Enhancing Production, Value Addition and Marketing of Indigenous Vegetables (cowpea, spider plant, nightshades, amaranth, pumpkin), French Beans and Mushrooms among Smallholder Farmers in Kenya

Annual Planning Workshop on KAPAP Vegetable Value Chain Project
National Museums of Kenya, Nairobi

February 11, 2013

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7. Mr. Fredrick Musieba, Kenya Industrial Research & Development Institute
Executive Summary
The Vegetable Value Chain is supported by Kenya Agricultural Productivity and Agribusiness Project (KAPAP). This workshop was intended to share project findings from the first year’s activities, with stakeholders, and map out activities for the second year. The meeting had been called to present research findings of the different vegetables in the project. The programme was organized in form of presentations, which were accompanied by discussions emanating from the presentations.
# Table of Contents

Executive Summary .............................................................................................................. 1  
Acknowledgement ................................................................................................................ 3  
Workshop Objectives and Expected Outputs ........................................................................ 3  
  Workshop Objectives ......................................................................................................... 3  
  Expected Outputs of the Workshop .................................................................................... 3  
Brief on the KAPAP Vegetable Value Chain Project ............................................................. 4  
Progress Reports for the Year 2012 ..................................................................................... 7  
  1) Progress Report on French Beans ................................................................................... 7  
  2) Progress Report on the Spider Plant ........................................................................... 12  
  3) Progress Report on Mushrooms Value Chain ............................................................... 18  
  4) Progress Report on the Amaranth ............................................................................... 30  
  5) Progress Report on the Cowpea .................................................................................. 39  
  6) Progress Report on the Pumpkin ................................................................................ 48  
  7) Progress Report on the Nightshade ............................................................................ 63  
KAPAP Vegetable Value Chain Project Planning Workshop Programme ............................ 71  
List of Participants ............................................................................................................... 73
Acknowledgement
The KAPAP vegetable Project team sincerely appreciates:

• National Museums of Kenya for hosting this workshop,
• Mount Kenya University for organizing the workshop,
• Kenya Agricultural Productivity and Agribusiness Project (KAPAP) Secretariat for providing the funds,
• Participants & twining researchers for availing themselves,
• Employers for allowing us time to spend on this project

Workshop Objectives and Expected Outputs

Workshop Objectives
The planning workshop objectives were as follows for the year 2012:

1. To provide feedback by the various collaborators on the project achievements
2. To share research findings for year 2012
3. To discuss the work plan for year 2 and include suggestions by World Bank on enhanced value addition and postharvest technologies activities in the project (The World Bank was intending to add more money in those two activities).

Expected Outputs of the Workshop
1. Work plan for year 2 developed
2. Collaboration in the project enhanced
3. Information Sharing enhanced

The progress reports and research findings from the project implementation teams were delivered in the following order:

1) Prof. John H. Nderitu (Lead scientist)/Mount Kenya University team
2) Prof. Richard M. S. Mulwa and Dr. Joseph W. Matofari /Egerton University team
3) Mr. Fredrick Musieba/ KIRDI team
4) Dr. Esther Kioko/National Museums of Kenya team
5) Dr. Margaret J. Hutchinson /University of Nairobi team
6) Prof. Dorcas Isutsa/ Chuka University team
7) Dr. Darius Andika/Jaramogi Oginga Odinga University team
Brief on the KAPAP Vegetable Value Chain Project


Lead Scientist
1. Prof. John H. Nderitu, Mount Kenya University

Collaborators
2. Prof. Dorcas K. Isutsa, Chuka University
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7. Mr. Fredrick Musieba, Kenya Industrial Research & Development Institute

Partners:
1. Dr. Josephine Ongoma, KLEEN Homes & Gardens, an NGO;
2. Mr. Evans Njuguna, Njoro Canning Factory Limited

Background Information
The vegetable crops prioritized for research in the project are:
- Indigenous vegetables (nightshades, amaranth, cowpea, spider plant and pumpkin),
- Mushrooms and
- French beans.

Constraints
1. Indigenous vegetables
   - Quality planting materials and agronomic packages.
   - Limited value addition & post-harvest handling technologies.
   - Poor marketing and distribution channels.
   - Negative perception and low acceptability.
2. Mushrooms
   - Lack of adequate supply of quality spawns.
   - Limited production technologies.
   - Limited value addition and postharvest handling technologies.
3. French beans
   - Overuse and misuse of pesticides for management of pests.
   - Lack of awareness on local utilization.
   - Limited postharvest practices and value addition.

Objectives
Overall objective
- To increase production, value addition, marketing and utilization of indigenous vegetables, French beans and mushroom products among smallholder farmers in Kenya.
Specific Objectives

• To enhance safe production of indigenous vegetables, French beans and mushroom products through IPM practices.
• To improve postharvest handling, value addition and utilization of indigenous vegetables, French beans and mushroom products.
• To enhance marketing opportunities for indigenous vegetables, French beans and mushrooms among smallholder farmers.
• To enhance mechanisms for information, communication and knowledge sharing along the indigenous vegetable, French beans and mushroom value chain.
• To undertake initial project screening with a view to identifying environmental, social and gender concerns that must be addressed together with the pests in the proposed research project.

Outcomes

• Availability of high quality and affordable seed and spawn for IVs, French beans, and mushrooms, respectively.
• Reduced vegetable postharvest loses along the value chain and increased volumes of high quality vegetables in markets.
• Increased range of vegetable products and per capita consumption.
• Increased smallholder and community awareness and consumption of IVs, French beans and mushrooms; and overall improved incomes from vegetable enterprises disaggregated by gender.
• Improved food safety and acceptability of the indigenous vegetables along the Value Chain within an expanded market catchment

Research Plan/Methodology

Project Sites
Homa Bay, Kakamega, Tharaka, Nyeri, Kilifi, Embu and Siaya Counties

Outputs and Activities

1. Crop improvement
   1.1 Germplasm collection, evaluation, and selection of IV varieties and mushroom spawn for production.
   1.2 Farmer participatory seed bulking and distribution of selected pure lines for IVs.

2. Agronomic Practices
   2.1 On-farm evaluation of cropping systems for IVs, French beans and mushrooms.
   2.2 On-farm trials on integrated soil, water and nutrient management for French beans and pumpkins.
   2.3 On-farm trials on Integrated Pest Management (IPM) options for French beans.

3. Improvement of Postharvest Handling Technologies
   3.1 On-farm evaluation of low cost produce handling sheds.
   3.2 Evaluate shed covering materials.
   3.3 Evaluate existing bulk packaging materials and promote the best bets.
   3.4 Develop, evaluate and promote new bulk packaging technologies.
4. **Improvement of value addition**
   4.1 Improve utility packaging technologies.
   4.2 Evaluate utility packaging materials and methods.
   4.3 Conduct consumer preference on packaging materials and methods.
   4.4 Evaluate product transformation technologies.
   4.5 Evaluate vegetable dehydration methods and promote the best bests.
   4.6 Evaluate milling and blending options for dried IVs and mushrooms

5. **Improvement of product quality and utilization**
   5.1 Develop quality guidelines for IVs and mushrooms along the vegetable value chain.
   5.2 Conduct quality evaluation of IVs and mushrooms along the vegetable value chain.
   5.3 Develop improved vegetable recipes.
   5.4 Evaluate sensory qualities of the finished vegetable products
   5.5 Analyze the nutritional integrity of vegetable products.
   5.6 Evaluate the shelf life of the vegetable products.

6. **Improve marketing opportunities for the vegetables**
   6.1 Develop supplier-buyer databases.
   6.2 Analyze produce volumes and pricing trends.
   6.3 Determine competing vegetable products.
   6.4 Conduct consumer preference profiling and marketing platforms.
   6.5 Evaluate farmer market organization models.
   6.6 Evaluate efficiency of market outlets.

7. **Increase Information, Communication & Knowledge Sharing Along the Vegetable Value Chain**
   7.1 Needs assessment of vegetable value chain.
   7.2 Package information for various VVC actors.
   7.3 Identify effective communication strategies for the VVC actors and operators.
   7.4 Produce communication materials for the VVC actors and operators.
   7.5 Transmit information using different media.
   7.6 Train chain actors in agronomic practices, post-harvest handling, value addition and marketing.
   7.7 Train chain actors in agribusiness in IVs, mushrooms and French beans.
   7.8 Formulate an IPMP that is uniform and adopted for all actors in the vegetable value chain.
Progress Reports for the Year 2012
1) Progress Report on French Beans
(John H. Nderitu and Bernald O. Ogola, MKU)

Horticultural sector contributes 33% GDP to the Kenyan economy, employing four million people. Kenya was exporting about 5584 tonnes of French beans per year and that those engaged in the production were mainly small scale farmers in the countryside. The constraints to French bean production include production inputs, transport and export regulations. The broad objective for the study was to determine pest management practices among small scale French bean production and efficacy of integrated pesticide regimes in managing thrips.

Broad Objective
• To determine pest management practices among small scale French bean production and efficacy of integrated pesticide regimes in managing thrips.

