ASARECA
Transforming Agriculture for Improved Livelihoods

Proceedings of the

Regional Stakeholders' Workshop on Snap Beans Commodity Value Chain

IMPERIAL RESORT BEACH HOTEL

9–10 DECEMBER 2009

Maureen Katafiire, Michael Ugen and Mwamburi Mcharo

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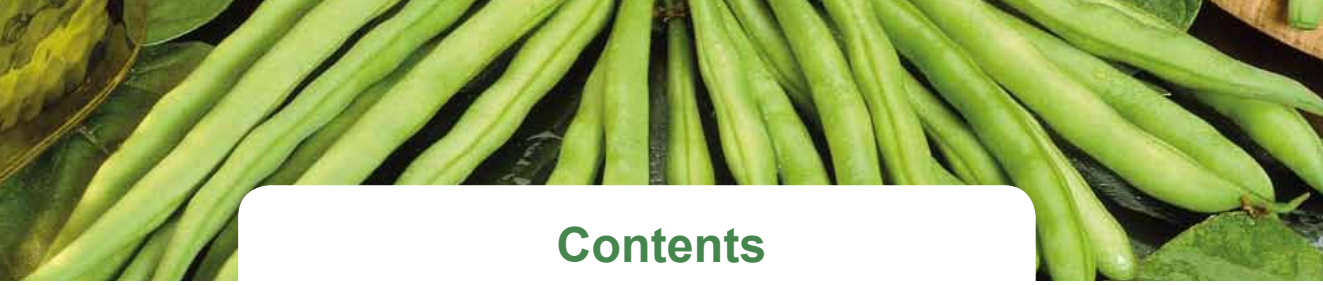
Acronyms

AIN	African Incubator Network
AMA	Agribusiness management associates
ALS	Angular leaf spot
ASARECA	Association for Strengthening Agricultural Research in East and Central Africa
AT	Action threshold
BSM	Bean stem maggot
CBB	Common bacterial blight
CBO	Community based organisation
CIAT	International Center for Tropical Agriculture
COMESA	Common Market for Eastern and Southern Africa
ECA	East and Central Africa
ECABREN	East and Central Africa Bean Research Network
EICTDA	Ethiopian Information and Communication Technology Development Agency
FAO	Food and Agricultural Organization of the United Nations
GLOBALGAP	Global good agricultural practices
HCDA	Horticultural Crops Development Authority
IDM	Integrated disease management
INWM	Integrated nutrient and water management
IPDM	Integrated pest and disease management
IPM	Integrated pest management
KARI	Kenya Agricultural Research Institute
KIRDI	Kenya Industrial Research and Development Institute
KIST	Kigali Institute of Science and Technology
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MoFPED	Ministry of Finance, Planning and Economic Development
NaCRRI	National Crops Resources Research Institute
NARO	National Agricultural Research Organisation
NARS	National agricultural research system
NARL	National agricultural research laboratories
NGO	Non-governmental organisation
NOGAMU	National Organic Movement of Uganda
PPP	Public–private partnership
RAB	Rwanda Agricultural Board
RCBD	Randomised Complete Block Design
RHODA	Rwanda Horticulture Development Association

SARI	Selian Agricultural Research Institute
SUA	Sokoine University of Agriculture
TAHA	Tanzanian Horticultural Association
UIRI	Uganda Industrial Research Institute
UEPB	Uganda Export Promotion Board
WAITRO	World Association of Technology and Research Organizations



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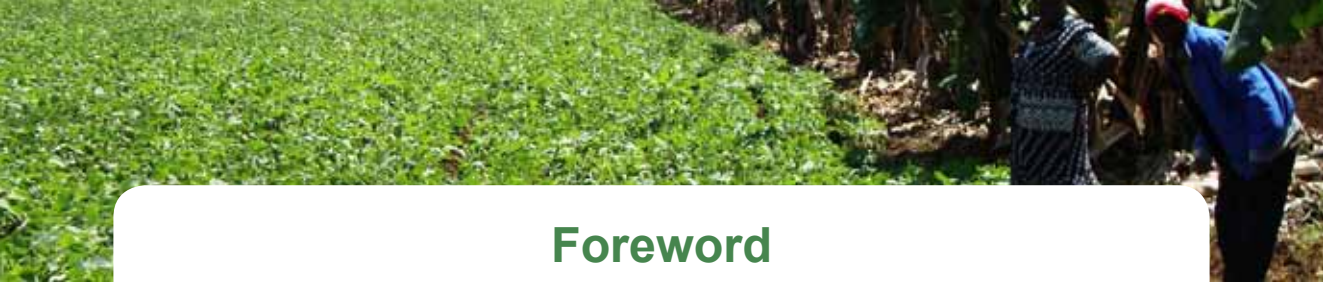
Acknowledgements

We are grateful to Dr Seyfu Ketema, Executive Director ASARECA, for facilitating this regional stakeholders' workshop on the snap bean commodity value chain. His knowledge on value chains contributed greatly to the success of this workshop.

We also thank the ASARECA programme management unit (led by the Deputy Executive Director, Dr Eldad Tukahirwa) for its intellectual input and moral support shown during the workshop. The administrative assistant, Ruth Nankinga, and the finance unit of ASARECA also deserve mention for their assistance.

We thank the directors of the national agricultural research institutions of the four ASARECA countries where the snap beans project is implemented for allowing their staff to participate in this workshop. We cannot forget the contribution of the international agricultural research centres, academic institutions, government institutions, farmer organisations, development partners, non-governmental organisations and the private sector.

To all of you, named and unnamed, who contributed to the success of the workshop, we extend our sincere thanks.



Foreword

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) was established in September 1994. It comprises 10 member countries: Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda.

ASARECA is a sub-regional non-profit organisation whose mission is: *To enhance regional collective action in agricultural research for development, extension, training and education to promote economic growth, fight poverty, eradicate hunger and enhance sustainable use of resources in eastern and central Africa (ECA)*.

This mission is a commitment to overcome poverty and hunger in the Eastern and Central Africa (ECA) region. ASARECA sees improved delivery and the impact of scientific knowledge, policy options and technologies as powerful instruments to drive the sub-region towards meeting the goals of the Comprehensive Africa Agriculture Development Programme (CAADP), the agricultural agenda of the of the African Union's (AU) New Partnership for Africa's Development (NEPAD), and the Millennium Development Goals (MDGs).

The 10 ASARECA countries have been and are currently investing in agricultural research, extension, education and training. While ASARECA mobilises operational finances for sub-regionally planned agricultural innovation activities, the partner national agricultural research systems (NARS) contribute their infrastructure, personnel and a certain amount of funding towards the sustainable implementation of the programmes. The heads of state of the 10 countries, along with all their counterparts in Africa, have committed themselves to the goal of CAADP to increase the share of their national budgets for agriculture to 10%. The support provided to ASARECA by the development partners adds value to ongoing agricultural development efforts in the sub-region towards the achievement of the goals of CAADP.

Over the past two years, ASARECA has accomplished major works that reviewed past performance, current status and future projections of agricultural performance in ECA and laid out strategic directions and priorities for 2007–2016. It has also laid out the strategic directions and priorities for agricultural development in the region, in the context of CAADP and the MDGs.

ASARECA serves as a forum for promoting regional agricultural research and strengthening relations among NARS, in ECA and between NARS and the

international agricultural research centres.. In this role, ASARECA is also linking agricultural research to policy makers and regional economic and political institutions like the Common Market for Eastern and Southern Africa (COMESA), the Forum for Agricultural Research in Africa (FARA) and AU/NEPAD.

ASARECA adds value to the work of NARS in the sub-region through:

- Identifying shared goals and promoting economies of scale and scope through collaboration, specialisation and sharing of results.
- Identifying sub-regional public goods that would be under-produced in the absence of shared goals and a regional mechanism.
- Sharing knowledge and experiences with institutional innovation for more effective agricultural research for development (AR4D), extension and agricultural training and education.

Central to the vision and mission of ASARECA is the recognition of the value of regional collaboration and the need for regional collective action among member countries and their partners. Also central to the ASARECA vision and mission is the notion that agricultural research, convened and facilitated by ASARECA, furthers development aims such as broad-based economic growth, poverty eradication and improvement of livelihood.

ASARECA has seven programmes:

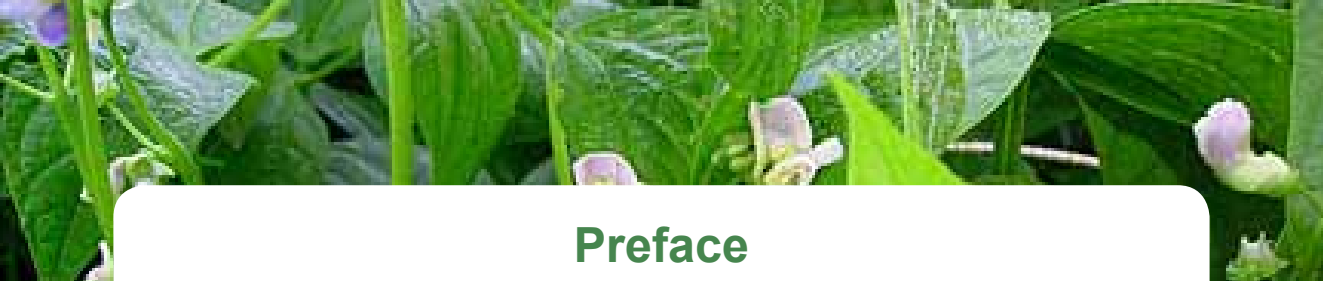
1. Staple Crops Programme
2. High Value Non-Staple Crops Programme
3. Livestock and Fisheries Programme
4. Agro-Biodiversity and Biotechnology Programme
5. Natural Resource Management and Biodiversity Programme
6. Policy Analysis and Advocacy Programme
7. Knowledge Management and Up-scaling Programme

What is presented in this document are the proceedings of the regional snap beans stakeholders workshop organised for the ASARECA High Value Non-Staple Crops Programme through collective action of all the ASARECA member NARIS

and all major ASARECA stakeholders. I would like to thank, the High Value Non-Staple Crops Programme Manager, Dr Mwamburi Mcharo, and all our stake holders for working hard to enable ASARECA define the future direction and priorities of the snap beans sub-sector in the context of the Sub-regional High Value Non-Staple Crops Programme.

Seyfu Ketema

Executive Director, ASARECA



Preface

The High Value Non-Staple Crops Programme began in January 2009 when the programme manager reported for duty. Since then, the programme has gone through the process of reviving three projects that were previously under the Eastern and Central Africa Bean Research Network (ECABREN) and Trees-on-Farm Network (TOFNET). The programme then commissioned a background paper to conduct a value chain analysis of the high value crops sub-sector in ASARECA countries. This paper culminated in the programme strategy-planning workshop that was held in June 2009.

The regional snap beans stakeholders' workshop is a follow-on activity to define the future direction of the snap bean project titled *Enhancing the Competitiveness of Snap Beans for Domestic and Export Markets*. The deliberations in the workshop sought to understand the prevailing conditions governing the snap bean sub-sector. Also, the workshop was an opportunity to prepare for the next phase of the project after its suspension three years earlier.

We hope that these proceedings have captured the essence of the workshop and the intense intellectual debate that went into the preparation of the final document.

Mwamburi Mcharo
Manager, High Value Non-Staple Crops Programme

The Executive Director's Opening Speech

The following is a summary of the workshop opening speech given by the ASARECA Executive Director, Dr Seyfu Ketema.

"It is with great joy that I welcome you all to this important regional stakeholders' workshop. The High Value Non-Staple Crops Programme is one of the new programmes in ASARECA. I wish to express my gratitude to Dr Mwamburi Mcharo for being able to bring together stakeholders from various countries and institutes. This workshop is of great importance because it is going to discuss issues that influence the snap beans value chain.

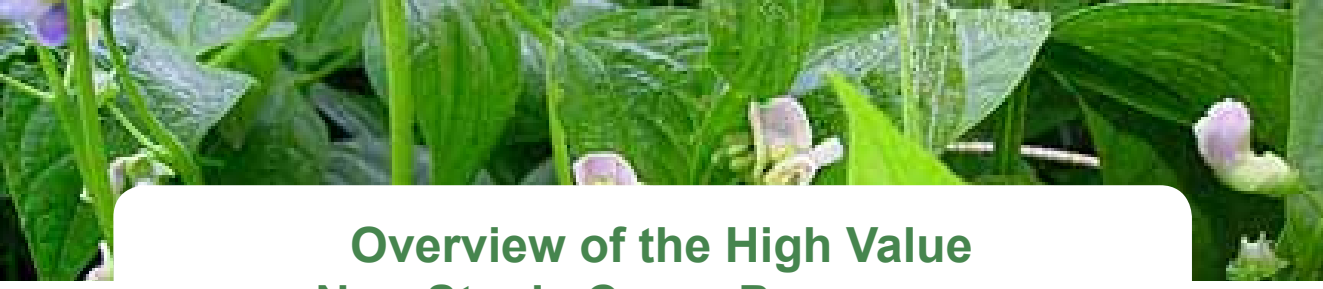
The issues that led to the termination of the snap bean project funding in 2007 were beyond ASARECA control; 2007 to 2008 were very difficult years for ASARECA, but we have made some achievements. The year 2009 has been successful in terms of consolidating the positive changes being made in ASARECA towards realising the vision of making ASARECA a "*regional leader in agricultural research and development for improved livelihoods in eastern and central Africa*." The governance structure of ASARECA has been transformed and the changes in the management of research have been completed. All the seven programme managers and their assistants have been recruited and the programmes are functional.

The ASARECA mission is "*to enhance regional collective action in agricultural research for development, extension, training and education to promote economic growth, fight poverty, eradicate hunger and enhance sustainable use of natural resources in eastern and central Africa*." This mission reflects the organisation's commitment to help confront some of the root causes of chronic hunger and poverty in the eastern and central African (ECA) region. ASARECA views improved delivery and impact of scientific knowledge, policy options and technologies as powerful instruments to drive the sub-region towards meeting the Comprehensive Africa Agriculture Development Programme (CAADP) agenda of the New Partnership for Africa's Development (NEPAD) and the Millennium Development Goals (MDGs).

The 10 ASARECA member countries have invested and continue to invest in agricultural research, extension and training. While ASARECA mobilises operational finances, the partner national agricultural research systems (NARS) provide the infrastructure, human resources and even funding to support sustainable implementation of the programme activities that address problems of regional significance. I appreciate the contribution of stakeholders. Likewise, the support given to ASARECA by development partners adds

value to ongoing agricultural development efforts in the sub-region, thereby contributing to the realisation of the CAADP objectives. ASARECA continues to receive indispensable financial and technical support from development partners through both the Multi-Donor Trust Fund (MDTF) and in their individual capacities. In addition, ASARECA is facilitating establishment of four centres of excellence in the region, namely: cassava in Uganda, rice in Tanzania, wheat in Ethiopia and dairy in Kenya. Let me take this opportunity to express my gratitude to all ASARECA stakeholders for their continued support in helping the people of the 10 countries pursue their dream to realise sustainable economic growth and improved livelihoods.

With these few words I declare this workshop open and I wish you fruitful deliberations. It is my great hope that the outcome of the meeting will improve the snap bean value chain. I also wish you a nice stay in Uganda and safe flights back home. Thank you."



Overview of the High Value Non-Staple Crops Programme

M. Mcharo

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Dr Mwamburi Mcharo, the manager of the High Value Non-Staple Crops Programme (HVNSC), welcomed the workshop participants. He reported that the programme was one of the new programmes in ASARECA. He informed the participants that the programme started in January 2009 when he reported on duty and that his assistant Ms Maureen Katafiire joined ASARECA in September 2009. He thanked all who were involved in organising the regional stakeholders' workshop whose theme was "Snap beans commodity value chain", especially Dr Ugen Michael the principal investigator of the project "Enhancing competitiveness of snap beans for domestic and export markets." Dr Mcharo expressed his gratitude to all the participants who responded positively to the invitation and urged them to use this opportunity to interact with the various stakeholders from diverse countries and institutes. He mentioned that the workshop was of great importance because it was going to discuss issues that influence the snap beans value chain.

The programme manager discussed the formation of the programme mentioning that it inherited some activities on beans and coffee from the Eastern and Central Africa Bean Research Network (ECABREN) and the Coffee Research Network (CORNET) respectively, and added tea, oil crops, fruits and vegetables, and other pulses.

He outlined the programme strategic plan, whose objectives are:

1. To enhance sustainable production, productivity and quality of HVNSCs
2. To enhance utilisation of HVNSCs for improved nutrition and health
3. To develop adaptation and mitigation strategies for effective response to climate change
4. To enhance access to and competitiveness in the domestic, regional and global markets of HVNSCs

He also discussed the medium term plan and highlighted its sub-themes as follows:

- Development and promotion of integrated high value non-staple crop management innovations

- Promotion of uptake of appropriate available high value non-staple crop technologies in ECA sub-region

- Development of sustainable and efficient multiplication and delivery systems for high value non-staple crop seed and other planting materials

- Development and implementation of strategies for improving value chain efficiency and enhancing market competitiveness of high value non-staple crops

He briefly mentioned the programme outputs and the matching ASARECA result areas:

1. Technologies generated and promoted to uptake pathways (ASAR2)

2. Strengthened institutions for market access (ASAR3&4)

3. Improved information and knowledge sharing (ASAR5)

4. Research capacity strengthened (ASAR4)

Dr Mcharo concluded by unveiling the progress made by the programme since its inception. Among other things he mentioned that:

1. The project intervention areas were already identified,

2. The competitive grant system (CGS) projects formerly under the networks had been revived and were ongoing. The ongoing projects are:

    - Enhancing competitiveness of snap beans for domestic and export markets implemented in Kenya, Uganda, Tanzania and Rwanda

    - Processing of tree-fruits and vegetables implemented in Tanzania and Rwanda

    - Intensification of Integrated Agro-systems for Climbing Beans implemented in Burundi, Rwanda and eastern Democratic Republic of Congo

The manager assured participants that ASARECA had completed its restructuring process and that the projects would have constant cash flow as long as they adhered to project contract agreements by making timely submissions of both technical and financial reports supported by a work plan.

