### KAPAP

(Transforming Agriculture for Improved Livelihoods)

**KAPAP Competitive Grant System (KAPAP-CGS)**

<table>
<thead>
<tr>
<th>KAPAP REFERENCE NUMBER</th>
<th>KAPAP CGS/VEGETABLES</th>
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<tbody>
<tr>
<td><strong>LEAD ORGANIZATION</strong></td>
<td>Mount Kenya University</td>
</tr>
<tr>
<td>Principal Investigator</td>
<td>Prof. John H. Nderitu</td>
</tr>
</tbody>
</table>
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| 3. | Dr. Darius Andika Otiato | Jaramogi Oginga Odinga University of Science & Technology, P. O. Box 210-40601, Bondo. Email: oandika@yahoo.co.uk |
| 4. | Dr Esther Kioko / Dr. Patrick N. Muthoka | National Museums of Kenya Email: pmuthoka@museums.or.ke |
| 5. | Prof. Richard M. S. Mulwa & Dr. Joseph Matofari (Food Scientist) | Egerton University, P. O. Box 536 - 20115, Egerton rmulwa@egerton.ac.ke |
| 6. | Mr. Fredrick Musieba | Kenya Industrial Research & Development Institute, P. O. Box 30650-00100, Nairobi Tel.:+254-20-6003842,020-535966 Email: dir@kirdi.go.ke OR musieba@yahoo.com |
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**PROJECT TITLE**
Enhancing Production, Post harvest Handling, Value Addition and Marketing of Indigenous
<table>
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<tr>
<th>(a) Sub-sector research area</th>
<th>Horticulture</th>
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<tr>
<td>(b) Value chain</td>
<td>Vegetables</td>
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<tr>
<td>(c) Project location</td>
<td>Kakamega County (Butere/Mumias Sub County)</td>
</tr>
<tr>
<td>(d) Duration of the project</td>
<td>2 years</td>
</tr>
<tr>
<td>(e) Date of submission</td>
<td>September, 2013</td>
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**BACKGROUND**

Horticulture is among the four key sub-sectors in the Kenyan Agricultural Industry, contributing 33% of total GDP and 38.5% of exports. The country is well endowed with a wide range of agro-ecological zones for vegetable production ranging from the coastal lowlands to upper highlands. This allows production of a wide range of high value horticultural crops including vegetables, with potential to contribute significantly to the growth of the sub-sector and transformation of the Kenya’s Agriculture from subsistence to commercially oriented sector as envisioned in key national policy blueprints (Vision 2030 & ASDS 2009-2014). The major categories of vegetables produced include exotic, indigenous, Asian and other emerging vegetables destined for domestic, regional and international markets. The majority of vegetable producers and workers are women. Men and youth play mainly the supportive role in transportation and marketing of the produce. About 96% of the total horticultural production is consumed locally (HCDA, 2009). However, the export market earns the country in revenue in terms of foreign exchange compared to what is earned locally. In 2012, the value of horticultural produce exported was over KES 125 billion. Despite the importance of vegetables in the economy, various constraints have been identified in their value chains for research and innovation. The vegetable crops prioritized for research in the present KAPAP CGS collaborative research initiative are indigenous vegetables including; nightshades, amaranth, cowpea, spider plant and pumpkin.
Indigenous vegetables, which had been neglected for a long time, have in recent years gained popularity and demand due to campaigns in support on their nutritional and in some cases medicinal values (Holland et al., 1991). About 220 different species of indigenous vegetables are utilized in Kenya (Maundu et al., 1999). Of all the indigenous vegetables grown countrywide, cowpea (Vigna unguiculata (L.) Walp.), amaranth (Amaranthus spp.), pumpkin (Cucurbita spp.), spider plant (Cleome gynandra), night shades (Solanum complex), jute mallow (Corchorus spp.), and slender leaf (Crotalaria brevidens and Crotalaria ochroleuca) are the preferred species grown by many communities (Maundu et al., 1999). However, scanty information is available on actual production and trade value of these vegetables. A survey on the commercial potential for cowpea, nightshade and amaranth in the Nairobi and Kisumu markets conducted in 2006, indicted an annual traded volume of 4.3 tonnes worth KES 142 million (Weinberger and Pichop, 2009). This indicated their considerable potential for income generation and food security; hence, poverty alleviation in Kenya.

