Proceedings of the seed potato project planning workshop held at AIRC KARI NARL, Nairobi, April 02, 2012

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Acknowledgement

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1. EXECUTIVE SUMMARY

The potato project is financially supported by National Council for Science and Technology (NCST). This workshop was intended to share the project findings from the first year activities, with stakeholders, and map out activities for the second year. The meeting had been called to present findings of the study from, the first phase studies and then agree on the activities for year 2. The programme was organized in form of presentations, which were accompanied by discussions emanating from the presentations. The workshop was attended by participants from potato industry (researchers, farmers, extension service providers, farmer association and potato council).
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2. WORKSHOP OBJECTIVES AND EXPECTED OUTPUTS

Prof. John H. Nderitu

2.1. Objectives of the workshop
The objectives of the workshop were outlined and discussed by the stakeholders. These included:

1. To provide feedback to stakeholders on project achievements
2. To share research findings
3. To highlight dissemination activities
4. To establish linkages on ongoing activities related to the seed potato subsector
5. Establish a roadmap to seed potato research and development

2.2. Outputs of the workshop
1. Work plan for year 2 developed
2. Collaboration in the project enhanced
3. Information sharing enhanced
3. PRESENTATION BY POTATO FARMER ASSOCIATION

Mr. Njogu, Chairman; Kenya National Potato Farmers Association (KENAPOFA)

- Association of farmers formed since 2003
- Farmers in this meeting were not aware of the association probably because of low publicity by the association due to less funds
- The association has grown through support by KARI, MOA, GTZ, BAF and others
  - They have held workshops where potato has been declared the second most important food crop in Kenya and fourth in the world after maize, rice and wheat
- One of the successes of the association is the legal notice of May 2005
- Main challenge on seed potatoes have been handled by several stakeholders
  - Government has done a lot
  - Stakeholders also done a lot
  - Now we have almost 10% of the seed through formal channels compared with less than 1% nationally
- Leaders elected from main potato growing areas
  - March 2006 the team was formally accepted by the MOA
- The Association has been fighting to phase out trading in extended bags using a legal notice of 2008
- The association has been partnering with researchers to enhance efficiency of potato value chain
- The association is grateful to NCST for funding this project
- The association is pleased by support from NPCK who even are giving the association an office
4. PRESENTATION FROM MINISTRY OF AGRICULTURE

DAO, Nyandarua Central District

- The ministry has worked together with KARI and farmers on storage facilities in the past year within this project activities
  - Farmers had benefited from Njaa Marufuku funding (KES 120,000 from MOA)
- Potato is the main crop in Nyandarua, and ranks first in horticulture and food crop
  - Supports many people in the chains
- Challenges
  - Lack or shortage of seeds: Bacterial Wilt disease and prolonged dry spells
  - Farmers consume what they have including the seeds
- The project is timely and will help farmers to seed secure
  - Will raise farmer income
  - Enhance economic stability of the county
5. EXPERIENCE FROM A SMALLHOLDER CERTIFIED SEED PRODUCER

Mr. Maingi

- The enterprise is located at Timau, Meru County
- Specialized on seed potato production, and, cow zero grazing
- Seed potato production
  - 10 ha farm
  - Started 2007
  - Production with KARI tigoni license.
- Challenges
  - Require sizeable land for rotation - minimum 3 year cycle
  - Packaging expenses
  - Costing: cost benefit assessment
    - Economics of scale
6. THE POTATO SUBSECTOR OVERVIEW

Wachira Kaguongo, CEO - National Potato Council of Kenya (NPCK)

6.1. Growth and development strategy for Kenya
- According to NEPAD, ASDS (2010-2020) and Vision 2030 the Growth and development of Kenyan economy will be achieved mainly through
- Identifying the sub-sectors that have the greatest potential to drive growth and reduce poverty
- Exploiting potential of commodities that have a large production base and a large and growing demand in the region

6.2. How important is potato in Kenya?
- Potato ranks as 2nd most imp. food crop after maize
- both a staple food and a cash crop
- It is grown by about 800,000 farmers under 158,000 ha
- Total output is about 1.1m tons per year
- Annual potato production is worth Kshs 46billion at consumer prices
- It is grown in highlands of central, eastern & rift valley provinces, mainly in:
  - Kiambu, Nyeri, Meru, Nyandarua, Nakuru, Bomet, Narok, Bungoma, Taita-Taveta and Elgeyo-Markwet counties
- there is increasing demand to supply growing cities with cheap and convenient food-
- Convenient potato products-chips, crisps etc
- It plays important role in national food & nutrition security
6.3. **Is potato potential exploited?**
- Yields have declined by 11% until recently - have oscillated between 6-8 t/ha, which is too low compared to:
  - 25 t/ha that can be attained by a progressive farmer under rain fedcdns
  - over 50 t/ha can be attained under intensive farming
  - Egypt = 26 t/ha, SA = 35 t/ha
- It is a strategic crop for poverty alleviation
  - provides income & employment in production to consumption continuum
- It’s potential as food, nutritional & income security crop is yet to be fully exploited

6.4. **How is the potential of potato as a food & nutritional security crop?**
- produces more starch per unit land & time
- It has good attributes for diversification which enhances food security thro:
  - Diversified diets, rich in nutrients & vit, fast growth
  - Good for horizontal and vertical diversification
  - Helps stabilize farmer incomes
  - helps shield poor farmers from unstable international prices - (not highly traded in Kenya)
- Good in mitigating effect of climate change

6.5. **Current and targeted status**

<table>
<thead>
<tr>
<th>CURRENT STATUS</th>
<th>TARGETED STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-commercialized, uncompetitive and low productivity subsector</td>
<td>Robust, competitive and self-regulating industry</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Characteristics</th>
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</thead>
<tbody>
<tr>
<td>1. Low yields (&lt; 10 ton/ha)</td>
<td>1. High yields (&gt; 25 tons/ha)</td>
</tr>
<tr>
<td>2. Low agribusiness (&lt; 10%)</td>
<td>2. High agribusiness (&gt; 80%)</td>
</tr>
<tr>
<td>3. Low employment (3.3 million)</td>
<td>3. High employment (6.6 million)</td>
</tr>
<tr>
<td>4. Moderate income (46 billion)</td>
<td>4. High income (150 billion)</td>
</tr>
<tr>
<td>5. Low diversification</td>
<td>5. Vertical &amp; horizontal diversification enhancing food security</td>
</tr>
</tbody>
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6.6. **Causes and drivers**
<table>
<thead>
<tr>
<th>CAUSES OF CURRENT STATUS</th>
<th>DRIVERS TO TARGETED STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low quality seed (&gt;90%)</td>
<td>High quality seed-certified, clean, positively selected seeds, good seed storage (&gt;50%)</td>
</tr>
<tr>
<td>Limited number of suitable varieties</td>
<td>Specialized varieties - Processing, low land</td>
</tr>
<tr>
<td>Low input use</td>
<td>Intensive potato farming</td>
</tr>
<tr>
<td>Low awareness &amp; lack of information</td>
<td>Informed farmers</td>
</tr>
<tr>
<td>Poor marketing infrastructure</td>
<td>Improved infrastructure – good access roads, collection centers, appropriate marketing structures</td>
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<tr>
<td>Limited technologies &amp; knowhow</td>
<td>High level technologies &amp; knowhow</td>
</tr>
<tr>
<td>Low value addition</td>
<td>High value addition-value capture and transformation</td>
</tr>
<tr>
<td>Poor post-harvest management practices</td>
<td>Good postharvest mgmt practices - Kenya-GAP, EA standards, traceability,</td>
</tr>
<tr>
<td>Inadequate regulatory and policy framework</td>
<td>Supportive regulatory and policy framework in place - adherence to contract farming etc</td>
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<tr>
<td>Low private sector involvement</td>
<td>High private sector involvement</td>
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<tr>
<td>Limited expertise</td>
<td>More expertise at different levels of subsector</td>
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<tr>
<td>Lack of development plan</td>
<td>Subsector development plan</td>
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<tr>
<td>Low budgetary support</td>
<td>Adequate budgetary and institutional support</td>
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<tr>
<td>Limited and uncoordinated research</td>
<td>Market driven research</td>
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6.7. Recent initiatives and interventions

- Initiatives by SHDs & devt partners - if sustained can help develop the industry:
  - PSDA-GIZ, CIP, USAID, MOA, NCST, KARI, private sector, etc
- Introduction of rapid seed multiplication methods
- Clean & positively selected seeds production
- Subsector studies, legal notices & seed potato master plan, value chain analysis
- Formation of central platform – NPCK
- Private sector involvement in seed production
  - Kisima farm, GTIL etc
- Some direct funding from MOA
• Note: high quality seed is viewed as key to unlocking the subsector potential