Enhancing competitiveness of snap beans for domestic and export markets: Project overview

M. Ugen

National Agricultural Research Organisation (NARO),
National Crops Resources Research Institute (NaCRRI), PO Box 7084, Kampala, Uganda

This project is one of the ASARECA Competitive Grant System projects under the High Value Non-Staple Crops (HVNSC) Programme. The project is running in four countries shown below:

Country	Partner institution	Team leader
Uganda	National Agricultural Research Organisation (NARO)	M.A. Ugen (Principal Investigator)
Kenya	Kenya Agricultural Research Institute (KARI)	A. Ndegwa
Kenya	University of Nairobi (UON)	A. Ndegwa
Rwanda	Rwanda Agricultural Board (RAB)	A. Musoni
Tanzania	Selian Agricultural Research Institute (SARI)	F.S. Ngulu

Importance of snap beans

Snap bean as a commodity is growing in importance because it has potential to address food and nutrition insecurity and is a good source of income (domestic and export markets).

Constraints

- Lack of suitable snap bean varieties
- Susceptibility to pests and diseases
- Low soil fertility
- High post-harvest losses
- Lack of market information and infrastructure

Project hierarchy of objectives

Super goal

Increased economic growth and improved livelihoods in ECA while enhancing the quality of the environment.

Goal

Enhanced sustainable productivity, value added and competitiveness of sub-regional agricultural system.

Purpose

Enhanced utilisation of improved snap bean germplasm/varieties and management practices for increased quantity and quality, household income and health and nutrition in ECA.

Key research outputs

- Capacities of stakeholders to participate in domestic, regional and international markets and market chains enhanced
- Snap bean varieties that meet domestic and export markets developed
- Improved pest, disease and nutrient and water management packages developed and validated
- Improved pre- and post-harvest management packages for snap beans validated
- Uptake and utilisation of snap bean technologies enhanced

Progress from previous phase, 2006/2007

Project outputs

Output	Milestones achieved
1. ***Capacities of stakeholders to participate in domestic, regional and international markets and market chains enhanced***	• Markets and market chains characterised • Gaps and opportunities identified • Large unexploited domestic markets exist • Need to promote local consumption and utilisation • Snap beans provide a big source of employment and income generation among rural youth and women. • Quality requirements for all sector of the markets is a problem to the players. • Pre- and post-harvest handling a major cause of reduced quantity and quality
2. ***Snap bean varieties that meet domestic and export markets developed***	• Developed segregating populations • Wide variability for quality characteristics exist • Twenty most promising lines identified for participatory on-farm evaluation • Exchange of breeding materials among participating institutions

Output	Milestones achieved
3. Improved pest, disease, and nutrient and water management options/ packages for snap beans validated	• Assess the economic impact of pests and diseases (survey of farmers' perceptions, knowledge and management of pests) • Cultural practices and botanicals have potential to reduce pest infestation • Better results can be obtained when combined with synthetic insecticides • Combinations of organic and inorganic inputs have high potential to improve soil fertility resulting in improved yields and quality
4. Improved pre- and post-harvest management packages for snap beans validated	• Snap bean recipes developed in Tanzania • Field testing of management practices commenced
5. Uptake promotion and capacity development for snap bean technologies enhanced	• Stakeholder planning workshops held • Papers presented at seminars, workshops and conferences • MSc and undergraduate thesis/reports prepared • Projects monitored and evaluated • Project audited at the end of first phase • Snap bean post-harvest constraints documented

Activities for second phase, 2009/2010

Planned activities

Output	Activities
1. Capacities of stakeholders to participate in domestic, regional and international markets and market chains enhanced	1.1 Synthesis of snap bean value chain report into one regional report 1.2 Develop stakeholder action plans for market participation
2. Snap bean varieties that meet domestic and export markets developed	2.1 Identify and evaluate potentially marketable snap bean lines in multi-location yield trials 2.2 Evaluate and select potentially marketable lines from the new developed segregating population

Output	Activities
3. Improved pest, disease, and nutrient and water management options/ packages for snap beans validated	3.1 Assess economic impact of pests and diseases on snap bean production 3.2 On-farm evaluation of integrated pest and disease management practices across the region 3.3 On-farm evaluation of soil fertility and water management practices
4. Improved pre- and post-harvest management packages for snap beans validated	4.1 Regional synthesis of key snap beans pre- and post-harvest constraints 4.2 Validate promising pre- and post-harvest technologies across the region to improve product quantity and quality 4.3 Develop recipes for snap beans for utilisation at farm level
5. Uptake promotion and capacity development for snap bean technologies enhanced	5.1 Produce breeder and foundation seeds 5.2 Continue to identify partners in production, exporting, processing and dissemination 5.3 Establish and strengthen linkages among partners along the snap bean value chain 5.4 Enhance stakeholders' skills in production, processing and marketing of snap beans 5.5 Package and disseminate information on improved snap bean production technologies and markets in pilot sites 5.6 Participatory monitoring and evaluation of the project.

Enhancing competitiveness of snap beans for domestic and export markets

M.A. Ugen,[1] A. Ndegwa,[2] J.H. Nderitu,[3] A. Musoni[4] and F.S. Ngulu[5]

[1]National Agricultural Research Organisation (NARO), National Crops Resources Research Institute (NaCRRI), PO Box 7084, Kampala, Uganda

[2]Kenya Agricultural Research Institute (KARI), Thika Research Centre, PO Box 220, Thika, Kenya

[3]University of Nairobi, Faculty of Agriculture, Department of Plant Science and Crop Protection PO Box 29053, Nairobi, Kenya

[4]Crop Production Department, Rwanda Agricultural Board (RAB), PO Box 138, Butare, Rwanda

[5]Directorate of Research and Development, Selian Agricultural Research Institute (SARI) PO Box 2794, Arusha, Tanzania

Executive summary

Snap beans, *Phaseolus vulgaris* L., are grown and are being promoted in Kenya, Tanzania, Uganda and Rwanda for food and to generate income for small-scale farmers. This project intends to increase production and export of snap beans by developing and availing improved production practices to small-scale farmers. Emphasis will be placed on developing and disseminating improved varieties, improved pest and disease management options, improved integrated soil fertility and water management options and improved post-harvest management options in order to increase volume and value of snap bean products. The value chain approach will be emphasised. The estimated cost of the project is US$394,606 for two years.

Introduction

Snap beans (*Phaseolus vulgaris* L.) are growing in importance in the socio-economic systems of east and central Africa (ECA). It is a crop with great potential for addressing food insecurity and better incomes and for alleviating poverty in the region. The crop ranks first among the export horticultural crops in Kenya and contributes to an average of 18% value of all horticultural export crops in the country (HCDA 2003). For the last five years, it is estimated that Kenya exported 25,000 metric tonnes of the crop with a value of approximately US$60 million. Other ECA countries with increasing production of snap bean are Rwanda, Tanzania and Uganda. Snap bean production is dominated by rural, small-scale farmers, especially women and the youth; this forms a major source of their income.

Supplying snap beans with quality characteristics conforming to target markets is vital to increasing consumption and export value. Insect pests and diseases are the major biotic constraints to snap bean production in ECA and contribute to the high yield losses

prevalent on farms in the region. The other constraining factor in snap bean production in the region is low soil fertility, especially low nitrogen and phosphorus (Wortmann et al. 1998). Perhaps the most fundamental bottleneck to snap bean production in the region is lack of high yielding, pest and disease resistant and premium market value snap bean varieties (Kimani et al. 2004). This, in part, is due to the fact that the materials grown in the region are entirely developed in the temperate region. Hence, they lack adaptation to our biotic and other environmental stresses.

In addition to the production constraints, post-harvest losses, especially at farm level take a significant (though un-quantified) toll on farmer yields and along the marketing chain. Snap bean is consumed fresh, therefore, proper preservation to access the desired markets is imperative. Generally, farmers in the ECA region lack proper post-harvest storage and handling facilities and technologies. Proper understanding of the marketing systems will further permit objective linkage of farmers to profitable markets or marketing agents. All these aspects constitute components of the proposed project.

Project justification

Smallholder snap bean production is threatened by lack of affordable and marketable snap bean cultivars whose seed can be produced and disseminated through formal and informal seed delivery systems. Current varieties are patented by multinational companies, which prohibit seed production by smallholder farmers. Seed produced in the region by companies is shipped to overseas destinations and re-imported, raising seed costs. Costly seed increases production costs and reduces returns to smallholder farmers. Most of the varieties are susceptible to diseases, especially rust. Smallholder farmers can hardly afford costly fungicides and pesticides. The use of these chemicals is now faced with new restrictions (Global good agricultural practices or GLOBALGAP) imposed by regulatory agencies in export destinations. Deployment of resistance genes such as *ur*, now available with regional network and improved technologies, will reduce reliance on costly chemicals and allow marketing of products that meet consumer requirements such as minimum residue levels. Governments of the collaborating countries have expressed interest in promoting snap bean in their agricultural revitalisation and poverty reduction strategies.

Progress of the previous phase (2006/2007)

During the previous phase snap bean markets and market chains were characterised. Reports from individual institutions are available and being synthesised into one regional report for sharing with stakeholders. The market chain analysis report (gaps and opportunities identified during the survey) will be presented to stakeholders who will then develop action plans for market participation.

Participating institutions identified some promising lines of snap beans which will be tested at multi-location sites for adaptability. Exchange of promising materials among

the institutions will constitute regional nurseries for testing at multi-location trials. Segregating populations were also developed and selection of promising lines with resistance to pests and diseases with acceptable market characteristics had just started. Selections from the segregating populations, exchange of materials among participating institutions and evaluation of these lines at multi-location trials will continue.

The most important diseases and pests were determined at farm level. The action thresholds for these pests will need to be determined. A number of management options for snap bean production were tested on station with limited participation of farmers. The next step is to evaluate the various management options (cultural practices, and natural and biological pesticides) under farmers' conditions for adaptation and adoption.

Key snap bean pre- and post-harvest constraints were identified and individual institution reports prepared. These reports will be synthesised into a regional report and posted on the ASARECA website for reference by a wider community. Pre- and post-harvest technologies that contribute to snap bean quality and quantity will be demonstrated at farm level.

Some strategic partners along the snap bean value chain were identified and more will need to be identified. Linkages among the partners will need to be strengthened. Participatory monitoring and evaluation will continue to be used to assess and monitor changes associated with project activities. The results of the project activities will be shared through reports, manuals and presentations at scientific conferences/workshops/seminars.

Super goal

Increased economic growth and improved livelihoods in ECA while enhancing the quality of the environment.

Goal

Enhanced sustainable productivity, value added and competitiveness of sub-regional agricultural system.

Purpose

Enhanced utilisation of improved snap bean germplasm/varieties and management practices for increased quantity and quality, household income and health and nutrition in ECA.

Research outputs and activities

Output	Activities
1. Capacities of stakeholders to participate in domestic, regional and international markets and market chains enhanced	1.1 Synthesis of the snap bean value chain report into one regional report 1.2 Develop stakeholder action plans for market participation
2. Snap bean varieties that meet domestic and export markets developed	2.1 Identify and evaluate potentially marketable snap bean lines in multi-location yield trials 2.2 Evaluate and select potentially marketable lines from the new developed segregating populations
3. Improved pest, disease, and nutrient and water management options/ packages for snap beans validated	3.1 Assess economic impact of pests and diseases on snap bean production 3.2 On-farm evaluation of integrated pest and disease management (IPDM) packages (cultural practices, biological and natural pesticides) 3.3 On-farm evaluation of soil fertility and water management practices
4. Improved pre- and post-harvest management packages for snap beans validated	4.1 Regional synthesis of key snap bean pre- and post-harvest constraints 4.2 Validate promising pre- and post-harvest technologies across the region to improve product quantity and quality 4.3 Develop recipes for snap beans for use at farm level
5. Uptake promotion and capacity development for snap bean technologies enhanced	5.1 Produce breeders' and foundation seeds 5.2 Continue to identify partners in production, exporting, processing and dissemination 5.3 Establish and strengthen linkages among partners along the snap bean value chain 5.4 Enhance stakeholders' skills in production, processing and marketing of snap beans 5.5 Package and disseminate information on improved snap bean production technologies and markets in pilot sites 5.6 Participatory monitoring and evaluation of the project

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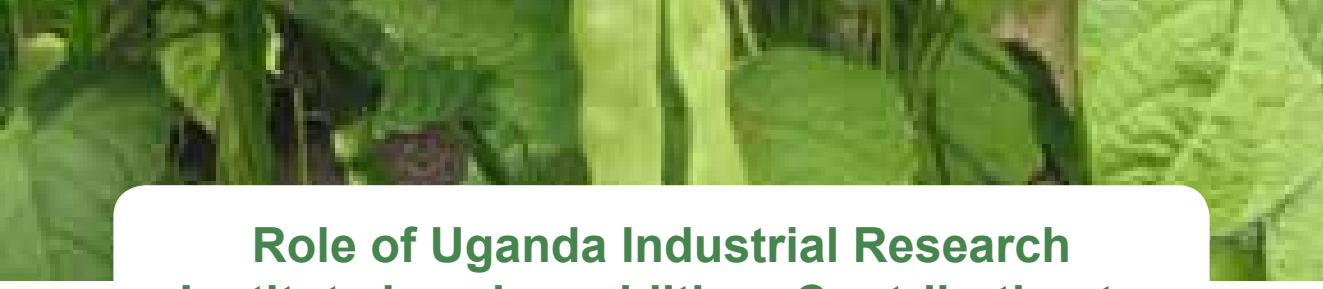

Role of Uganda Industrial Research Institute in value addition: Contribution to snap bean enterprise development

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Introduction

International perspectives on industrial research

Uganda continues to lag behind in its development efforts as seen from the daunting statistics and other manifestations such as the low levels of technology use, a manufacturing share of gross domestic product (GDP) of only 10% and a high rate of post-harvest losses (40% for some commodities) among others. Against such a status quo of a rather inchoate and even retrogressive pace of industrialisation, meaningful interventions can only be achieved through enhanced industrial research coupled with skills development and technology use. To better understand technology use and its relation to the current divide between poor and developed economies, a technology cluster map is used (Figure 1).

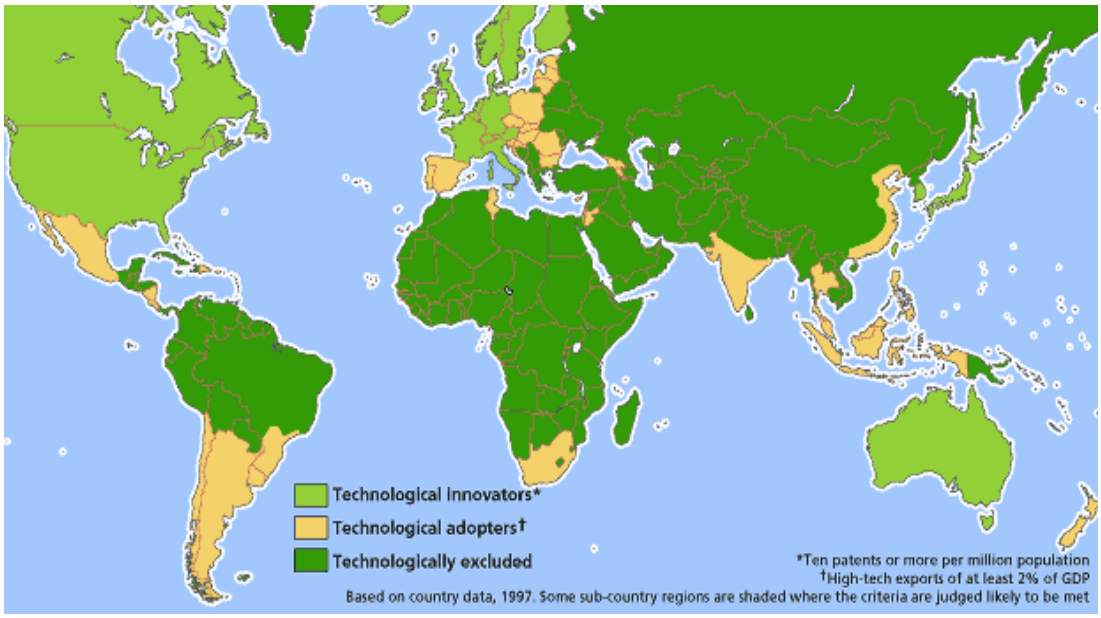

Figure 1. World map of technology clusters (circa 1997).

To assume and attain the status of technological innovators or adopters any country that is still technologically excluded must embrace industrial research which provides a range of benefits which include:

- A boost to economic growth (GDP)
- Increase in both human and natural resource productivity
- Commercial exploitation of basic research
- Enhanced speed of doing business
- Avenue for wealth creation
- Employment opportunities
- Reduced incidence of poverty
- Enhanced enterprise competitiveness
- Speeds up process of generation and use of new ideas
- Promotes introduction of new models
- Adoption of new patterns of work in order to utilise ICTs

About Uganda Industrial Research Institute

The Uganda Industrial Research Institute (UIRI) is a parastatal organisation operating under the auspices of the Ministry of Tourism, Trade and Industry; the institute was established by an Act of Parliament (Bill of 2002). Its core mandate is to engage in applied research and other activities (such as value addition) that will result in rapid industrialisation of Uganda. The mission is to catalyse the socio-economic transformation of Uganda and the region through enhanced technology use with a vision to be a model institution in applied research and technology sourcing as vehicles for incubating industry and to pioneer self-financing research and development (R&D).

Goals and objectives

- To undertake applied research for the development of products and optimal production processes, for Uganda's nascent industry.
- To develop and/or acquire appropriate technology, in order to create a strong, effective and competitive industrial sector.
- Act as a bridge between academia, government, and the private sector with respect to commercialisation of innovation and research results.
- Spearhead value addition activities in conjunction with national development priorities.

- Lead the national effort in technology transfer and technology diffusion, to assure the deployment of appropriate technologies.