Indigenous vegetables (AIVs) are mainly produced by smallholder farmers comprising the majority of the rural communities. The majority of actors in the AIVs value chains (VCs) are women; hence, the reference to the AIVs as ‘women crops’. Apart from contributing to incomes of the smallholder farmers, the ALVs play an important role in human nutrition and other benefits since they have significant quantities of protein, vitamins A&C, oils, and macro/micro-nutrients (Holland et al., 1991; Gruben and Chigumira-Ngwerume, 2004; Hutchinson et al., 2010). Productivity and agribusiness opportunities in AIVs are constrained by lack of quality planting materials and agronomic packages, poor post harvest handling technologies, limited value addition, negative perception/low acceptability and poor marketing organization and distribution channels (IPGRI, 2006). Further, the ALVs farmers in Africa grow their own landraces (Abukutsa-Onyango, 2003 and 2007).

KAPAP Collaborative Research Consortium on vegetables VC received funds in October, 2011 to commence work addressing some of the above-mentioned constraints in the VC. The project’s overall objective is to increase production and improve post harvest handling, value addition, marketing and utilization of indigenous vegetables, French beans and mushroom...
among smallholder farmers in Kenya. Various studies have been undertaken so far and significant progress made on the vegetable VC. Consumer preferences and challenges to night shade production in Siaya County have been identified through a baseline survey and stakeholders’ forums. Farmers in the region have been sensitized on value addition and the business potential of night shade. Preferred night shade accessions have been identified through participatory evaluations. In Homa Bay county, on-farm experiments on spider plant production methods have been conducted including training on appropriate handling of vegetables to reduce losses and maintain quality. A brochure on spider plant production and mechanisms for information sharing were explored during planning meetings and raining on planting technique and seed production conducted.

Germplasm collection of cow pea accessions was conducted during which 30 accessions were collected. These accessions have been evaluated for their growth, yield and preferences by farmers. Pumpkin germplasm was collected in Kakamega and Nyeri Counties and evaluations conducted to establish optimal water requirements various sources of mineral nutrients, and leaf harvesting regime that maximize pumpkin yields. The results of these studies have identified key areas of concern that require urgent attention. Accessibility and availability of quality seed of AIVs is a major challenge to the production of ALVs. Post harvest handling of the fresh vegetables is poor due to lack of appropriate methods leading to high losses. Farmers have limited access to markets and market information; therefore, depend heavily on middle men for the marketing of their produce. In addition, there is lack information in most communities where they are grown on potential for AIV products diversification and their medicinal values.

Farmers and extension service providers’ capacities have been enhanced through farmer field schools undertaken during the initial stages of the project on French beans. Farmer’s knowledge of pests and diseases affecting French beans has been established including marketing and certifications status. From the initial studies it shows that, the French beans market is threatened due to non compliance with GLOBAL-gap requirements. Therefore, training of farmers on GLOBAL-gap requirements and consequently certification is important to ensure market supply of quality French beans.

Two species of indigenous mushrooms have been ‘domesticated’ in the on going project and
experiments carried out to optimize yield and other desirable characteristics of production. The project team intends to upscale these efforts through training the spawn producers in the project area on production of quality spawn. Fresh mushrooms are perishable, and therefore need to be sold at a short time after harvesting allowing access to local markets. Simple processing technologies that can be undertaken by the farmer have been investigated for suitability to the smallholder context. Technologies such as drying, milling and blending of flours to make different mushroom based products have been developed in the current project. In addition, consumer awareness on mushroom utilization was intensified through the publication and printing of the mushroom recipes booklet. The project team will upscale this work in collaboration with small holder farmers in project area to test the commercial potential for processing mushrooms into value added products.

Despite the achievements of the current research work, challenges still exist; hence, need for further interventions to be addressed in the current proposal. The proposal will focus on improvement of seed supply systems and ensuring availability of clean planting materials, identifying and applying post harvest technologies that minimise losses, diversifying products from AIV and linking farmers to markets. Information sharing, good agricultural practices and market access for decision making by farmers will be enhanced. Focus on these areas will ensure increased productivity and incomes for improved livelihood of the target areas. The collaborators in the proposed target areas will focus their activities on seed systems, agronomic aspects of growing AIVs, post harvest handling, transportation and marketing in the focal areas of the study to build synergisms and create impact.