6.8. Next important question
• Who plays what role?
  o Government departments, Development partners, actors, other stakeholders
• Round table meeting
• Subsector development plan
• Seed potato import

6.9. NPCK stand on seed potato import
• PRA & agreement be availed immediately
• No part of Act/Legal notice permits seed potato from Ireland, Holland and UK without quarantine
• SHDs be involved & informed when making any changes & any protocols on seed potato import & variety introduction
• GoK & KEPHIS fast track streamlining of seed inspection & certification proc. & facilitates dev & sustainability of local SS
• GOK & KEPHIS working with NPCK and other stakeholders continue safeguarding the country from the dangerous diseases in Netherlands and other foreign countries
• Social, political and economic impact of seed potato imports be investigated
• KEPHIS maintain introduction of varieties thro tissue materials & not open quarantine or direct importation
• NPCK, SHDs & GOK draw import business protocol when PRA is done correctly, & economic and environmental impacts are acceptable importation is legalized
7. PROJECT SUMMARY: ON-FARM EVALUATION AND PROMOTION OF LOW-COST SEED POTATO STORAGE TECHNOLOGIES IN MAJOR POTATO GROWING COUNTIES OF KENYA

Prof. John H. Nderitu, MKU, Thika

7.1. Short summary of the Research
The potato (Solanum tuberosum L) is an important food security crop in Kenya being second to maize in production and utilization. The crop is grown in most highlands (1800-3000 m above sea level) but seed availability is a major constraint to increased ware potato production above the current 1 million tonnes. A socio-economic survey will be done to determine current farmers' practices. This project aims to research and promote low-cost storage technologies by growers of clean seeds. Common local cultivars will be evaluated for prolonged (5-7 months) storage under common ambient naturally air ventilation using diffused light. Promotion of low-cost on-farm storage technologies will be conducted to popularize seed storage at farm-level in different areas in the country. Researchers from KARI, CIP and Mt. Kenya University will collaborate in the seed storage and field evaluation trials to determine the performance of commonly grown varieties as well as the benefits of prolonged storage compared with the current practice of planting un-sprouted freshly harvested seeds. The National Potato Council of Kenya, the Ministry of Agriculture (extension), Mt. Kenya University and KARI will conduct the seed storage promotion and advocacy to enhance adoption of the technologies. This study will require support for a period of 3 years (6 growing seasons).

7.2. Background
In Kenya, potato is the second most important food crop after maize. The crop matures earlier (3-4 months) than maize and is grown in most highland areas (1800-3000 m above sea level) covering over 24 countries. There are approximately 800,000 growers in the country, cultivating 108,000 hectares, with production of over 1 million

7.3. Proposed project
Annual production of the crop is worth approximately KSh. 5 million at farm gate prices and more than KSh 10 million at consumer prices. The industry indirectly employs over 2.5 million as market agents, transporters, processors, vendors, retailers and exporters. Being labour-intensive, the crop provides needed employment to women and young people at the farm level. On average, yields have been stagnating at less than Ksh 10 tonnes per hectare. The acreage under production has increasing over the last 10 years (MoA, 2005). This increase is not reflected in productivity mainly due to unavailability and weak distribution of clean seed potatoes in the country during...
planting time. The low productivity shows a considerable waste of resources when compared to the 30-40 t/ha by progressive farmers and the research stations.

The seed potato tuber has to be stored in a way that it retains its vigour and healthy, disease-free condition up to the time of planting. Although this may be done in costly refrigerated storage, the low-cost needs of small-scale farmers, farmers’ associations and even larger private companies demand inexpensive methods of storage. Approximately 60,000 metric tonnes of good quality seed potato is required to support the production of ware potatoes. The ware potato farmers usually use their own farm-saved seed, contributing to approximately 95.6% of the country’s total seed demand, whilst both clean and carefully selected seed contribute 3.3%, and certified seed contribute to a paltry 1.1% (Seed Potato Master Plan, 2010). Use of certified seed and other quality seed needed to improve productivity has remained low, despite efforts made by the government and development partners over the years.

Recent climate change has not made matters any better for potato farmers due to drastic reduction in rainfall in most potato growing areas. In production regions adjacent to the Aberdares in the Kinangops, the Mau in Molo and the Mt Kenya in Meru, for example, the short rains have dwindle in certain years compared with the levels in the 1980s. In Kinangop, the long rains crop has to be planted early to escape severe frost in July and August. Although the Government originally recommended production of seed potatoes in the high altitude areas (1,800 metres above sea level and above), where occurrence of virus-causing aphid vectors (Myzus persicae) was low, the recent global warming has, however, changed this situation. Areas original suitable for seed production are no longer so due high temperatures, poor rainfall and increasing level of diseases and pests. The changed weather conditions have led to erratic rainfall patterns affecting potato productivity, particularly when poorly sprouted seed is used by farmers for planting as is currently the norm. Well-sprouted seed lead to early crop establishment and in the case of certified seed production, assists the crop escape late season infestation by aphids as the seed crop matures faster for dehaulming, 2-3 weeks before harvest.

The availability of more seed, following introduction of a storage technology such as Diffused Light Stores (DLS) that is easily affordable by farmers, becomes more necessary than ever in the effort to increase the contribution of the potato in feeding the increasing population now estimated to be over 38 million people. Diffused Light Storage (DLS) is a technique which aids in the control of sprout growth and lessens pest and disease damage.

Many old and newer Kenyan potato varieties are currently not in the National Seed System due to the problem of long seed dormancy periods. Although varieties, such as Kenya Baraka, Roslin Tana, Kenya Sifa, and Kenya Faulu amongst others have a
niche market for processing, farmers do not grow them because they remain dormant for more than 8 weeks after the onset of the rains. In developed countries, availability of seed of commercial varieties is ensured through refrigerated storage (4.4°C and high relative humidity, 95%). Such facilities like the 40 tonne-cold store at Tigoni for basic seeds and the over 2,000 tonne store for certified seeds at ADC-Molo are expensive for individual small-scale farmers due to the high construction and maintenance costs. The national potato programme has so far been financially constrained to provide the necessary information regarding appropriate low-cost seed storage know-how to aid adoption of the technology. Low-cost and appropriate storage could be used to encourage growers of clean seeds to lobby recognition of another seed category of seed known as Quality Declared Seed, to complement those the two already accepted for trade (GoK, 2005, MoA/GTZ-PSDA,2009). This scenario would make more seed available including encouraging farmers to maintain their own seed stocks in virus-free condition as a way of increasing national seed supply.

Increased use of improved seed storage is expected to contribute towards solving the chronic shortage of quality seed and increase potato productivity to reduce food insecurity and increase household incomes, whose effect will go far beyond the project period. Given better disease control methods and availability of good quality seed at planting time, potatoes could probably be the most productive crop in terms of nutrient production per unit area and of returns on invested capital and labour in the high altitude areas of Kenya (Ballesterm and Holler, 1977). Despite training both farmers and extension for over 30 years, no evidence exists to show that farmers pre-sprout their seeds to the level required for sustained potato production in the current changes in weather patterns in the growing areas. Information on current practices is necessary for success of the project. Raising farmers’ awareness on the benefits of DLS will highly increase its utilization with consequent results of increased yield per unit area. Moreover, if seed farmers use improved stores they will get much higher incomes from the sale of quality seed to ware potato producers.

7.4. Justification
The chemical “rindite” was previously used for pre-sprouting of freshly harvested seed potatoes. This chemical though effective is no longer available for environmental safety reasons forcing use of un-sprouted seeds by most growers of clean seed and ware potatoes (Shibairo at al., 2006). No reliable alternative is yet availability except for prolonged storage (5-7 months) using diffused light conditions at ambient temperature and natural ventilation. Availability of well-sprouted seed is necessary to enable quick maturity of potato using the little and erratic rains occasioned by climate change during the short and long rainy seasons. Information is necessary on the storability and yield potential of early (3months), medium (3-4 months) and late (4-5 months) maturity cultivars to enable
promotion and adoption of low-cost on-farm handling and storage know-how. Reasons for lack of interest or incentives in seed storage in low-cost stores such as the DLS also require elucidation. The acceptance of high-yielding varieties such as Tigoni and Asante has been high yet promising seed handling and storage practices including the DLS technologies remains low. Identifying the reasons for non adoption and diffusion of improved post harvest storage practices is necessary in order to avail good quality seeds and in good condition at planting time.

7.5. Objectives

The main objectives of this study will be to:

1. Conduct socio-economic survey to obtain cost effective on-farm storage technologies for promotion
2. Evaluate seed storability potential of major potato cultivars under different storage practices
3. Evaluate field performance of major cultivars from different storage practices and periods.
4. To promote adoption of promising on-farm storage technologies.