UIRI general *modus operandi*

- Conduct research and formulate appropriate processes and source technologies
- Establish pilot plants for training and real life production; run business incubators
- Package technology to train entrepreneurs
- Monitor and assist entrepreneurs in the smooth running of their enterprises
- Currently the institute has the following services and infrastructure in place:
  - Pilot processing plants
  - Laboratories for chemical analysis
  - Microbiology analysis
  - Materials and handmade paper for product research and development.
- Established countrywide partner centres in form of model agro-processing facilities for potato, peanut butter, fruit juice and meat among others
- Small and medium-sized enterprise (SME) outreach programme (see Figure 2)
- Fabricated new technologies:
  - silk processing
  - multi-nutrient blocks
- A centre for food fortification for East, Central and Southern Africa
- A state-of-the art business development centre
- Industrial resource centre and a conference centre with all the modern amenities
- Extensive capacity building for UIRI staff

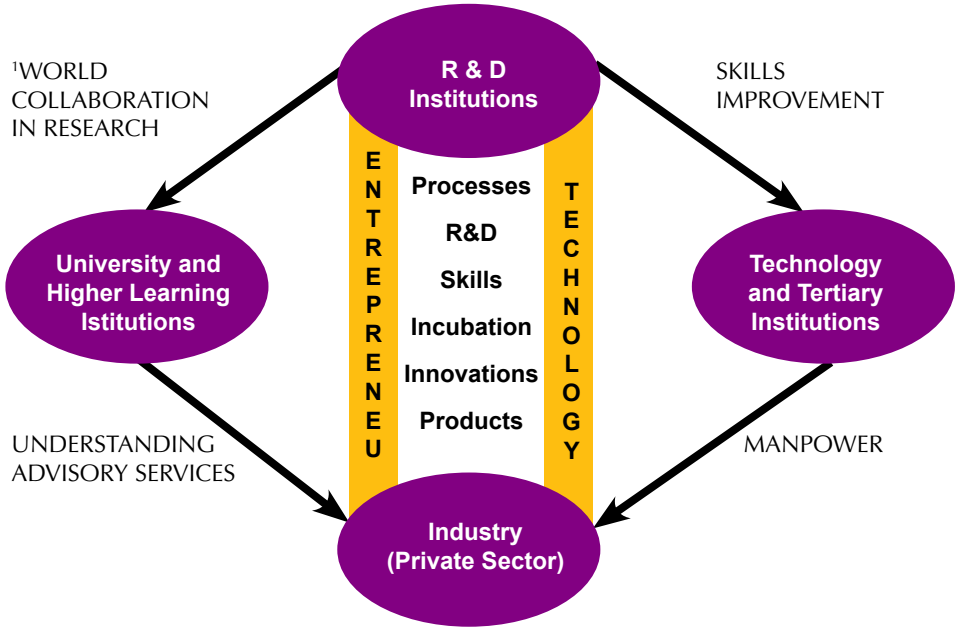

Figure 2. Partnerships/stakeholders in the development of SMEs in Uganda.

Business incubation at UIRI

The institute started an in-house business incubator in 2004 with a client base that includes:

- An E-Tech centre which is involved in fabricating kits for teaching science in secondary and higher schools.
- Info Access Technology Ltd—an entrepreneur specialising in the development of biometric identification software.
- Food processors—clients are involved in meat, potato, fruit and dairy processing.
- Vaccine production specialising in Newcastle disease vaccines.

As a consequence of this successful business incubator initiative, UIRI has been at the forefront of the formation of the African Incubator Network (AIN) as a regional coordinator for ECA. Globally, UIRI is an active member of the World Association of Technology and Research Organisations (WAITRO)[1], where the Executive Director, Prof Charles Kwesiga is 2nd Vice President and a member of the Executive Committee. Collaborative efforts between UIRI and other regional business incubation practitioners like the Kenya Industrial Research and Development Institute (KIRDI), the Kigali

1 WAITRO comprises 160 member institutions in 80 countries, is affiliated with the UN and has its headquarters in Kuala Lumpur, Malaysia.

Institute of Science and Technology (KIST), World Ahead Consulting in Dares Salaam, and the Ethiopian Information and Communication Technology Development Agency (EICTDA) in Addis Ababa have been taking root. Based on these experiences so far UIRI is set to develop its business incubation further and to share experiences with other stakeholders across the African continent.

Specific services offered by the incubator

As indicated above the rest of the world is now engaged in third generation business incubators. The envisaged business incubator centre of excellence is intended to apply the principles of technology transfer and leapfrog some of the evolutionary steps of the business incubation process, so that it can engage in state-of-the-art best practices of business incubation. This has to take into consideration the unique realities and circumstances of the African business environment.

Participating enterprises are offered some or all of the following services:

- Entrepreneurship training that addresses the unique needs of individual enterprises.
- Business advisory services including marketing, promotion, and business development.
- Mentoring.
- Shared business support services (e.g. Internet, conference facilities).
- Networking.
- Technology and technical know-how.

These services are premised on an exhaustive review of the challenges faced by enterprises and the lacunae that enterprises in Africa tend to experience, and on the informed opinion that if these needs are met the prospects for success of the enterprises are enhanced.

Models of incubation at UIRI

UIRI is one of the organisations spearheading the government's strategy of public–private partnership (PPP), specifically in terms of enabling the nascent industrial sector to become more vibrant and for enterprises to become viable. The strategy for the implementation of an elaborate business incubator at UIRI is rooted in the experience and current business incubation practise at the institute. Currently, the institute is involved in three types of incubators:

In-house incubation whereby the incubatees operate within the UIRI campus and are offered shared services, e.g. utilities, Internet and other amenities.

- Virtual incubation—the incubatees are located off-campus in urban or peri-urban settings usually as stand-alone enterprises. Support from UIRI entails technology sourcing, capacity building and, in some cases, even facilities and infrastructure.
- Collaboration based on the principle of PPP whereby an enterprise is supported by UIRI to meet specific needs and usually in accordance with the fulfilment of some government development initiatives and priorities.

Innovation and incubation

The business incubation model provides a key environment in which a range of innovations can be harnessed and built into a successful new business enterprise. Such innovations come from the following major activities that are closely interrelated as summarised in Figure 3.

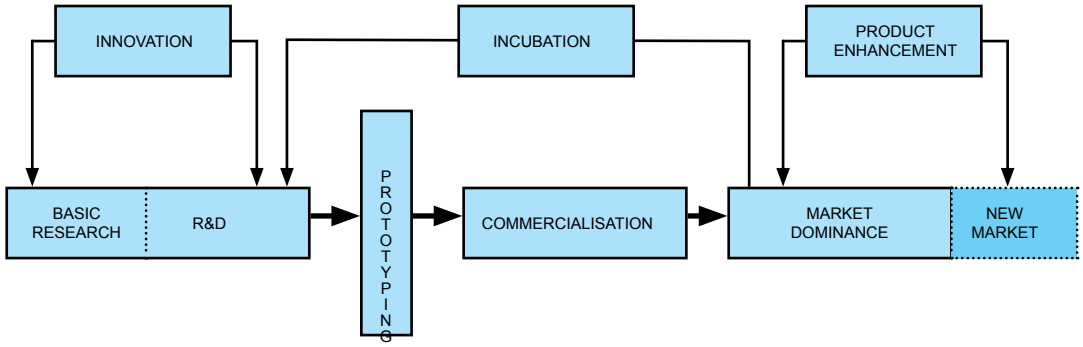

Figure 3. Schematic of the business incubation model.

The success of an incubator will be measured by the "graduation" and eventual performance of its clients who are able to produce and market products to either new or already existing markets.

The product value chain

The product value chain (bringing it all together) is demonstrated in Figure 4.

This is the new language of the champions of economic transformation and prosperity. It is a globally accepted concept meant to create the necessary discipline to delineate the activities of individuals (farmers, input dealers etc.) and institutions and mapping out their relevance to the whole process of transforming raw materials into value-added

marketable products. The Ministry of Trade, Tourism and Industry has the mandate to oversee three key elements within this entire value chain, i.e. value addition (UIRI), quality (UNBS) and marketing (UEPB). These play complementary roles in close partnership with the private sector with the end result being delivery of products as demanded by the market.

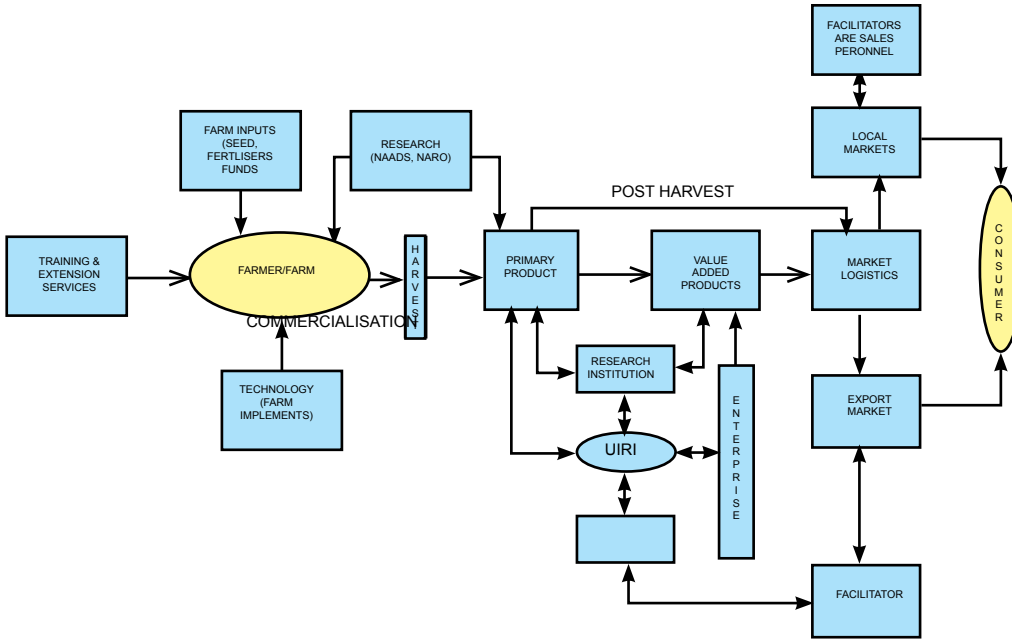

Figure 4. The product value chain.

Overview of adding value to snap beans in Rwanda

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Introduction

Vegetables play a significant role in human nutrition; they contribute vitamins, minerals and dietary fibre. However, fresh agricultural produce loses substantial amounts of vitamin C due to several factors such as extended storage, high temperature, low relative humidity, chilling injury and physical damage.

Scenario of snap bean production in Rwanda

Snap beans are mainly grown in Masaka and Bugesera areas of Rwanda and are for the local fresh vegetable market. The concept of value-added agricultural products is new to Rwandan farmers. The East African Seed Growers (Kenya), a foreign seed company, works with farmer organisations to facilitate export fresh snap beans (Variety: *Teresa*) to Europe. The surplus pods are sold in the domestic market for local consumption.

Nutrition

Due to health concerns in Rwanda many people in all socio-economic categories consume a lot of fruits and vegetables. Current emphasis is five to six servings of fruits and vegetables per day.

Understanding the concept of adding value to snap beans

Consumers are very demanding and willing to pay for services and convenience in the market place. The addition of time, place, and form to a commodity in order to meet the preferences or tastes of the consumer is termed as adding value. Value-added agricultural products offer farmers a way to increase the value of the products they grow and sell by providing products and services that satisfy consumer needs. Value-added food products are either raw or pre-processed commodities whose value has been increased through the addition of ingredients or processes that make them more attractive to the buyer and more readily usable by the consumer. Adding value is a production/marketing strategy driven by customer needs and perceptions. Value-added produce such as pre-packaged fresh-cut fruits and vegetables are becoming popular for busy consumers. Fresh-cut produce is defined as any fresh fruit or vegetable or their

combinations that has been trimmed, peeled, washed and cut into 100% usable product that is bagged or packaged. It is imperative that good agricultural practices (GAP) and rigid microbiological protocols be practised when producing these fresh-cut products.

Some ways of adding value to snap beans

Snipped fresh snap beans

The fresh snap bean pods are picked by hand and kept in cooling sheds at the farm. The pods are then graded by size and rinsed in chlorinated water before snipping the top and tail ends. After snipping the ends the pods are surface dried and bagged using controlled atmosphere packaging (CAP).

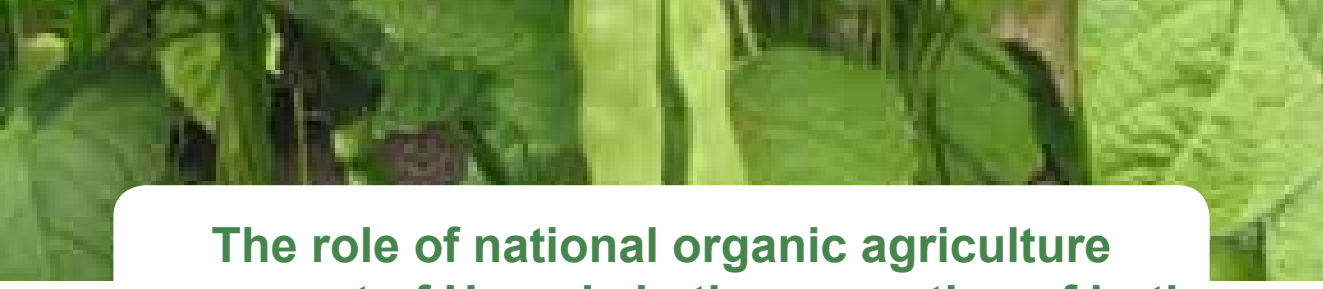
Fresh snap beans

Fresh snap bean pods are picked by hand when they are still tender with no strings. They are kept in cooling sheds at the farm. The pods are then graded by size and weighed before packing in paper cartons. Other snap beans processing methods include drying, freezing of green pods and canning green beans.

Adding value to highly perishable food products such as snap beans is inevitable. It is necessary to add value so as to reduce or avoid post-harvest losses, increase availability during off season, increase consumption, and to generate a steady income.

Conclusion

Kigali Institute of Science and Technology will train communities to add value to snap beans through their existing satellite centres in Nyagatare and Ruhengeri.



The role of national organic agriculture movement of Uganda in the promotion of both domestic and international export markets of snap beans

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Introduction

The National Organic Agricultural Movement of Uganda (NOGAMU) is an umbrella organisation which brings together producers, processors, exporters, non-governmental organisations (NGOs) and other stakeholders with the common purpose of promoting development of organic agriculture in Uganda. Currently, NOGAMU has a membership of over 280 organisations countrywide (producer organisations, export companies, NGOs and business support institutions). It is headed by a board of directors which is elected every 3 years by members at the general assembly. The board appoints the management of NOGAMU. The chief executive officer (CEO) oversees the day-to-day business of the organisation and the secretariat. NOGAMU operates under four thematic areas: a) domestic and export market development; b) training, research and extension; c) standards and certification; and d) policy, advocacy and strategic relations.

Background to organic agriculture

Worldwide the demand for organic products is estimated to be worth over US$46 billion and growing at a rate of over 30% per year. Uganda has about 33% of Africa's certified organic production land. Between 2001 and 2002 Uganda had only 15,000 certified organic farmers. Currently, the country has over 200,000 such farmers, the highest in the world. Uganda's value of organic exports was over US$30 million in 2008/09. The average growth rate of the sub-sector has been about 50% per annum for the last 4 years.

Domestic and international marketing by NOGAMU

NOGAMU links farmers and exporters of a wide range of organic products to buyers in domestic, regional and international markets. Some of the organic markets include the NOGAMU shop located at Kabalagala, a Kampala suburb; NOGAMU outlets in Jinja, Fort Portal, Bwindi etc.; local supermarkets located in Kampala City l; international schools like Lincoln International; and Kenyan Supermarkets like Uchumi and Nakumatt. Some of the International markets include Europe, United States of America, Canada, United Arab Emirates and Japan.

Organic products exported from Uganda include: a) fresh fruits (pineapple, apple banana, mango, papaya, passion fruit, jack fruit); b) processed fruits (frozen fruit pulp of pineapples and passion fruit); c) shea nuts, coffee, cocoa, cotton, sesame; and d) spices: (vanilla, cardamom, black pepper, ginger, bird's eye chilli). International market access requirements for fresh fruits and vegetables are tough (especially the standards related to food safety and traceability). Conventional vegetables (snap beans) face many market access restrictions, e.g. maximum residue level (MRLS) requirements. Organic snap beans are subjected to fewer international market restrictions than conventional snap beans are.

Market opportunities for organic snap beans

Global demand for organic products is increasing, especially for snap beans. This is as a result of increased consumer concerns about health and safety, increased consumer consciousness regarding the environment and socio-economic issues related to production and marketing. This is also due to consumer concerns and demand for proof of traceability and transparency in conducting business. Organic products have an advantage over conventional products because of price premiums. Premiums range from 25% upwards while some go as high as 200%. This provides marketing opportunities for the producers, increasing their income, ensuring self-reliance and improving their livelihoods.

NOGAMU has established an Organic Trade Point Database to keep records of the several inquiries (email, telephone and walk-in) for organic products including snap beans. Several exporters contact NOGAMU for help to identify reliable suppliers of organic snap beans to meet the demand from the German and Belgian markets.

Locally, at the NOGAMU shop in Kabalagala, organic snap beans are one of the fastest selling items. Organic snap bean supply in Uganda is operated on a basket delivery scheme by the NOGAMU shop. In this system, consumers order online, the shop places the orders for supplies and farmers deliver products to the shop. Staff at the NOGAMU shop prepare the baskets of assorted items which are delivered to the consumers.

Challenges facing supply of organic snap beans in Uganda

Only one (Namulonge Horticultural Farmers Association) out of over 60 farmer groups supplying the NOGAMU organic shop and basket delivery scheme, grows organic snap beans. Farmers manage both pests and diseases organically to guard against the market access restrictions faced by conventional vegetables (snap beans).

Certified organic farmers in Uganda have problems accessing organic seed for snap beans. The market lacks untreated conventional seeds required for organic production. Unfortunately, even the treated conventional snap bean seeds are not easily available and are also of poor quality. Lastly, the farmers lack awareness about opportunities and benefits of producing organic snap beans.

NOGAMU contribution

NOGAMU has conducted several training meetings for various farmers on organic snap bean production. Through NOGAMU the producers are linked to interested buyers and assisted to market their produce through the organic shops. NOGAMU is interested in forming partnerships with ASARECA and other organisations to increase supply of organic snap beans in ECA. NOGAMU is willing to help producers respond to the export market demand and the meet the snap bean needs of the growing domestic, regional and international demand.

The role of business development service providers in the snap beans value chain in Uganda

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Introduction

This paper provides a brief historical background of the business development service (BDS) in Uganda and a description of the work done on snap beans value chain development. Agribusiness Management Associates (AMA) Uganda Ltd., was incorporated in 2003 and since then has been involved in advising farmers and produce buyers on aspects of crop production, post-harvest handling and marketing. In addition, the company offers services in market linkages, market data collection and dissemination, and undertakes socio-economic studies. The company also works with major commercial farms like those growing flowers in areas of good agricultural practices (GAP). These include Milieu Project Sierteelt–GAP (MPS-GAP) for flowers and GLOBALGAP for other horticultural crops, supervisory skills improvement in commercial farms and post-harvest handling. The company offers technical assistance to farmers in areas of food safety and market standards. Through working with farmers, AMA realised the need to stimulate capital mobilisation starting with farmer's savings to invest in their farming businesses. In Kasese District, AMA works closely with farmers who grow vanilla for export to United States of America, hot pepper and snap beans for export to Europe and Moringa seeds for the Kenyan market.

