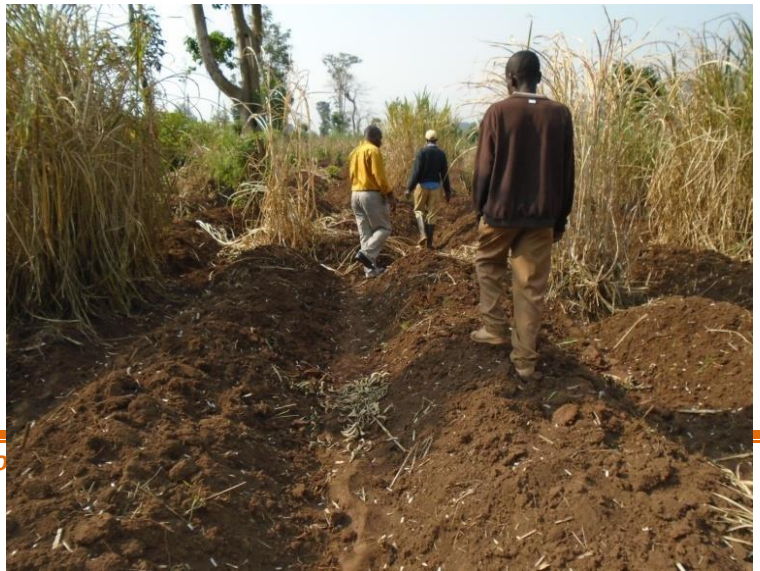


Figure 5: Assessing outcome of capacity building in ridge-making

4.3 PLANTING

The shelf-life extension technologies work best when the roots are healthy. For roots to be healthy, growers need to plant healthy and vigorous stakes derived from healthy plant stems. The planting stage is therefore crucial since cassava is propagated using stem cuttings. Trainees were sensitized and trained in best practices in stem handling for increased yield. Trainees' capacities to identify clean planting materials were strengthened. The following issues were covered at this regard:

1) Planting material should be cut from healthy and mature plants 10 – 12 month old

2) Stems should be handled with care to avoid destroying the nodes.

3) Stems should be cut with sharp tools into 25 cm cuttings and should have 5 to 7 nodes

4) Stems should be cut from disease free materials or healthy plants.

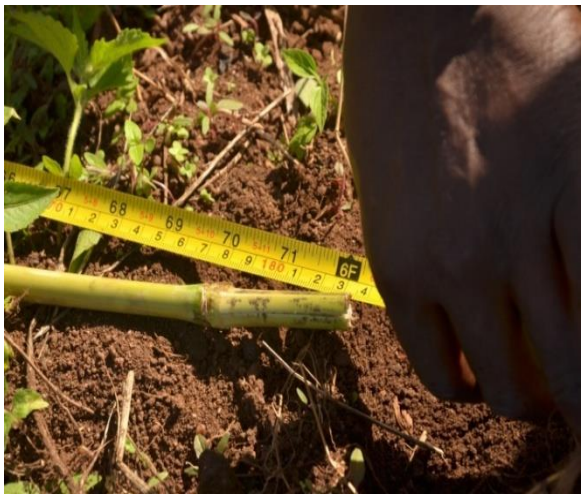


Figure 6: Identifying healthy planting material

The training on planting of cassava cuttings involved measurement of spacing between plants. It also involved a discussion on all the current planting techniques that farmers employed. These include horizontal, inclined and vertical planting. Horizontal planting was recommended and farmers were trained accordingly. This technique maximizes root growth and promotes the production of roots of a size suitable for the shelf-life extension treatments. This training was imparted to both men and women who were thereafter tasked to implement what they had learned. They later provided a feedback to the entire group.