To package information on on-farm stores to all the chain actors

7.6. Expected Outputs

7.6.1. Promising on-farm seed storage technologies identified.
Economic evaluation of promising on-farm storage technologies to determine acceptability and socioeconomic variables that influence its adoption at farm level will be the major output of the study. Cost-benefit and adoption and diffusion rate will be documented taking into consideration the socioeconomic factors of potato farmers. The economic evaluation will be factored into all the study objectives to give it qualitative and quantitative aspects of storage technologies.

7.6.2. Seed storage potential of various cultivars under different on-farm storage practices evaluated.
This involves evaluation of commercial and promising new varieties and minitubers from aeroponics will be determined. Storability of the cultivars will be evaluated to determine new and old cultivars suitability and the output of the study will be used to inform farmers on importance of storage to production of specific cultivars.
7.6.3. On-farm field performance of major potato cultivars under different storage periods evaluated.

The final performance of various cultivars previously stored will be at the field. This will be important to demonstrate the value of storage to the performance and enhance own-saved seed and productivity.

7.6.4. Promising on-farm seed storage technologies promoted and adopted.

The evaluated cultivars, storage technologies will be promoted for adoption by farmers. Seed analysis for bacterial wilt and viruses as well as monitoring of pest and diseases at the stores and field will be promoted to enhance effective management of seeds in the store. The main output here will be adoption rates and performance of on-farm seed storage technologies. The project will aspire to demonstrate the benefits of seed storage to traders, seed growers.

7.6.5. Information sharing and publications produced and package

This task will enable the project implementation agencies to share results and lessons learned from the project. This will act as a feed-back mechanism for further research and improved potato productivity.
8. ON-FARM SEED POTATO STORAGE IN NYANDARUA COUNTY

Dr J.N. Kabira, KARI Tigoni

8.1. Introduction
In order to improve the quality of farm-saved seed, farmers are usually encouraged by extension and researchers to conduct positive seed selection to improve quality of farm-saved seeds. If such “clean seeds” are well-sprouted before planting, the on-farm yields can be improved substantially above 10 t/ha particularly when complimented with adequate fertilizer and crop protection practices.

Nyandarua is one of the largest potato county in Kenya. Located in Central Kenya, the county occupies an area of approximately 3523 km², out of which 2011 km² is good agricultural land. There are approximately 700,000 farm holdings with an average acreage of 7.6 acres. The estimated population of the district was 406,0900 with 73,000 farm families in 1994.

Despite promotion of potato production technologies in Nyandarua since the 1970's, the production has not increased much and average yields have remained less than 10 t/ha compared to on-station figures of 30-60 t/ha. Most farmers use freshly harvested tubers for planting since “rindite” the pre-sprouting chemical was withdrawn from the market in the 1990's. Seeds used to be sold by ADC following 7-9 months of cold stored (4°C) but the well-sprouted seed ceased being available when ADC collapsed in the late 1980's.

The NCST seed project aims to promote use of well-sprouted seeds by farmers. The research aims to evaluate sprouting behaviour of common varieties in naturally ventilated stores and encourage farmers to keep up their own good quality seed stocks. This way higher on-farm yields can be attained and diseases such wilt and viruses could be minimized or eliminated altogether.

8.2. Materials and Methods

8.2.1. Long rains season, 2011
17 varieties were grown at KARI-Tigoni using recommended practices for seed during the year 2011 long rains season. The trial was a randomized complete design with three replications. The crop was given supervisory field inspection by KEPHIS.

8.2.2. Short rains season, 2011
Eight (8) varieties were grown as for season I during the short rains season, 2011. The crop was again supervised by KEPHIS during growth. Seeds for this trial had been stored for 8 months from the seeds obtained from the long rains harvest. Tuber yield was determined by weight from selected plants. The cultivars in both seasons were dehauled after tubers
reached seed size. They were harvested two weeks later and cured for 3 weeks following which they were sorted and graded.

Seed storage. Cold storage was for 4 C and 95% relative humidity. DLS was under ambient air conditions and indirect light.

- Crates, sacks and net bags were used to store at least 5 kg of tubers. Seed size I and II were used for the storage under refrigerated and diffused light. The seeds were stored in crates or net bags.
- Duplicate samples of 5 kg of seed tubers were placed in crates (25 kg) or net bags (18kg) and placed on a platform in a platform in a diffused light seed store.
- The tubers were examined for sprouting every 4 weeks. The storage sites were KARI-Tigoni and 7 growers in Nyandarua County.

8.3. Results and Discussion

8.3.1. Plant emergence

All varieties in both cold store and diffused light treatments had achieved 100% emergence by 30th of November, that is approximately three weeks after planting. Emergence varied with variety. Dutch Robjin, Tigoni and Asante were faster from materials under DLS. Kenya Sifa, Dutch Robjin, Roslin Bvumbwe, Pimpernel and Roslin Tana were slower to emerge, almost a week after DLS materials.

Some reasons for late emergency of stored varieties in the cold room include:

1. Varieties Desiree, Dutch Robjin and Kenya Sifa normally have few long sprouts after long cold room storage. At planting they normally break off hence necessitating resprouting. That can explain why these varieties merged much later than the others.
2. As for the case of Roslin Tana, this variety normally it has low storage capacity and its over sprouting could have led to almost 80% sprout damage hence late resprouting leading to late emergence.
3. The cold room materials are normally very cold (4%) and therefore take almost three weeks to adapt to outside temperatures, hence the longer emergence period. Careful handling would, however, be required to prevent breakage during planting.
8.3.2. Tuber yields

![Figure 1](image1.png)

Figure 1. On-farm weight of tubers per plant in cold store and DLS materials

Mavuno, Romano and Desiree performed well while Anett was the poorest under the two storage conditions. Severe late blight infestation late on in the season coupled with too much rain affected yields in most varieties.

![Figure 2](image2.png)

Figure 2. Weight loss in Diffused light storage over time

8.3.3. Acceptability for seed under cold storage conditions

There was constant power failure which affected the storability of the 8 varieties. Many varieties had weak elongated sprouts some up to 40 mm in length. Although the other varieties had long.
Sprouts they were still acceptable for seed but careful handling was required to prevent breakage at planting.

Figure 3. Weight loss in Cold storage over time

Figure 4. Weight loss in different storage facilities

8.3.4. Acceptability for seed under DLS conditions

The market acceptability of eight varieties following storage is given in figure 5. Kenya Mavuno (Score 2.7) was the poorest under DLS condition followed by Tigoni (Mean score 4.3) and Desiree (mean score 4.00). Most acceptable varieties were Kenya Mpya (5.3), Asante (5.3) and Sherekea (7.7 score), with the later being by far the most acceptable.
Figure 5. Market acceptability of seeds following 8 months of storage

**8.3.5. Tuber shrinkage**

Most varieties appeared un-acceptable following storage under DLS condition probably due to excessive shrinkage. With exception of Kerr’s pink all other varieties were acceptable following cold storage. Sherekea was the most firm (score 6.9) following 8 months of storage. Kenya Mavuno (3.7), Tigoni (3.7), Kerr’s Pink (4.3), Dutch Robjin4.7) among others would be acceptable for sale as seed while Kenya Karibu, Asante and Kenya Mpya were just acceptable following storage under Diffused light conditions.

Figure 6. Acceptability of cold stored seeds
8.3.6. On-farm storability and field performance of selected varieties

On-farm seed storage following the long rains season was done in selected farms in Nyandarua County. The seeds were stored in farmers stores as shown in Table I.

Table I. NYAHURURU AND KINANGOP SEED POTATO STORAGE PROJECT

<table>
<thead>
<tr>
<th>SEED POTATO VARIETY</th>
<th>TYPE OF STORAGE</th>
<th>CONTACT PERSON</th>
<th>COMMENTS</th>
</tr>
</thead>
</table>
| KAGEMA FUKUZA NJAA (OL-JORO-ROCK) | • Kenya Mpya (Rep 1, 2 & 3)  
• Asante (Rep 1,2 & 3)  
• Sherekea (Rep 1, 2 & 3)  
• Desiree (Rep 1,2 & 3)  
• Kenya Mavuno (Rep 1, 2 & 3)  
• Kenya Karibu (Rep 1, 2 & 3)  
• Tigoni (Rep 1,2 & 3)  
• Dutch (Rep 1,2 & 3) | David Kariuki Mwangi  
0725-531829  
Mama - 0724317686 | Ordinary wooden store, Iron-sheet roofed. One chamber only. |
| PY. HORT. (OL-JORO-ROCK) | • Kenya Mpya (Rep 1, 2 & 3)  
• Asante (Rep 1,2 & 3)  
• Sherekea (Rep 1, 2 & 3)  
• Desiree (Rep 1,2 & 3)  
• Kenya Mavuno (Rep 1, 2 & 3)  
• Kenya Karibu (Rep 1, 2 & 3)  
• Tigoni (Rep 1,2 & 3)  
• Dutch (Rep 1,2 & 3) | Peter Maina Wambugu  
0723-078941 – Waithanj  
0723-078935 - Maina | Ordinary wooden store Partitioned into two chambers up & down |
| GATARWA EVER-GREEN (OL-KALAU) | • Sherekea (Rep 1, 2 & 3)  
• Kenya Mpya (Rep 1, 2 & 3) | Peter Kimani Mungai – 0722-296292  
Peter Mugo Mwangi – 0722-646981  
Fredrick Mathenge 0725-630388 (DAO office Ol-Kalau) | Wooden structure covered with Polythene (green house) all round |
The storage in Nyandarua is on-going. Data on tuber weight loss and acceptability as seed of the 8 varieties was be collected during planting in April when the long rains start. Following planting, the materials will be assessed periodically to determine their performance. Farmers will be asked for their views regarding the performance of the varieties.