Specific objectives
• To determine pest management strategies used by small scale French bean farmers in Embu
• To evaluate the efficacy of integrating biological, synthetic and botanical pesticides in management of thrips.
• Enhance capacity of French bean farmers and extension providers

a) Determination of current pest control practices

Sampling procedure
▪ Sample size-70
▪ Multistage sampling technique
▪ Farmers randomly selected from the list of French bean farmers
▪ Structured questionnaire

Data collected
▪ Challenges to French beans production
▪ Farmer’s knowledge of pests and their management practices.
▪ French bean varieties grown, harvesting and post harvest
▪ Marketing, marketing channels and certification status of farmers
### Results

#### Farmers harvesting and post harvest practices in Embu East district

<table>
<thead>
<tr>
<th>Post harvest activities</th>
<th>Mwea east</th>
<th>Embu east</th>
<th>Where rejects are taken</th>
<th>Mwea east</th>
<th>Embu east</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorting</td>
<td>39.5</td>
<td>65.6</td>
<td>Sold locally</td>
<td>13.2</td>
<td>18.8</td>
</tr>
<tr>
<td>Washing</td>
<td>60.5</td>
<td>34.4</td>
<td>Thrown away</td>
<td>21.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Good and reject</td>
<td>47.4</td>
<td>50</td>
<td>Used at home</td>
<td>2.6</td>
<td>18.8</td>
</tr>
<tr>
<td>Different grades</td>
<td>31.6</td>
<td>37.5</td>
<td>Fed to livestock</td>
<td>52.6</td>
<td>59.5</td>
</tr>
</tbody>
</table>

#### Marketing, marketing channels and certification status of farmers in Embu East district

<table>
<thead>
<tr>
<th>Activity</th>
<th>Measure</th>
<th>Mwea east</th>
<th>Embu east</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing channel</td>
<td>Brokers</td>
<td>63.2</td>
<td>28.1</td>
</tr>
<tr>
<td></td>
<td>Exporters/processors</td>
<td>36.8</td>
<td>71.9</td>
</tr>
<tr>
<td>Point of sale</td>
<td>Sold at home</td>
<td>60.5</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Transported to exporters</td>
<td>13.2</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>Transported to central collection point</td>
<td>18.4</td>
<td>90.6</td>
</tr>
<tr>
<td></td>
<td>Transported to brokers</td>
<td>7.9</td>
<td>0</td>
</tr>
<tr>
<td>Distance to collection point(Kilometers)</td>
<td>1</td>
<td>18.4</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10.5</td>
<td>17.9</td>
</tr>
<tr>
<td></td>
<td>3 and more</td>
<td>10.6</td>
<td>57.1</td>
</tr>
<tr>
<td>Implementation of market standards</td>
<td>Yes</td>
<td>23.7</td>
<td>9.4</td>
</tr>
<tr>
<td>Type of standard</td>
<td>Global GAP</td>
<td>23.7</td>
<td>9.4</td>
</tr>
<tr>
<td>Plans for certification</td>
<td>Yes</td>
<td>15.8</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>Certified</td>
<td>0</td>
<td>3.1</td>
</tr>
</tbody>
</table>
b) Effects of integrating biological, synthetic and botanical pesticides on pod quality and yield of French beans

**Design-RCBD**

**Treatments**
- chemical plus biological pesticides
- chemical plus botanical pesticides
- conventional pesticide –
- botanical plus biological
- Biological pesticide
- Control plots - no pesticide application.

**Data collected**
- Growth parameters
- Thrips population
- Pod quality
- Pod yield

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Marketable Season 1</th>
<th>Marketable Season 2</th>
<th>Unmarketable Season 1</th>
<th>Unmarketable Season 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical+Biological</td>
<td>7.69b</td>
<td>5.61bc</td>
<td>2.30b</td>
<td>4.38ab</td>
</tr>
<tr>
<td>Chemical+Botanical</td>
<td>7.22b</td>
<td>5.72bc</td>
<td>2.77b</td>
<td>4.27ab</td>
</tr>
<tr>
<td>Conventional</td>
<td>8.58c</td>
<td>6.25c</td>
<td>1.167a</td>
<td>3.75a</td>
</tr>
<tr>
<td>Botanical+Biological</td>
<td>6.27a</td>
<td>4.91a</td>
<td>3.72c</td>
<td>5.13c</td>
</tr>
<tr>
<td>Biological</td>
<td>6.55a</td>
<td>5.30ab</td>
<td>3.69c</td>
<td>4.69bc</td>
</tr>
<tr>
<td>Control</td>
<td>6.27a</td>
<td>5.11ab</td>
<td>3.72c</td>
<td>4.88bc</td>
</tr>
<tr>
<td>LCD</td>
<td>178.6</td>
<td>1.998</td>
<td>178.6</td>
<td>2.01</td>
</tr>
<tr>
<td>Cv%</td>
<td>13.8</td>
<td>1.6</td>
<td>13.8</td>
<td>1.6</td>
</tr>
</tbody>
</table>
### Effect of different pesticide spray regimes on yield of French bean

#### Season 1
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fine</th>
<th>Extra fine</th>
<th>Rejects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical + Biological</td>
<td>MEAN</td>
<td>MEAN</td>
<td>MEAN</td>
</tr>
<tr>
<td>Chemical + Botanical</td>
<td>226c</td>
<td>1020b</td>
<td>406b</td>
</tr>
<tr>
<td>Conventional</td>
<td>154ab</td>
<td>744a</td>
<td>453bc</td>
</tr>
<tr>
<td>Biological + Biological</td>
<td>199bc</td>
<td>1347c</td>
<td>289a</td>
</tr>
<tr>
<td>Control</td>
<td>200bc</td>
<td>636a</td>
<td>554c</td>
</tr>
<tr>
<td>LCD</td>
<td>110a</td>
<td>609a</td>
<td>536c</td>
</tr>
<tr>
<td>CV%</td>
<td>18</td>
<td>9.9</td>
<td>6.4</td>
</tr>
</tbody>
</table>

#### Season 2
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fine</th>
<th>Extra fine</th>
<th>Rejects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical + Biological</td>
<td>MEAN</td>
<td>MEAN</td>
<td>MEAN</td>
</tr>
<tr>
<td>Chemical + Botanical</td>
<td>4.38ab</td>
<td>1563ab</td>
<td>419.8b</td>
</tr>
<tr>
<td>Conventional</td>
<td>4.27ab</td>
<td>1586b</td>
<td>364.6ab</td>
</tr>
<tr>
<td>Biological + Biological</td>
<td>3.75a</td>
<td>1708b</td>
<td>206.6a</td>
</tr>
<tr>
<td>Control</td>
<td>5.13c</td>
<td>1448ab</td>
<td>408.3b</td>
</tr>
<tr>
<td>LCD</td>
<td>4.69bc</td>
<td>1425ab</td>
<td>382.5ab</td>
</tr>
<tr>
<td>CV%</td>
<td>12.9</td>
<td>9.17</td>
<td>4.88bc</td>
</tr>
</tbody>
</table>

#### Data collected
- Gender
- Factors affecting attendance

### Enhancing capacity of French bean farmers and extension service providers

#### Farmers Field School
- Sensitization/awareness creation
- 33 farmers identified
- Training were done once a week from planting to harvesting

### Farmer Field School Attendance

<table>
<thead>
<tr>
<th>Date</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>25/10/12</td>
<td>12</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>30/10/12</td>
<td>12</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>8/11/12</td>
<td>11</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>15/11/12</td>
<td>12</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>20/11/12</td>
<td>9</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>29/11/12</td>
<td>7</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>6/12/12</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>11/12/12</td>
<td>7</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>
Training of farmers at the site
2) Progress Report on the Spider Plant
(Prof. Richard M. S. Mulwa and Dr. Joseph W. Matofari /Egerton University team)

Specific Objectives

• Enhancing production of spider plant vegetable & products.
• Improving post-harvest handling, value addition and utilization of spider plant vegetable products.
• Enhancing marketing opportunities for spider plant vegetable for smallholder farmers.
• Enhancing mechanisms for information, communication and knowledge sharing along the spider plant vegetable value chain.