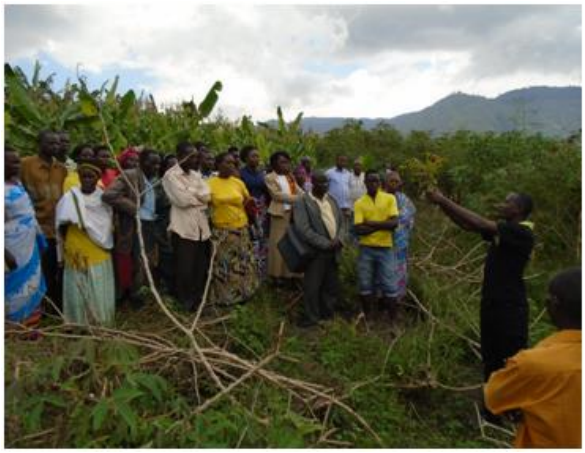
Figure 7: Cassava planting material

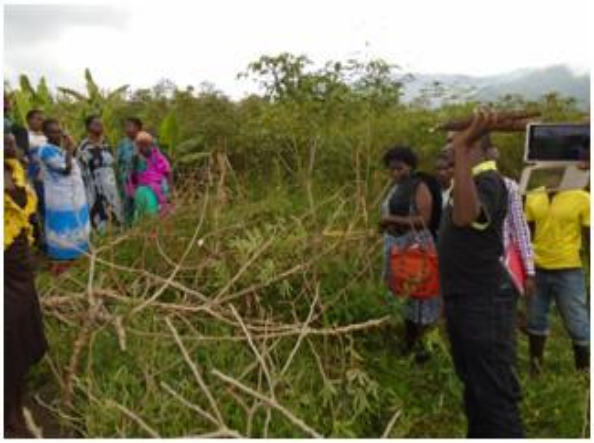
Figure 8: Measuring plant spacing

Planting was done by hand. Spacing between plants was measured to be 60cm. Several sticks measuring 60cm were cut. This was achieved by using a tape measure. These sticks were later used by farmers to mark the spacing between plants along the same ridge. Placing of the cuttings in the ground (Figs. 9 & 10) was done in such a manner that the side with the largest number of nodes should face upwards. This is done to maximize yield. Furthermore, this planting technique promotes the sprouting in the same direction in the entire field and hence assists in minimizing mechanical damages during harvesting since the location of the roots in the ground is more predictable.

Figure 9: Rwibaale farmer group planting cassava

Figure 10: Trainee planting cassava on ridges



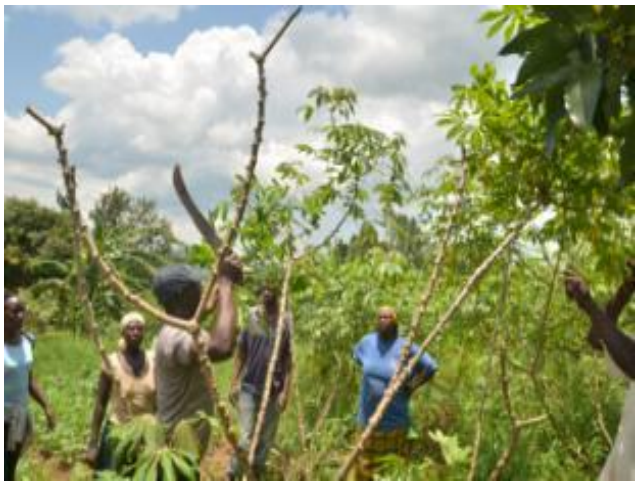


Figures 11: Identifying diseased materials *Figure12: Differentiating cassava diseases*

Participants were trained in ways of identifying healthy planting materials and cassava roots. The idea was to assist them in locating plots where they could obtain clean planting materials (Figs. 11 & 12).

4.4 PRUNING

Pruning, also known as de-topping, involved cutting off the top most braches having green leaves. These are usually lateral branches. The cut-off point is a few inches (2 to 3) from where the green leaves are attached to the lateral branch. Pruning is done on plants that are between 8 and 12 months old and it is carried out 7 days before harvest. On the seventh day the pruned plants are harvested.



Pruning was found not only to delay the onset of PPD but also improve the eating quality. Pruning technique is not practiced in Uganda. Participants were therefore sensitized about the importance of pruning. The trainees from both Kyenjojo and Kabarole districts were introduced to this technique and were given hands-on training in how to carry out pruning. Practical sessions were conducted on pruning and its intended benefits. Fresh roots from pruned plants were compared with those from unpruned plants and participants examined PPD progression and also the eating quality. Figure 13 and 14 show trainers imparting knowledge on pruning in Kyenjojo and Kabarole respectively. Figure 15 shows a pruned garden in Kabarole.

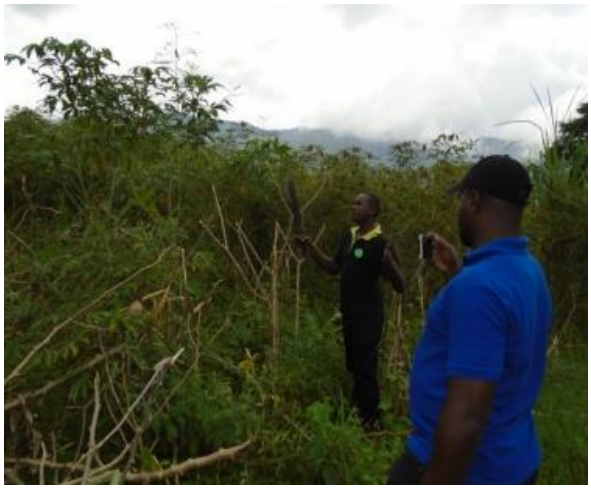


Figure 13 and 14: Trainers show pruning technique

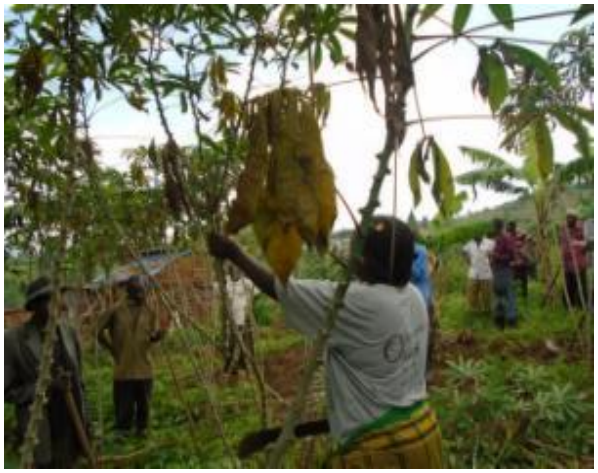


Figure 35: A female farmer practicing pruning

Figure16: A pruned field

4.5 HARVESTING

Current harvesting practices were found to contribute largely to the early onset of PPD in cassava due to injuries inflicted on the roots during harvesting. Farmers traditionally dig up the cassava roots by using a hoe and not paying attention to minimizing injuries. In addition, the traditional way of cutting off the peduncle of the root exposes the flesh and, therefore, contributes to accelerate the PPD.