### 8.4. Way Forward
- Promote DLS adoption to increase seed availability for long dormancy varieties
- Evaluate on-farm seed storage and its field performance (KARI, MoA, MKU, CIP and NPCK-NCST funded project)

### 8.5. Action
1. KARI Tigoni to incorporate pest management for seed potato
   a. Pesticide spray
b. Aphid proof store

c. Use of Maigoya
9. SOCIO-ECONOMIC SURVEY ON-FARM SEED POTATO STORAGE TECHNIQUES

David Kipkoech and Nancy Ng'anga

9.1. Introduction
The seed potato tuber has to be stored in a way that it retains its vigour and healthy, disease-free condition up to the time of planting. Although this may be done in costly refrigerated storage, the low-cost needs of small-scale farmers, farmers’ associations and even larger private companies demand inexpensive methods of storage. Approximately 60,000 metric tons of good quality seed potato is required to support the production of ware potatoes. The ware potato farmers usually use their own farm-saved seed, contributing to approximately 95.6% of the country’s total seed demand, whilst both clean and carefully selected seed contribute 3.3%, and certified seed contribute to a paltry 1.1% (Seed Potato Master Plan, 2010). Use of certified seed and other quality seed needed to improve productivity has remained low, despite efforts made by the government and development partners over the years.

Seed storage conditions can affect the physiological status of the seed, sprouting potential, and disease presence. Options to maximize storage conditions for ideal seed performance require the integration of several storage parameters including: temperature, humidity and airflow. While the latter two parameters are important, storage temperature, in particular, can be manipulated to alter physiological age. The warmer the storage temperatures, the more advanced the physiological age of the seed will become. Cultivar seed performance varies with respect to seed storage and aging. A particular level of physiological age in seed lots may be desirable for one cultivar but sub-optimal for another. A survey was done to determine on-farm seed potato storage practices used by farmers and cultivars involved so as to guide experimental designs to evaluate storage technologies.

9.2. Methodology

9.2.1. Study area
The study was conducted in Nyandarua country in Central Province of Kenya situated in the central part of the country. The county was selected because it is one of the major Irish potato growing districts of Kenya. The county produces 107,241 tons of potatoes annually (Nyandarua) from an estimated of 13,986 ha this translates to potato productivity of 7.6 (MoA, 2008). The district falls within the central highlands with an altitude range of between 2,350 and 3,000 m above sea level with a mean temperature of 22°C. The mean annual rainfall is 1,000 mm and reliable. Land ownership is predominantly freehold. The
majority of the farms in the area are small scale. The land size per household varies across the divisions but with an average of 2 hectare (Jaetzold 2006). Agriculture is the main economic activity in the county with dairy production being dominant, and followed by Irish potato production. It has two planting seasons: the long and short rain. Irish potato is planted in both seasons of the year. The major cash crops in the district include wheat, pyrethrum and horticultural crops such as cabbages, garden peas and carrots.

9.2.2. Data

The survey was conducted amongst selected seed and ware potato growers in Nyandarua County to determine current knowledge and utilization of seed pre-sprouting technology. Thirty six farmers were randomly selected from 5 districts of the county. Information was gathered using a questionnaire with closed-and open-ended questions. The questionnaire targeted potato farmers to determine their current seed production and handling practices, current storage practices, training and knowledge status on seed issues. Interviewees were selected from divisions of the county with potato as the major crop. Extension officers (front line staff and crops officers) were questioned to get in-depth information on on-farm storage situation in their respective districts.

9.3. Results

9.3.1. Farmers’ characteristics

Table 1: General characteristics of respondents

<table>
<thead>
<tr>
<th>Main occupation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers (88.9%)</td>
<td></td>
</tr>
<tr>
<td>Secondary occupation (47.2%)</td>
<td></td>
</tr>
<tr>
<td>Main occupation of respondent’s spouses were farmer (94.4%)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education level</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 1 to 8 (61.1%)</td>
<td></td>
</tr>
<tr>
<td>Secondary education (31.6%)</td>
<td></td>
</tr>
<tr>
<td>Tertiary education 2.7%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (61.1%)</td>
<td></td>
</tr>
<tr>
<td>Male (38.9 %)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age of the respondents was 48 years (Std. dev 15.9)</td>
<td></td>
</tr>
<tr>
<td>Spouses was 34 years (Std. dev. 25)</td>
<td></td>
</tr>
<tr>
<td>Average Hh. memberships were 5 individuals</td>
<td></td>
</tr>
<tr>
<td>Average experience of 12 years (Std. dev. 11.5) growing potato</td>
<td></td>
</tr>
</tbody>
</table>
Average farm size - 7.79 acres
Cultivated potatoes in only 1.31 acres
Average seed potato area 1.01 acres

Majority (83.3%) do not produce seed separately
Majority 66.7% of farmers grow potatoes twice in a year and thrice (33.3%).

Figure 1: Popular varieties grown in Nyandarua County
Figure 2: Farmers source of seed

- Own harvest: 47%
- Untrained farmer: 42%
- Open market: 3%
- MoA/KARI: 8%

Figure 3: Farmer Potato Seed Use

- Unclean: 96%
- Certified: 1%
- Quality: 3%
- Untrained farmer: 42%
- MoA/KARI: 8%
- Own harvest: 47%
Varietal preference:

- Yield advantage (44.4%), has big tubers (13.9%), early maturing (19.4%), seed availability (5.6%), market demand (5.6%) and high dry matter with good eating qualities (9.4%)

Seed size:

- Majority (86.1%) of farmers planted the recommended tuber sizes (egg-size), but some (8.3%) planted smaller one
- Majority (66.7%) farmers do not cut haulms before harvest
- Minority (30.6%) farmers usually dehaulm potatoes 1 to 4 weeks before harvest as dictated by market
- Majority (86.1%) of farmers sort their seed before storing while 14.9% do not

Table 2: Methods used to pre-sprout seed

<table>
<thead>
<tr>
<th>Method used</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Putting them in the pit</td>
<td>11.1</td>
</tr>
<tr>
<td>Bagging them</td>
<td>41.7</td>
</tr>
<tr>
<td>Putting them near the fire place</td>
<td>5.6</td>
</tr>
<tr>
<td>Spread them in the store</td>
<td>11.1</td>
</tr>
<tr>
<td>Leave on the farm till eye opens up</td>
<td>8.3</td>
</tr>
<tr>
<td>Seed chit</td>
<td>2.8</td>
</tr>
</tbody>
</table>
### Storage:

<table>
<thead>
<tr>
<th>Type of storage used</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark store</td>
<td>58</td>
</tr>
<tr>
<td>Diffused light store</td>
<td>5.6</td>
</tr>
<tr>
<td>Dark room/living house</td>
<td>5.6</td>
</tr>
<tr>
<td>In lighted store in gunny/sisal bags</td>
<td>2.8</td>
</tr>
<tr>
<td>In a heap inside a lighted store</td>
<td>8.3</td>
</tr>
<tr>
<td>Covered in heap inside a lighted store</td>
<td>5.6</td>
</tr>
<tr>
<td>Store with a mabati roof</td>
<td>5.6</td>
</tr>
<tr>
<td>Spread them in the store</td>
<td>5.6</td>
</tr>
<tr>
<td>Pits</td>
<td>2.8</td>
</tr>
</tbody>
</table>

#### 9.3.2. Seed storage

- Majority (86.1%) of farmers understand the difference between planting freshly harvested and pre-sprouted seed.
- Majority (66.7%) did not know the effects sprouted seed had on yields.
- Some of the reasons farmers gave for sprouting seed potato were:
  - Have uniform emergence,
  - Early emergence,
  - Better yield and
  - Less weed
- Most farmers (76.7%) are not aware of the improved seed store like diffused light store (DLS).
- Most farmers (69.4%) stored all the varieties they commonly grow for seed.
- The storage period was for less than one month to three months.
- Farmers do not pre-treat the stored seed.
- Majority (72.2%) of the farmers reported some storage losses.
- Most farmers (83.3%) had not had on-farm seed potato storage training compared to 16.7% who had it. Source of training:
Table 3: seed price difference at harvest and planting time