French beans value chain in Uganda

The development of commercial production and marketing of snap beans was re-ignited in the mid-1990s by a United States Agency for International Development (USAID)-funded Investment in Developing Export Agriculture (IDEA) Project. During that time, work under the high value component focused on identifying and supporting a suitable private sector client base of producers, producer organisations, traders and exporters. The project staff concentrated on analysing the constraints to and opportunities for snap bean production for export. Support was provided to farmers by undertaking on-farm trials of snap bean varieties (Paulister and Amy). At the same time, the project consulted with the market to determine their requirements. The project played a critical role in encouraging local and foreign investors to invest in production and export of snap beans, mainly to Europe. The IDEA project supported one company known as Mairye Estates to sign a contract with one of the supermarkets in UK to produce and supply the

beans. The contract ran for about 2 years, but the investor decided to concentrate on cut flowers. Since that time over 90% of snap beans production has remained for the domestic market.

Activities in snap bean production and marketing on the local market

The key challenges in snap bean value chain development have been the result of poor quality beans which are stringy and short due to high temperatures. Accessibility and affordability of suitable varieties under Ugandan conditions has been low; most snap bean varieties are bred for European conditions and the certified seed is too expensive for ordinary farmers. An additional challenge has been the high incidence of pests and diseases, leading to over-dependence on expensive agricultural chemicals. The producers and buyers of snap beans have also experienced hindrances due to lack of infrastructure to support the cold chain from production to market. Export opportunities of snap beans to regional markets do exist, however, farmers need to be organised and produce under contract. This will guarantee market and motivate the farmers. For the export market to Europe, the demand for the product is enormous; the only big challenge is compliance with standards and regulations. For example, traceability of the produce is a requirement under the EU food safety regulations. Simple affordable structures should be established to support compliance with these regulations and standards required in Europe.

Figure 1. Cooling shed made out of local materials at one of the vegetable farms in Wakiso, Uganda.

Most Ugandan farmers produce snap beans on a very small scale. They lack the means to irrigate their gardens during the dry period and only rely on rainfall to produce snap beans. The fertility of most soils is deteriorating and farmers are unable to raise the required market volumes and maintain regular supply due to lack of irrigation equipment. The long distances from suitable production areas to the airport in Entebbe are also a big challenge to snap bean farmers. The middlemen end up benefiting more from the business than the producers do.

Figure 2. A charcoal cooler at Sulma foods in Luwero, Uganda.

Opportunities/conclusion

The existence of partnerships among research institutions in the region can leverage efforts and resources to develop and commercialise new crop varieties. Smallholder farmers have reasonable knowledge and skills to produce snap beans. BDS providers like AMA knowledgeable in snap bean value chains are available to support production through marketing. There is a growing domestic market demand for fresh vegetables and a number of supermarkets in the city can be used as steady buyers. Due to EAC integration snap beans grown in the cooler districts of Kabale, Kisoro and Rukungiri can

be exported through the Kigali International Airport. Traceability and other phytosanitary requirements from European importers will continue to be barriers to growth in fresh produce exports. Uganda will realise significant fresh produce export growth only with further investment from large agribusiness firms, such as those invested in Kenya. Adding value to snap beans through product development and packaging innovations will support future growth in the fresh snap bean market in Uganda.

Enhancing productive sector competitiveness: Lessons from the Competitiveness and Investment Climate Strategy (CICS) Secretariat

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Introduction

The Competitiveness Investment Climate Strategy (CICS) (formerly known as Medium Term Competitiveness Strategy (MTCS) Secretariat, was set up in 2003 to support the implementation of the Medium Term Competitiveness Strategy (MTCS) for 2000–2005. After MTCS 2000–2005 the secretariat designed the CICS plan for 2006–2010.

The CICS Secretariat carries out the monitoring, coordinating and facilitation roles so as to enhance productive sector competitiveness. It works closely with CICS implementation agencies both in the public and private sectors. The policy guidance is provided by a Steering Committee chaired by the Permanent Secretary/Secretary to the Treasury (PS/ST) in the Ministry of Finance, Planning and Economic Development. The CICS supports a high level public to private dialogue with the Presidential Investors Round Table (PIRT).

Targets for CICS—2006 to 2010

CICS has a target of achieving a gross domestic product (GDP) growth rate of more than 7% per annum, a private sector investment of more that 25% of GDP, a revenue collection at 20% of GDP. CICS also wants Uganda to be among the top reformers in Africa, with a population of poor of below 30%.

CICS priority areas of action

CICS selected three priority action areas—competitiveness of the productive sectors, competitiveness of the investment climate and competitiveness in the regional and global markets—as areas where Uganda would benefit in trade. CICS went further and identified the agriculture, tourism and service sectors plus the industry and manufacturing sectors as the most competitiveness and productive sectors in the country. Infrastructure reforms, financial services, commercial justice, business registration, land registration and adjudication and public and private partnerships were selected as suitable for competitiveness of the investment climate. Transit trade, non-tariff barriers, product standards and regional integration were selected as areas where Uganda would have a chance at competitiveness in the regional and global markets.

Investment climate action areas

Under the investment action areas indicators for tracking competitiveness were formulated (Global Competitiveness Report and Doing Business Report). CISC seeks to accomplish linkages of infrastructural development to clusters or growth corridors. They also track and facilitate enactment of prioritised commercial laws and offer support to the land and company (URSB) registries.

Reform areas to improve rankings

CISC identifies six reform areas for improving ranking: a) streamlining property registration procedures; b) consolidating procedures for start up and launching online services for company registration; c) launching a one-stop-shop for traders at borders; d) passing of key commercial laws, e.g. Insolvency law, to shorten time lines for the re-organisation of a distressed company; e) operating the credit reference bureau; and f) reducing the time spent in property valuation (currently 5–7 months).

Competitiveness in regional and global markets

In order to improve competitiveness in regional and global markets, several items were considered including: a) development of a national standards policy and strategy; b) monitoring transit facilitation initiatives; c) putting in place sound the clock customs services; d) reducing the number of roadblocks along the northern corridor; e) reducing the number of weigh bridges; and f) harmonising axle load limit.

In order to achieve regional integration, policies and laws must be simplified and harmonised and the existing competitive law must be domesticated. The leadership team (Steering Committee) should advocate for lower freight costs for exports (flowers and fish).

CISC collaborates with several partners engaged in: a) business reforms such asthe World Bank and other relevant agencies; b) commercial laws, Ministry of Justice and Constitutional Affairs (MOJCA), Uganda Law Reform Commission (ULRC), Parliament, etc.; and c) those responsible for forming cluster forums, donors (USAID, SIDA, SNV), public sector(MAAIF, MTTI) and private sector representatives.

Concepts addressing productive sectors competitiveness

Five concepts have been selected to address the productive sectors: a) multi-stakeholder platforms for promoting cooperation and helping to build trust among the chain actors; b) value chain analysis: a full range of activities required to bring a product or

service from conception, through different stages of production, delivery to ultimate consumers and final disposal after use; c) competitiveness plans that form the basis for understanding key markets, crucial for addressing both global and domestic markets; d) cluster approach: defined as a process of firms and other actors co-locating within a concentrated geographical area, cooperating around a certain functional niche, and establishing close linkages and working alliances to improve their collection competitiveness . Changing of mindset is crucial to cluster development; and e) public-private partnerships: arrangements whereby government actors and private sector (enterprises, research institutions and civil society organisations) jointly undertake development programmes and other initiatives for mutual benefit.

Multi-stakeholder platforms are important because of information sharing and building trust, and hence open up opportunities for cooperation, enhancing innovation and creativity, facilitating private sector participation in resource mobilisation and execution and prioritising and sequencing of interventions.

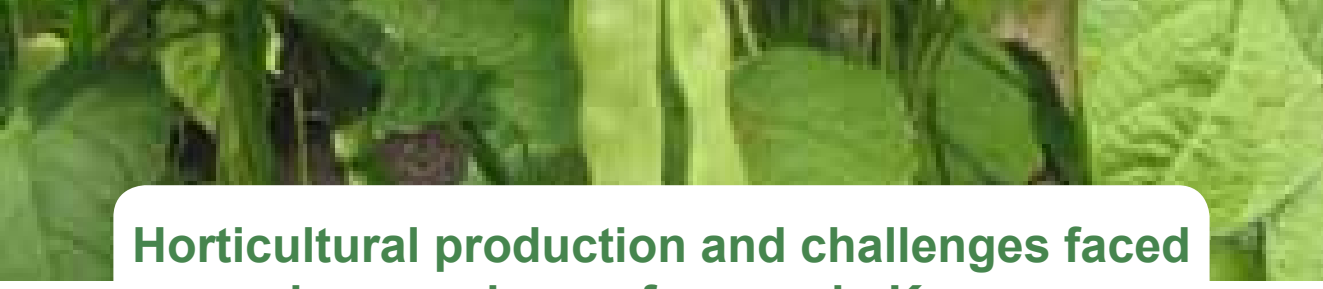
Key issues in productive sector competitiveness

Some of the key issues in the productive sector include infrastructure (transport and energy), access to financial services, timely enactment of commercial laws and public-private partnership laws, and developing institutional frameworks.

Support to improve the competitiveness of commodity sub-sectors has been part of the activities of the team that introduced the participatory market chain approach (PMCA) in Uganda. It carried out market studies for the Irish potato and honey sub-sectors, contributed to attaining acceptable standards for honey in the EU, organised multi-stakeholder platform meetings for citrus and was involved in advocacy for increased funding in the coffee, fish and flowers sub-sectors.

Possible areas for collaboration in the snap bean sub-sector

CICS and the snap bean stakeholders have several possible areas for collaboration. These include: advocacy into national policy and budget processes, multi-stakeholder platforms facilitation, support to value chain studies and mobilisation for public and private sector participation.



Horticultural production and challenges faced by snap beans farmers in Kenya

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Introduction

This paper briefly discusses the challenges faced by horticulture farmers in Kenya, especially those dealing with snap beans. It gives an overview of the role the Horticultural Crop Development Authority and its roles, responsibilities and contribution to the snap beans sector in Kenya. It also provides some data showing the trend of horticultural production in Kenya from January 2005 to June 2009.

Background of the Horticultural Crops Development Authority

The Horticultural Crops development Authority is a state corporation established under the Agriculture Act Cap 318 through a subsidiary legislation in 1967, legal notice No. 229/1967. It is the government regulating agency for the sub-sector. It is mandated to facilitate development, promotion, coordination and regulation of the horticulture industry in Kenya. The horticultural sub-sectors include floriculture, olericulture, pomology, and spices and herbs.

Roles and responsibilities of HCDA

HCDA provides advisory services to the Government of Kenya and the horticulture industry to facilitate proper planning, provide market intelligence information, provide specialised extension services to farmers and to facilitate marketing of horticultural produce.

Core functions HCDA

HCDA carries out the overall sector coordination, provides extension services to farmers, registers farmer groups and offers crop and produce inspection. It carries out market intelligence activities; arbitrates disputes; conducts market surveys; collects, analyses and disseminates data; is involved in trade negotiations; facilitates agricultural shows and exhibitions; registers produce dealers; and offers advice to the government on the horticulture sector.

Horticultural industry in Kenya

While the agriculture sector employs 80% of Kenya's population, a large proportion of these workers is engaged in the labour intensive and fast-growing horticulture sub-

sector. The export performance of horticulture for 2007 was 385,188 tons and for 2008 was 423,129 tons, valued at KES 57.3 billion (USD 670 million) and 73.7 billion (USD 862 million) respectively. The overall growth in volume was 9.8% and 29% in value for the same period. Below are a series of figures showing the trend of export trade in Kenya.

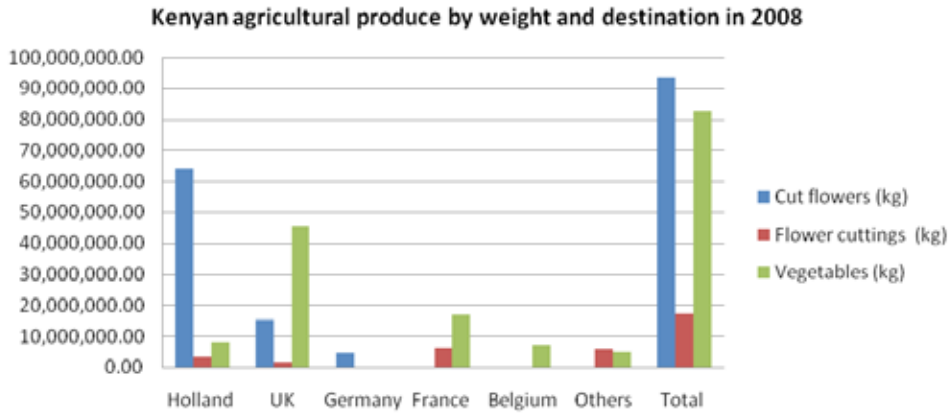


Figure 1. Kenya exports by destination and weight.

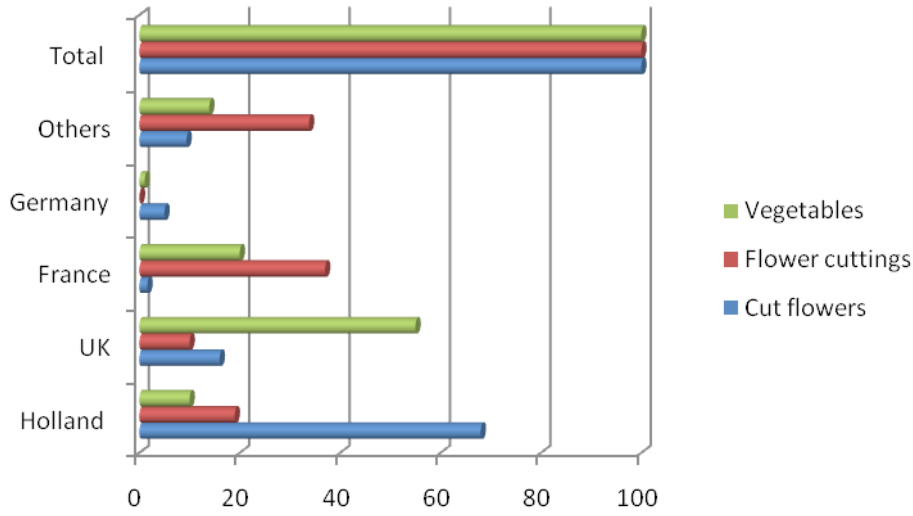


Figure 2. The destination of Kenyan produce in 2008 (%).

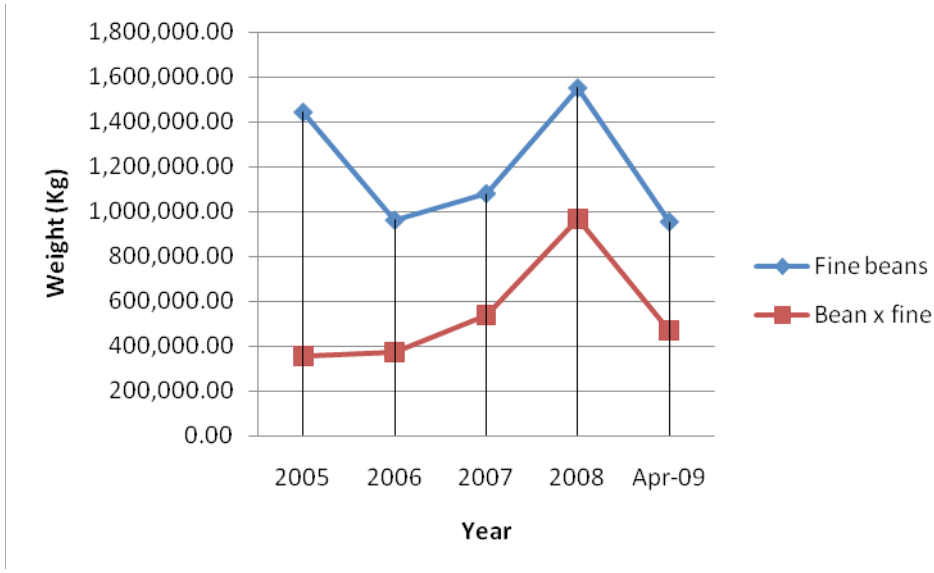


Figure 3. The trend of snap bean exports (by weight) from Kenya from 2005 to 2009.

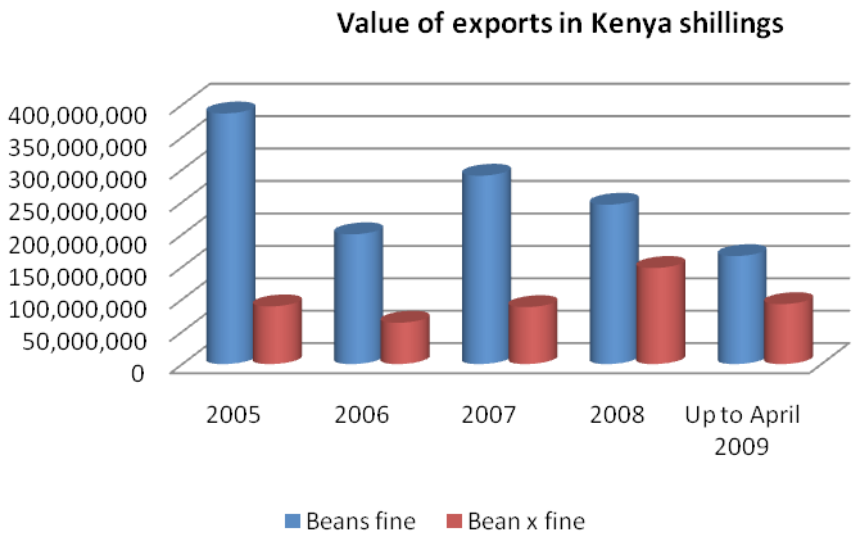


Figure 4. The trend of snap bean exports value in Kenya shillings from 2005 to 2009.