Practical sessions on harvesting were conducted to show farmers best practices that minimize injury to roots. The sessions emphasized the importance of limiting injuries to roots. The trainees were introduced to careful methods of harvesting. For this to occur there was a need to avoid uprooting using a hoe since it is difficult to know where the roots are. The alternative was to carefully remove the upper soils, and later use hands to locate the roots (Figure 17 and 18).

The roots would then have to be pulled out by hand and usually by two people. Figure 18 shows a woman using her hands to locate the roots and get them out without causing any injury. This is extremely difficult where cassava is not planted in ridges.

Figure 17: A female farmer removing the top soil during harvesting

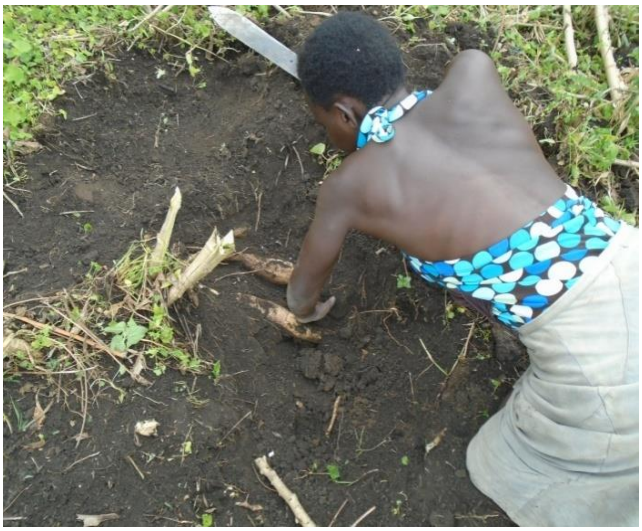


Figure 18: A trainee using hands to locate roots

Novel ways of harvesting roots were demonstrated and explained to the trainees. Each of the practice was assessed and its value shown in terms of assisting effective application of waxing and relative humidity technology in extending the shelf-life of cassava.

Harvesting is the most challenging activity. This is the stage where injury is most likely to occur. Once this happens, the root is not suitable for shelf-life extension treatments despite good shape or size. Trainees were instructed to avoid using a hoe but use hands to locate the roots. Therefore after the first stage of removing the top grass, the next stage involved using hands to locate the roots. In addition the plants are cut short to make it easier for the farmer to pull the roots out of the soil. This process would normally take about six minutes per plant. However, where the ground is soft especially during the rainy season, the process takes less time – about two minutes per plant.

As indicated earlier on, minimizing use of a hoe implies that a lot of energy has to be used to get the cassava roots out. Figure 19 below shows male farmers pulling out the roots. The act involves cutting the stems so that they are short; slightly shaking the plant as pulling-out is done. If the plant is still firmly stuck in the ground, more of the top soil is gently removed and the act is repeated until the roots are harvested. Harvesting could sometimes be difficult (Figure 20). However, when cassava is planted in ridges harvesting is easier, quicker and injuries are minimized. Participants were able to experience this.