STATEMENT OF THE PROBLEM AND JUSTIFICATION

In the course of implementation of the on-going KAPAP CGS Collaborative Research Project in the vegetable VC, gaps have been identified; hence, the need appropriate interventions with respect to deepening and up scaling of the on-going activities for enhanced impact. The identified constraints and possible interventions are as outlined below:
(a) Major constraints in the AIV value chain include lack of clean (certified) seeds and unsustainable production of required volumes of high quality AIVs to meet increasing market demand. Farmers depend on saved seed or seed bought from the local markets and whose quality and timely availability is not assured. Thus, this often results in poor germination and establishment; hence, low yields. To ensure availability of high quality seed, the project seeks to undertake participatory development of a seed system and germplasm management for the AIVs through development of seed supply model, training on seed business ventures to ensure constant seed supply through community managed outlets. This therefore calls for urgent improvement on farmers’ selection and storage techniques for the harvested seed to ensure maintenance of quality as per the protocol to be developed by the research consortium in collaboration with KEPHIS. Production and quality of AIVs have remained low due to low input nutrients, lack of appropriate cropping systems, infection by pests and diseases and other problems related agronomic practices. It is therefore important to build farmers capacity on good agricultural practices that will ensure production of high quality and safe AIVs. The proposed work will build on findings and up scale achievements of the on-going research. The focus will be on optimizing manure and fertilizer use and application of IPM options for low cost production of AIVs.

(b) Currently, the magnitude of post-harvest losses of AIVs in Kenya is estimated to be about 50% because the vegetables are highly perishable. These losses both in quantity and quality occur at various stages of the VC, ‘from farm to fork’. The losses are attributed largely to poor harvesting and post harvest handling practices resulting in rapid deterioration due to mechanical, physiological and microbial factors. The time of harvesting, methods of harvesting, handling of harvested produce both in the field and under storage, and mode of transport determine the final quality of the vegetables and magnitude of the losses.

(c) The proposed intervention, therefore, is to build the capacity of farmers on better harvesting strategies and post harvest handling practices. Change in farmers’ practices
such as harvesting their vegetables during the cooler parts of the day (early morning or late evening), sorting the vegetables to remove the diseased or pest-infested, and erection of simple on-farm shades for temporary holding of harvested vegetables as they await direct local buyers, can significantly reduce the on-farm losses currently incurred. For farmers who produce large volumes targeting far flung markets, better storage to prolong the shelf life and hence marketing period of the fresh vegetables is important. Researchers on the previous project will work with farmers to formulate experiments on effects of packaging materials and mode of transportation on post harvest quality of the vegetable. Farmers training on dehydration of the AIVs during time of excess supply will be conducted and market acceptance tests carried out. This project proposes to use coolers to extend the shelf life and maintain the quality of freshly harvested AIVs in the focal area. This project also proposes an evaluation of improved packaging technologies for both dry and fresh AIVs.

(d) Different processing technologies provides an effective way to extend shelf life of AIV products especially during the high seasons, thus ensuring continued supply even during the lean seasons. Grading is an important aspect of value addition at both farm/retail and industrial level. The farmers will be trained on how to mix the vegetables for local market while the processor will conduct mixing targeting the urban market. The processor will conduct juicing and puree development of these AIVs. Working with the farmers coordinated by CSU, solar driers will be located at Ekero in Mumias sub county for dehydration of excess unsold AIVs for milling and blending by the processor. Although concerted efforts are being made to ensure that the consumer receives high quality AIVs, there is no assurance that preparation methods used ensure that the nutritional benefits of the vegetables are realized. Different preparation methods used by consumers variably affect the nutritional integrity of the AIVs. The project will therefore seek to explore the different preparation methods used for the different AIVs and how they affect the nutritional quality of the vegetables. Based on the findings, recipes for preparation of the different AIVs and other campaign materials will be developed to encourage increased consumption and utilization of AIVs.
These options for value addition variably impact on the nutrient profiles in the AIVs. It is therefore important to evaluate the effect of the different value addition options on the nutritional quality of the processed products and make recommendations on which of them ensures high nutritional integrity of the vegetables. The current collaborators on the ongoing project will carry out evaluations on dehydration, blending, juicing, puree, milling and nutritional quality in the focal area of study.

(e) Evaluation of the existing market structures, pricing trends at both farm gate and industrial level is important for economic analysis. With expected increase in production of AIVs in the focal area, the proposed project will evaluate existing market structures to streamline the supply systems targeting local markets including; matungu, Mumias, Kwhisero and Butere. On the other hand open air markets in urban areas such as kakamega, Wakulima, Gikomba and existing fresh produce supermarkets such as Nakumatt, Uchumi and Tuskeys will be explored for the fresh produce. With dehydrated vegetables and value added products, supermarkets, hospitals, children feeding centers, homes for aged and health shops will be targeted.