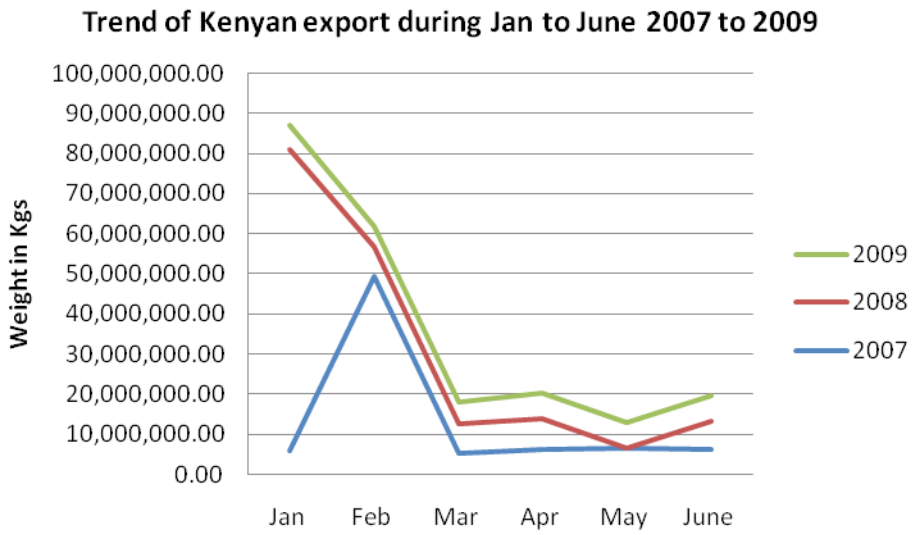


Figure 5. Snap bean export details for 2007 to 2009 (January to June).

Snap beans varieties grown in Kenya

Various snap bean varieties are grown in Kenya for both the fresh and processing markets. For fresh marketing the following varieties are grown: Amy, Pekera, Teresa, Paulista, Rexas, Samantha and Cupvert. Currently, three varieties are being grown for processing: Julia, Vernandon and Sasa.

Snap beans are grown mainly in five major provinces: Nairobi, Central, Eastern, Western and Rift Valley.

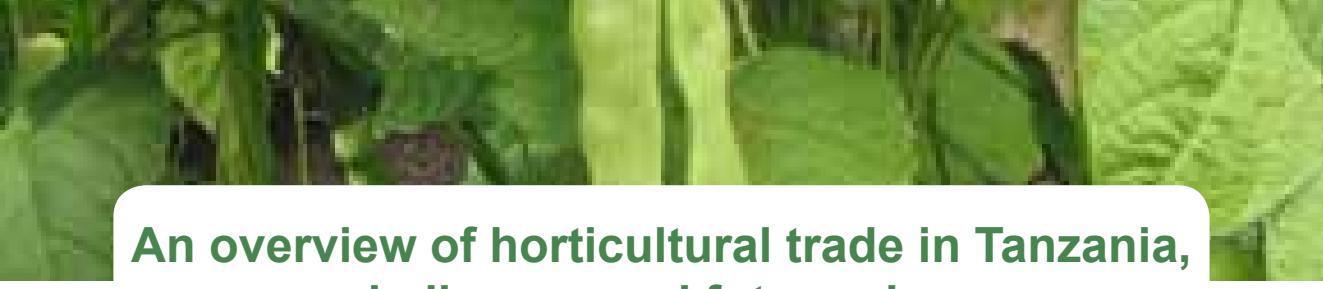
Major challenges

Some of the major challenges to the snap beans sector include: the high cost of inputs like agricultural chemicals; adulteration of some of the inputs and insufficient application of key inputs; unfavourable global trends; and increased competition for horticultural products—the presence of West Africa in the snap bean market has tremendously reduced the volume of sales. The producers are also hindered by low application of modern technology and they lack adequate quality control systems. The snap bean crop is susceptible to many pests and diseases that lower the pod quality. Kenya is frequently hit by droughts. The infrastructure is poor and inappropriate for highly perishable produce like snap beans. The market and marketing infrastructures are inadequate and the multiplicity of taxes makes the export business unprofitable.

Recommendations

The government must develop strategies to mitigate the adverse effects of climatic change such as improved varieties, water management systems, environmental conservation practices, enforcement of environmental laws and improved horticultural research. The government must also put in place sufficient infrastructure and reduce operational costs to facilitate value chains.

As far as compliance to market requirements is concerned, there is need to build the capacity of farmers and to train trainers and enhance plant health regulations and standards between the EAC countries. The countries in the region need to work together to review the policies on taxes and trade so as to accommodate horticultural issues. The governments should offer more financial assistance to farmers through loans and guaranteed credit schemes.



An overview of horticultural trade in Tanzania, challenges and future plans

J. Mkindi

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Background

The Tanzania Horticultural Association (TAHA) is an umbrella organisation that advocates for issues of the private sector. It is member based, representing the interests of horticultural investors at all levels. The association serves as the voice of the industry, a catalyst for transformation, and an agent of change and reformation of the industry in Tanzania.

Objectives and main strategic activities of TAHA

The TAHA initiatives aim to improve production and productivity of horticultural crops, diversification of market opportunities, creation of employment opportunities along the value chain and generation of income. This will enhance the contribution of the horticultural sector to poverty reduction and national development. TAHA was formed for the purposes of lobbying and advocacy, technical support, information dissemination, and promotion of the industry and the products of members.

Horticulture in Tanzania

The horticulture industry in Tanzania comprises the floriculture, vegetables, fruits, spices and herbs and tubers sub-sectors. Horticulture is the fastest growing agriculture sub-sector in Tanzania with a recorded growth rate of 8–10% per annum. Recently, the industry was recognised as an engine for economic growth making a significant contribution to the national poverty alleviation strategy. The horticulture sub-sector is labour intensive and about 2 million Tanzanians depend on horticulture for their livelihood.

The country has a large potential for production of tropical, sub-tropical and temperate fruits, vegetables and spices due to a wide range of suitable agro-climates. Tanzania has the potential to produce 2 million metric tonnes of fruits worth at least TSh 1 trillionor about US$1 billion. In addition to fruit, approximately 1.2 million metric tonnes of vegetables can be produced annually valued at TSh600 billion (USD 600 million). However, in many of the agro-climatic zones the production potential is grossly underutilised.

Horticulture can offer significant contributions to the realisation of the MDGs. These include food and nutrition security, increased income and poverty alleviation and

sustainable socio-economic growth. The horticulture industry in Tanzania generates about US$150 million per annum from export revenues alone.

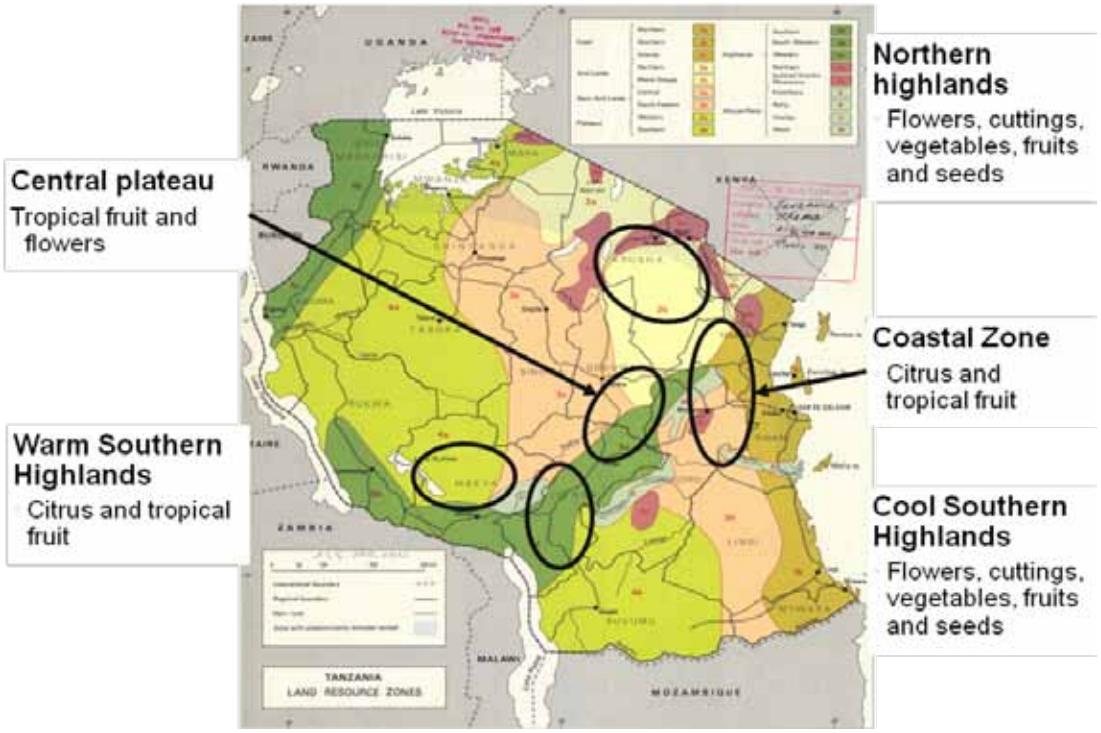


Figure 1. Major horticultural production areas in Tanzania.

Export trend

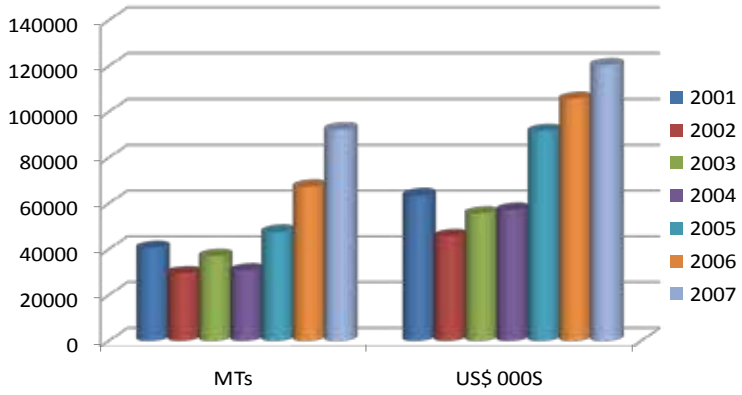


Figure 2. Export trends for horticultural produce in Tanzania, 2001–2007.

Range of horticulture products

Tanzania has a wide range of horticultural products under the fruits, vegetables and flowers sub-sectors. Some of these include:

- Fruits: apples, avocado, banana, blackberries, guava, grapefruits, jackfruits, limes, mango, orange, passion fruit, pears, pineapples, raspberries, strawberries etc.
- Vegetables: Asian vegetables, baby corn, beans, cabbage, carrot and baby carrots, cauliflower, eggplant, kale, leeks, onion and shallot, okra, peas (mange-tout, snap and snow peas), potatoes, spinach, tomatoes etc.
- Flowers: cut flowers (roses, Gerbera, Aster, Lisianthus, Gysophilla, million stars, Hypercium, papyrus, tuberose and fern) and cuttings (chrysanthemum, herbs and border plants) and flower seeds.

Consumption of horticulture Produce in Tanzania

Average consumption of fruits and vegetables is about 30 kg per capita in urban areas and about 17 kg per capita in rural areas. Fruits and vegetables provide most of the vitamins and minerals needed for the health of the nation. However, the current consumption is less than half the recommended rate calling for more production of these products. Thus, nutrition education and promotion of fruits and vegetable as nutritional crops would facilitate the increase in demand and hence horticultural production.

Markets for Tanzania's fresh produce

The main market for Tanzanian horticultural produce is Europe. About 75–80% of fresh flowers go to the auctions in Holland. Other markets in Europe include Norway, Germany and the UK. The upcoming markets include USA, Japan and the Middle East. The EAC and SADC provide the regional markets.

Developments in the sector

The sector has achieved a lot as a result of the partners' interventions in the horticulture industry. The industry is now receiving substantial support from the Government of Tanzania, the Dutch Government (which is funding the World Summit on Sustainable Development Public-Private Partnership Programme), from USAID to the Horticulture Development Council of Tanzania, World Bank funding for the Tanzania Cluster Competitive Programme, the World Trade Organisation funding Standards and Trade Development Facility, and other development partners through the Agricultural Sector Development Programme.

Main challenges

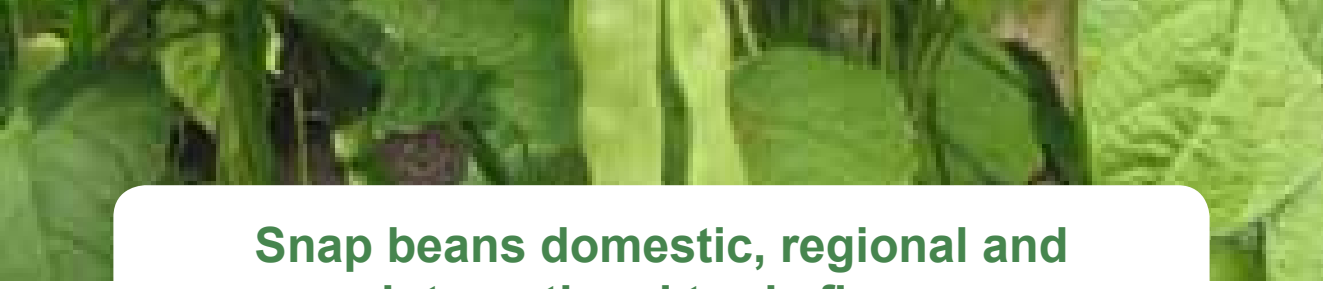
The industry is faced with several constraints: inadequate infrastructure, lack of easy access to funds, limited technical skills/expertise capacity to conform to market and production standards, inappropriate government policies and red tape bureaucracy, unstable market conditions and long market chains, poor access to innovative

horticultural technologies including improved seeds, etc. and high costs of agro-inputs. The industry is also affected by global climatic changes.

Recommendations

In order to boost the horticulture sector, the government has to address several constraints: providing sufficient and appropriate infrastructure, reducing operational costs and facilitating the value chains. The government must establish agricultural development banks and credit guarantee schemes to facilitate easy access to funding for small-scale growers. The small-scale farmers also require mobilisation into formal groups so as to facilitate capacity building and farmer exchange programmes. There is need to revise the current agricultural and trade policies that do not favour horticultural production and marketing so as to accommodate horticultural issues and the involvement of the private sector. Globally, the climate has changed and adversely affected the horticultural sub-sector. The government needs to come up with strategies to mitigate the adverse effect of climatic change addressing areas like water management systems, improved varieties, environmental conservation practices and others. Environmental laws should be enforced and promulgated and also appropriate horticultural research showing that we have true facts for proper decisions. There is need to diversify and develop new product lines.

One of the ways of solving some of the challenges facing the horticulture sector is working together as a region, and a continent to tackle common or cross-cutting issues. It is also important to encourage effective public-private partnerships and to encourage more investments in the sector from development partners, through feasible and sustainable projects.



Snap beans domestic, regional and international trade flows

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The Uganda Export Promotion Board (UEPB) is mandated by statute No. 2 of 1996 in the Constitution of the Republic of Uganda. UEPB is a public institution under the Ministry of Trade, Tourism and Industry. It was formed to facilitate the development, diversification, promotion and coordination of all export related activities that lead to export growth on a sustainable basis.

UEPB functional roles

UEPB has several functional roles. The board provides trade and market information services, develops export products by stimulating quality and quantitative supplies, provides trade promotional services, customised export trade advisory services and training and formulates and makes recommendations to the Government of Uganda. UEPB also develops export plans, policies and strategies.

Market research entry platform

Through its Market-Linked Programme, UEPB identifies markets and organises companies through trade missions to utilise opportunities. This programme started with 12 Ugandan companies from the foods and beverages sector at the beginning of 2009. Another trade mission was held during January 2010 and comprised 25 companies from Tanzania and western Kenya. The programme advises producers on product development, innovation, financial management systems and compliance with standards among others. One of the companies helped in 2009 has already exported 2 tonnes of its product worth US$5000 as a first batch; 6 more will export their products as soon as Uganda National Bureau of Standards (UNBS) issues them Q-marks.

Market information dissemination

Stakeholders are registered with UEPB and their details are stored in the board's database. UEPB provides stakeholders with information from already established trade information systems and the Private Sector Trade & Business Information System aimed at addressing trade information needs. The information provided includes: up-to-date information on prices of different items, market access, buyers, market trends in major markets, consumption trends and basic information on how to start exporting. The text message (SMS) mobile facility is also up and running;

using this method producers can access local, regional and international market prices on their mobile phones.

Service delivery tools

The sector has put in place profiles on different products; these are available and accessible at UEPB offices. The board also makes strategic market forecasts. This is a report that contains information on current market situations for all products, market dynamics and proposed intervention areas to tap into existing market opportunities. The board also prepares Market Information Briefs (MIB) and disseminates them monthly.

Service delivery channels

UEPB offers free (no cost) export counselling and advisory services at UEPB offices. Regional Export Information Points (REIPS) have been established in Mbale, Bushenyi, Gulu and Nebbi. In 2010 UEPB ran no-cost Export clinics to assist stakeholders intending to join the export business. The board has future plans to construct an Export Development Centre. This will house an incubation centre for products and will have demonstrations of value addition technologies for all products. UEPB will also be facilitating the sale of export documents: export registration certificate, EAC certificate, COMESA certificate, Morocco certificate and China SPS certificate to ease the current process which is burdensome because the documents are not centralised.

What are snap beans/green beans?

Snap beans, also widely known as French beans, are unripe beans. They are becoming more important to the socio-economic system in ECA. Most snap beans produced in East Africa are round and thin, mainly to suit the European market. ECA countries which are increasing production of the crop are Kenya, Uganda, Sudan, Tanzania and Rwanda. Snap beans production is dominated by rural small-scale farmers. However, they are also grown by large commercial companies for export to overseas supermarkets and for the canning industries.

Trade flow analysis [market trends] green beans

Total world's import in volume and value and percentage:
The total volume of imported snap beans in the world market is 955,726 tons (Table 1).

Trend over 2004–2008 (% growth)

Annual growth from 2004–2008 worldwide was 36% in value and 22% in volume.
India grew by 86% and 59%, Japan 11% / -2%, China 78% /58%, USA 16% /11%, Viet Nam 20% /6%.

Table 1: **Total world's green bean imports**

Country	Weight (tons)	Percentage market share
India	367,050	**44.79**
Japan	52,190	**10.94**
China	79,641	**7.06**
USA	25,718	**4.4**
Viet Nam	47,314	**4.4**

Main supplying countries in the world

Myanmar is the leading supplier of snap beans with 51.68% world market share. It is followed by China 20.43%, Colombia 7.07%, Thailand 5.53% and Australia 2.85%.

The supply from East African countries is as follows: Tanzania is ranked 7th in the world with production of 14,748 tons and 1.48% market share; Rwanda is ranked 15th with 2829 tons and 0.31% market share; Kenya is ranked 18th with 1126 tons and 0.19% market share; and Uganda is ranked 25th with 1038 tons and 0.07% of the world's market share.