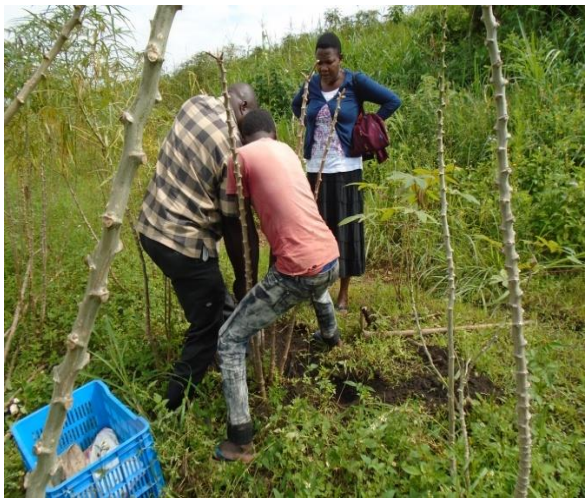


Figure 19: Men pulling out roots from the soil

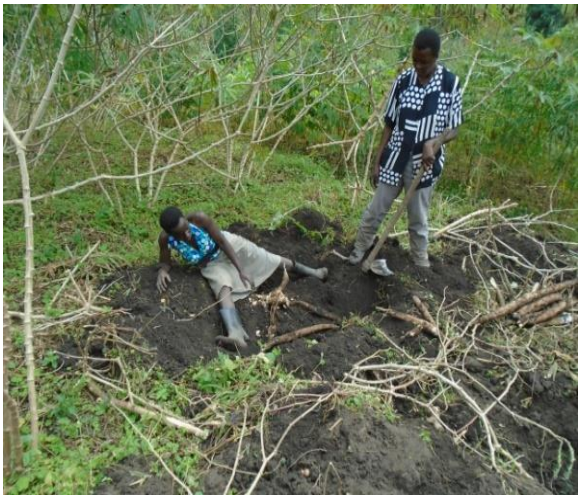


Figure 20: A woman farmer falls trying to harvest roots

Once the plant is pulled out of the ground, the roots are carefully cut off in such a way that they retain the peduncle (Figures 22 and 23). The cutting point should be nearest to the stem so that the roots have a longer peduncle to enhance preservation. Machetes or secateurs are recommended for cutting off the roots from the stem, leaving a small piece of peduncle on the roots so that the parenchyma is not exposed to the air.

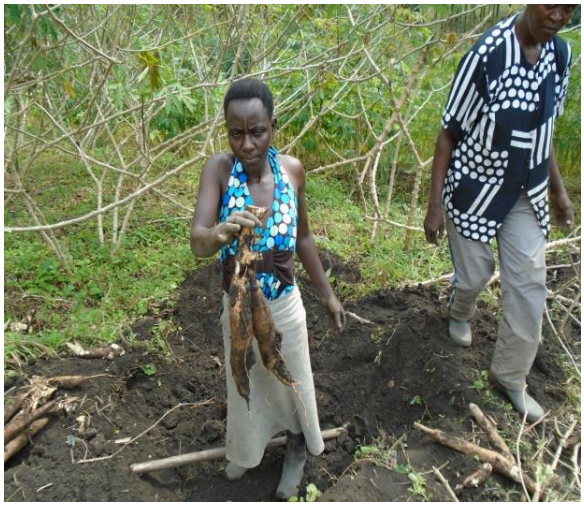


Figure 21: Well harvested roots

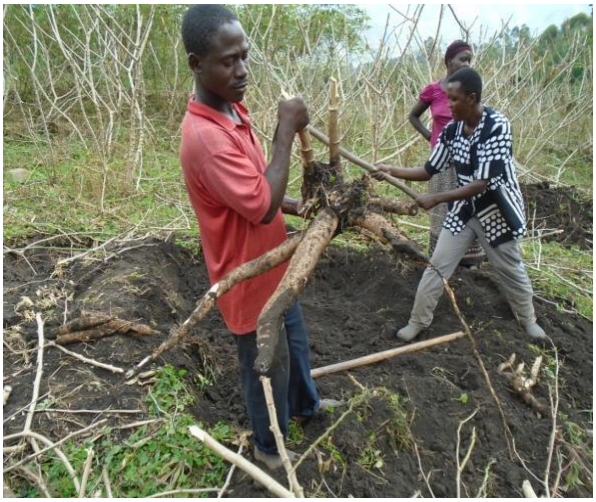


Figure 22: Pulled out roots still attached to the stem

Harvested cassava roots are placed in crates for transportation from the farm and loaded onto a truck,or on motorbikes for onward transportation to the pack house. Damaged and unwanted, oversized or undersized roots are separated to be used for other purposes. Roots of identical sizes or grades were put in the same crates.

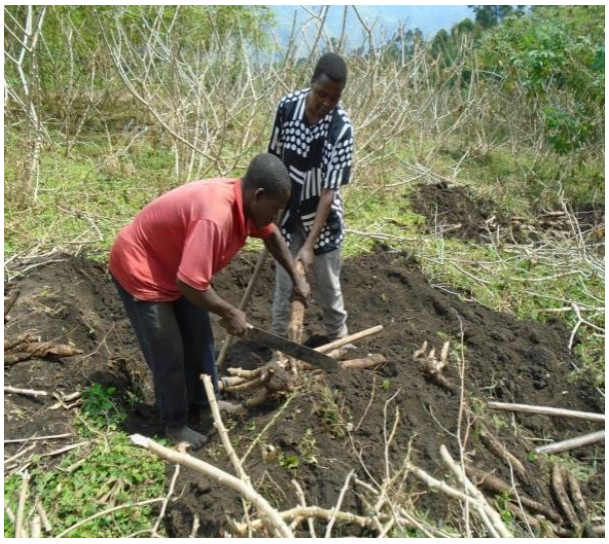


Figure 23: A trainee cutting off roots from the stem

Figure 24: A trainee packing roots in a crate

Participants were instructed not to over-fill the crates (Figure 24). A gender perspective was included in the training. Crates were packed to weigh between 15 to 20 kg, with 15 kg being the most suitable weight that could easily be carried by women as well. The number of roots in the crate was determined by their size, and shape. One challenge was related to roots that were longer and therefore could not fit in the crate. In such a case these are placed on the crates so that they do not get damaged/broken.