Constraints to Spider plant production, postharvest technologies and marketing

• Absence/ limited seed supply systems
• Extension of vegetative phase - Enhancement of vegetative mass regeneration for increased production
• Quality vegetable presentation for enhanced acceptance
• Development of appropriate post-harvest technologies
  – Vegetable processing
    • Drying and mixes
    • Fresh pre-packs for supermarkets

Activity 1

• Reconnaissance survey of Project County – Homa Bay
• Selection of project partners – Farmers’ CBOs
• 4 initially selected
  – Currently working with 3 CBOs
    • Kendu Bay
    • Kabondo
    • Oyugis
• Findings: Spider plant only grown in kitchen gardens in a few homes
Activity 2

- Production technology mainstreaming
  - Planting bed preparation
  - Seed sowing and early crop care

Completed beds/ sowing

Newly established field – Kendu Bay
Homa Bay site

Low productivity - Extension of vegetative phase – increasing vegetable productivity
Low productivity - Extension of vegetative phase – increasing vegetable productivity

- On station experiments with undergraduates going on to investigate combinations of fertilizer, manures and deflowering on crop yields

Bulk handling of produce

Use of produce crates & packaging bags

Analysis of post harvest produce losses from bulk handling systems
Seed production

Ecotype evaluation for variety development

27 Co-types being evaluated at 3 sites to select best ones for variety development – Koibatek ATC

Year 2 activities

- Integrated soil, water and nutrient management
  - Use of FYM
  - Mulches and drip irrigation in dry seasons
- Post harvest handling and Value Addition
  - New bulk handling & utility packaging technologies – test runs and selection
  - Vegetable processing technologies – dehydration (Njoro Canning Partner)
    - Blanching and drying
    - Drying – solar, sun drying - student
    - Milling and mixes - Student
- Farmer trainings on post harvest handling and value addition techniques
Tangible benefits to farmers

Mr. Jagero

Nyar Egerton
3) Progress Report on Mushrooms Value Chain
Enhancing Production, Value Addition and Marketing of Indigenous Mushrooms among Smallholder Farmers in Kenya

(Fredrick Musieba, Stella Wanjiku, Knight Moraa, Bitutu Nyambane/ KIRDI team and Dr. Esther Kioko, collaborator from the National Museums of Kenya)

Introduction
• Mushrooms are valuable natural resources.

• Over-exploitation of wild mushrooms from the forests have not only resulted in shortage of various mushrooms but the extinction of several species in nature.

• In order to meet the growing demand for the mushrooms, it becomes important to conserve the mushrooms species by way of domestication.

• Domestication of the wild forms will ensure mycological identity, genetic improvement, quality and continuity in supply.

Overall Objective
To increase production, value addition, marketing and utilization of indigenous mushroom products among smallholder farmers in Kenya.

Specific Objectives
• To improve safe production of indigenous mushroom products through IPM practices

• To improve postharvest handling, value addition and utilization of indigenous mushroom products.

• To develop marketing opportunities for indigenous mushrooms among smallholder farmers.

• To develop mechanisms for information, communication and knowledge sharing along the indigenous mushroom value chain.

• To undertake initial project screening with a view to identifying environmental, social and gender concerns that must be addressed by the proposed research project. Subsequently, develop collaboratively an Integrated Pest Management Plan (IPMP) that must be shared and implemented amongst the various collaborators as well as shared and imparted to the other stakeholders who will be involved in this research.
**Project location**
Kakamega County

**Expected Outputs**

- Production of indigenous mushrooms products improved through IPM approaches.
- Postharvest handling, value addition and utilization of indigenous mushroom products improved.
- Marketing opportunities for indigenous mushroom products developed.
- Mechanisms for information, communication and knowledge sharing on mushrooms along the vegetable value chain developed.
- Environmental, social, gender and food safety concerns identified and sustainable strategies to address them undertaken.
- Availability of high quality and affordable mushrooms spawn
- Reduced postharvest losses along the indigenous mushrooms value chain and increased volumes of high quality mushrooms in markets.
- Increased range of mushrooms products and per capita consumption.
- Increased smallholder and community awareness and consumption of mushrooms; and overall improved incomes from mushrooms enterprises disaggregated by gender.
- Improved food safety and acceptability of the indigenous mushrooms along the Value Chain within an expanded market catchment.
Achievements:

Output 1. Production of vegetables enhanced through IPM

<table>
<thead>
<tr>
<th>Activity</th>
<th>Progress</th>
<th>Gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1. Crop Improvement</td>
<td>Baseline survey on utilization of mushrooms in Kakamega County</td>
<td>• Meagre germplasm</td>
</tr>
<tr>
<td>1.1.1. Germplasm collection, evaluation, and selection</td>
<td>Germplasm has been collected, characterised and evaluated</td>
<td>• Inadequate good quality spawn</td>
</tr>
<tr>
<td>1.1.2. Farmer participatory seed bulking and distribution of selected pure lines for IVs</td>
<td></td>
<td>• Poor production packages, low yields and quality of produce</td>
</tr>
<tr>
<td>1.2. Agronomic practices</td>
<td>Production trials have been undertaken</td>
<td>• Pest susceptible exotic varieties, overuse and misuse of pesticides, hazardous exposure of growers, consumers &amp; the environment, leading to development of chemical pest-resistance</td>
</tr>
<tr>
<td>1.2.1. Evaluate cropping systems for IVs, French bean and mushrooms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.2. Integrated soil, water &amp; nutrient management</td>
<td>Pest management through IPM approach being undertaken at Marama West, Kakamega County (M.Sc. student)</td>
<td></td>
</tr>
<tr>
<td>1.2.3. Pest management</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Baseline Survey on utilization of mushrooms in Kakamega County

• The pre-testing of data collection tools was done in December, 2011
• In February, 2012, data collection was carried out in five districts: Butere, Kakamega Central, Kakamega North, Kakamega South, and Lugari
• Information was gathered from 250 respondents
• Data was analysed using SPSS Version 17.0.1

Baseline Survey results

• Most of the respondents were female (70%).
• Many respondents had attained secondary school education (45%)
• Majority (98%) of the respondents had knowledge on mushrooms and had used them as food material.
• Wild mushrooms were a public good and free for all
• Collection of mushrooms was observed to be women’s and children’s occupation
• Mushrooms were seasonal, emerging only during rainy seasons

Poisonous mushrooms

• Scanty information was given on the poisonous species

Preservation of mushrooms

• Solar drying and smoking.

Trading in mushrooms

• Mushrooms are sold in the markets and roadsides
Recipes
The wild edible mushrooms are prepared according to diverse recipes

Beliefs on mushrooms production and utilization
Mushroom collection, production and utilization among the Luhya sub tribes are governed by diverse beliefs. For example:
  • Some believe that Termitomyces microcarpus mushroom is vomited by a snake.
  • Mushrooms are gifts from the ancestors

Awareness and adoption of mushrooms production technology
  • Majority of respondents were aware that mushrooms grew seasonally in the wild and their role was just to harvest.
  • On other hand, majority (93%) didn’t know that mushrooms can be grown artificially and be available throughout the year
  • However, majority (98) expressed interested in the training if offered

Threats and conservation status
  • Termitomyces mushrooms have a mutualistic symbiotic relationship with termites of the subfamily Macrotermitinae.
  • The termites are considered as pests in the sugarcane plantations, thus the farmers are using pesticides to control them.

Conclusion
  • The data presented here indicate that collection, processing and utilization of wild edible mushrooms is still an important economic activity in Kakamega County.
  • The study revealed that wild edible mushrooms habitats and germplasm are being destroyed.
  • These threats of depletion necessitate development of cultivation techniques that can be easily adopted by local farmers for conservation of this resource.

Collection and characterization of wild edible mushrooms from the Kakamega County
  • Mushroom samples were collected in April 2012 during rainy season.
  • They were collected according to the macro fungi sample collection protocol outlined by Mueller et al.,2004.
  • All isolates were identified based on morphological criteria using macro and micro characters in accordance with appropriate keys.
  • Five species of Termitomyces, 1 species of Pleurotus, and 2 species of Auricularia mushroom were collected and identified.
  • The starting culture from living mushroom fruit bodies of different varieties of wild edible mushrooms were obtained by tissue culture and spore prints (Stamets, 2000).
• Mushroom spawn was prepared according to the protocol by Isikuemhen et al., (2000).
**Termitomyces sp.** mushroom spawn

**Auricularia delicata** on dead log in Kakamega forest

**Auricularia auricula** on dead log in Kakamega forest

**Pleurotus citrinopileatus** mushroom growing on dead log of *Antiaris toxicaria* in Kakamega forest

**Pleurotus citrinopileatus** spore culture
Pure culture of *Pleurotus citrinopileatus* mushroom

*Pleurotus citrinopileatus* mushroom in the incubation room

*Pleurotus citrinopileatus* mushroom ready for harvesting at the KIRDI Mushroom Pilot Plant
Mushroom pests management through IPM approach

Achievements:

Output 2. Post Harvest Handling, Value Addition and Utilization of Vegetables Enhanced

<table>
<thead>
<tr>
<th>Activity</th>
<th>Progress</th>
<th>Gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1. Improvement of post harvest handling technologies</strong></td>
<td></td>
<td>• High post-harvest loses.</td>
</tr>
<tr>
<td>2.1.1. Low cost produce handling sheds</td>
<td></td>
<td>• Limited post harvest handling technologies, value addition and utilization studies done.</td>
</tr>
<tr>
<td>2.1.1.1. Evaluate shed covering materials</td>
<td></td>
<td>• Lack of expertise.</td>
</tr>
<tr>
<td>2.1.1.2. Evaluate produce storage environments</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.1.2. Packaging technologies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1.2.1. Evaluate existing bulk packaging materials and promote the best bets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1.2.2. Develop, evaluate and promote new bulk packaging technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.2. Value addition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2.1. Improve packaging technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2.2.2. Product transformation technologies</strong></td>
<td></td>
<td>• Limited post harvest handling technologies, value addition and utilization studies done.</td>
</tr>
<tr>
<td>2.2.2.1. Evaluate vegetable dehydration methods and promote the best bets</td>
<td></td>
<td>• Lack of expertise.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Poor food safety.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Low per capita consumption.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Limited agribusiness opportunities, and sensitization.</td>
</tr>
<tr>
<td>2.2.2.2. Evaluate juicing and pureeing methods and promote them</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2.2.3. Evaluate milling and blending options</td>
<td>Mushroom milling, bakery and pastry products</td>
<td></td>
</tr>
<tr>
<td>2.3. Product quality and utilization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3.1. Quality guidelines for the vegetables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3.1.1. Conduct quality evaluation of IVs and mushrooms along</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Insect pests were a major problem in mushroom production. Pest management studies through IPM approach were being undertaken at Marama West, Kakamega County by a M.Sc. student. Of the sampled insect pests from all the three sites, one insect pest species was common and infestation was high during the incubation phase of mushrooms. Work on the utilization of mushrooms at the household level had been done with the main objective being formulation of easy to prepare recipes using locally available ingredients. Recipe manual had also been compiled.
Utilization of Mushrooms at the House Hold Level

Objective:
• The main objective was to formulate easy to prepare recipes using locally available ingredients and to compile the recipes into a manual.