(f) In summary the current project will be implemented in collaboration with County service Units and service providers, working in the focal area. The opportunities including seed and planting materials supply systems, post harvest handling and preservation, value addition and markets analysis will be given deeper focus. The project will adopt stakeholder participatory, collaborative and multidisciplinary and interdisciplinary approaches to ensure the interventions are responsive to environmental safeguards, climate change, food safety, and social and gender welfare.

To achieve its objectives and develop products from AIVs, the project team will apply an innovative/research pathway that will inform on status and provide mechanisms for monitoring. The innovative pathway is as indicated in schematic diagram below.
Figure 1: Schematic innovation/research pathway for developing products from AIVs.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Collaborating contact persons</th>
<th>Roles and responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt. Kenya</td>
<td>Prof. John H. Nderitu</td>
<td>✓ Lead scientist</td>
</tr>
<tr>
<td>University</td>
<td>Collaborator/Role</td>
<td>Activities</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
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</tbody>
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| University of Nairobi                                 | Dr. Margaret J. Hutchinson                                                        | - Provision of cow pea seeds for bulking  
- Cow pea information packaging  
- Contribute to training chain actors in agronomic practices, post harvest handling and value addition at the proposed project focal area. |
| Jaramogi Oginga Odinga University of Science & Technology (JOOUST) | Dr. Darius Andika Otiato                                                          | - Coordinating role of CSU, collaborators and service providers from the research side at the focal area  
- Provision of nightshades seeds for bulking  
- Nightshades information packaging  
- Contribute to training chain actors in agronomic practices, post harvest handling and value addition at the proposed project focal area. |
| National Museums of Kenya                              | Dr. Esther Kioko / Dr. Patrick N. Muthoka                                         | - Provision of Amaranth seeds for bulking  
- Amaranth information packaging  
- Contribute to training chain actors in |
<table>
<thead>
<tr>
<th>Egerton University</th>
<th>Prof. Richard M. S. Mulwa and Dr. Joseph Matofari</th>
<th>✔ Provision of spiderplant seeds for bulking ✔ Spider plant information packaging ✔ Contribute to training chain actors in agronomic practices, post harvest handling and value addition at the proposed project focal area.</th>
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<tbody>
<tr>
<td>Kenya Industrial Research &amp; Development Institute</td>
<td>Mr. Fredrick Musieba</td>
<td>✔ Mushroom spawn production</td>
</tr>
<tr>
<td>East African nutraceuticals</td>
<td>Mr. Joseph Wanyeki</td>
<td>✔ Value addition and marketing (canning, packaging and marketing of all the vegetables including).</td>
</tr>
</tbody>
</table>

**PARTNERS**

<p>| CSU, Butere-Mumias Sub County | Mr. James Libaako | ✔ Coordinator ✔ Coordinating role to Mobilize farmer groups for seed bulking, vegetable production, post harvest handling, value addition, marketing and information sharing of AIVs and mush rooms. |
| Masinde Muliro University of Science &amp; Technology (MMUST) (Service Provider) | Dr. Humphrey Nyongesa | ✔ Lead Scientist ✔ Mobilize farmer groups for seed bulking, vegetable production, post harvest handling, value addition, marketing and information sharing of AIVs and mush rooms. |</p>
<table>
<thead>
<tr>
<th>GOAL AND OBJECTIVES</th>
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<tr>
<th>Butere-Mumias African Leafy Vegetables Value Chain (CBO)</th>
<th>Mr. Jared Okutoyi Ateya</th>
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<tbody>
<tr>
<td>✓ Coordination of activities in the collection centres</td>
<td></td>
</tr>
<tr>
<td>✓ Formation AIV cooperative society</td>
<td></td>
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<tr>
<td>✓ Identify seed bulking sites</td>
<td></td>
</tr>
<tr>
<td>✓ AIV and mushroom production, value addition and marketing</td>
<td></td>
</tr>
<tr>
<td>✓ Management of collection centres</td>
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GOAL
Contribute to increased production, post harvest handling marketing and utilization of indigenous vegetables products to transform the vegetable production subsector into a commercially oriented enterprise for food safety and nutrition security, increased household incomes and employment creation, with due consideration of environmental safeguards, social, and gender issues.

OVERALL OBJECTIVE
To increase seed supply, improve post harvest handling and value addition, marketing and utilization of indigenous vegetables products among smallholder farmers in Kenya.