4.6 TRANSPORTATION

Crates were carried on the head by both women and men during transportation from the farms to the nearest location where they could be loaded onto a motorbike or pick-up truck. They then would be transported to the pack house for treatment. Avoiding crates resting on the roots was recommended to avoid damages. This was done by ensuring gaps between the crates. Roots were transported gently to the processing center (Figure 25 and 26).

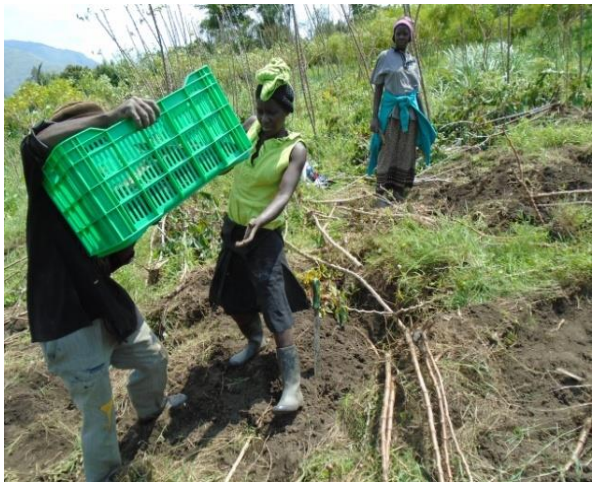


Figure 25: A male helps a woman carry a crate

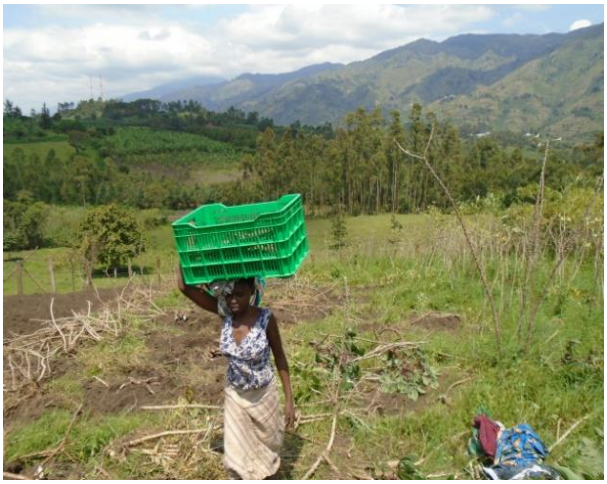


Figure 26: A female transporting crate from the field

4.7 SORTING AND GRADING

At the pac khouse, roots were again sorted and graded. Sorting is done to remove broken, or damaged roots. Grading is done to differentiate roots according to size i.e., big, medium and small. Sorting is often the first activity once the roots arrive at the pack house.

Trainees were taught to reduce the peduncle. Roots should have a peduncle that is not too short and not too long

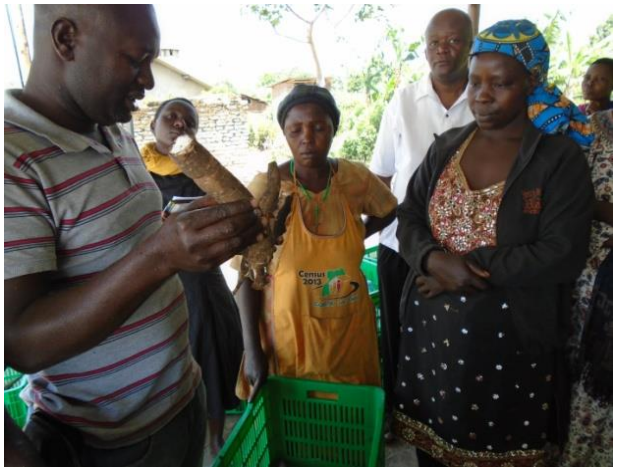


Figure 27: A trainer shortening the peduncle

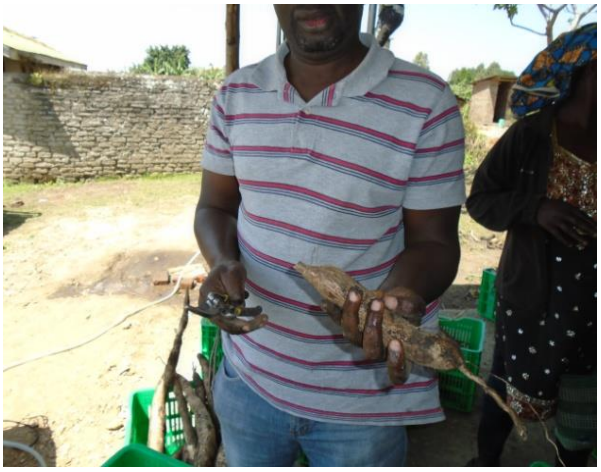


Figure 28: A trainer shows roots unsuitable for waxing

4.8 WASHING

Trainees were shown how to wash cassava roots. They were trained in how to mix the solution which contains water, a surfactant and a fungicide. Using a brush with soft plastic bristles, roots were gently scrubbed in a trough of cold water, to remove any soil and foreign matter that might be attached to them. Roots were rinsed in fresh clean water in another trough, while inspecting the roots for bruises and other damages. During this process, care was taken not to bruise the roots.