Common ingredients

The following products have been developed at KIRDI
• Dried whole mushrooms- oyster and button
• Mushroom flakes
• Mushroom powder/ flour
• Dried Mushroom vegetable mixes
• Composite flours
• Mushroom seasoning.
• Recipes were developed using the products and also using fresh mushrooms, i.e. button and oyster.
• The recipes incorporated baked products, red meat, white meat, stir fries, vegetables, and starches such as rice, wheat and maize meal.
• The prepared dishes were presented to members of the division for evaluation and the successful ones were compiled in a small manual that will be shared with various interest groups at a later date.
Spiced mandazis

Stir fried vegetables with mushrooms
4) Progress Report on the Amaranth

(Dr. Esther N. Kioko and Dr. Muthoka /National Museums of Kenya team)

The areas of research focus in amaranth value chain include:

- Needs assessment of amaranth value chain
- Evaluation of farmer organization
- Germplasm collection
- Farmer participatory seed bulking
- Pest survey, identification and integrated pest management
- Awareness and information dissemination

The research team had established Pilot plots at Meru Museum and Experimental plots established at MUCST. Farmer workshop was conducted on the 20th September 2012 to share experience on the amaranth value chain. Participants included farmers from two locations, MUCST, traders, researchers, Ministry of Agriculture.

Seeds germination tests were done. The seeds were sourced from three suppliers’ i.e Incas Health International Limited, Nubian and Simlaw Seed Company limited.

Two Species: A.cruentus; A. dubius

Progress

- Entry point: Ruiri KAPP Amaranthus SHG, Buuri District, Meru County (74F, 31 M)
- March/April 2012 seed from Simlaw
- Pilot plots established at Meru Museum
- Experimental plots established at MUCST
- Farmer field demonstrations
- Farmer workshop 20\textsuperscript{th} Sep. 2012 held to share experience on the amaranth value chain
- Participants included farmers from two locations, MUCST, traders, researchers, MoA

\textbf{Amaranth Activities Progress}
- Workshop resolutions: farmers to prepare land on time
- NMK/Simlaw to cater for seed

- October 2012 Seeds purchased from Incas Health International Limited.
- About 40 farmers planted in October 2012
- NMK-Meru plots
Constraints

- Poor seed processing and storage methods on-farm – plastic papers, open buckets, gunny bags
- Poor agronomic practices – land preparation, edge effects, uniform
- Research on optimum growth parameters lacking
- Extension services poor
Variation in seed quality on-farm compared to commercial sources (Table on germination)

<table>
<thead>
<tr>
<th>Collection date</th>
<th>Sampled farms</th>
<th>Locality</th>
<th>Days to max. germination</th>
<th>Germination %</th>
</tr>
</thead>
<tbody>
<tr>
<td>21/9/12</td>
<td>Joyce Gakii</td>
<td>Nchoroiboro</td>
<td>3</td>
<td>100%</td>
</tr>
<tr>
<td>21/9/12</td>
<td>Joyce Mathew</td>
<td>Nchoroiboro</td>
<td>7</td>
<td>74%</td>
</tr>
<tr>
<td>21/9/12</td>
<td>George Mureithi</td>
<td>Ruiru</td>
<td>3</td>
<td>100%</td>
</tr>
<tr>
<td>21/9/12</td>
<td>Mwongera George</td>
<td>Nchoroiboro</td>
<td>7</td>
<td>70%</td>
</tr>
<tr>
<td>21/9/12</td>
<td>Zachary Mureithi</td>
<td>Ruiru</td>
<td>7</td>
<td>74%</td>
</tr>
</tbody>
</table>

Seed quality from commercial sources (Table on germination)

<table>
<thead>
<tr>
<th>Purchase date</th>
<th>Source</th>
<th>%</th>
<th>Days to germinate</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/10/2012 – A. cruentus</td>
<td>Incas</td>
<td>100 %</td>
<td>2</td>
</tr>
<tr>
<td>11/10/2012 – A. dubius</td>
<td>Simlaw Seed Co.</td>
<td>100 %</td>
<td>3</td>
</tr>
<tr>
<td>01/10/2012 – A. cruentus</td>
<td>Simlaw Seed Co.</td>
<td>100 %</td>
<td>7</td>
</tr>
<tr>
<td>01/10/2012 – A. cruentus</td>
<td>Nubian</td>
<td>100 %</td>
<td>3</td>
</tr>
</tbody>
</table>

Handling to enhance seed quality

- Maturity – harvest at the point, same height (cut/squeeze, seed colour)
- Select shoots with enough seeds
- At least 30 health plants - diversity
- Harvest seeds to make 1 kg
- Avoid infested or diseased plants
- Put in appropriate – sugar bags, cottons
Plant health – no pests

Processing – drying the key factor

- Spread as thin layer under shade conditions
- Turn seeds over every four hours
- Every evening put seeds in container
- Return seeds indoors overnight
- Remove pests manually
- Leave for at least 10 days or when seeds are dry enough

Storage = how long?

- Open absorbent containers – khaki bags, cloth bags
- Sealed containers - Jerry cans, glass bottles
An Integrated Pest Management Approach of Amaranth Insect Pests in Meru County Kenya (Kagali Robert Nesta)

Introduction
- Amaranth belongs to the family Amaranthaceae
- There are over 60 sp. and 6000 var of amaranth
- It is consumed both as a vegetable and grain crop
- Amaranth was registered in 1991 as a crop in Kenya
- For the last one decade there has been a sharp rise in demand for African Leafy Vegetables.

Statement of the problem
Amaranth production is hampered by pest infestation. There is need to identify the pest complex of amaranth as well as develop a cheap and environmentally safe strategy to control/ manage pest in amaranth.

Research Objectives
1. To collect and identify insect pests associated with Amaranthus sp.
2. To collect and identify natural enemies found on amaranth.
3. To determine the yield loss as a result of insect pest damage
4. To determine the effects of various control strategies on the population of insect pest of amaranth.

Materials and Methods

Study Design
- Stratified sample collection was used to study insect diversity and abundance
In the *ex-situ* research completely randomized block design was used

**Sampling of insect pest and natural enemies**
- Sampling for insect pests and natural enemies was done at least twice every fortnight
  - Insects were collected by hand, beating sheet, sweep nets and pit falls.
  - Healthy plants were uprooted and stems and roots dissected to examine the presence of phytophagous insects

![Image of sampling insects](image)

**Plate 1a,b: Culturing of larvae for further identification**
- Insect pests were collected into vials, labeled and taken to the laboratory at NMK for identification, curation and archival.
- The specimens were killed and mounted on entomological pins for specific taxonomic identification

**Results & Discussion**
- A total of 21 species of insects have been identified so far
- This were grouped into 16 families and further into five orders:
  - Coleopteran
  - Heteroptera
  - Hymenoptera
  - Lepidoptera
  - Orthoptera
List of insect species found in the amaranth crop during the first growing season