Specific Objectives
1. To increase availability and supply of clean seed through capacity building, improved cultural practices, bulking, packaging, storage and distribution channels in the study focal area.
2. To reduce post harvest losses in AIVs, and mushrooms through promotion of better post harvest handling practices and technologies among small holder AIVs farmers.
3. To improve value addition and utilization of AIVs, and mushroom products through development of innovative processed products with improved shelf life.
4. To develop markets and agribusiness opportunities for AIVs, French beans and mushrooms among smallholder farmers.
5. To develop mechanisms for information, communication and knowledge sharing along the indigenous vegetable and mushroom value chain.

EXPECTED OUTPUTS AND OUTCOMES
OUTPUTS:
1. Availability and supply of clean AIVs seed through capacity building, improved cultural practices, bulking, storage and distribution channels in the study focal area improved.
2. Post harvest losses in AIVs through promotion of better post harvest handling practices and appropriate technologies among small holder AIVs farmers achieved.
3. Value addition and utilization of AIVs products through development of innovative processed products with improved shelf life.
4. Marketing and agribusiness opportunities for indigenous vegetables products developed.
5. Mechanisms for information, communication and knowledge sharing along the indigenous vegetable value chain developed.

Activities
Availability and supply of clean seed through capacity building, cultural practices, bulking, storage and distribution channels in the study focal area improved.
- identification of farmers for seed production
- training of farmers for on quality seed production
- identification of field sites for seed production
- land preparation
- seed distribution and planting
- seed harvesting
- seed bulking
- construction of seed storage facilities
- development of appropriate seed packaging technologies for commercialization
- development of guidelines on quality seed production
- on-farm experiments to determine effect of cultural practices on seed quality

Post harvest losses in AIVs, through promotion of better post harvest handling practices and technologies among small holder AIVs farmers reduced:
- evaluation of effects of modes of transport on quality of AIVs
- evaluation of effects of modes of packaging on quality of AIVs
- training of farmers on weights standardization of AIVs
- evaluation of effect of coolers on AIV shelf life
- evaluation of different shade materials on AIVs shelf life and quality
- experiments on effect of pre-harvest factor such as pesticides use and cultural practices on post harvest quality of AIVs.
- Construction of storage facilities for AIVs at the collection centres.
Value addition and utilization of AIVs products through development of innovative processed products with improved shelf life improved:

- grading of AIVs at farm and industrial levels
- training of farmers on fresh AIVs mixing for ready cooking
- formulation of fresh AIVs mixing ratio.
- juicing and puree products development
- Demonstration of AIV drying procedures at AIVs collection points
- training of farmers on AIVs dehydration procedures and maintenance of quality
- milling and blending of the dehydrated AIVs for products development
- nutritional analysis of the developed products

Marketing and agribusiness opportunities for indigenous vegetables products developed.

- certification of developed products from AIVs
- development of business opportunities by CSU and entrepreneurs
- promotion of products in the AIVs enterprise
- identification of potential AIV markets
- development of models/systems for collection and bulking
- linking youth groups to business development services such as Uwezo fund
- link producers to buyers and industries

Mechanisms for information, communication and knowledge sharing along the indigenous vegetable value chain developed.

- Consumer studies on acceptability of AIV products
- conduct value chain stakeholders meeting in the project site
- development of production and value addition manuals
- use other media platforms to advance project activities on AIVs
- Training of all value chain actors.

OUTCOMES

1. Increased supply of clean AIV seeds for farmers involved in production in focal area in
2. Reduced vegetable postharvest losses along the value chain and increased volumes of high quality vegetables in markets in focal area in Butere-Mumias
3. Increased range of vegetable products, business strategies and per capita consumption in focal area in Butere-Mumias
4. Improved food safety and acceptability of the indigenous vegetables along the Value Chain within an expanded market catchment.
5. Increased smallholder and community awareness and consumption of AIVs, French beans and mushrooms; and overall improved incomes from vegetable enterprises disaggregated by gender.

BENEFICIARIES OF THE OUTPUTS AND OUTCOMES
The primary beneficiaries of the outcomes of the project will be small-scale producers/farmers of AIVs in the project focal areas and other players along the value chain. Improved productivity is expected to stimulate value addition and marketing activities targeting high end markets for AIVs, thereby creating employment opportunities especially for the youth and women within the target communities. To ensure that significant benefits accrue to target vulnerable groups, efforts will be made to ensure collection of gender disaggregated data during surveys, and inclusion of women and youth in all project activities including trainings and other consultative fora. It is anticipated that improved production, value addition and marketing of IVs, French beans and mushrooms will stimulate and attract investments by small-scale entrepreneurs. Similarly private sector involvement for the provision of inputs and services will be enhanced. The Government will also benefit through the collection of revenue, from various players along the IVs and mushroom value chains.