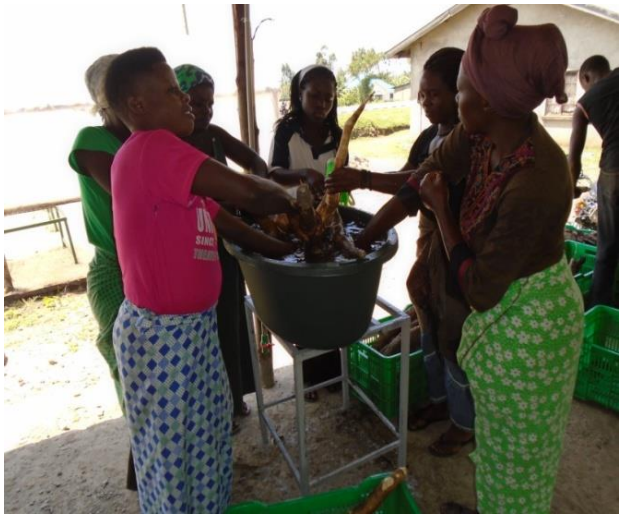


Figure 29: A trainer washing roots

Figure 30: Hands-on experience in washing roots

4.9 AIR-DRYING

Air-drying training involved demonstrating how roots are placed on a special drying area at the pack house, and the process of cross-checking to make sure they are ready for waxing or high relative humidity storage. For high relative humidty, roots were dried for 20 minutes. In the case of waxing, roots needed to be completely dry. Participants were taught how to examine fully dried roots. Fully air-dried roots would be warm without any feeling of coldness or humidity if touched.

Figure 31: Trainees at a drying session

Figure 32: Women trained in root drying

4.10 WAXING AND RELATIVE HUMIDITY STORAGE

After the drying process, the fresh roots are now ready for either of the two treatments, i.e. waxing and high relative humidity storage. In case of relative humidity storage (Figure 33), participants were trained in ways of carrying out the following actions:

1) Weighing the roots in packs of about 3 kgs

2) Packing the weighed roots into polythene bags and seal

3) Labelling the bags (name of variety, weight, date of processing, name & address of processor, safety and nutritional information, best before date, storage conditions, how to prepare for cooking/home use).

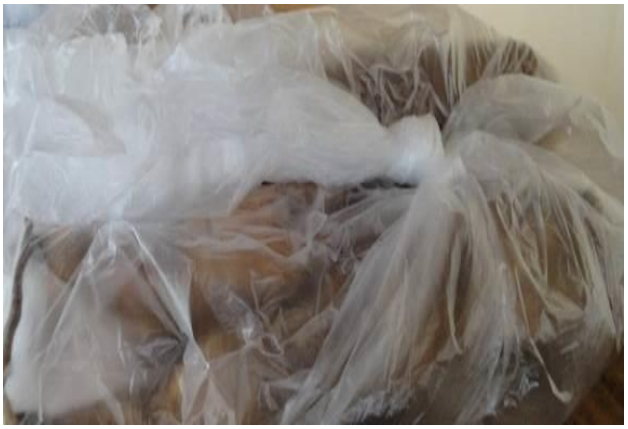


Figure 33: High relative humidity stored roots

On the other hand, the waxing training involved taking the trainees through the following activities:

1. Heating the food grade wax in a rectangular stainless steel tank (600mm x 400mm x 450mm deep) using gas or electric heater to a temperature between 140°C - 160°C

2. Using a thermometer to ensure that the temperature of the molten wax is maintained between 140^{o}C and 160^{o}C during the process

3. Assembling the dried roots into fabricated metallic baskets

4. Completely submerging the metallic baskets containing the roots into the molten wax for 1-2 seconds

5. Innovations in waxing longer and bigger roots that do not fit in the basket.

Figure 34: Trainees at a waxing session

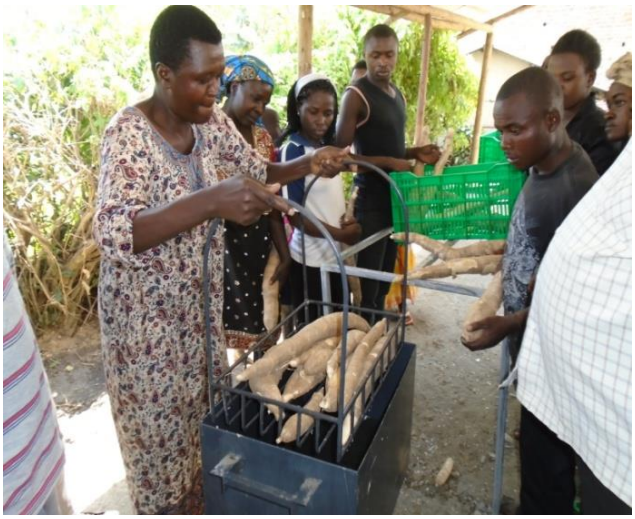


Figure 35: Woman waxing cassava roots

4.11 PACKAGING

The trainees were trained on the process of packaging waxed roots, which involved the following:

1) Packing the waxed roots into crates

2) Weighing the roots (each crate should ideally weigh about 20 kgs)

3) Labelling the crate/package with the name of variety, weight, date of processing, name & address of processor, safety and nutritional information, best before date, storage conditions, how to prepare for cooking/home use)

5 EVALUATION

At the end of each training session, a training evaluation was carried out to get feedback from the trainees on their experiences. The evaluations covered course content, subject matter relevance, and practicability of imparted knowledge and practices.