<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coleoptera</td>
<td>Buprestidae</td>
<td>Buprestis sp.</td>
<td>Stem-girdling Weevil</td>
</tr>
<tr>
<td></td>
<td>Curculionidae/Cleoinae</td>
<td>Hypolabus nubilus</td>
<td>Amaranthus Weevil</td>
</tr>
<tr>
<td></td>
<td>Tenebrionidae/Lagrinae</td>
<td>Lagra sp.</td>
<td>Darkling Beetle</td>
</tr>
<tr>
<td></td>
<td>Coccinellidae</td>
<td>Chelomenis sulphurea</td>
<td>Lunate Ladybird</td>
</tr>
<tr>
<td></td>
<td>Curculionidae</td>
<td>Chelomenis lunata</td>
<td>Shiny Cereal Weevils</td>
</tr>
<tr>
<td>Hemiptera</td>
<td>Redunidae</td>
<td>Rhinocoris segmentalis</td>
<td>Assassin Bug</td>
</tr>
<tr>
<td></td>
<td>Pentatomidae/Scutellarinae</td>
<td>Sphaerocoris annulus</td>
<td>Shield-backed Bug</td>
</tr>
<tr>
<td>Coridae</td>
<td>Pentatoma sp.</td>
<td>Cletus indicator</td>
<td>Horned Coreid Bug</td>
</tr>
<tr>
<td></td>
<td>Cletus virudala</td>
<td>Green Stink Bug</td>
<td></td>
</tr>
<tr>
<td>Coreidae</td>
<td>Pentatoma sp.</td>
<td>Cletus capensis</td>
<td>Horned Coreid Bug</td>
</tr>
<tr>
<td>Pentatoma sp.</td>
<td>Pentatoma sp.</td>
<td>Nysius bimotatus</td>
<td></td>
</tr>
<tr>
<td>Tingidae</td>
<td>Dictyla nodipennis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coreidae</td>
<td>Cletus ochraceus</td>
<td>Horned Coreid Bug</td>
<td></td>
</tr>
<tr>
<td>Minidae</td>
<td>1 spp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hymenoptera</td>
<td>Formicidae</td>
<td>Solenopits sp.</td>
<td>Tropical fire ant</td>
</tr>
<tr>
<td></td>
<td>Braconidae</td>
<td>Bracon sp.</td>
<td>Wasp</td>
</tr>
<tr>
<td>Vespidae</td>
<td>Polybia sp.</td>
<td>Leaf Wasp</td>
<td></td>
</tr>
<tr>
<td>Lepidoptera</td>
<td>Sphingidae</td>
<td>Herpetogramma bipunctalis</td>
<td>Beet webworm</td>
</tr>
<tr>
<td>Orthoptera</td>
<td>Pyralidae</td>
<td>Sphenaratum sp.</td>
<td>Grasshopper</td>
</tr>
</tbody>
</table>

- The damaging species are found in four orders and can be further be grouped into:
  - Stem/Root Pest
  - Foliar Pest
  - Grain Pest
- Natural enemies of this pest found in 2 orders:
  - Coleopteran – Coccinellidae
  - Hymenoptera

- Population of important insects collected on amaranth

  - Population of the natural enemies remains fairly distributed throughout the season.
  - Grasshopper population is high when the plant is young and it decreases as the plant matures.
  - The major grain pest are: *Cletus sp.* and *Nezera virudala*
  - *Herpetogramma* sp. population increases as the plant matures.
There was significant difference between the mean grain loss in all treatments (N: 18, p-value: 1.902e-06).

The highest loss was observed during the second planting date. This can be attributed to build up of the pest from first planting date.
5) Progress Report on the Cowpea

(Dr M. Hutchinson, Dr. Jane Ambuko, Prof. Florence Olubayo, Mr. Francis Muniu/ UoN team)

Several activities that have been undertaken include:
- Project Inception - Nov 2011
- Value chain mapping exercise – Feb 6-8 2012
- Germplasm collection – February – March 2012
- Household, consumer and trader surveys in April and May 2012
- Germplasm evaluation - 1st trial – May-June 2012, 2nd trial – August – December 2012

A baseline study in Kilifi had been undertaken and learnt that the cowpea leaves were called “Mkunde” and the seed “Kunde” by the locals. The survey results showed that Kilifi County is a low food security area and crop production is done through intercrops with maize, cassava, cashew nuts, coconuts and bananas (rare). Approximately 33% of land was allocated to cowpeas and had an average yield of 5 tonnes of cowpea leaves/acre/season and 3 bags of cowpea seed/acre.

The following characteristics were mentioned as basis of selection of the cowpea variety grown: Use and color, taste and market, time to maturity, ability to regenerate depending on the next activity and all are selected for the BNF benefit. Cowpea roots produce poisonous substance that is toxic to human but also serve to control some weeds e.g. nut grass.

Major constraints to production of cowpeas
- High costs of inputs
- Poor market (poor prices)
- Seasonality (all farmers produce at the same time – periods of glut)
- Pests and diseases
- Climatic conditions (drought)
- Land (forced to intercrop rather than pure stands) in some areas
- Soil fertility
Ranking of the above ALVS based on consumption, production and market preference

<table>
<thead>
<tr>
<th>Name</th>
<th>Consumption</th>
<th>Production (frequency)</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Amaranth (Mchicha)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2. Solanum</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3. Cowpeas</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4. Mchunga (Wild lettuce)</td>
<td>5</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>5. Mwangani</td>
<td>9</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>6. Mrenda</td>
<td>4</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>7. Pumpkin leaves</td>
<td>6</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>8. Moringa</td>
<td>8</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>9. Cassava leaves</td>
<td>7</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>10. Hako la aviere (Matako ya Wazee)</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>11. Kidemu</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>12. Vongonya</td>
<td>10</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

Gender concerns in the cowpea value chain

<table>
<thead>
<tr>
<th>Activity</th>
<th>Adult male</th>
<th>Adult female</th>
<th>Female child</th>
<th>Male child</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land preparation</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input sourcing</td>
<td>X</td>
<td>XX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td>XX</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Management - weeding</td>
<td>XX</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Harvesting</td>
<td>XX</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Marketing</td>
<td>XX</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation</td>
<td>XX</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of proceeds</td>
<td>XXX</td>
<td>XX</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Germplasm collection evaluation and selection of cowpeas

- The activity was carried out from 4/4/12 to 13/4/12 and we collected the germplasm from Kilifi and Mombasa counties within 2 agro ecological zone. (Coast Lowland 3 and Coast Lowland 4)
- The areas covered in Kilifi County were Malindi, Magarini, Lango Baya, Bamba, Ganze, Vitengeni, Chonyi, Bahari, Kikambala and Likoni in Mombasa County.
- The indigenous varieties were hard to collect as most farmers were now planting the improved ones.
- 32 cowpea accessions were collected from Kilifi and Mombasa counties and an evaluation and selection trial was established at KARI Mtwapa.
<table>
<thead>
<tr>
<th>No</th>
<th>Details</th>
<th>No</th>
<th>Details</th>
<th>No</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kaimakoko</td>
<td>16</td>
<td>Usimpe mtu</td>
<td>31</td>
<td>VT - 02</td>
</tr>
<tr>
<td>2</td>
<td>Katatariko</td>
<td>17</td>
<td>Mnyenze</td>
<td>32</td>
<td>VT - 01</td>
</tr>
<tr>
<td>3</td>
<td>Kiringongo mawe</td>
<td>18</td>
<td>Mnyenze X</td>
<td></td>
<td>Coding of varieties/ unknown local names</td>
</tr>
<tr>
<td>4</td>
<td>Kunde kubwa</td>
<td>19</td>
<td>Mtsemer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Kunde za Kigiriama</td>
<td>20</td>
<td>MG - 01</td>
<td>**</td>
<td>MM - Malindi Magarini</td>
</tr>
<tr>
<td>6</td>
<td>KVU</td>
<td>21</td>
<td>MLB – 01</td>
<td>**</td>
<td>MLB - Malindi Langobaya</td>
</tr>
<tr>
<td>7</td>
<td>MM - 05A</td>
<td>22</td>
<td>MLB – 02</td>
<td>**</td>
<td>MLK - Mombasa Likoni</td>
</tr>
<tr>
<td>8</td>
<td>MM - 05B</td>
<td>23</td>
<td>MLB – 05</td>
<td>**</td>
<td>VT - Vitengeni</td>
</tr>
<tr>
<td>9</td>
<td>Murahai</td>
<td>24</td>
<td>MLB - 06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>MM - 01</td>
<td>25</td>
<td>MLB-07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Sura Mbaya</td>
<td>26</td>
<td>MLK - 02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>MM - 02</td>
<td>27</td>
<td>MLK - 03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>MM - 03</td>
<td>28</td>
<td>Mwandat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>MM - 04</td>
<td>29</td>
<td>Usimpe mtu kubwa</td>
<td></td>
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<tr>
<td>15</td>
<td>Mixed MLB</td>
<td>30</td>
<td>Usimpe Mtu mdogo</td>
<td></td>
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</tr>
</tbody>
</table>

**Evaluation of cowpeas**

![Image of cowpeas]
Value Chain Actors Mapping

The following were interviewed:

1. Farmers
2. Traders (Rural assemblers/brokers, urban brokers, wholesalers, retailers, hawkers (mama mbogas))
3. Food retailers (restaurant, hotels, other food vendors (e.g., kiosks))
4. Municipal market authorities in Kongowea market and Marikiti (downtown) market
5. Cowpea grain/seed traders
6. Cowpea researchers (in KARI)
7. Agricultural extension staff
8. Farmer groups
Marketing channels of cowpeas

Sega market: cowpeas arrive in this market in bags and are sold wholesale or retails

Mature cowpea leaves sold as heaps in Sega market. No standards measurement scale exists
A retailer stuffing mature cowpea leaves into a plastic bag. The bag costs Ksh 10

Young cowpea sold in bundles in Kongowea market. The young leaves cost more

Cowpea grain: most local farmers grow cowpea for grains and are only starting to eat leaves
Consumption – kiosks/ farmers
- Limited to communities from Western Kenya and the middle to high income consumers who consume it for health/nutrition reasons.
- The most common vegetables sold in these outlets were amaranth and kale.
- Why?
  - Low demand;
- Not used to cowpeas – indigenous people

High-end tourist markets
- Common - Spinach, kale and amaranth - even during cultural nights
- Why not cowpea–
  - Lack of consistent supplies of “good-looking” cowpea
  - Poor handling and unsure safety standards
  - Lack of traceability.