Uganda's competitive advantage

Uganda's climate is summer year round with moderate temperatures (15°C–30°C), with a bimodal rainfall pattern combined with relatively rich soils that support organic farming and leading to two harvests a year. Where rain is supplemented with irrigation all-year-round production takes place. The November to February harvest period in Uganda coincides with the northern hemisphere winter-period of peak demand for fresh fruits and vegetables in Europe. The country has sufficient skilled, semi-skilled and unskilled manpower. Makerere University trains graduates specialising in processing and post-harvest technologies of fruits and vegetables. The government is currently posting agriculture graduates to work as extension officers in all sub-counties. Researchers and specialists in agronomy, agricultural economics, plant breeding and soil science are available at the national agricultural research institutions (NARIs) to provide expert advice. Agricultural colleges and institutes in the country offer certificate and diploma courses. The graduates from these institutes acquire skills and knowledge making them suitable as foremen and general farm workers. Uganda continues to provide far cheaper unskilled man power than any other country in the region.

Challenges threatening exports of horticulture

Most of the snap beans farmers cultivate on a small scale. The costs of proving compliance (certification) are therefore too high for these farmers to afford. Examples of the certification are the organic certificate, GLOBALGAP certification and other certifying

bodies depending on the buyers of the produce. Ugandan farmers and exporters face financial constraints due to high interest rates rendering the produce too expensive and therefore uncompetitive. Most financial institutions require collateral which most small-scale farmers or traders lack. Due to the small size of the enterprises our stakeholders lack the capacity to respond to export opportunities in terms of quality and quantity. Most of the stakeholders have and want to maintain a subsistence mentality, but commercial production and value addition is the way to go. Pests such as bean stem maggots, and diseases such as rust, attack farmers' crops and they are controlled using expensive agricultural chemicals, reducing farmers' profits. Worldwide there is a challenge of price fluctuations. Farmers must be able to determine the needs of different markets because they vary. Stakeholders have to develop technologies that will sustain them in global competitiveness.

Opportunities

Currently, the Uganda Government subsidises loans for agricultural production or processing by 10%. Ugandan Fair Trade standards are in process. Demand for Ugandan products is increasing within the EAC market and demand for Ugandan organic products (snap beans) in growing in European markets. With funding from the Royal Dutch Embassy regional studies on integrated chain control addressing issues of suppliers with a system of tracing and tracking supported by documentation are ongoing and will have a competitive advantage. Several markets are available to Uganda: duty free market access to USA under AGOA and EU under everything but arms (EBA), China 420 products, India (bilateral), Japan (GSP) and Morocco. When Ugandan stakeholders organise themselves in groups or cooperatives they will be able to penetrate and maintain themselves in the competitive global market.

Importance of GLOBALGAP standards in the trade of snap beans

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Introduction

GLOBALGAP, formerly known as EUREPGAP, is a pre-farm-gate standard, started in 1997 as a fruits and vegetable protocol. It was initiated by a group of retailers known as the Euro-Retailer Produce Working Group (EUREP). It is currently managed by a trade organisation comprising retailers, producers, produce marketing organisation, suppliers and food manufactures from various continents, thus the name GLOBALGAP. Its scope has been widened to include the production of coffee, tea, flowers and ornamental plants, livestock, feeds, nursery stock and aquaculture. The GLOBALGAP protocol defines the elements of good agricultural practices (GAP); the certificate covers the whole agricultural production process of the certified product from farm inputs like feed or seedlings and all the farming activities until the product leaves the farm. The scheme covers the pre-plant (seed and nursery control points) to non-processed end product (produce handling control points). It includes topics such as integrated pest management (IPM), quality management system (QMS), Hazard Analysis and Critical Control Points (HACCP), worker health, safety, welfare and environmental pollution and conservation management.

Participation is voluntary and based on objective criteria. The standard is subject to a three year revision cycle of continuous improvement to take into account technological and market developments. GLOBALGAP is a business-to-business label and is therefore not directly visible to consumers. Currently, there are 100,000 GLOBALGAP certified producers from over 100 countries. Thirty-seven major retailers in Europe have signed up for the standard.

GLOBALGAP certification is carried out by independent and accredited certification bodies. It is open to all producers worldwide. It includes annual inspections of the producers and additional unannounced inspections.

Objectives

The overall aim of the standard is to ensure safe and sustainable production. Sustainability in that we meet the needs of the present without compromising the ability of future generations to meet their own needs. The standard gives guidelines on stewardship *of both natural and human resources*. It is based on the principles of product quality and safety, workers' welfare, health and safety, consumer safety and environmental conservation.

Background

GLOBALGAP came into existence as a response to consumer concerns due to trade being globalised and previous food scares. Some consumers were concerned about the safety of food and the environment while others had concerns about social welfare issues. Retailers cannot physically visit the production sites to evaluate the practices in place. They therefore developed private label brand names to be used on the products. Retailers were looking for a solution to ensure that the produce they were buying was safe and its production had no negative environmental and social impacts. They agreed to work together and develop the best practice standard that all of them could agree upon. The standard basically consists of 15 control points:

1. **Traceability**
   Each grower is required to build a system that allows for tracking and tracing of the produce. The system should allow for tracing treatments given to the crop right from planting. Since GLOBALGAP is a pre-farm gate standard, the traceability is the responsibility of farmers until they hand over the produce to the buyer. Farmers are required to provide the buyer with information that will allows the products to be traced back to the farm and to assure that the produce is from a GLOBALGAP certified farm.

2. **Record keeping**
   Growers are required to keep all records necessary for GLOBALGAP for a minimum of 2 years. The period may be longer if required by local legislation.

3. **Varieties and stocks**
   Choice of rootstocks and varieties should be based on the fact that growing the crop will require minimum application of pesticides and fertilisers. The grower is expected to have a system in place to check and safeguard the quality of the seed to be used. Genetically modified organisms (GMOs) should only be used where local legislations and product buyers have allowed their production.

4. **Site history and site management**
   Each grower is required to have a clear document that provides information on the production locations and conditions that apply to the site. The grower must conduct a risk assessment on every new production site. The data collected are used to determine the rate of fertiliser application to avoid pollution of the soils. Growers are also expected to document management plans describing cultivation activities.

5. **Soil and substrate management**
   Growers are required to demonstrate that their cultivation practices do not encourage soil degradation. Substrate sterilisation must be recorded.

6. **Fertiliser usage**
   The principle of GAP is that farmers reduce or regulate the overall input of fertilisers to the minimum level. The grower will be expected to develop a crop or soil management plan which takes into consideration several issues influencing nutrient uptake. Fertiliser application equipment must be maintained in good working condition and fertilisers should be stored in a safe and proper manner.

7. **Irrigation/fertigation**
   Growers must determine crop water requirements before irrigation. Irrigation must be done sustainably with minimal waste; the quality of water must be determined and the results documented.

8. **Crop protection**
   Aims at reducing and regulating the use of chemical pesticides and promotes application of IPM strategies.

9. **Harvesting**
   All workers harvesting produce must be aware of the hygiene requirements when handling produce. They must attend training on hygiene principles. The standard requires that harvested produce is stored in a designated storage area, not in the open field.

10. **Produce handling**
    Chemicals used for post-harvest treatment should be acceptable in both the country of production and in the destination country. Growers are required to demonstrate that they regularly receive updates on legislation on chemical usage from specialised organisations. Clear records on type of chemicals used, when, where and how must be kept. Washing of fresh produce holds one of the highest health risks. The quality of water and method of washing determine how much residue will remain on the product; too much can result in a food hazard. Therefore only potable water should be used for washing produce. The water must be analysed and proved to meet the European Community regulation on microbiological aspects used to define portable water. Growers are required to analyse their water regularly.

11. **Waste and pollution management, recycling and re-use**
    Growers must be aware that they are generating waste and causing pollution. They are required to develop means of minimising pollution and waste production, re-using and recycling waste.

12. **Work health, safety and welfare**
    Growers are required to meet the local labour regulations. The standard, however, stipulates the minimum requirements in regard to workers health, safety and welfare.

13. Environmental issues

The standard requires growers to have a conservation management plan. The grower should have a policy that stimulates biodiversity development and reduces negative impact to the environment where the grower is operating.

14. Complaint handling

Growers are required to have a clear procedure on how to deal with complaints.

15. Internal audit

Growers are required to undertake an internal audit at least once a year.

Certification options

GLOBALGAP certification can be achieved under four options.

Option 1:
Individual grower or company is certified for the GLOBALGAP standard. The compliance certificate is owned by the company or that particular grower. The grower or company is required to conduct a self-assessment against the standard at least once a year.

Option 2:
A group of farmers are certified and the compliance certificate belongs to the group. Here the group must have an operational and well documented quality system and they are required to conduct an internal audit at least once a year. During the audit a sample of growers is chosen at random by the auditor and compliance is determined based on those audited.

Option 3:
This is exactly like option 1, but here the grower is audited and certified against a scheme that has been benchmarked to GLOBALGAP such as Kenya GAP or MPSGAP.

Option 4:
In this case, a group of farmers are certified against a scheme that is benchmarked with GLOBALGAP. Requirements for certification are similar to those of option 2.

Why GLOBALGAP in the trade of snap beans?

Snap beans are vegetables that are eaten raw or slightly cooked. Thus, they carry a high health risk if not properly handled. There is therefore need to ensure their safety right from the farm to the consumer. Food regulations in Europe require that food safety is guaranteed at all levels of the commodity chain. All supply chain actors are therefore obliged to demonstrate their efforts to keep contaminants and pesticide residues at acceptable levels. The retailers can only guarantee quality with certification.

In the East African region snap beans are grown for export mainly to Europe. In Europe food regulations are stringent thus compliance with market standards is very important for one to sell. Without certification and adhering to strict hygienic standards one may fail to access the European market.

What does certification with GLOBALGAP bring into the snap beans trade?

Certification with GLOBALGAP comes with approval of the snap beans by the consumers. It is a guarantee for quality and more so for safety. Thus customer confidence in the produce increases with certification. Adoption of the standard helps define the acceptable production practices. The GLOBALGAP protocol consists of technical modules that clearly describe the right way to grow safe and high quality snap beans. This increases efficiency in production processes, saving money and time. As a result of increased knowledge on cultivation methods, product quality increases; this translates to increased income for certified farmers.

Adoption of the standard will encourage observation of ethics in the trade. Ethics in trade are important for the smooth running and continuity of business. Ethical traders take into account their business partners' interests and will build trust and long-lasting relationships with partners. This leads to prosperity in business.

What are the benefits of GLOBALGAP certification?

Complying with the GLOBALGAP standard is beneficial to the grower. Certification guarantees the following to the grower:

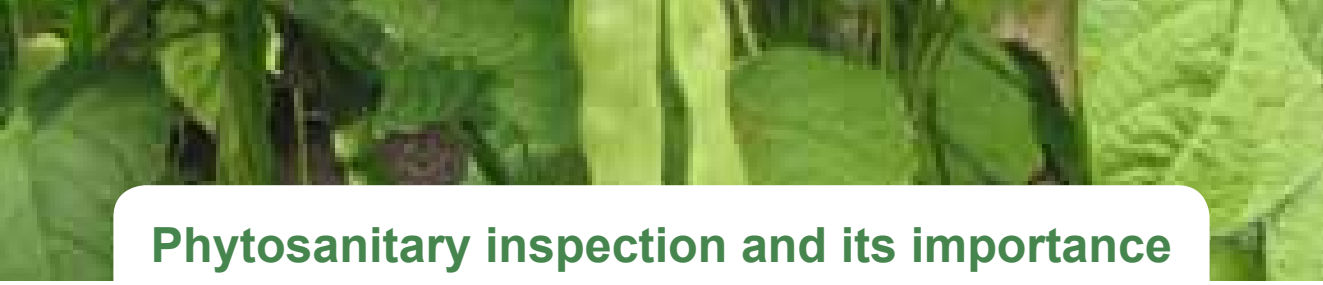
- **Safety**: Safety levels of the produce, workers and consumers will be improved. As farmers implement the guidelines in the protocol, they develop capacity to quickly identify risky places, attend to emergencies and to minimise produce contamination.
- **Market access**: Growers are unable to access certain markets unless they are certified.
- **Image building**: Getting GLOBALGAP certification is a way to demonstrate one's commitment to produce and trade in safe snap beans.
- **Continuity**: Following the guidelines in the protocol helps one to continue in business: markets will be receptive, resources will be conserved, quality will be good and customers' confidence will be won thus the continuity in business.
- **Supply chain transparency**: All farm activities and important decisions will be documented. Information transfer will be possible when required.
- **Increased levels of efficiency**: Management systems will be in place and the required technical knowledge will be developed. This will translate into reduced waste of resources and money saved.

- **More income**: With improved product quality and access to good markets, income to the farm will increase.
- **Acceptance** into the GLOBALGAP family

This is a big family consisting of big players in the trade of produce.

Conclusion

The GLOBALGAP standard can be used as both a management and a marketing tool. As a management tool it is instrumental in building commercially viable management systems at the farms. Implementation of the standard may stimulate useful innovations, for example, smallholders have devised their own ways of having running water to wash their hand in locations where there is no piped water. The standard can also be used as a marketing tool because it can be used to secure market access or to maintain an existing market. Above all, it is a sure way to sustainable agriculture which is in everybody's interest. It is a tool for preserving the environment for the next generation.



Phytosanitary inspection and its importance to both domestic and international markets

C. Murekezi

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Introduction

The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) has the mandate to carry out phytosanitary inspection in Uganda. Agricultural inspectors, plant health inspectors or phytosanitary inspectors from the Phytosanitary and Quarantine Inspection Services (a section in the Crop Protection Department) carry out this activity. The Crop Protection Department is headed by a commissioner, who is assisted by two assistant commissioners one for regulation and certification and another for diagnostics and epidemiology. These two are assisted by a team of competent inspectors and laboratory assistants. Whereas, routine phytosanitary inspection falls under regulation and certification, post-entry inspection is under diagnostics and epidemiology section. The day to day activities of phytosanitary inspection day to day activities are guided by three Acts of Parliament: The Plant and Plant Health Act 1962 (currently under review), The Seed and plant Act 2006 and The Agricultural Chemical Act 2006.

What is phytosanitary inspection?

Phytosanitary inspection is the visual inspection made by an authorised body to ensure that a consignment containing plant/plant product is free of pests, diseases and any weed species of quarantine importance and/or to determine compliance with phytosanitary regulations of the importing country.

Why is phytosanitary inspection carried out?

According to the World Trade Organization (WTO) agreement (Article 2 No. 1) of which Uganda is a signatory, every member country has the right to take phytosanitary measures to protect its human, animal or plant health or life and phytosanitary inspection is considered as one of these measures.

Who is responsible for phytosanitary inspection in Uganda?

The Phytosanitary and Quarantine Inspection Services in Uganda is mandated to carry out phytosanitary inspections. The section is the official National Plant Protection Organisation (NPPO) in the country and is duly recognised as such by the International Plant Protection Convention (IPPC). The Phytosanitary and Quarantine Inspection

Figure 1. Snap beans garden in Wakiso, Uganda.

Services is responsible for ensuring that all plant/plant products entering or leaving the country are certified to be free of quarantine pests and diseases and any invasive weed species.

Standards adhered to

The IPPC is an organisation that is concerned with securing common effective action to prevent the spread and introduction of pests of plants/plant products and to promote appropriate measures for their control. The organisation was borne out of the SPS agreement as part of WTO agreements. WTO is an organisation tat advocates for liberalising trade; it operates a system of rules. This organisation also acts as a forum for member states to negotiate trade agreements as well as settle any trade disputes. The WTO is not only about liberalising trade but in many cases it also supports trade barriers, especially when they concern protecting the health of consumers or the preventing the spread of pests and diseases. Matters concerning the prevention of pests/disease spread and human health all fall under the Sanitary and Phytosanitary Agreements (SPS).

Three intergovernmental bodies are responsible for setting standards by which the health of people, plants and animals are protected from undesirable consequences of international trade:

- International Plant Protection Convention (IPPC): IPPC is responsible for setting standards on how to prevent the spread and introduction of pests and diseases in plants and plant products.
- Codex Alimentarius (CODEX): CODEX is responsible for setting sanitary and technical standards for food safety, including food standards for commodities, codes

of hygienic or technological practice, limits for pesticide residue in foods, and standards for contaminants and food additives.
- Office Internationale des Épizooties (OIE): OIE is responsible for setting standards for the movement of animals and animal products.

Why carry out phytosanitary inspection?

- Phytosanitary inspection must be carried out before plant or plant products are marketed. This is to ensure the products destined for the market are: Free of any injurious pests and diseases
- Free from any invasive weed species
- Free of any unauthorised genetically modified organisms (GMOs)
- Properly treated
- That all the conditions stated in the importation permits have been adhered to.

Any consignment destined for sale outside its country of origin usually undergoes phytosanitary inspection. This is done to ensure that the consignments are not rejected at points of entry into importing countries as a result of pests/diseases. A phytosanitary certificate is issued when the inspector is satisfied that the consignment is free from pests/diseases; this in turn gives both exporter and importer confidence in the health of the consignment in question.

Figure 2. Consignment of plant products at Entebbe International Airport.

When is the inspection done and what standards are followed?

Inspection can be done at different times:

- Before a consignment is packed for export.
- During the packing of a consignment.
- After the consignment is packed and ready for loading (samples are taken in this case).
- At the point of entry (in case an import).

The standards followed during inspection are found in the standard operating procedures (SOP). Each country formulates its own SOPs. These procedures are harmonised among all member countries through the IPPC. The standards cover packaging, storage temperatures and any phytosanitary treatments before dispatch of the consignment.

Challenges

The challenges face as a department include:

- Lack of sufficient funding to carry out routine inspections.
- Lack of awareness among the general public on the importance of phytosanitary issues.
- Lack of sufficient staff to man the points of entry of plants /plant products.

Conclusion

For Uganda to penetrate and establish a niche in the regional and global snap beans markets, the country must comply with the set standards. This can only be achieved after streamlining the domestic standards. Therefore the Crop Protection Department of MAAIF needs to create and improve awareness among both public and private sector who are stakeholders in the value chain of snap beans. One of the ways to achieve this is by recruiting more inspectors and running programmes in the media on phytosanitary standards and regulation and good agricultural practices and other relevant topics. The department should work more closely with other key ministries and organisations. For example, agricultural inspectors should participate more in training and trade shows organised by relevant sectors to keep abreast with current market requirements.