RESEARCH PLAN/METHODOLOGY
The primary beneficiaries of the outcomes of the project will be small-scale producers/farmers in the project focal areas in Butere-Mumias Sub County and other players along the AIVs value chains. At the collection center, the roots of the fresh AIVs will be removed and they will be bunched in acceptable consumer rations. They will be packaged in reed baskets and transported in various
markets. The withered AIVs will be sorted and stocks removed, then blanched and dried using a solar tunnel drier. They dried AIVs will be packaged in polypropylene bags and transported to the processor. The processor will pack the dehydrated AIVs in smaller packages convenient for consumers. Value addition will enhance marketing activities targeting high end markets for AIVs, thereby creating employment opportunities especially for the youth and women within the targeted area. It is anticipated that improved, value addition and marketing of AIVs will stimulate and attract investments by small-scale entrepreneurs.

**Availability and supply of clean seed through capacity building, improved cultural practices, bulking, storage and distribution channels in the study focal area improved.**

To improve the AIVs seeds availability and supply among the smallholder farmers, farmers will be identified using the CSU for seed production. These farmers will be trained with expertise from the collaborators working on the previous project. The training will include conditions necessary for clean seed production, cultural practices affecting seed quality, harvesting methods, handling and processing of the AIVs seed maintaining quality. To ensure availability of the seeds produced, storage facilities for fresh vegetables and farm inputs will be constructed at the identified collection centre at Ekero, Mumias Sub-county. Appropriate packaging methods for the seeds for commercial purposes will be identified together with farmers. To ensure sustained quality and clean seed production collaborators from the previous project will develop guidelines for producing quality seeds. On-farm experiments will be conducted to determine effect of different cultural practices on seed quality. This will emphasise to farmers the importance of avoiding leaf harvesting of crops grown for seed.

**Post harvest losses in AIVs, and mushrooms through promotion of better post harvest handling practices and appropriate technologies among small holder IVs farmers achieved.**

Post harvest handling of the vegetables is influenced by factors including transportation, packaging materials as well as storage methods. To address this key element on the vegetables value chain, collaborators on previous project will work closely with farmers in the CSU centres in Kakamega county. Transportation of AIVs will be done utilizing polypropylene bags, plastic crates and reed baskets. Weight Standardization of the vegetables after harvest is important for evaluating cost benefit income. Therefore, farmers will be trained on how to determine produce weight. This will be
achieved by providing weighing machines to the farmers. To ensure collective synergies in marketing of the produce, collection centres will be established in the study area where farmers will bring their produce for storage. To avoid losses of excess produce, these centres will be provided with cooling structures in the collection sheds. Farmers will be trained on pre-harvest factors such as pest, pesticides use and cultural practices management.

**Value addition and utilization of AIVs products through development of innovative processed products with improved shelf life improved**

Value addition is important for marketability of the produce and development of a variety of products which will meet diverse market needs. To achieve this, grading of the AIVs will be done at both farm and at the collection centres where the roots of the fresh AIVs will be removed. They will be packaged in reed baskets and distributed in various markets. The withered AIVs will be sorted and stocks removed, then blanched and dried using a solar tunnel drier. They dried AIVs will be packaged in polyethylene bags and transported to the processor. The processor will pack the dehydrated AIVs in smaller packages convenient for consumers. Fresh mixed vegetables in different ratios acceptable to the consumer will be evaluated by the processor and recipes developed. Other recipes to be developed will be, AIVs juices and purees, dehydrated vegetables soup broth and dehydrated mixed AIVs formulations. Dehydration of vegetables will be done at the focal area and sold to the industries. Nutritional analysis of the developed products will be determined by the processor.