Value addition:
Not sure as “Most people eat with their eyes first. If the eye tells a person that the food is good, then the rest matter less”.
Possibility: freezing, vacuum packing, MAP

Evaluation of cowpea accessions 2012
High Yielders
1. Mwakipipi
2. Mtsemeri
3. Katsetse
4. MM-03

Summary and planned activities for year 2
- We are on course in the implementation of the project and anticipate completion of the planned activities on time weather conditions permitting

Activities Planned
- Data analysis and selection of about 5 superior accessions/varieties
- Farmer participatory seed bulking and distribution of materials
- Evaluation of cropping systems for cowpeas – mainly fertilizer use
- Evaluation of (alternative) bulk packaging technologies
- Evaluation of farmer organization models
6) Progress Report on the Pumpkin

Enhancement of Productivity, Value Addition and Utilisation of Dual-purpose Pumpkin among smallholder farmers in Kenya

(Prof. D. K. Isutsa (PI), Dr. B. Nyende; Prof. Tuitoek; Dr. P. Njiraine; Dr. J. Otieno; Dr. M. Kasina; Mr. E. Njuguna (Collaborators), James K.K.; Jedidah W.K.; Dionysious W.M.; Margaret M.M. (Students), Chuka University, MoA, Jomo Kenyatta University, Egerton University, Njoro Canners, and KARI Regional Research Centres)

Background
Pumpkin (Curcubita moschata Duch.) in an emerging fruit-vegetable that belongs to the family Cucurbitaceae and is known by various other vernacular names. It originated in Central to South America, from where it has spread to many other continents, including Africa where it has become naturalized and is categorized among indigenous vegetable (Abukutsa-Onyango, 2007). In 2000, worldwide production of pumpkins stood at 16 million tons from 1.3 million ha, while production in Africa was approximately 1.8 million tons on 140,000 ha, yielding 12.8 t/ha on average. On a global scale, pumpkin is amenable to making many products using its tender leaves or mature fruits. However, preferences vary from region to region. Leaves are the main edible product in African countries, leaving fruits under-utilized (Abukutsa-Onyango, 2003). In West Africa, seed consumption is common. In Asian countries, pumpkin seeds have several medicinal applications such as anti-helmintic and skin ailments relief. Pumpkin is an important food because most parts of the plant can be eaten and are rich in nutrients (Holland et al., 1991). Pumpkin is very rich in carotenoids that keep the immune system strong and healthy. Pumpkin beta-carotene is a powerful antioxidant and anti-inflammatory agent. It helps prevent build up of cholesterol in arteries, thus reducing chances of strokes. Being rich in alpha-carotene, pumpkin slows down aging and prevents cataract formation. Pumpkins reduce the risk of macular degeneration that usually results in blindness. Pumpkin’s high fiber improves bowel health, potassium lowers hypertension risk, and zinc boosts immune system and bone density.
**Statement of the Problem**

Pumpkin is neglected in formal research and is most under-utilized in African countries. Cultural practices in African countries are still extensive, while seed, fruit and leaf vegetable yields are depressingly low due to a combination of poor agronomic practices. Almost no improvement for high and premium seed, fruit and leaf vegetable yields, pest resistance and quality has been performed in African countries. Preferred local African landraces risk disappearing due to introduction of exotic cultivars, and their seeds are in perpetual short supply. Pumpkin is little produced, commercialised and consumed in Africa. Meagre value addition is done to pumpkins found in African markets. No export statistics exist in the Kenyan Horticultural Crops Development Authority on-line databases. Processed products of the fruit are virtually nil in African countries. There is exists no documented pumpkin value chain (PVC), preference and consumption trends in Kenya.

**Research Justification**

Pumpkin is a multi-purpose, easy-to-cultivate crop with high nutritional and medicinal values. Pumpkin plants produce large leaves and fruits usable in diverse ways. De-veined tender leaves and mature fruits are cherished by rural folk and certain urban dwellers. Fruits have a tough rind that prevents bruising during transportation to distant markets, thereby helping prolong shelf-life.

Identification and conservation of landraces will provide germplasm for improving cultivars for pest-resistance, fruit, leaf and seed yields, depending on consumer-preferred usage. Streamlining certified seed supply and improving crop management will prove a boon to growers looking for alternative high-value crops to help boost and sustain their livelihoods. Boosting certified seed supply, crop production and value addition will increase income generation for growers, as well as food security and foreign exchange earnings for the country. These milestones will benefit all value chain stakeholders, including crop germplasm conservators, plant breeders, inputs suppliers, crop producers, retailers, wholesalers, exporters, processors and consumers. A documented PVC, preference and consumption trends in Kenya will enable all stakeholders identify gaps, constraints and potential benefits, and thereby develop effective intervention or exploitative measures and policies.
Goal/Purpose
To collect, evaluate, characterise and conserve germplasm, increase productivity and value of the under-utilized, dual-purpose pumpkin for enhanced incomes, economic growth, food and nutrition securities.

General Objectives
Improve dual-purpose pumpkin production, processing, packaging technologies and develop innovative processed products for consumers.

Specific Objectives
2. Develop pure seeds of dual-purpose pumpkin in Kenya.
3. Develop optimal crop management packages for sole pumpkin production.
4. Add value to fresh produce and develop new recipes for pumpkin produce

Outputs
1: Preferred landraces of dual-purpose germplasm identified and preserved.
2: Production of indigenous vegetables (pumpkins) improved through:
   - Crop Improvement
   - Agronomic practices
3: Postharvest handling, value addition and utilization of pumpkins improved through:
   - Improvement of post harvest handling technologies
   - Value addition and recipe development
   - Produce transformation and utilization
4: Mechanisms for information, communication and knowledge sharing developed through:
   - Information, communication and knowledge sharing

Beneficiaries of the outputs and outcomes
1. Small-scale and resource-poor farmers will gain adaptable and preferred cultivars.
2. Resource-poor farmers will have easy access to high quality and quantity seeds.
3. Small-scale growers will have proven cropping systems for commercial production.
4. Consumers and sellers will have diverse processed food products with prolonged shelf-life to choose from to improve their nutrition and to satisfy customer needs, respectively.

5. Processors, chefs and consumers will have new and diverse recipes for preparing delicious foods and meals.

6. Postgraduate students will have projects to work on to earn higher degrees.

7. Agro-industries will benefit from the skilled graduates and increased pumpkin raw materials for processing.

8. Scientific community will benefit from the publications, protocols and literature availed.

Research plan/methodology

1. Collect, evaluate, characterize and conserve pumpkin germplasm in Kenya

Collection will be conducted in Western and Central Kenya. A questionnaire will be administered in these regions to document the pumpkin value chain. Seeds will be extracted from fruits, washed to remove pulp, air-dried and planted in pots in a greenhouse to raise plants for evaluation and characterisation. Characterization of landraces will use both morphological and molecular techniques (Chigwe and Saka, 1994; Gwanama et al., 2000; Grubben and Chigumira-Ngwerume, 2004). Code-numbered seed samples of landraces will be deposited in the Kenya Plant Genetic Resources Gene Bank. The landraces will be evaluated and selected based on growers’ and consumers’ demands such as high yields, early maturity, good flavour and size, drought tolerance and pest tolerance.

2. Develop pure seeds of dual-purpose pumpkin in Kenya.

Best-performing landraces will be planted to multiply seeds in pure standards on-station and on-farm. On-farm seed production and saving will be taught to smallholder farmers, emphasizing growing of preferred pumpkins in isolation and exclusively for seed production, extraction, drying, packaging and storage for later use. Choice of landraces to save and their quantity will depend on preference and size of future planting (Abukutsa-Onyango, 2007).

3. Develop optimal crop management packages for sole pumpkin production.

3.1. The effect of farmyard manure and leaf harvesting intensity on productivity will be investigated. Cattle farmyard manure (FYM) is expected to work through soil fertility
enhancement, moisture stress amelioration and source-leaf renewal. Farmyard manure will be interacted with LHI to study how they influence leaf and fruit yields (sink-source relationship). For each province the adapted and preferred variety of pumpkin will be planted during the long and short rains.

3.2. Effect of irrigation will be studied with a view to promote year-round or semi-arid regions production. Leaf harvesting intensity will be interacted with irrigation rate. The most preferred cultivar will be used in each target region.

4. **Add value to fresh produce and develop new recipes for pumpkin produce**

4.1. Food processors, including bakeries, hotels and restaurants will be approached to include pumpkin produce in their foods. The products will be offered to buyers and consumers through supermarkets, bakeries, hotels and restaurants and preference assessed.

4.2. Value addition strategies for and by producers, sellers and processors to be investigated include leaf or fruit drying, waxing whole fruits, wrapping, slicing and mixing in pre-diced vegetables for busy customers. The products will then be offered to consumers through selected supermarkets and retailers.

4.3. Surveys will be conducted to document usage modes in the target regions and to guide researchers in development of recipes for preferred and new products. A schedule for gauging popularity will be developed to capture: frequency of use, preference by gender, reasons mode is preferred, reason not preferred, ingredients and proportions used. The cuisines will be blended and samples taken to determine nutritional contents following standard protocols (AOAC, 1995; Okalebo *et al*., 2002).