<table>
<thead>
<tr>
<th>One-sample test</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price per unit of seed at harvest in KES</td>
<td>11.838</td>
<td>35</td>
<td>0.000</td>
<td>1151.6</td>
</tr>
<tr>
<td>Price per unit of stored seed at planting time in KES</td>
<td>3.929</td>
<td>35</td>
<td>0.000</td>
<td>2154.1</td>
</tr>
</tbody>
</table>

![Pie chart showing distribution of storage information]
Table 4: Socioeconomic factors affecting on farm seed potato storage

<table>
<thead>
<tr>
<th>Variables</th>
<th>Wald Score</th>
<th>Significance.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.149</td>
<td>0.023</td>
</tr>
<tr>
<td>Household head (M=1,F=0)</td>
<td>7.441</td>
<td>0.006</td>
</tr>
<tr>
<td>House head education (Years)</td>
<td>4.774</td>
<td>0.029</td>
</tr>
<tr>
<td>Family size (Number)</td>
<td>2.611</td>
<td>0.106</td>
</tr>
<tr>
<td>Seasons (Number)</td>
<td>4.425</td>
<td>0.035</td>
</tr>
<tr>
<td>Experience (Experience)</td>
<td>1.745</td>
<td>0.186</td>
</tr>
<tr>
<td>Area under potato (Acres)</td>
<td>6.287</td>
<td>0.012</td>
</tr>
<tr>
<td>On-farm training (Yes=1,No=0)</td>
<td>3.823</td>
<td>0.051</td>
</tr>
</tbody>
</table>

**Statistical tests**

-2 Log likelihood: 23.588
Cox & Snell R Square: 0.438
Nagelkerke R Square: 0.618
Omnibus test (Chi-square): 20.728 (N=7) 0.004

9.3.3. Socioeconomic factors determining farmers’ decision to store or not to store

It was hypothesized that farmers’ decision to store or not to store is influenced by the combined effects of a number of factors related to the farmer’s objectives and constraints. Empirically, binary choice models assume that individuals (the economic units) are faced with a choice between two alternatives to store or not to store. The choice they make depends on the characteristic of an individual. These could be farmer’s experience, age of the respondent, household head education, labour (family size), extension intensity and season’s cycles. The principle goal of choice models is to enable us to determine the probability that an individual with a given set of attributes will make a one choice rather
than the other. The relationship for farmers’ choice given their attributes can be given as follows;

\[ Y_i = \beta_0 + \beta_1 X_i + \beta_n X_n + \epsilon_i \]

\[ Y_i = \begin{cases} 1 & \text{if farmer stores} \\ 0 & \text{if farmer donot store} \end{cases} \]

A binary dependent variable

\( \beta_i \) = parameters to estimated

\( X_i \) = Explanatory variables or farmers attributes

\( \epsilon_i \) = independently distributed random variable

Table 4: Socioeconomic factors affecting on farm seed potato storage

<table>
<thead>
<tr>
<th>Variables</th>
<th>Wald Score</th>
<th>Degree of freedom</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.149</td>
<td>1</td>
<td>0.023</td>
</tr>
<tr>
<td>Household head (M=1,F=0)</td>
<td>7.441</td>
<td>1</td>
<td>0.006</td>
</tr>
<tr>
<td>House head education (Years)</td>
<td>4.774</td>
<td>1</td>
<td>0.029</td>
</tr>
<tr>
<td>Family size (Number)</td>
<td>2.611</td>
<td>1</td>
<td>0.106</td>
</tr>
<tr>
<td>Seasons (Number)</td>
<td>4.425</td>
<td>1</td>
<td>0.035</td>
</tr>
<tr>
<td>Experience (Experience)</td>
<td>1.745</td>
<td>1</td>
<td>0.186</td>
</tr>
<tr>
<td>Area under potato (Acres)</td>
<td>6.287</td>
<td>1</td>
<td>0.012</td>
</tr>
<tr>
<td>On-farm training (Yes=1,No=0)</td>
<td>3.823</td>
<td>1</td>
<td>0.051</td>
</tr>
</tbody>
</table>

Statistical tests

-2 Log likelihood          | 23.588     |
Cox & Snell R Square       | 0.438      |
Nagelkerke R Square        | 0.618      |
Omnibus test (Chi-square)  | 20.728 (N=7) | 0.004 |
The "Sig." column shows the statistical significance difference at less than 5%.

As shown in table 4 Cox & Snell R square and Nagelkerke R square statistics, shows that the model successfully explained 61.8% of the data variability. Omnibus Tests of Model Coefficients: shows a chi-square statistic comparing the model with a simpler model (in this case, the model with only an "intercept"). Larger values of the chi-square statistic (20.728) indicate a bigger difference in fit between this and the simpler model. It therefore shows the model adequately and significantly fit the data. The socioeconomic factors which significantly affected the farmers choice to store were Household head (p=0.023), household held education (p=0.006), number of seasons (p=0.035), area under potatoes (0.012) and on-farm training (p=0.051).

9.4. Actions
1. Brochure for seed on farm storage system: end of April 2012
   a. By KARI Tigoni
   b. Information to be used by MOA to train and upscale at farm level where survey show 80% of farmers have no information on the same
2. Train extension officers on on farm storage
   a. May 2012
10. PROMOTION AND ADOPTION OF LOW COST STORAGE TECHNOLOGY

Nancy Ng’ang’a and David Kipkoech

10.1. Whose Advice Do Farmers Think Is Best?
Depends on the activity along the value chain

- Best variety advisor-MoA (best in Meru, 3rd in Nyandarua after farmers from other areas & neighboring farmers)
- Seed source- MoA, neighboring farmers
- Seed size-MoA
- Seed rate-MoA
- Seed storage-parents &MoA
- Ware storage-farmers from other areas (Nyandarua), parents (Meru)

10.2. Who Are Farmers Getting Their Info From?

Depends on the specific activity along the value chain

- Variety introduction-neighboring farmers, farmers from other areas (+MoA in Meru)
- Seed sources-parents, neighboring, farmers from other areas (Nyandarua) & neighboring farmers, MoA (Meru)
- Seed size-combination of sources (Nyandarua), MoA (Meru)
- Seed rate-combination of sources (Nyandarua), MoA (Meru)
- Amount & type of fertilizer-combination of sources, farmers from other areas (Nyandarua), neighboring farmer, MoA (Meru)
- Type & amount of chemicals-chemical companies
- Seed storage-parents, combination of sources (Nyandarua), MoA (Meru)
- Ware storage-parents

Depends on the County

- Significantly more farmers in Meru get their potato production info from the MoA compared to those in Nyandarua

10.3. How promote technologies

- Demonstration plots will be established with the participating farmers to show neighbours and potential buyers that the higher yields obtained from stored quality seed more than compensate the additional costs.
Field demonstration trials comparing the performance of freshly harvested seed with that from the most appropriate storage will be conducted in the Nairobi International Show at the KARI and Ministry of Agriculture stands.

The AIRC documentation unit (KADOC) will collaborate in the publicity campaign. The National Potato Council of Kenya will assist in developing the promotion strategy. Promotional content will include: publicity campaign (brochures, public barazas, media etc), field days, exhibitions, trade shows, etc. Linking ware potato growers to seed storage operators will be undertaken.

10.4. Technologies to be promoted

Technologies to be promoted will include:
- Good quality seed including minitubers produced through aeroponics.
- Improved varieties i.e newly released Kenya Gold for processing into crisps.
- Farm practices for production of good quality seed.
- Improved storage practices.

10.5. The methods of promotion (NCST Proposal)

- Incubation of on-farm storage
- Use of ATC and farm storage structures to create awareness (set demonstrations)
  - Hold at least one National Potato Seed Forum per year
  - Facilitation of formation of National Seed Committee
- Brochures.
- Documentary on seed potato storage.
- Training materials
- Publication of information in the KARI, KENFAP, Mt. Kenya University, NCST, and Potato Council websites.
- Publication in scientific journals, Conference papers.
- Field days, trade fairs and shows. (2 farmers field)
- Print and electronic media.
- Linking ware potato growers to seed storage operators (a database of seed multipliers=KARI –TIGONI TO TAKE INITIATIVE to give the potato desk MoA, NPCK), Give farmers Ciagi as part of experiment.