**Marketing and agribusiness opportunities for AIVs**

Existing markets for AIVs will be assessed and potential ones identified as the entry point for developed products. Farmers will be advised by CSU and service providers on best marketing approaches in their local open air markets. They will also be linked to AIVs processors where they will package their produce to meet client’s specifications. The processor will develop strategies to open new markets for the value added products. The value added products will include fresh mixed AIVs formulations, AIVs juices and purees, dehydrated soup broths, dehydrated mixed AIVs. The existing AIVs markets only sells fresh produce hence creating an opportunity for dehydrated AIVs products. Previous market surveys indicate huge potential for dehydrated AIVs in supermarkets like Uchumi, Tuskys and Naivas all which sell fresh AIVs. The survey indicated that since the fresh
produce withers within 5 hours on the shelf, they are unable to have enough stocks that can satisfy
the market hence creating the opportunity in these markets for dehydrated AIVs. Other potential
areas are in hospitals where there is a demand for AIVs but storage becomes a challenge due to their
short shelf life. Current survey shows that Butere-Mumias region (focal area) has the potential of
producing 300 Metric tonnes of fresh AIVs per year. Currently they are only selling less than 10% of
the potential output. This creates a huge potential for both fresh produce and dehydrated AIVs. To
create awareness of the developed AIVs products, 3 promotional centers will be opened by the
processor in Nairobi CBD area. The centres will advertise the products by giving out brochures,
samples of the products and creating awareness of where the products can be found. In store
promotions in supermarkets will also be carried out. Hospitals and other feeding centres will be
given brochures and promotional samples. Feed back on consumer acceptability will be assessed and
best achieved products promoted. Dehydrated AIVs will mainly target base of pyramid consumers
and hospitals due to there long shelf life (6 months).

**Mechanisms for information, communication and knowledge sharing along the indigenous vegetable value chain developed.**

Knowledge, communication and information sharing is important for success of the project and
dissemination of the results obtained. The project therefore proposes to conduct a stakeholders
meeting of all researchers on the previous project together with other actors in vegetable value chain
to be on the same level of discussion during the implementation of the up scaling process. To
maintain constant information on research work, technologies, value added product knowledge and
markets available, the farmers, researchers, collaborators, processors and markets will be
communicated to through developed mechanisms. Manuals describing production techniques and
value addition based on the findings of existing initiatives will be developed. The research
consortium will also explore jointly with CSUs in the ALV value chains the utilization of media and
other platforms including regional agricultural shows, exhibition, local radio stations, regular
meetings, products brochures and farmer to farmer exchange visits to ensure information reaches a
wider audience. Value chain actors will also be informed and trained where need arises by the
respective collaborators.

Data will be collected at all stages and analyzed through quantitative and qualitative statistical
methods such as ANOVA, regression, correlation, and Chi-square, as appropriate.

### MAJOR ASSUMPTIONS AND RISKS

#### ASSUMPTIONS
1. Willingness of various actors and stakeholders in the vegetable value chains to participate in the research work in the project focal area.
2. Favourable weather conditions to carry out field experiments.
3. Conducive socio-economic and political environments.
4. Resources available as planned to conduct research activities.
5. Time allocated by the financier shall suffice the research workload.
6. The involvement of county government in development of by-laws and marketing of AIVs and mushrooms.

#### RISKS
1. Unfavourable socio-economic and environmental conditions.
2. Unpredictable weather conditions.
3. Low preference of farm-saved seeds and processed products.
4. Running out of time before completion of planned activities.

<table>
<thead>
<tr>
<th>LOGICAL FRAMEWORK</th>
<th>(In sequence of how results will be derived)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Narrative summary</strong></td>
<td><strong>Objectively verifiable indicators</strong></td>
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</tbody>
</table>
| Goal: To contribute to increased incomes and improved welfare of smallholder | • Increased household income contribution by AIVs and mushrooms farmers  
• Inclusion of indigenous vegetables and mushrooms in | • Periodic economic reviews  
• Statistical abstracts  
• HCDA statistics | • Conducive climatic conditions  
• Socio-economic environment that favours indigenous vegetables |
| farmers through increased production, marketing and utilization of indigenous vegetable | routine diets of urban and rural households  ●New investments in indigenous vegetable value chain enterprises | Purpose  
To enhance smallholder seed availability, AIVs production, post harvest handling, value addition and utilization of IVs in niche markets through transformation of vegetable sub sector into a commercially oriented industry for food and nutrition |  ●Increased market outlets for AIVs  
Increased value chain activities along the value chain.  
Increased incomes of small-scale producers and other value chain actors  
Availability of AIVs seed to farmers and retail outlets.  
Increased AIVs acreage in the focal area  
●GOK Ministry reports  
HCDA reports  
M&E reports  
Value chain actors’ records  
●Commercial uptake of indigenous vegetables and mushroom in niche markets |
security, food safety, employment creation, with due consideration of environmental safeguards, social, and gender issues.