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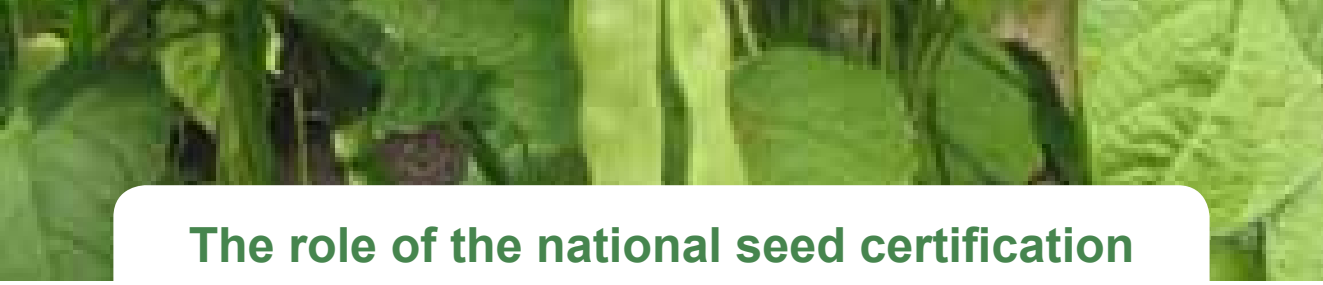

The role of the national seed certification services/variety description in snap bean commodity value chain in East and Central Africa

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Introduction

The National Seed Certification Services (NSCS) is a national agency responsible for the regulation of both the formal and informal seed sectors in Uganda. It is institutionalised under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Department of Crop Protection, by an Act of Parliament, the Seed and Plant Statute 1994. The Act was reviewed to the Seed and Plant Act 2006.

The major role of NSCS is to implement the above Act. Its activities include

1. Registering and licensing of all seed merchants, conditioners and dealers.
2. Reviewing, adjusting, maintaining and enforcing seed standards.
3. Providing training to persons responsible for the implementation of the Act.
4. Inspecting and certifying seed field crops.
5. Inspecting seed factories.
6. Receiving and testing all new varieties intended for release and multiplication.
7. Carrying out distinctness, uniformity and stability (DUS) tests.
8. Monitoring the activities of the formal and informal seed sectors.
9. Accrediting and licensing field inspection, seed sampling and laboratory seed testing.
10. Carrying out field inspection, testing, labelling, sealing and eventual certification.
11. Reviewing the history and performance records of selected varieties.
12. Determining the economic value of cultivated varieties.
13. Making recommendations for de-gazetting obsolete varieties
14. Determining varieties to be fully released, partially released, referred or rejected.
15. Issuing seed import/export permits.

Importance of the DUS tests

DUS tests distinguish the new variety from existing ones of the same crop species. A variety is considered new if it has at least one character that distinguishes it from existing ones. The tests are ultimately used to qualify a variety for listing in the national variety catalogue. DUS is also important in variety protection under the protection of plant breeders' rights and variety protection.

DUS in snap beans

Variety description is a mandate of the NSCS provided for by the Seed Act. It is a vital tool to guide decision making during the National Variety Release Committee meeting. This meeting normally convenes twice a year to consider the release of new plant varieties for farmers to use.

Characterisation of plants

Plant characterisation under the DUS is normally conducted using the Union for Protection of Varieties (UPOV) guidelines. Under UPOV plant descriptor guidelines are provided giving both quantitative and quantitative characters.

Characterisation of snap beans

In Uganda, snap beans are considered non-indigenous vegetables and farmers who engage in snap bean production rely entirely on imported seeds. Therefore snap bean production is not yet subjected to the rigorous certification requirements that other grain crops such as maize, dry beans, rice, ground nuts etc. normally undergo**.**

To introduce a variety of snap beans in the country for seed production, one may be required to list the variety in the national variety catalogue. In such a case, the variety would be subjected to all the certification requirements that other crops undergo.

The description procedure for snap beans would then be similar to that of bush beans.

Descriptive characters in snap beans under the UPOV guidelines include:

- Seedling hypocotyl colouration (anthocyanin pigmentation)
- Plant growth habit (bush or climbing)
- Branching type
- Flowering positioning
- Flower colour
- Pod type
- Pod tip length
- Colour of mature pods
- Seed colour
- Hilum colour

Seed trade (seed export/imports)

The Government of Uganda has provided an enabling environment to facilitate seed trade by enacting the seed law that provides for the institutionalisation of a seed regulatory body providing quality assurance in the seed sector. Liberalisation and privatisation have

encouraged the emergence of private seed companies. Currently, these companies are the major players in the seed industry.

In its role to facilitate trade in the agricultural crop sector, MAAIF (while executing its regulatory functions) applies the provisions of two complementary Acts, namely the Seed and Plant Act 2006 and the Plant Protection Act 1962 (currently under review) to provide exporters/importers of seed/plant materials permits to enable free movement of such goods for trade or research purposes.

Procedure for seed import/export

1. Applicant submits intent to import/export to the Commissioner Crop Protection (MAAIF).
2. Application is received and reviewed (whether intended material is for research, vegetable seed or material already listed in the national variety catalogue).
3. If satisfactory, a seed import permit is issued by NSCS.
4. Application is attached to the permit issued for further processing in the Phytosanitary and Quarantine Section of the department.

Membership to regional/international organisations to facilitate trade

OECD membership

Uganda is a member of the Organisation for Economic Cooperation and Development (OECD) seed certification scheme. Seed crops inspected and certified using this scheme are eligible for entry into the international market.

ISTA membership

Uganda is not yet a full member of the International Seed Testing Association (ISTA) however, work has already been initiated to assist the national seed laboratory to acquire ISTA accreditation. This will enable the laboratory issue ISTA certificates that accompany seeds entering the international market. Currently, ISTA personnel or personnel accredited to ISTA have made several audit visits to the national seed laboratory.

UPOV membership

Currently Uganda is not a member of UPOV, although variety description utilises UPOV guidelines.

IPPC membership

Uganda is a member of the International Plant Protection Convention (IPPC). This is an international body that requires that a member country puts in place a mechanism to regulate or prevent entry of pests and diseases of quarantine importance.

Seed policy issues in East and Central Africa

National seed policies are meant to guide the seed sector in the country. A well formulated seed policy should aim at:

1. Steering the industry to be environmentally sustainable.
2. Non-conflicting statements with other existing related policies.
3. Guiding the operations of all stakeholders.
4. Promoting/facilitating growth of the industry, without compromising national agriculture.

A well formulated policy streamlines the formulation of the legal framework to regulate the industry. Within the region, the legal framework to regulate the seed industry may differ slightly, however, the standards used in the inspection and certification process can be harmonised.

Accomplishments

Through ASARECA funding, East African seed regulatory bodies (Kenya Plant Health Inspectorate Services—KEPHIS; National Seed Certification Service of Uganda—NSCS; Tanzania Official Seed Certification Institute and National Seed Service of Rwanda) convened to harmonise seed inspection procedures and standards. Procedures for variety description are also being harmonised.

Regional seed policy concerns

The ASARECA member countries ought to operate as a common trading bloc. To do this the countries must develop/harmonise seed and other trade related policies to facilitate trade and exchange of germplasm.

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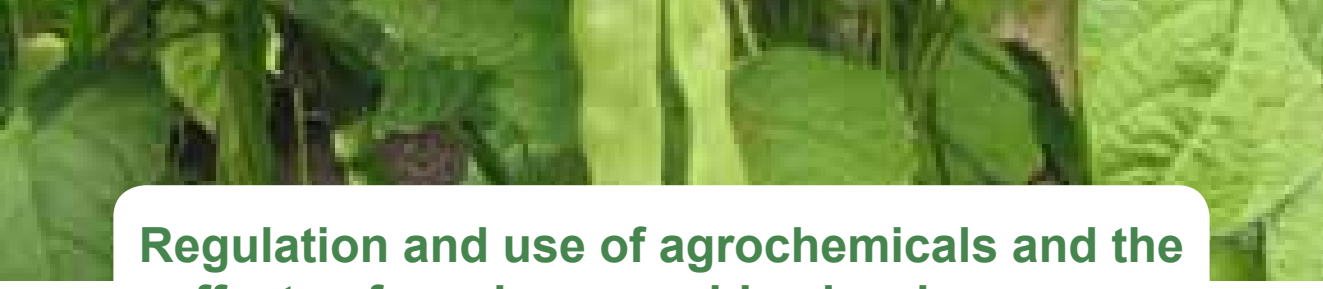

Regulation and use of agrochemicals and the effects of maximum residue levels on snap bean production for domestic, regional and export markets

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Introduction

In Uganda, vegetables, cut flowers and fruits have evolved to become major foreign exchange earners. The most important vegetable is green beans, popularly known as French beans. Most of the snap beans are produced by small-scale farmers and are destined for Europe, mainly UK, France, Germany and the Netherlands.

French beans are attacked by various pests. All parts of the plant can be attacked by one or more pests, but damage to pods is particularly a problem because it lowers pod quality leading to rejection by exporters. Since bean stem maggots can wipe out entire bean fields, they are regarded by many farmers as the most important pest hindering snap beans production. Severe infestation with bean flower thrips leads to abortion of flowers and pods, reducing yield and quality. The severity of the pest infestation depends on location and season.

Farmers must protect plants and plant products against such organisms in order to prevent a reduction in yield or damage, and ensure both the quality of the products harvested and high agricultural productivity. They use different methods including organic pest control methods, use of resistant varieties, crop rotation, mechanical weeding, biological control and chemical control methods such as the use of plant protection products.

One of the most common methods farmers use to protect plants and plant products from the effects of harmful organisms is to apply foliar pesticides. Pesticides are considered indispensable, with more than two-thirds of the farmers thinking they would lose more than 80% of the crop without the chemicals. The high pest infestation demands frequent pesticide application. Therefore most farmers have occasionally resorted to using inorganic chemicals too close to harvest time in order to reap a clean crop. However, this method of application leaves excess chemical residues on the harvest.

Role of MAAIF in the regulation and control of agrochemicals

MAAIF has formulated an Institutional Policy Framework on Pesticide Use. The underlying rationale for regulating agricultural chemicals rests on two issues. First, the likelihood that their uncontrolled use could have negative consequences on public health, occupational health and safety, crop/animal safety, the environment and trade. In economic terms some of those consequences take the form of external costs. Second is the existence of information failures or asymmetries. For example, while the producer knows what chemicals have been applied to a food crop, consumers are unlikely to be able to tell.

The combination of the hazardous nature of many agricultural chemicals and the ways in which they can be used means that users can potentially impose external costs in several ways. Inappropriate use of agricultural chemicals on agricultural products may leave residues at a level that disrupts domestic and export trade. The sensitivity of Uganda's trading partners to chemical residues in agricultural produce, for example, on snap beans, means that violation of an internationally accepted residue limit by one Ugandan producer can have a wide ranging negative effect on returns to Ugandan exporters of the same product.

Agricultural chemical legislation: Laws and their implementation

Uganda has its own national legislation known as the Agricultural Chemicals Control Act 2006 which forms the basis for numerous regulations on agricultural chemical registration and use, efficacy, safety and suitability. Uganda is also signatory to a number of international legislations. The country is a signatory of the FAO Code of Conduct including the Rotterdam Convention on the Prior Informed Consent and therefore has an obligation to make efforts to implement these international agreements. Besides, USA and the EU-legislation on agricultural chemical residues in imported foodstuffs are of vital interest to Uganda, because agricultural exports are almost exclusively oriented toward the EU and USA. The rejection of Ugandan exports may cause significant setbacks to the national economy.

In addition, the government has enforced many international agreements related to the management of chemicals including: a) the Montreal Protocol related to the phasing out on methyl bromide; b) the Stockholm Convention; and c) the Biodiversity Convention on the conservation of biological diversity.

One of the main objectives of the East African Community (EAC) and of its partner states EAC is to ensure food security, poverty reduction and improvement of standards of living. The EAC Agriculture and Rural Development Policy emanates from the broader vision and provisions of the Treaty for the Establishment of the East African Community. The other major objective is to improve and intensify crop production in the region to meet local and export requirements for food and raw materials.

The EAC has so far developed and adopted harmonised regulatory procedures for management of crop pests for the following:

1. Harmonised labelling requirements developed pursuant to Article 108 (a) and (e) of the Treaty for the Establishment of the East African Community to be used by partner states in order to ensure safety, efficacy and potency of pest control products.

2. Harmonised procedure to be used by the partner states in efficacy evaluation of pest control products for plants and for the presentation of research findings.

3. Harmonised application forms so that information provided by the applicants helps determine the suitability of a product to the proposed use and potential hazards to the users, bystanders and not target organisms. The forms are accompanied by registration requirements and guidelines on active ingredient and formulated product dossier.

4. Developed a project to promote the development of a private sector-led production, input supply and trade.

MAAIF has overall responsibility for legislation and supervision related to agricultural chemicals. At MAAIF, the Crop Protection Department is responsible for registering and controlling the appropriate use of agricultural chemicals by following regulatory activities. Uganda has a national registration scheme in place. Currently there are two essential components of a national registration scheme. First are the product assessment and authorisation activities of the Agricultural Chemical Board (ACB) and its associated product quality controls. Second is the control of sales and use activities. Before supply, sale or distribution agricultural chemical dealers are required to register their products and obtain approval for product labels from ACB. The board is responsible for the assessment, registration and regulation of agricultural chemicals up to the point of retail sale.

Agricultural chemicals registered for use on snap bean

The decision to apply for registration of a chemical product for use in Uganda is made by the potential registrant and so is the choice of target and host species to include in an application for a new product or an application to expand the approved coverage of an already registered product. Those choices may be influenced by a number of factors including prospective sales of the product (or the extended coverage), the impact on the registrant's other products (if any) and the costs and timing of the registration process. For large-scale uses of a product there may be a reasonable coincidence between the product's potential value to users and the incentive for registration. For some smaller-scale uses the coincidence may not be that great—a particular use of a product may be important to a small group of potential users, but of limited commercial interest to the registrant. The registration process thus does not provide any guarantee of access even for uses which are potentially valuable and would meet the ACB assessment criteria if evaluated.

However, the agrochemical regulations provide that pesticides shall be recommended for the control of specific pests on all host crops rather than being recommended for use on specific crops except for phytotoxicity and residue considerations. A key focus for the regulation is to ensure that all commercial products meet acceptable performance and quality.

Some countries, especially in the EU always provide a list of recommended agricultural chemicals to be used on particular crops.

Maximum residue levels and snap bean export

A maximum residue level (MRL) is a standard set for a maximum residue under good agricultural practice (GAP) for the approved use of the product. By virtue of the decision points built into the assessment process MRL for a food product will always be at a level well below that which would be a health risk. So while a breach of MRL is clearly an indication of a failure to use a product appropriately, it may not have any direct health implications. Nevertheless, users must apply agricultural chemicals only in ways that keep residues below MRLs. Regardless of size of the additional health risk from a particular MRL breach, the regulatory approach under the National Registration Scheme is explicitly risk based. Agricultural chemical use even within regulatory limits can carry with it some risk.

Maximum residue levels are increasingly being used by countries importing agricultural produce as one of the conditions to be met by the exporting country apart from phytosanitary conditions. Agricultural imports with residue levels above those agreed by Codex Alimentarius are often rejected.

The Codex MRLs are the single global standard which are referenced by WTO under the Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) agreement as the international standards in food and feed moving in international trade. However:

1. While governments have been encouraged to accept Codex standards, it is left to governments to decide whether they should implement them.

2. Codex MRLs, standards and related texts were recommendations to governments and a reference in international trade while the establishment of regulations on MRLs at the national level was the responsibility of member countries.

3. MRLs are not harmonised internationally. This creates agricultural trade irritants. Countries routinely reject crops with pesticide residue levels higher than their national MRL values or when MRLs are absent. The consequences are barriers to trade. Globally harmonised MRLs will reduce or eliminate potential trade barriers.

The cost of regulatory intervention by any nation with the intent to protect human health can be significant. This is particularly true for developing countries intending to penetrate markets in the developed countries. The application of EU regulations on harmonised MRLs has resulted in a decrease in vegetable exports from Africa by over 60% compared with the previous scenario when international standards were in use. Farmers, therefore, have fewer market outlets and hence lower incomes.

In response to harmonised MRLs for pesticides in EU, countries need to produce vegetables that satisfy consumers looking for produce without risks to human health. Producers are compelled to use approved pesticides in accordance with techniques that conform to the principles of GAP, avoiding pesticide residue levels in excess of acceptable MRLs. However, the vegetable producer faces the following problems:

1. Harmonisation of MRLs by EU set at the detection threshold "Limit of Detection" (LOD—the equivalent of analytical zero). This means that no detectable trace of residue will be tolerated. The zero analytical level affects vegetable crops due to the absence of toxicological and eco-toxicological data required for the determination of MRLs.

2. The regulatory changes within the EU will seriously affect the Ugandan economy unless the safety conformity of the horticultural product exported in the EU is demonstrated. The governments of EU member states reviewed the regulations and issued a new regulation that replaces Directive 91/414/EEC (enforced from April 2009). The new Directive became legally binding in all countries in October 2010. The regulation provides for pesticide approvals based on "cut-off criteria (hazard based criteria)". The regulation will result in removal of most of the active ingredients from the conventional older pesticides. .

Conclusions

The use of agricultural chemicals, especially biopesticides in Uganda is currently low, but potential exists considering the huge horticultural industry (major user of agricultural chemicals). A greater percentage of vegetable export is destined for the EU market which has recently introduced the pesticide MRLs requirement that all horticultural produce to EU market has to meet. With the introduction of the new EU regulations with pesticide approvals based on "cut-off criteria (hazard based criteria)", Uganda has to start embracing environmentally safe methods of pest control now, if it is to continue enjoying and sustaining this market.

While appreciating that the use of agricultural chemicals is indispensable for the greater majority of horticultural production, the industry faces the challenges of demonstrating conformity to set MRLs at every stage. Worse still, Uganda has not set its own MRLs

to prove the quality of her export-oriented produce relating to agricultural chemicals usage. In the absence of accepted data on residues by pesticide/crop combinations, most of the conventional older pesticides have had their MRLs set at LOD or zero. This implies that the pesticides should not be used on crops intended for export to the EU market.

Recommendations

- Develop a residual monitoring plan and set up supervised trials to establish the national maximum pesticide residues.
- Strengthen national analytical capacity for pesticide residue and formulation analysis by procuring and equipping the national reference pesticide analytical laboratory at Namalere with modern instruments and equipment.
- Seek external support for strengthening joint efforts in capacity building, regional and international harmonisation, information sharing and establishment of quality assurance protocols and procedures.
- Strengthen post-registration monitoring and surveillance of agricultural chemicals both at the retail outlet and on-farm use.