10.6. ACTIONS

1. Use ATC for storage structure promotion in field days
2. Electronic media by Prof Nderitu
3. Develop training materials: KARI Tigoni
4. KARI Tigoni to incorporate the farmer variety as part of treatments immediately
11. DEVELOPMENT OF ON-FARM SEED STORAGE PROJECT

11.1. Activities
Where are we now?

The following activities have already been done as envisioned at the start of the project:

<table>
<thead>
<tr>
<th>Output/activity</th>
<th>How far</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output 1. Promising on-farm seed storage technologies identified</strong></td>
<td></td>
</tr>
<tr>
<td>1.1: Project inception workshop</td>
<td>Done</td>
</tr>
<tr>
<td>1.2. Select pilot areas in the counties</td>
<td>Done</td>
</tr>
<tr>
<td>1.3 Collaborators meeting to develop the survey questionnaire</td>
<td>Done</td>
</tr>
<tr>
<td>1.4. Socio-economic seed storage survey</td>
<td>Done</td>
</tr>
<tr>
<td>1.5. Data analysis, Data entry</td>
<td>Done</td>
</tr>
<tr>
<td>1.6. Report writing</td>
<td>Done</td>
</tr>
<tr>
<td>1.7. Information sharing on socio-econ survey report</td>
<td>Done</td>
</tr>
<tr>
<td>sub-total</td>
<td>Done</td>
</tr>
<tr>
<td>**Output 2. Seed storage potential of various cultivars under different on-</td>
<td></td>
</tr>
</tbody>
</table>
2.1 Purchase of initial seed for experiments
Done

2.2 Selection for storage practices (DLS and farmers storage practices)
Done

2.3. Capacity building of farmers and extension staff
Done

2.4 Farm selection by extension officers
Done

11.2. Resources
The following is the amount of money available for project implementation

<table>
<thead>
<tr>
<th>Output/ activity</th>
<th>Year -2</th>
<th>By whom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 2. Seed storage potential of various cultivars under different on-farm storage practices evaluated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5 Storage experiment’s supplies</td>
<td>226,000</td>
<td>KARI, MKU, CIP</td>
</tr>
<tr>
<td>2.6 Storage technologies improvement</td>
<td>160,000</td>
<td>KARI, MKU, CIP</td>
</tr>
<tr>
<td>2.7 Setting up the experiment in selected sites and data collection</td>
<td>67,200</td>
<td>KARI, MKU, CIP</td>
</tr>
<tr>
<td>2.8 Data analysis and report writing</td>
<td>0</td>
<td>KARI, MKU, CIP</td>
</tr>
<tr>
<td>sub-total</td>
<td>453,200</td>
<td></td>
</tr>
</tbody>
</table>

Output 3. On-farm field performance of major potato cultivars under different storage periods evaluated

<table>
<thead>
<tr>
<th>Output/ activity</th>
<th>Year -2</th>
<th>By whom</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1. Land preparation and planting</td>
<td>24,000</td>
<td>KARI, MKU, CIP</td>
</tr>
<tr>
<td>3.2. Farm inputs</td>
<td>169,200</td>
<td>KARI, MKU, CIP</td>
</tr>
<tr>
<td>3.3. Farm supplies</td>
<td>39,467</td>
<td>KARI, MKU, CIP</td>
</tr>
<tr>
<td>3.4. Production of clean seed by selected farmers</td>
<td>133,333</td>
<td>KARI, MKU, CIP</td>
</tr>
<tr>
<td>3.5. Field evaluation of stored cultivars both new and old</td>
<td>41,600</td>
<td>KARI, MKU, CIP</td>
</tr>
</tbody>
</table>
### 3.6 Data collection
- **Sub-total**: 85,440
- **KARI, MKU, CIP**

### 3.7 Data analysis and reporting
- **Sub-total**: 25,000
- **KARI, MKU, CIP**

### Output 4. Promising on-farm seed storage technologies promoted and adopted

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost</th>
<th>Implementing Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Promotional campaign and up scaling of identified seed storage technologies</td>
<td>200,000</td>
<td>NPCK, MoA, MKU, KARI</td>
</tr>
<tr>
<td>4.2 Linking seed multipliers with storage capacity to ware potato growers</td>
<td>44,000</td>
<td>NPCK, MoA, MKU, KARI</td>
</tr>
<tr>
<td>4.3 Seed fair, Field days, shows and seed forum</td>
<td>70,950</td>
<td>NPCK, MoA, MKU, KARI</td>
</tr>
<tr>
<td>4.4 National Seed Committee meeting</td>
<td>138,200</td>
<td>NPCK, MoA, MKU, KARI</td>
</tr>
<tr>
<td>4.5 Mobile Based Information Systems (SMS)</td>
<td>50,000</td>
<td>NPCK, MoA, MKU, KARI</td>
</tr>
<tr>
<td>4.6 Print and electronic media</td>
<td>60,000</td>
<td>NPCK, MoA, MKU, KARI</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>563,150</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Output 5. Information sharing and publication

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost</th>
<th>Implementing Agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Technical seed storage workshops</td>
<td>141,050</td>
<td>KARI, MKU, MoA, NPCK</td>
</tr>
<tr>
<td>5.2 Paper in local conference proceeding</td>
<td>55,000</td>
<td>KARI, MKU, MoA, NPCK</td>
</tr>
<tr>
<td>5.3 Publications (Papers in-referred journal)</td>
<td>25,000</td>
<td>KARI, MKU, MoA, NPCK</td>
</tr>
<tr>
<td>5.4 Brochures, leaflets, technical notes</td>
<td>15,000</td>
<td>KARI, MKU, MoA, NPCK</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>236,050</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Total annually (KES): 1,770,440**
11.3. Institutional Budget

In the first year, activities of some partners did not use their budget. This means they did not implement the project’s objectives.

<table>
<thead>
<tr>
<th>Output/ activity</th>
<th>Total budget per output (KES)</th>
<th>Percentage budgetary allocation by institution (2011-2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KARI</td>
<td>MKU</td>
</tr>
<tr>
<td><strong>Output 1. Promising on-farm seed storage technologies identified</strong></td>
<td>671,100</td>
<td>402,660</td>
</tr>
<tr>
<td><strong>Output 2. Seed storage potential of various cultivars under different on-farm storage practices evaluated</strong></td>
<td>%</td>
<td>0.60</td>
</tr>
<tr>
<td><strong>Output 3. On-farm field performance of major potato cultivars under different storage periods evaluated</strong></td>
<td>1,244,100</td>
<td>746,460</td>
</tr>
<tr>
<td><strong>Output 4. Promising on-farm seed storage technologies promoted and adopted</strong></td>
<td>1,126,300</td>
<td>337,890</td>
</tr>
<tr>
<td><strong>Output 5. Information sharing and publication</strong></td>
<td>%</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Total Budget and Institutional Allocation (KES)</strong></td>
<td>5,000,000</td>
<td>2,520,480</td>
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</tbody>
</table>

In the second year, the following is expected to be done and budget allocated in the same way:

<table>
<thead>
<tr>
<th>Output/ activity</th>
<th>Year 2 budget per output (KES)</th>
<th>Percentage budgetary allocation by institution/Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KARI</td>
<td>MKU</td>
</tr>
<tr>
<td><strong>Output 1. Promising on-farm seed storage technologies identified</strong></td>
<td>%</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Output 2. Seed storage potential of various cultivars under different on-farm storage practices evaluated</strong></td>
<td>%</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>453,200</td>
<td>271,920</td>
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<tr>
<td><strong>Output 3. On-farm field performance of major potato cultivars under different storage periods evaluated</strong></td>
<td>%</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>518,040</td>
<td>310,824</td>
</tr>
<tr>
<td><strong>Output 4. Promising on-farm seed storage technologies promoted</strong></td>
<td>%</td>
<td>0.30</td>
</tr>
</tbody>
</table>
### Output 5. Information sharing and publication

<table>
<thead>
<tr>
<th>%</th>
<th>0.30</th>
<th>0.30</th>
<th>0.00</th>
<th>0</th>
<th>0.20</th>
</tr>
</thead>
<tbody>
<tr>
<td>236,050</td>
<td>70,815</td>
<td>70,815</td>
<td>0.00</td>
<td>47,210</td>
<td>47,210</td>
</tr>
</tbody>
</table>

### Total Budget and Institutional Allocation (KES)

| 1,770,440 | 822,504 | 531,132 | 97,124 | 159,840 | 159,840 |

11.4. Way forward to achieve desired outputs

- Promising on-farm seed storage technologies identified.
- Seed storage potential of various cultivars under different on-farm storage practices evaluated.
- On-farm field performance of major potato cultivars under different storage periods evaluated.
- Promising on-farm seed storage technologies promoted and adopted.