Participants appreciated and welcomed the new knowledge on agronomic and harvesting techniques that were imparted to them. All the participants strongly agreed that the course content was suitable and relevant to their training needs. The training approach was very practical with participants having hands-on experience. Similarly all the trainees strongly agreed that the practical nature of the training was very useful and that they would continue to practice what they had learned and provide the project implementation team with regular feedback regarding uptake of these technologies within their communities.

ANNEXES

ANNEX 1: CONSOLIDATED LIST OF PARTICIPANTS TO THE TRAINING SESSIONS

No	Participant	Institution/Designation	District
1.	Nuru Kisembo	Farmer	Kyenjojo
2.	Evas Mwesigye	Farmer	Kyenjojo
3.	James Tibalyebwa	Farmer	Kyenjojo
4.	Ntaganda Agustine	Farmer	Kyenjojo
5.	George Byarugaba	Farmer	Kyenjojo
6.	Sylvano Baguma	Farmer	Kyenjojo
7.	Naziwa Ziyada	Farmer	Kyenjojo
8.	Kiiza Violet	Farmer	Kyenjojo
9.	Nyindo Monday	Farmer	Kyenjojo
10.	Joseph Musinguzi	Farmer	Kyenjojo
11.	Jane Kyalimpa	Farmer	Kyenjojo
12.	Teopista Mbabazi	Farmer	Kyenjojo
13	Hasifa Mugabirwe	Farmer	Kyenjojo
14.	Happy Kisembo	Farmer	Kyenjojo
15.	Julie Nyakaisiki	Farmer	Kyenjojo
16.	Banura Violet	Farmer	Kyenjojo
17.	Tumuhairwe Justine	Farmer	Kyenjojo
18	Namara Scovia	Farmer	Kyenjojo
19.	Kyampaire Provia	Farmer	Kyenjojo
20.	Asiimwe Medias	Farmer	Kyenjojo
21.	Katusabe Kevina	Farmer	Kyenjojo
22.	Mutegeki Lillian	Farmer	Kyenjojo
23.	Turimurugyendo Rose	Farmer	Kyenjojo
24.	Kugonza Fred	NGO	Kyenjojo
25.	Kebirungi Christine	Farmer	Kyenjojo
26.	Tweheyo Regi	Farmer	Kyenjojo
27.	Arinaitwe Alexander	Farmer	Kyenjojo
28.	Kyalimpa Julius	Farmer	Kyenjojo
29.	Muhanguzi Amos	Rural Trader/Assembler	Kyenjojo
30.	Musinguzi Joseph	Farmer	Kyenjojo
31.	Wampungu Gilvensi	Farmer	Kyenjojo
32.	Hakiza John	Farmer	Kyenjojo
33.	Byarugaba Sam	Farmer	Kyenjojo
34.	Tusiime Medius	Farmer	Kyenjojo
35.	Kanyunyuzi Peter	Farmer	Kyenjojo
36.	Twinomujuni Allen	Farmer	Kyenjojo
37.	Matovu Moses	NaRL, Trainer	Kampala
38.	Wanda Kelly	IITA, Trainer	Kampala
39.	Aceng Sharon	MUK, Trainer	Kampala
40.	Waigumba Simon Peter	IIRR. Trainer	Kampala
41.	Nuwamanya Ephraim	NaCRRI, Trainer	Kampala
42.	Katusabe Maureen	Farmer	Kabarole