**Major assumptions and risks**

1. Resources and funding will be adequate to support the proposed research activities.
2. Local communities will be willing to share their crop germplasm with the researchers.
3. Seed production and food processing companies will be willing to partner in this project.
4. The weather will be conducive to allow successful completion of field experiments.
5. Pumpkin will continue gaining popularity among local and urban consumers.
6. Postgraduate students will be willing to pursue advanced studies in this fruit vegetable.
7. Collaborators will be commitment to play their part successfully.
8. One or more of the above-mentioned assumptions will not hold true.

**Preliminary results**
The research has been implemented successfully in Kakamega and Nyeri KAPAP Regional Service Units (RSUs) as well as Chuka, KARI-Embu and KARI-Kabete.

**Output 1: Vegetable Production Enhanced**

**1.1.1b Germplasm collection, evaluation and selection**

**1.1.3b Seed bulking and distribution of selected pure seeds of pumpkins**
- Germplasm was collected in the KAPAP recommended Kakamega and Nyeri RSUs.
- Accessions were planted on Chuka University Farm to provide material for evaluation.
- Morphological characterisation and evaluation was based on IPGRI descriptors.
- Farm evaluation of baby trials is continuing on farmers’ farms in the RSUs.
- Mother trials first round are continuing at KARI Kakamega and Embu.
- Among the 155 accessions collected 8 accessions failed to germinate and 1 accession died before the commencement of data collection.
- 146 accessions gave data on vegetative, stem, root and inflorescence characters.
- Only 126 accessions formed fruits.

**Morphological characters recorded were:**
- Nodes to the first fruit,
- Stem thickness,
- Leaf ratio,
- Days to first flowering,
- Days to 50% flowering,
- Penduncle length,
- Fruit flesh thickness,
- Fruit length width ratio,
Days to first mature fruit,
Maturation period and
Total fruit weight.

Nyeri pumpkins

Kakamega pumpkins
- Significant variability was found among 146 accessions of cucurbits.
- Fruit weight ranged from 0.5 to 19.3 kg per accession.
- Fruit length/width ratio ranged from 0.7 cm to 2.1 cm.
- Morphological traits that varied greatly were fruits.
- All accessions had leaf veins, large leaf size, leaf pubescence density-adaxial was dense while abaxial was intermediate, leaf lobes were shallow, leaf base shape was cordate.
- Leaf shapes were pentalobate and all accessions had roots at internodes.
- Leaf outline of 108 accessions was broadly ovate.
- Most accessions (101) were variegated i.e. green with silvery strips.
• 45 accessions were either solid green or dark green.
• 88 accessions showed moderate senescence when fruits matured.
• 44 accessions portrayed conspicuous concurrent senescence.
• All accessions were monoecious.
• Most flowers were male.
• Most male flowers were earlier than female flowers.
• 9 accessions had female flowers appearing before male flowers.
• Flower colour varied.
• Most accessions (101) had orange flower colour.
• 38 accessions exhibiting globular shape.
• 42 accessions had an average fruit size averaging 1.2 kg.
• One accession matured within the range of 91-110 days.
• Delay in fruit maturity was due prolonged drought.
• 99 accessions regenerated second fruit cycle after harvest.
• 27 accessions had no signs of second fruit cycle as vegetative part dried up.
• Predominant fruit skin colour at maturity ranged from green to orange.
• Secondary fruit skin colour pattern that varied from speckled to striped.
• Fruit surface ranged from smooth to skin surface with warts, and
• Internal flesh colour ranged from white to yellow.
• Main colour of outer layer ranged from yellow to salmon (pink-red).
• All the accessions had fruit vein tracks and the peduncle abscised when overripe.
• Deep fruit ribbing was in 40 accessions and 69 accessions had small blossom scars.
• Kakamega accessions yielded (310 kg), compared to Nyeri’s (183.75 kg) in total.
• Min and max fruit weight in Kakamega was 0.5 kg & 19.25 kg/accession, respectively.
• Min and max fruit weight in Nyeri was 0.25 kg & 8 kg/accession, respectively.
• Average fruit weight for the Kakamega accessions was 4.8 kg.
• Average fruit weight for Nyeri accessions were 2.96 kg.
• It took more days for fruits in the Nyeri region to mature.
• Kakamega accessions had more thick fleshed fruits.
• Kakamega accessions showed more variation in characters.
• Nyeri accessions showed variation in flowering, maturation, and stem girth.
• Green-leafed accessions were very vulnerable to pests and diseases compared to variegated accessions.
• Green-leafed accessions fruited early but most aborted and didn’t reach maturity.
• Green-leafed accessions fruit number averaged 1 fruit per accession.

Conclusions
• There is great variation in pumpkins in Kenya.
• Cultivars seem to be interbreeding a lot.
• Conservation of naturalised germplasm needs to be expedited to save it from further distortion and extinction.

Continuing Work on Germplasm
• Mother trials evaluation of performance: By researchers
• Baby trials evaluation of performance: By farmers
• Mother versus baby trials determine whether results on-stations of researchers can be replicated on-farms of growers.
• Molecular characterisation
• Pure seed bulking of preferred landraces
• Distribution of pure seeds to farmers
• Farm-saving of seeds
• Germplasm conservation with the GBK

Challenges in Germplasm collection
• Activities are expensive
• Funding is inadequate
• Coverage of all of Kenya as desired proved costly
• Professional expertise is expensive and hard to secure
1.2.2a Integrated Soil, Water and Nutrient Management

Subproject Title: Mineral nutrients sources and leaf harvesting intensity (LHI) effects on fruit and leaf vegetable yields

Research Sites: Nyeri and Kakamega RSUs

Nutrient source: 0, 4 g 10N:10P:10K, 4 & 8 kg FYM per plant

LHI: 0, 1, 2, 3 leaves per branch once per week

- Fertilizer type had a significant effect on leaf weight harvested in all the days of evaluation, including cumulative weight.
- The no fertilizer had significantly the lowest leaf weight, while 8 kg FYM had significantly the highest harvested leaf weight.
- Fertilizer source had an effect on number of fruits harvested in both sites.
- In both sites, 8 kg FYM had more fruits compared with the other nutrients.
- However this was not significantly different with 4 kg FYM in Nyeri.
- No fertilizer had significantly the lowest fruits harvested in both sites.
- Fertilizer type had effect on fruit weight in both sites.
- In both sites, FYM at 8 kg had more fruit weight compared with the other treatments.
- However this was not significantly different with FYM at 4 kg in Kakamega.
- The zero fertilizer had significantly the lowest fruits harvested in both sites.
Leaf harvest intensity had a significant effect on leaf weight in both sites.
The highest leaf weight was recorded for plants with three leaves harvested per branch in both sites.
The control had significantly the lowest leaf weight.
Leaf harvest intensity had a significant effect on number of fruits harvested in both sites.
In both sites, control had more fruits harvested compared with the other treatments.
The 0 LHI had significantly highest fruits harvested in both sites.
Leaf harvest intensity had a significant effect on fruit weight in both sites.
In both sites, the 0 LHI had significantly more fruit weight compared with the other LHIs, while the 3 LHI had significantly the lowest fruit weight.

Conclusions
- FYM was superior to NPK
- 8 kg FYM was superior to all other nutrient levels
- Nutrient source effect on both leaves and fruits was significant
- 0 LHI = no leaf vegetables but highest fruits
- 3 LHI = highest leaf vegetables but lowest fruits
- LHI effect on both leaves and fruits was significant
- Sites (Nyeri and Kakamega) led to same conclusions
Subproject Title: Irrigation rate and leaf harvesting intensity effects on fruit, seed and leaf yields

Research Sites: KARI Embu and KARI Kabete

Irrigation rate: 1, 2, 3, 4 litres per plant once per week

Defoliation: 0, 1, 2, 3 leaves per branch once per week

Rain shelters such as these ones were used to keep out rain water

Results

KARI-Embu
- Effects of irrigation rate (L) and LHI (R) were significant on leaf weight (g).
- 1 litre was the only one significantly different from the other litres.
- 0 LHI was the only one significantly different from the other LHI.
KARI-Kabete
- Effect of irrigation rate (L) NS and LHI (R) significant on leaf weight (g)
- Leaf weight increases with increase in irrigation rate & then declines
- 0 LHI was the only one significantly different from the other LHI
Results on leaf yield were as expected. Increase in irrigation rate & LHI increased leaf yields.