Information sharing and publications produced and packaged.
12. PLENARY DISCUSSIONS

12.1. Potato Desk Officer Ministry of Agriculture HQ
Mr Maina Machangi

- Requested MOA officers in the field to promote and take potatoes very seriously
- There are some counties where potatoes are not second option and farmers need high support
- Poor quality seeds make potato production to be uneconomic venture
- KEPHIS are justifying importation of seeds due to poor farmer yields but this is not so according the presentations today
  - It is not the aspects of varieties we have since KARI Tigoni is getting 30-60 tonnes per ha
  - The main aspect is seeds and thus this project is very important
- Promises to work hard to promote potato during his period
- Let us harmonize activities amongst the stakeholders
12.2. Final remarks

Dr Jackson Kabira

- Currently Kari Tigoni lacks funds to support seed potato and requests MOA to support
- Highly touched to see the seed group talking on behalf of the industry and providing guide to researchers on what the industry wants
- We are finalizing the first year project report so that we seek funds for second year, about 1.7mi
  - This project is based on aspects of climate change, arguing that if we have sprouted seeds, then small rains will impact a lot on production
13. PRESS RELEASE BY NPCK ON POTATO SEED IMPORT

13.1. Seed production and marketing issues in Kenya

13.1.1. Local seed production issues

1. The seed inspection process has been a major bottleneck and has a lot of inefficiencies in form of delays and false results that discourage new private investors

2. That the government should commit itself to continue supporting financially and in all other ways local production and distribution of seed potatoes. There must be an elaborate plan to uplift and sustain local seed production before embarking on fast tracking importation.

3. There lacks plans for fast tracking introduction and release of special utilization and low land varieties

4. That seed potato master plan should be supported, updated and integrated into the government’s potato subsector plan

5. There are some widely adopted farmer varieties that should the government should fast tracking characterization, cleaning and availability their quality seed farmers

13.1.2. Seed import issues

1. There are very many dangerous potato diseases in The Netherlands and Europe in general that we must protect our country and vulnerable farmers against.

2. Potato is a security crop and must be protected by all relevant institutions and government to avoid depending on importation

3. That open quarantine is not appropriate and safe since untested tubers, diseases and pests could find their way to farmer fields.

4. That KELPHIS devolves being the main player of imports and leave it to the seed merchants. Otherwise, it cannot be a regulators and the main player of the imports. What role is KEPHIS undertaking in this issue.....an importer or seed merchant?

5. It is important to note that importation of seed potatoes is not the panacea of potato production in this country. Every effort to support local seed production by government agencies and international agencies must not be spared

6. That Plant protection Act Cap 324 section 8, does not ban importation of potato tubers but provides for and “importation in accordance with conditions of permit previously obtained” (No permit previously existed and the Act quoted does not permit seed tubers from Ireland, Holland and UK as purported during the presentation)

7. Kenyans will rely on the extra quality control step practices by the Netherlands and information availed by Netherlands to KEPHIS (This is unacceptable
because the exporting country becomes the regulator—Kenyan Safety will be purely under the mercy of the exporting country!

8. That since “ban on imports is based on sound scientific evidence” then NPCK should share the evidence with KEPHIS. (The papers on many dangerous diseases found in The Netherlands which the NPCK shared with KEPHIS were intended to inform and caution you of the need to perform a thorough and objective PRA. Unfortunately you don’t seem to have appreciated the material sent to you).

9. The impression that Kerr’s pink, Dutch Robjin, Roselin Eburu, Anett, Maritta, Desiree, Kenya Baraka, Roslin and others varieties were imported as seed potatoes to the country is wrong. All these varieties went through the due process of screening and no one variety went to farmers for direct planting in the field.

10. That not part of Act or Legal notice authorizes or permits seed potato from Ireland, Holland and UK without quarantine

11. The Stakeholders be much more involved and informed when making any changes and any protocol development in matters relating to seed potato import and introduction of varieties.

12. That the government and KEPHIS fast track streamlining of seed potato inspection and certification processes and facilitates development and sustainability of local seed subsector

13. That government and KEPHIS working with NPCK and other stakeholders continue safeguarding the country from the dangerous diseases in Netherlands and other foreign countries

14. That the social, political and economic impact of seed potato imports be investigated to ensure that the current effort in seed production is not seriously affected

15. That we uphold the former requirement by MD KELPHIS that seed potatoes be introduced in this county only through tissue materials and not open quarantine or direct importation as proposed by the current MD

16. The NPCK, stakeholders and other relevant arms of the government draw importation and seed potato import business protocol in the event that the PRA is done correctly, and economic and environmental impacts are acceptable and seed importation is legalized.

17. No import of seed potato should be done until all these issues are cleared and solved

18. The NPCK appreciate the need to facilitate business ventures in all the sectors but this must be done within the cornerstones of sustainability and existing laws. More importantly, facilitation of import business cannot be at the expense of pushing the smallholder farmers and local seed producers out of their livelihood
and putting the future of the country at risk and at the mercy of foreign merchants. In line with this the NPCK insists that the proposed importation be stopped until the technical issues are resolved, the stakeholders involved and a way forward agreed upon by all.

Wachira Kaguongo
CEO, National Potato Council of Kenya

Prof John H. Nderitu
Chairman, National Potato Council
14. PUBLICATIONS IN THE LOCAL DAILY PRESS

14.1. Daily Nation, Tuesday 24th April 2012: New research claims to increase potato yields in Kenya

LOW YIELDS, poor prices, and inaccessible markets have for years characterized the potato industry in Kenya.

Many farmers have abandoned the crop. However, if a research being undertaken by local scientists is anything to go by, the industry is set for a turnaround. Mr. Jeff Kamau, a potato farmer from Kipipiri, Nyandarua County, says he is one of the growers who have remained optimistic over the years.

"Many of my colleagues left potato farming and have ventured into other crops, but I chose to soldier on, and going by what we have been told, things seem to be looking up. We hope this will succeed," says Mr Kamau.

Scientists are now researching low-cost technology for potato seed storage to cushion farmers against losses. This will ensure that farmers use the right seeds to increase yields.

The research is being undertaken by the National Council of Science and Technology.

Mt Kenya University Deputy Vice-Chancellor, Prof John Nderitu, who is spearheading the research, says there is a need for the country to come up with proper storage technologies to protect farmers against the losses that they have incurred over the years.

Approximately 800,000 farmers cultivate potatoes, with production estimated at over a million tonnes every season.

Prof Nderitu says the industry employs over 2.5 million people as market agents, transporters, processors, vendors, retailers, and exporters, hence the need to explore proper storage technologies. Being a labour-intensive venture, the crop provides employment to women and young people at the farm level.

Prof Nderitu, however, expresses concern that production has been falling due to lack of access to proper seeds. "Production has stagnated over the years, mainly due to unavailability and weak distribution of clean seed potatoes in the country during planting time," he said.

Kenya needs 60,000 tonnes of certified potato seeds every year, although only 600 tonnes are available with 96 per cent of farmers using their own harvest for replanting. This encourages the spread of the devastating bacterial wilt disease, leading to poor harvests. Imported seeds worsen the situation as they can introduce new diseases.

Mr Kamau considers the new research a godsend, citing the numerous woes farmers face.

Xinhua
By CATHERINE RIUNGU

Potato farmers in Kenya have opposed a decision by the government to import seed from
the Netherlands, insisting that the move will kill the little but growing initiative to produce
clean planting seed potato and will expose the country to potato diseases

While the Ministry of Agriculture argues that the imports seek to bridge an imbalance
between demand and supply of seed potato, the private sector players say a lot of
resources have been invested in increasing production of seed potato over the past three
years, therefore, the timing of the Dutch imports is wrong.

Two weeks ago, the Kenya Plant Health Inspectorate Service (Kephis), which signed the
deal to import seed potato last September, called a stakeholder’s meeting to discuss a way
forward following a decision by the National Potato Council of Kenya (NPCK) to mobilise
opposition to the government’s move until proper consultations are held.

The chief executive of the council, Wachira Kaguongo, has challenged Kephis to make
public the details of the agreement. But Kephis managing director James Onsando termed
the matter “sensitive,” and accused the private sector of blowing things out of proportion.
“We are consulting with a view to coming up with a position in due course,” he said.

Agriculture Permanent Secretary Romano Kiome said the imports are temporary and
meant to increase the current 1 per cent production capacity. “It’s a stop-gap measure to
bridge the deficit and increase production,” he said adding that it has not been determined
yet how much is going to be imported.

The head of the Kenya Agricultural Research Institute (KARI) potato research station based
in Tigoni, near Nairobi, Jackson Kabira, said Kenya should increase funding for research
instead of importing seed. Mr Kabira said the country has the capacity to grow seed but
inadequate funding and misappropriation of land for research has hampered its ability to
supply sufficient planting materials. KARI and the Agricultural Development Corporation
are fighting for the return of stolen land, whose hiving off in the 1990s adversely affected
production.

The crop is one of the country’s staple foods and has great potential to address food
insecurity, given its higher yield per square metre of land and three harvesting seasons
annually.
However, lack of policy, storage, marketing and value-addition strategies has limited its potential to improve livelihoods and earn the country foreign exchange.