| **Outputs** | **Availability and supply of clean seed through capacity building, cultural practices, bulking, packaging, storage and distribution channels in the study focal area improved.** | **● At least 50 farmers trained on seed bulking in the focal area by end of first year of study.**
**At least one AIV seed packaging technology developed by end 1st yr of study.**
**At least 5 bulking sites identified by end of 1st yr of study.**
**At least one locally quality AIV seed produced by end of year 1.** | **List of trained farmers and certificates of participation.**
**Report on number of sites.** |
| --- | --- | --- | --- |
| **Post harvest** | **● At least one Suitable**
**Number of** | **● Local availability of** |  |
<table>
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<tr>
<th>Value addition and utilization of AIVs, and mushroom products through development of innovative processed products with improved shelf life improved</th>
<th>At least one suitable methods of fortification AIV by end of Y1 developed</th>
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<tbody>
<tr>
<td></td>
<td>At least one suitable methods of fortification mushrooms developed by end of Y1</td>
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<td></td>
<td>At least one suitable vegetable recipes developed</td>
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<td>packaging materials for evaluation</td>
<td>Number of consumers using the recipes. Manual on recipes and fortification.</td>
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<tr>
<td>losses in AIVs, and mushrooms through promotion of better post harvest handling practices and appropriate technologies among small holder IVs farmers achieved</td>
<td>and locally adaptable produce packaging technology availed by end of year 1</td>
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<td></td>
<td>At least one loss reducing technology developed by Y1</td>
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<td></td>
<td>by y1 for both mushrooms and AIVs</td>
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</table>
| Marketing and agribusiness opportunities for indigenous vegetables, French beans and mushroom products developed. | • At least increase volumes of AIVs and mushrooms by 5% by y1 from the target area  
• At least increase income by 5% by y1 in the target area  
• Agribusiness opportunities increased by at least 5% by Y1 | The units of AIVs and mushrooms sold  
Sales from the AIVs and mushroom |   |
| Mechanisms for information, communication and knowledge sharing along the indigenous vegetable and mushroom value chain developed | • At least two computers for ICT installed by end 6th month.  
• Training of value chain actors by end of 6th month.  
• At least 1 exchange farmer to farmer visit by end of y1 | Report of the stakeholders meeting. |   |
REFERENCES


HCDA. 2009. Horticultural Crops Development Authority Annual Report


IPGRI 2006


### Appendix 1: Gantt chart for the project activities.

<table>
<thead>
<tr>
<th>Outputs and planned activities</th>
<th>Y1Q1</th>
<th>Y1Q2</th>
<th>Y1Q3</th>
<th>Y1Q4</th>
<th>Y2Q1</th>
<th>Y2Q2</th>
<th>Y3Q3</th>
<th>Y2Q4</th>
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<tr>
<td><strong>OUTPUT 1. Vegetable production enhanced</strong></td>
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<td>1.1 Farmers and field sites identification at focal site</td>
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<td>1.2 Training of farmers on quality seeds production and development manuals</td>
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<td>1.3 Training of farmers on GLOBAL gap regulations in French beans production</td>
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<td>1.4 Experiments on effect of cultural practices on seed quality at the focal site</td>
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<td>1.5 Development of seed packaging technologies and seed bulking at focal site</td>
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<td><strong>Output 2.0 post harvest losses reduction through improved handling and appropriate technologies</strong></td>
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<td>2.1 Evaluation of modes of transport and packaging at focal site</td>
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<td>2.2 Evaluation of coolers and shade materials on shelf life of AIVs</td>
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<td>2.3 Effect of preharvest factors on post harvest quality of AIVs at focal site</td>
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<td><strong>Output 3 Value addition and innovation of processed products</strong></td>
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<td>3.1 Grading and formulation of AIV mixes</td>
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<td>3.2 Grading, juicing and puree development</td>
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<td>3.3 Milling and blending</td>
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<td>3.4 Nutritional analysis of products</td>
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<td><strong>Output 4 Development of Marketing and agribusiness opportunities for indigenous vegetables</strong></td>
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<td>4.1 Certification of developed products from AIVs</td>
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<td>4.2 Development of business opportunities, entrepreneurs and assessment of novel marketing arrangements</td>
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<td>4.3 Promotion of youth groups to source funds to support their AIVs business</td>
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<td><strong>OUTPUT 5. Mechanisms for information, communication and knowledge sharing along the IVs.</strong></td>
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<td>5.1 Conduct value chain stakeholders meetings in the project site</td>
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<td>5.3 Training chain actors in post-harvest handling, value addition, marketing and business opportunities in AIVs</td>
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<td>Co-ordination of project activities</td>
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