KARI-Embu
Effect of irrigation rate (L) NS and LHI (R) significant on fruit weight (kg)

KARI-Kabete
Effect of irrigation rate (L) NS and LHI (R) significant on fruit weight (kg)

Fruit harvesting is not complete.
Results of cumulative fruits might be as expected.
Fruit abortion affected treatments and cause(s) need(s) to be investigated.
Field Challenges

- Moles
- Rain shelter expense.
- Hailstones.
- Powdery mildew.
- Fruit abortion

Output 2: Postharvest handling, value addition & utilization of pumpkins improved

2.1.2.2a Develop, evaluate and promote new bulk packaging technologies
2.2.2.1a Evaluate pumpkin dehydration methods and promote the best ones
2.3.2a Develop improved recipes for pumpkin

- Elaborated proposal is ready
- Experimentation to start this year
- Will work on produce transformation, blending, packaging, shelf-life, recipe development, nutrient content & integrity, income generated

Challenges

- Experiments are expensive
- Funds are inadequate
Planned activities for 2013

**Output 1:**
- Field evaluation of accessions
- Molecular characterisation of accessions
- Participatory pure seed bulking and distribution
- Germplasm conservation at GBK
- Complete nutrient and water management experiments
- Data analysis and publication

**Output 2:**
- Embark on postharvest, value addition & recipe development experiments

Planned activities for 2014

**Output 4:**
- Transmission using different media
- Train stakeholders in optimal pumpkin agronomic practices, post-harvest handling, value addition and marketing strategies.
7) Progress Report on the Nightshade

Enhancing Production, Value Addition and Marketing of Indigenous Vegetables (nightshades), among Smallholder Farmers in Kenya

Dr. Darius Otiato Andika, Jaramogi Oginga Odinga University

Germplasm collection and evaluation

- **S. grossidentatum.** Plant parts covered by dense long white glandular pubescence, including leaves (i and ii), stems, peduncles, pedicels and calyces (iii and iv); fully ripe berries light green-yellowish green (iv).

- More hairy variant. **S. villosum.** Plant parts covered by long white eglandular hairs including leaves (i and ii), stems, peduncles, pedicels and calyces (iii and iv); corolla have prominent purple strips (iii); hair density variable
• Less hairy variant of *S. villosum*. Plant parts covered by short eglandular hairs (variable density); corolla may have purple strips (iii); ripe berries turn yellow, dropping with pedicels

• *S. tarderemotum*. Variable leaf morphology (i). Berries turn either light green (ii), purple, or green with purple patches when ripe; always drop with pedicels (iii). Inflorescence may be simple (ii) or branched once (iv).

• *S. florulentum*. Variation in leaf morphology (i and ii). Inflorescences extensively branched (ii). Berries turn dull purple (iv) and drop with pedicels when fully ripe
• *S. villosum* variant with entire/undulate leaf margins (i) and erect growth habit (ii).

• *S. villosum* variant with spreading growth habit (i) and entire/undulate leaf margins (ii).

• Prostrate variant of *S. scabrum*. Stems prostate (i) often purple colored; flowers (iii) white or light purple; inflorescences sometimes branched.
Purple-stemmed *S. scabrum* variant. Erect growth habit; leaves medium (i) to large (ii); with varying intensities of purple coloration. Flowers (iv) usually deep purple, with distinctly brown anthers.

- *S. scabrum* variant. Erect-spreading growth habit; leaves large (i and ii) with varying intensities of purple coloration. Stems and leaf veins usually light purple. Flowers (iv) usually light purple with brown anthers.

- Large leaved *S. scabrum* variant. Erect habit; leaves large (i and ii); few flowers/fruits per inflorescence (iii). Leaves and stems green; flowers (iv) white with yellow anthers.
• Green-stem, spreading *S. scabrum* variant. Spreading habit; medium-sized green leaves, erect pedicels; white flowers; yellow anthers.

• Erect, green-stemmed *S. scabrum* variant. Erect habit (i); medium-sized green leaves. Flowers (ii) white with yellow anthers. Stem often more woody.

• *S. americanum*. Erect-spreading habit (i and ii); entire-undulate green leaves with no pubescence. Flowers (iii) white with yellow anthers. Berries dark purple, shiny; erect pedicels; berries drop from pedicels when fully ripe (v).
Participants in stakeholders’ forum from Siaya County

Issues and Way Forward

• Community seed bulking and seed bank within Siaya County.
• Formation of farmer groups – for purposes of investing in water tanks to store roof catchment water for irrigation.
• Promote AIV - to create awareness on importance of AIV nutrition and utilization.
• Post harvest handling - Train stakeholders on improved post harvest handling of AIVs.
• Marketing – carry out market survey to establish the most popular and consumer preferred AIV-nightshade. In addition, encourage formation of producer marketing groups to undertake AIV farming as a business

• Train farmers and encourage them to practice value addition techniques such as blanching, drying and packaging to make the vegetable more attractive and available during dry season

• Train farmers on the importance of farmer record keeping and create linkages between vegetable traders at various markets in Bondo to create increased demand for AIV

• All stakeholders in the meeting agreed to initiate commercialization of AIV production especially African nightshade

**Market Survey in Siaya County**

• Needs assessment of nightshade vegetable value chain actors
• Develop supplier-buyer database for night shade
• Analyze produce volumes and pricing trends for nightshades
• Determine competing products for nightshades
• Conduct consumer preference profiling for nightshades

*Market interviews with AIV traders at Bondo market*
Retail trader displaying AIV vegetables at Siaya market center

Water deficiency as a major obstacle to AIVs production
KAPAP Vegetable Value Chain Project Planning Workshop Programme

PLANNING WORKSHOP ON KAPAP VEGETABLE VALUE CHAIN PROJECT AT THE OLD BOARDROOM, NATIONAL MUSEUMS OF KENYA, NAIROBI

11TH FEBRUARY 2013

PROGRAMME

<table>
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<tr>
<th>Time</th>
<th>Activity/presentation</th>
<th>By who</th>
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<tbody>
<tr>
<td>Session I:</td>
<td>Chair person:</td>
<td>Prof. John Nderitu, MKU</td>
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<td>Rapporteurs</td>
<td>Mr. Fredrick Musieba, KIRDI</td>
</tr>
<tr>
<td>8.30-8.45 am</td>
<td>Arrival, Registration</td>
<td>Ms Josephine Kyaa, NMK</td>
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<tr>
<td>8.45-9.00 am</td>
<td>Introductions</td>
<td>Dr. E. N. Kioko, NMK</td>
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<tr>
<td>9.00-9.10 am</td>
<td>Welcome and opening remarks</td>
<td>Dr. Geoffrey Mwachala, Director, Research and Collections, NMK</td>
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<td>9.10-9.20 am</td>
<td>Overview of the project</td>
<td>Prof John H. Nderitu, Principal Investigator, MKU</td>
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<tr>
<td>9.20-9.50 am</td>
<td>Key note speech</td>
<td>National Coordinator, KAPAP</td>
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<td>9.50-10.00 am</td>
<td>Remarks by other key guests</td>
<td>Dr Caleb Ikitoo, Research Specialist, KAPAP</td>
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<tr>
<td>10.00-10.30 am</td>
<td>Group Photo and Tea/Coffee Break</td>
<td>All</td>
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<tr>
<td>Session II:</td>
<td>Chairperson:</td>
<td>Prof. Dorcas Ikutsa, Chuka University</td>
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<td>Rapporteurs:</td>
<td>Dr Mulwa, Egerton</td>
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<tr>
<td>10.30 am -12.45 pm</td>
<td>Presentations by project implementing collaborators</td>
<td>Prof. Nderitu/Mount Kenya University team</td>
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<td>Dr R. Mulwa/ Egerton Univeristy team</td>
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<td>Mr Fredrick Musieba/ KIRDI</td>
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<td>Dr. E. Kioko/NMK team</td>
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<td>Dr M. Hutchinson/ UoN team</td>
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<td>Prof Dorcas Ikutsa/Chuka University team</td>
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<td>Dr Andika/Bondo University team</td>
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<td>Invited researchers/Private sector team</td>
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<tr>
<td>12.45-1.15 pm</td>
<td>General Discussions/Feedback</td>
<td>All participants</td>
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<tr>
<td>1.15-2.00 pm</td>
<td>Lunch</td>
<td>All</td>
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<tr>
<td>Time</td>
<td>Activity</td>
<td>Presenter/Implementing Collaborators</td>
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<tr>
<td>2.00-2.45 pm</td>
<td>Presentation and discussion on the work plans for each component for year 2</td>
<td>Prof Nderitu /implementing collaborators</td>
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<td>2.45-3.45 pm</td>
<td>Presentation of Concept note for further funding by the World Bank on specified identified areas</td>
<td>Dr Caleb/implementing collaborators</td>
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<tr>
<td>3.45-4.20 pm</td>
<td>General discussions</td>
<td>All participants</td>
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<tr>
<td>4.20-4.30 pm</td>
<td>Conclusions and way forward</td>
<td>Prof Dorcas Isutsa</td>
</tr>
<tr>
<td>4.30-4.35 pm</td>
<td>Vote of Thanks</td>
<td>Dr. Richard Mulwa, Egerton University</td>
</tr>
<tr>
<td>4.35-4.55 pm</td>
<td>Tea/Coffee/</td>
<td>All participants</td>
</tr>
<tr>
<td>5.00 pm</td>
<td>KWAHERI /Departure</td>
<td></td>
</tr>
</tbody>
</table>
# List of Participants

**PLANNING WORKSHOP ON KAPAP VEGETABLE VALUE CHAIN PROJECT AT THE OLD BOARDROOM, NATIONAL MUSEUMS OF KENYA, NAIROBI**

**11TH FEBRUARY 2013**

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