The chairman of the National Potato Council of Kenya, Prof John Nderitu, says the industry has been undermined since the 1970s by government interference, and just when private sector-led efforts to produce clean seed are beginning to pay off, “the government comes up with a decision that has thrown everything out of balance.”

Prof Nderitu, also the head of research at Mt Kenya University, is overseeing a programme spearheaded by the National Council for Science and Technology, that is working with farmers in Baringo to test the value chain — from seed, farm, marketing to processing — with a view to create a case study on how Kenya can manage the industry.

Researchers fear the possibility of foreign seeds introducing diseases that could spread across the region as has happened in the past with different crops. “Pests and diseases such as leaf minor, crown gall, maize stem borer and fruit flies have been introduced through imported planting materials, and the potato carries similar risks,” Prof Nderitu said.

Jungae Wainana, the chairman of Midlands — a potato processing company — says support for the existing capacity to grow new varieties and investment in cold storage and marketing is lacking. “The potato is a perishable crop requiring cold storage and transportation from high production to deficit areas,” he said.
15. **ANNEXES**

15.1.1. **Annex 1: Programme**

Programme for NCST Seed Potato Project Annual Planning Workshop, AIRC, KARI-NARL, Nairobi, 2\textsuperscript{nd} April 2012

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00 – 8.30am</td>
<td>Registration</td>
<td>Mr. Samuel Mathenge, MKU</td>
</tr>
<tr>
<td>8.30 – 8.45am</td>
<td>Welcome, Opening Remarks and Introduction</td>
<td>Dr. J. N. Kabira, KARI, Tigoni</td>
</tr>
<tr>
<td>8.45 – 9.00am</td>
<td>Workshop objectives and expected outcome</td>
<td>Prof. J.H. Nderitu, MKU</td>
</tr>
<tr>
<td>9.00 – 9.10pm</td>
<td>National and International linkage in seed potato research and development</td>
<td>Dinah Borus, CIP, Nairobi</td>
</tr>
<tr>
<td>9.10 – 9.20am</td>
<td>Public private partnership in seed production and seed business promotion</td>
<td>Ms. Marion Gathumbi, MOA HQTS</td>
</tr>
<tr>
<td>9.20 – 9.30am</td>
<td>Presentation by the potato industry</td>
<td>Mr. Wachira Kaguogo, CEO, NPCK</td>
</tr>
<tr>
<td>9.30 – 9.45am</td>
<td>Opening Remarks</td>
<td>CEO, NCST</td>
</tr>
<tr>
<td>9.45 – 10.00am</td>
<td>Overview of the NCST Seed Potato Project</td>
<td>Prof. J.H. Nderitu, MKU</td>
</tr>
<tr>
<td>10.00 – 10.15am</td>
<td>Presentation on Socio-Economic Survey on Seed Potato</td>
<td>Mr. Kipkoech and Nancy Ngaya, KARI, Tigoni</td>
</tr>
<tr>
<td>10.15 – 10.30am</td>
<td>Health Break</td>
<td></td>
</tr>
<tr>
<td>10.30 – 10.45am</td>
<td>Presentation on Evaluation of Seed Potato for effective storableability under different storage structures</td>
<td>Dr. J. Kabira, KARI Tigoni</td>
</tr>
<tr>
<td>10.45 – 11.00am</td>
<td>Presentation on Field evaluation of stored seeds for yield performance</td>
<td>Dr. J. Kabira, KARI Tigoni</td>
</tr>
<tr>
<td>11.00 – 11.15am</td>
<td>Presentation on Promotion and adoption of low cost storage technology</td>
<td>Mr. Kipkoech, KARI, Tigoni</td>
</tr>
<tr>
<td>11.15 – 11.30am</td>
<td>Presentation on Information sharing and publications</td>
<td>Prof. J.H. Nderitu, MKU</td>
</tr>
<tr>
<td>11.30 – 12.00pm</td>
<td>Guidelines on workplan and budget based on agreed activities for 2012/2013</td>
<td>Mr. Kipkoech, KARI, NARL</td>
</tr>
<tr>
<td>12.00 – 1.00pm</td>
<td>Group Discussion</td>
<td>Maron Gathumbi, MOA HQTS</td>
</tr>
<tr>
<td>1.00 – 1.30pm</td>
<td>Development of Seed Potato Road map</td>
<td>Mr. D. Kipkoech, KARI, Tigoni</td>
</tr>
<tr>
<td>1.30 – 1.45pm</td>
<td>Concluding Remarks</td>
<td>Dr. J. Kabira, KARI, Tigoni</td>
</tr>
<tr>
<td>1.45 – 2.45pm</td>
<td>Lunch and Departure</td>
<td></td>
</tr>
</tbody>
</table>
### Annex 2: List of Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Contact</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. J.H. Nderitu</td>
<td>MKU</td>
<td>0722 308581</td>
<td><a href="mailto:h.nderitu@mku.ac.ke">h.nderitu@mku.ac.ke</a></td>
</tr>
<tr>
<td>Mr. David Kipkoech</td>
<td>KARI, Tigoni</td>
<td></td>
<td><a href="mailto:dknnyamasia@yahoo.co.nz">dknnyamasia@yahoo.co.nz</a></td>
</tr>
<tr>
<td>Mr. Wachira Kaguongo</td>
<td>CEO, NPCK</td>
<td></td>
<td><a href="mailto:nkaguongo@npck.org">nkaguongo@npck.org</a>, <a href="mailto:npck@npck.org">npck@npck.org</a></td>
</tr>
<tr>
<td>Dr. J.N Kabira</td>
<td>KARI, Tigoni</td>
<td></td>
<td><a href="mailto:kari.tigoni@yahoo.com">kari.tigoni@yahoo.com</a></td>
</tr>
<tr>
<td>Dr. Muo Kasina</td>
<td>KARI</td>
<td></td>
<td><a href="mailto:kasina.j@gmail.com">kasina.j@gmail.com</a></td>
</tr>
<tr>
<td>Martha W. Kagunda</td>
<td>DAO Nyandarua Central</td>
<td>0710 758600</td>
<td></td>
</tr>
<tr>
<td>Maina Machangi</td>
<td>MoA-Kilimo</td>
<td>0722 642066</td>
<td><a href="mailto:josmaina@gmail.com">josmaina@gmail.com</a></td>
</tr>
<tr>
<td>Mr. Samuel Mathenge</td>
<td>MKU</td>
<td>0724 864698</td>
<td><a href="mailto:research@mku.ac.ke">research@mku.ac.ke</a></td>
</tr>
<tr>
<td>Maureen Elegwa</td>
<td>NCPK</td>
<td>0724 906170</td>
<td><a href="mailto:melegwa@npck.org">melegwa@npck.org</a></td>
</tr>
<tr>
<td>David K. Mwangi</td>
<td>Farmer - NCPK</td>
<td>0722 816281</td>
<td></td>
</tr>
<tr>
<td>Patrick G. Njogu</td>
<td>KENA POFA</td>
<td>0720 706456</td>
<td><a href="mailto:pnjogu07@gmail.com">pnjogu07@gmail.com</a></td>
</tr>
<tr>
<td>Peter Maina Wambugu</td>
<td>Py-hort</td>
<td>0723 078941</td>
<td></td>
</tr>
<tr>
<td>Peter Kimani Mungai</td>
<td>Gatarwa Ever-green</td>
<td>0722 296292</td>
<td></td>
</tr>
<tr>
<td>Jane Wanjiku</td>
<td>Kipipiri Manungua Farmer</td>
<td>0724 530741</td>
<td></td>
</tr>
<tr>
<td>Hellen Wairimu</td>
<td>Githioro farmers</td>
<td>0724 753798</td>
<td></td>
</tr>
<tr>
<td>David Kariuki Mwangi</td>
<td>Kagema Fukuza Njaa</td>
<td>0725 531829</td>
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</tr>
<tr>
<td>Jacinta M. Ilai</td>
<td>DAO Nyandarua North</td>
<td>0723 288669</td>
<td><a href="mailto:daonyandarua@yahoo.com">daonyandarua@yahoo.com</a></td>
</tr>
<tr>
<td>James W. Mungai</td>
<td>Farmer</td>
<td>0733 272002</td>
<td></td>
</tr>
<tr>
<td>Michael K. Kithenji</td>
<td>MoA</td>
<td></td>
<td><a href="mailto:mikekithinji@yahoo.com">mikekithinji@yahoo.com</a></td>
</tr>
<tr>
<td>Richard K. MUTHUMBI</td>
<td>MoA Kipipiri</td>
<td>0722 443897</td>
<td><a href="mailto:daokipipiri@yahoo.com">daokipipiri@yahoo.com</a></td>
</tr>
<tr>
<td>Mary Mungai</td>
<td>MoA</td>
<td></td>
<td></td>
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