43.	Abigaba Mary	Farmer	Kabarole
44.	Kabagambe Florence	Farmer	Kabarole
45.	Tumusiime Grace	Farmer	Kabarole
46.	Karungi Evelyne	Farmer	Kabarole
47	Kabatambuze Reste	Farmer	Kabarole
48	Rwakaikara Imelda	Farmer	Kabarole
49	Tumuhirwe Darfine	Trader	Kabarole
50.	Kajumba Beatrice	Farmer	Kabarole
51.	Mullangi Rose	Farmer	Kabarole
52.	Kayezu Margret	Farmer	Kabarole
53.	Kemigisa Enid	Farmer	Kabarole
54.	Mbabazi Goretti	Farmer	Kabarole
55.	Komuhendo Annet	Farmer	Kabarole
56.	Kusemererwa Margret	Farmer	Kabarole
57.	Tubananuka Grace	Farmer	Kabarole
58.	Kaboyega Monica	Farmer	Kabarole
59.	Tuhirirwe Irene	Farmer	Kabarole
60.	Kanyunyuzi Darfine	Farmer	Kabarole
61	Kabasomi	Farmer	Kabarole
63.	Komugisa Grace	Farmer	Kabarole
64.	Katuramu Mary	Farmer	Kabarole
65.	Mbabazi Bitu	Farmer	Kabarole
66.	Kansiime Grace	Farmer	Kabarole
67.	Kadoma Mustafa	Farmer	Kabarole
68.	Nzanzu Moses	Farmer	Kabarole
69.	Atalimukuru Daniel	Farmer	Kabarole
70.	Tugume Vincent	Farmer	Kabarole
71.	Katuramu George	Farmer	Kabarole
72.	Muhangi Victor	Farmer	Kabarole
73.	Ngabonanzi George	Farmer	Kabarole
74.	Happy Patson	Farmer	Kabarole
75.	Alitehe Kenneth	Farmer	Kabarole
76.	Mugisa Wilson	Farmer	Kabarole
77.	Musinguzi Joseph	Farmer	Kabarole
78.	Musiima Taddeo	Farmer	Kabarole
79.	Kairumba Stephen	Farmer	Kabarole
80.	Kiiza James	Farmer	Kabarole
81.	Kyalimpa Deo	Farmer	Kabarole
82.	Kyaligonza Augustine	Farmer	Kabarole
83.	Balinda John	Entreprenuer/pack house owner	Kabarole
84.	Karugaba Sam	Trader	Kabarole
85.	Peninah Bahiizi	DAO/ Extension	Kabarole
86.	John Bosco	Extension/Kichwamba Sub-county	Kabarole
87.	Doreen	Chief/Kichwamba Sub-county	Kabarole
88.	Aliganyira John	Worker/ pack house	Kabarole
89.	Robert	Worker/pack house	Kabarole

90.	Irene Kobusinge	Trader	Kabarole
91.	Bayende Micheal	Farmer	Kyenjojo
92.	Nsengimana Deo	Farmer	Kyenjojo
93.	Tusiime Patrick	Farmer	Kyenjojo
94.	John Bizimungu	Farmer	Kyenjojo
95.	Magezi John	Farmer	Kyenjojo
96.	Mapengi Patrict	Farmer	Kyenjojo
97.	Muhumuza Sam	Farmer	Kyenjojo
98.	Kyomuhangi Teopista	Farmer	Kyenjojo
99.	Nuwamanya Dunavenco	Farmer	Kyenjojo
100.	Kyomukama Jennifer	Farmer	Kyenjojo
101.	Twebaze Ruth	Farmer	Kyenjojo
102.	Orishaba Edson	Farmer	Kyenjojo
103.	Kobusingye Margret	Farmer	Kyenjojo
104.	Kyogabigwe Glades	Farmer	Kyenjojo
105.	Nasasira Glorius	Farmer	Kyenjojo
106.	Komuhangi Rodina	Farmer	Kyenjojo
107.	Babufunga Claire	Farmer	Kyenjojo
108.	Hakizamana Emmanuel	Farmer	Kyenjojo
109.	Murungi Isaac	Farmer	Kabarole
110.	Muhumuza Lawrence	Farmer	Kabarole
111.	Alituha Emmanuel	Farmer	Kabarole
112.	Arinaitwe Samuel	Farmer	Kabarole
113.	Kabagambe Yusuf	Farmer	Kabarole
114.	Mwesige Ronald	Farmer	Kabarole
115.	Good Richard	Farmer	Kabarole
116.	Rugumayo Clovice	Farmer	Kabarole
117.	Kabatambuze Reste	Farmer	Kabarole
118.	Kwesigwa Peter	Farmer	Kyenjojo
119.	Mugabirwe Hasifa	Farmer	Kyenjojo
120.	Mbabazi Goretti	Farmer	Kyenjojo
121.	Kamasaza Imelda	Farmer	Kyenjojo
122.	Kemigisa Enid	Farmer	Kyenjojo
123.	Rwegira Dennis	Farmer	Kyenjojo
124.	Komuhendo Annet	Farmer	Kyenjojo
125.	Kansiime Agnes	Farmer	Kyenjojo
126.	Tibananuka Beatrice	Farmer	Kyenjojo
127.	TumusimeGrace	Farmer	Kyenjojo
128.	Muhangi Rose	Farmer	Kyenjojo
129.	Tumusime Mary	Farmer	Kyenjojo
130.	Ntaganda Augustine	Farmer	Kyenjojo
131.	Asaba Paul	Trader	Kabarole
132.	Mwesigwa Charles	Trader	Kabarole
133,	Bamanya Chris	Trader	Kabarole
134.	Mbabazi Eunice	Trader	Kabarole
135.	Komujuni Judith	Trader	Kabarole

136.	Kobusinge Jane	Trader	Kabarole
137.	Kiiza Mary	Trader	Kabarole
138.	Tugume Adolf	Trader	Kabarole
139.	Karungi Mary	Trader	Kabarole
140.	Veronica Kabanyoro	Extension	Kabarole
141.	Byaruhanga Charles	Trader	Kabarole
142	Ezra	Pack house worker	Kabarole
143	Kunihira Hope	Pack house worker	Kabarole
144.	Roselyne	Pack house worker	Kabarole