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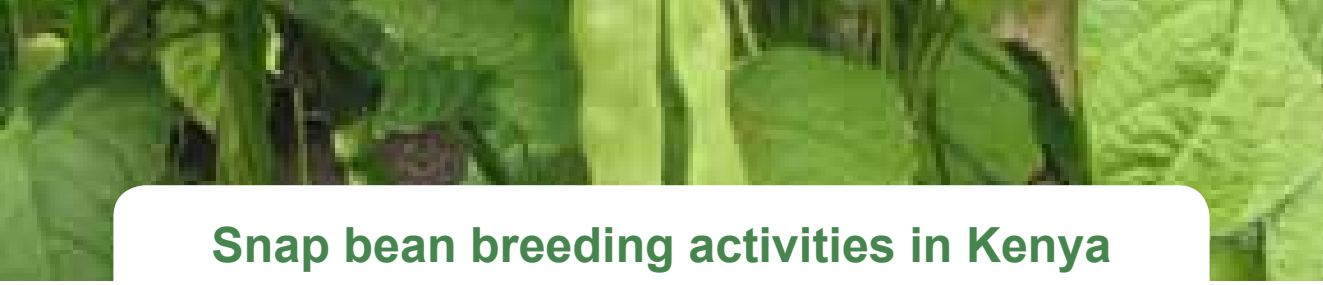

Snap bean breeding activities in Kenya

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Introduction

Snap bean (*Phaseolus vulgaris* L.), also known as French bean or green bean, is the leading export horticultural crop in Kenya, contributing 20% of total export horticultural crop earnings. For example, Kenya exported about 30 thousand metric tonnes of snap beans in 2009 valued at about KES 4 billion. (HCDA 2010). It is estimated that over 90% of the crop produced in Eastern Africa is exported to regional and global markets (CIAT 2006). Apart from Kenya snap bean is also an important export crop in Uganda, Tanzania, Zambia and Zimbabwe. In all the countries within the East African Community, snap bean production is dominated by small-scale rural farmers. Most producers in Eastern Africa grow round and thin podded types of snap beans which are preferred by the European markets as opposed to flat podded types suited for some American markets (CIAT 2006).

Productivity of snap beans in smallholders' farms is very low compared to that of commercial scale farms. One of the major constraints to smallholder snap production is the high cost of quality seed which sometimes is unavailable. This is partly because most commercial varieties, which are developed by multinationals such as Roy Sluis, Syngenta and Monsanto, are protected by legislation and no informal seed production is allowed. Seed produced locally on contract is exported for processing and packaging, and re-imported for sale to farmers. Contract snap bean growers are able to obtain quality seeds supplied on credit by buyers. However, due to prohibitive cost of seed, some farmers with no contractual arrangements plant seed saved from previous crop harvest (Lenne et al. 2005), thus leading to low yields and deterioration in crop quality.

In addition to high seed costs, lack of high yielding pest and disease resistant commercial snap bean varieties is perhaps the most critical constraint to snap bean production (Kimani et al. 2004). Commercial varieties of snap beans grown in Kenya (see Table 1) were developed in temperate regions particularly North America and Europe and are therefore not well adapted to biotic and environmental conditions in Kenya and other countries in East and Central Africa. These foreign varieties are very susceptible to bean rust, angular leaf spot, root rots and bean common mosaic virus among other diseases and pests, especially bean stem maggot, thrips, spiny bugs, pod bores, bean aphids, red spider mites and white flies (Nderitu et al. 1996; Kimani et al. 2004). Hence, farmers have to depend on very expensive fungicides and insecticides to reduce production and post-harvest losses associated with disease and pests. However, this option is not viable because of

the recently instituted maximum residual limits (CIAT 2006). Further, snap production in East and Central Africa is based on determinate types unlike the counterparts in South America who grow indeterminate types that yield more and can be harvested over a longer period (Kimani et al. 2004; CIAT 2006). To address the aforementioned issues, snap bean improvement strategies need to be developed and implemented in East and Central Africa. Currently, snap bean breeding efforts are being conducted in Kenya, Uganda and Rwanda. This study reviewed previous snap breeding activities and the current breeding efforts within the Snap bean Project (2006–2011) sponsored by ASARECA.

Table 1. List of some of the commercial varieties of snap beans grown in Kenya

Variety	Marketer	Pod quality attributes
Serengeti	Syngenta/Kenya Highland Seed Company	Fine/extra fine
Mara	Syngenta/Kenya Highland Seed Company	Fine
Tana	Syngenta/Kenya Highland Seed Company	Fine
Konza	Syngenta/Kenya Highland Seed Company	Fine
Soleon	Syngenta/Kenya Highland Seed Company	Fine
Tereza	Monsanto	Fine/extra fine
Amy	Monsanto	Extra fine/fine
Paulista	Monsanto	Bobby
Julia	Monsanto	Canning
Alexandra	Monsanto	Fine
Samantha	Monsanto	Fine/extra fine
Bravo	East African Seed Company	Fine
Grano	East African Seed Company	Fine
Ducato	East African Seed Company	Fine
Star 2052	Safari Seed Company	Fine/extra fine
Escalade	Hygrotech Company	Fine

Overview of previous regional snap breeding efforts

Snap bean breeding in Kenya started in 1998 at Kenya Agricultural Research Institute (KARI)-Thika with support from the International Center for Tropical Agriculture (CIAT) and the Eastern and Central Africa Bean Research Network (ECABREN) as a regional activity. These efforts led to development and subsequent release of Kutuless (J12) by KARI-Thika in 2000 (KEPHIS 2009). This variety is suitable for cultivation at 1000–1800 m above sea level, is resistant to rust and has good snap-ability and extra fine green pods. In 2000 ECABREN, in its strategy, recognised snap bean as one of the seven most important regional bean classes (CIAT 2004). The network selected the national agricultural research systems (NARS) of Kenya and Uganda to lead snap bean breeding based on their comparative advantage and the importance of the crop in these countries.

In 2001 a regional snap bean programme, initially supported by CIAT and ECABREN and in 2006 by ASARECA, was initiated to develop improved snap bean varieties with high yield potential, resistant to biotic stresses, and high pod quality for smallholder producers (CIAT 2006). This programme was located in Kawanda Agricultural Research Institute in Uganda, Moi University in Eldoret (Kenya), the National Horticultural Research Centre of KARI-Thika, and the Department of Plant Science and Crop Protection, University of Nairobi. After four years of screening snap bean varieties with farmers at Kawanda HAB 433, J12 and L3 varieties were selected.

In Rwanda, two commercial varieties namely Saxa and Loiret were being produced for European markets, but have succumbed to disease pressure (Nyabyenda 1991). The Rwanda Bean Program at RAB initiated a backcrossing breeding programme to improve on a commercial climbing bean variety Vuninkingi (G685) using exotic donor parents such as Thereza and Loiret.

Snap bean breeding in Kenya

The objectives of the snap bean breeding programme in Kenya are (Kimani 2010):

1. To select bush snap beans with multiple resistances to rust, angular leaf spot and anthracnose.
2. To evaluate advanced bush snap bean lines for pod quality, marketability, shelf life and high productivity, and resistance to aphids, thrips and bean stem maggot.
3. To select climbing snap bean lines with multiple resistances to rust, angular leaf spot and anthracnose.
4. To evaluate advanced snap climbing bean lines for pod quality, marketability, shelf-life and high productivity and resistance to nematodes and root rots.

KARI and the University of Nairobi have snap bean breeding programmes. The major traits of focus include pod shape, size and texture; resistance to rust, angular leaf spot,

anthracnose, root rots and common bacterial blight; and bush and climbing habit. ASARECA has been supporting snap bean breeding activities at both the University of Nairobi and KARI since 2006.

At the University of Nairobi breeding activities focused on identification and evaluation of marketable snap bean lines, development of segregating populations and evaluation of advanced bush and climbing beans. Forty-four bush breeding lines, 15 climbing lines, and 15 varieties of snap beans, including both fresh market and canning types, were identified and evaluated. Five climbers and 10 bush lines are promising and will be tested with farmers for pod yield and pod quality characteristics. The lines were evaluated for reaction to inoculation with rust, angular leaf spot and anthracnose in trials conducted at Mwea and Thika. Some of the lines showed resistance to two or more of these priority diseases. More than 30 populations have been developed between diverse sources of resistance to rust, angular leaf spot and anthracnose and advanced to F5 generation as population bulks. For some populations single plant selections were made in F3 and F4 generations. They were artificially inoculated with rust, angular leaf spot and anthracnose pathogens. Selections combining multiple resistance to these diseases and preferred pod characteristics were made. Progenies were evaluated for pod yield and quality and validated for resistance to diseases during the 2010 long rain season. Crosses to combine preferred thin round pod traits found in commercial cultivars with climbing growth habit found in accessions from Latin America have been planned. Latin America climbing snap beans have flat pods. However, flat pod types are not popular in domestic and export markets, especially in Europe.

At Moi University, 10 lines were developed and evaluated at multi-location trials between 2003 and 2004. Out of the 10 lines, 4 locally adapted snap bean cultivars with improved pod yield, resistance to anthracnose and rust, and marketable pod quality were evaluated in national performance trials. However, none of these varieties has been officially released to-date. Validation with exporters and with the Kenya Plant Health Inspectorate Services (KEPHIS) is still ongoing.

KARI-Thika developed a working collection of 15 snap bean varieties and developed crosses between a commercial variety and a locally improved rust resistant variety (Kutuless) between 2001 and 2005. Eight advanced lines are currently being tested on station.

Challenges to snap bean breeding in Kenya

Snap bean breeding in Kenya is bedevilled by several challenges including:

- Lack of funds for breeding and scaling-up seed.
- Limited number of snap bean breeders.
- Drought and limited availability of irrigation facilities which leads to crop failures.
- Limited participation of exporters/multinationals/seed merchants.

- Tight control of snap bean seed sector by multinationals.
- Limited application of biotechnology tools in selection.

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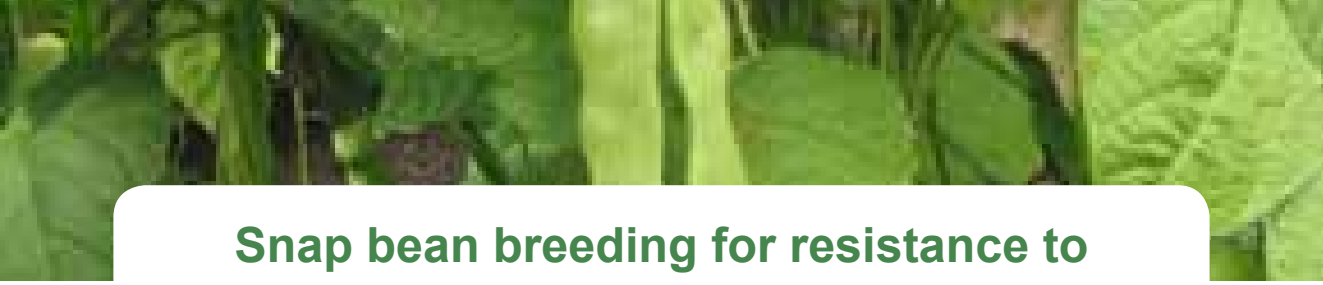

Snap bean breeding for resistance to rust and common bacterial blight

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Abstract

Antagonistic or synergistic interactions were not found between isolates of *Uromyces appendiculatus* var. *appendiculatus* and *Xanthomonas campestris* pv. *phaseoli* when inoculated to the same plants. A single dominant gene was suggested to control resistance to isolates of rust in the crosses .HAV 129 × G 17723 XG 685 XASC 73 XICTAHUNAPU FIFI. F 5/ 2P-2P-4P inp (herein referred to as L 3) × Paulista and/or Helda.

Lines HAB 433, BC 4, A 20, J 12, L 1 and L 12 had good combined tolerance of the three diseases. When used, these would result in lower expenses for chemical sprays. On-farm research showed that rust was the most limiting factor in snap bean production. Data analysis has shown that rust and common bacterial blight (CBB) negatively and significantly affected yields ($P < 0.05$). Some farmers have selected HAB 433 for yield and pod quality.

All the common bean and snap bean lines/cultivars tested were moderately susceptible, susceptible or highly susceptible, except HAB 433 and A 20 which were found resistant to *Xanthomonas campestris* pv. *phaseoli*. The reaction to common bacterial blight was quantitatively inherited and an association was detected with plant habit but not with rust reaction.

Introduction

Beans are one of the major sources of nutrients for poor and medium-scale farmer households in Eastern Africa. For example, in Uganda and Rwanda 80% of all households have one meal of beans each day. Beans are one single legume that is cultivated in more than 50% of the land area occupied by legumes. Despite being so widely produced and consumed, beans are extremely vulnerable to several diseases. Anthracnose, common mosaic and common blight plus rust continue to be major issues for dry bean growers, and white mould is a significant threat to snap beans. Some of these diseases are caused by pathogens with many different strains, so bean varieties that are resistant in one year or location may be susceptible the next year or in a different location.

Snap bean cultivars possess a thick succulent mesocarp and reduced or no fibre in green pod walls and sutures (Silbernagel 1986; Myers and Baggett 1999; Myers 2000). The green pods are harvested for fresh, frozen, and canning purposes. Different market

classes of snap bean cultivars are largely determined on the basis of pod shape (flat, cylindrical or oval), color (dark green, light green, yellow or purple) and length. Among snap bean cultivars, there can be a large variation in growth habit and adaptation traits.

Snap bean growers in Uganda and other east African countries spend a lot of money on pesticides to spray against rust. In the work described herein, gene pyramiding has been used. Gene pyramiding is a long process of combining several disease resistance genes, resulting in new cultivars with broad disease resistance. These bean cultivars are resistant to all known strains of the hyper-variable pathogens that cause these diseases (Pastor-Corrales et al. 2004).

Understanding the role of genes and finding ways to pyramid them into new varieties is a way of taking the traditional selection process in plant breeding to a new level. The work of pyramiding was done mainly at the International Center for Tropical Agriculture (CIAT) and then backcrosses for the recovery or inclusion of favourable agronomic characters was done in Uganda.

Materials and methods

The major problem noted among the available germplasm in Uganda was the narrow genetic diversity of the snap beans that are commercially grown, resulting in vulnerability to pathogens. The pathogens cause major diseases that reduce seed yields and the quality of pods while increasing the use of pesticides and thus production costs. The diseases include rust, anthracnose, angular leaf spot and common bacterial blight.

Forty snap bean lines from CIAT and five backcrosses were screened for reaction to rust (*Uromyces appendiculatus* var. *appendiculatus)* and common bacterial blight (CBB) caused by *Xanthomonas campestris* pv. *phaseoli*. All the entries were artificially inoculated with CBB using the razor blade method (Pastor Coralles). Two very susceptible lines (Paulista and Helda) were used as spreader rows for rust by planting them two weeks earlier on both sides of each test line. Data were recorded bi-weekly beginning at two weeks after inoculation.

In a second experiment the susceptible but good quality varieties Helda and Paulista were used as male and female parents and crossed with the resistant varieties HAB 433, L 3 and J 12 as seen in Table 1.

The two susceptible varieties were also crossed with the resistant entry where gene pyramiding was done, that is HAV 129 × G 17723 XG 685 XASC 73 XICTAHUNAPU FIFI. F 5/ 2P-2P-4P inp × Paulista and/or Helda. The variety with the pyramided genes is herein referred to as L 3. Gene pyramiding used genes from tepary and runner beans.

Table 1. Reaction of some bean lines to rust, common bacterial blight and angular leaf spot

Variety	Reaction to CBB	Reaction to rust	Reaction to als
HAB 173	4	5	2
HAB 414	7	5	3
HAB 433	2	2	4
A 20	3	3	3
K 3	4	6	3
J 12	2	3	3
L 12	4	5	3
L 3	2	2	2
BC 4.5	6	6	3
BC 4.8	5	3	7
BC 7.5	5	6	5
PAULISTA	6	8	7
HELDA	7	8	6

Scores: 1–3 = resistant, 4–6 = intermediate; 7–9 = susceptible.

Snap bean breeding work resumed in the 2009 season by planting all the previously screened entries at Kawanda Agricultural Research Institute. Most of them had lost viability except 11 entries that were evaluated during the season when CBB and rust were found to be the most limiting diseases. The study also found that stem and pod inoculation were the best means of screening for varietal resistance to CBB.

Resistant entries to angular leaf spot (ALS), rust and CBB were identified using a 1–9 scale: 1–3 resistant, 4–6 intermediate and 7–9 susceptible.

Results and discussion

Antagonistic or synergistic interactions were not found between isolates of *Uromyces appendiculatus* var. *appendiculatus* and *Xanthomonas campestris* pv. *phaseoli* when inoculated to the same plants. A single dominant gene was suggested to control resistance to three isolates of rust in the crosses of L 3 × Paulista and/or Helda. Results similar to these were reported by Freytag et al. (1992) and Musaana et al. (1993a, 1993b) in back crossing experiments with PI 260418 as a parent. The gene was found to be different from Ur-4 rust- resistant gene present in the Andean bean Early Gallatin. However, resistance found in the common bean, including that introgressed from the scarlet runner (Freytag

et al 1982;Park and Dhanvantari 1987; Miklas et al 1994) and tepary beans involve one or more genes with major effects and five to eight genes or QTLs with small effects (McElroy 1985; Silva et al 1989; Nodari et al 1993;Jung et al 1996). This explains the high levels of resistance in the cross involving the parent L 3 reported herein.

Lines HAB 433, BC 4, A 20, J 12, L 1 and L 12 had good combined tolerance of the three diseases. These, if found good for the consumer characters, would result in lower expenses for chemical sprays. On-farm research showed that rust was the most limiting in snap bean production. Data analysis has shown that rust and CBB negatively and significantly affected yields ($P < 0.05$). Some farmers selected HAB 433 for yield and pod quality such as: pod size, shape, length, snappiness and taste.

The reaction to common bacterial blight was quantitatively inherited and an association was detected with plant habit, but not with rust reaction. Results similar to these were reported by Silbernagel (1986), Nodariet et al. (1993), Ariyarathne et al. (1996), Myers and Bagget (1999) and Pastor-Corrales et al. (2004).

In the crosses, F2 and F3 plants were grown in the screen house. They were inoculated with CBB, and the data were recorded and analysed. In both the F2 and F3 generations we recovered more resistant plants when HAB 433 was used as a female parent than when used as a pollen contributor (Figure 1). By F3 over 80% of the plants had scores of 1–4 where HAB 433 was a female and Paulista a male.

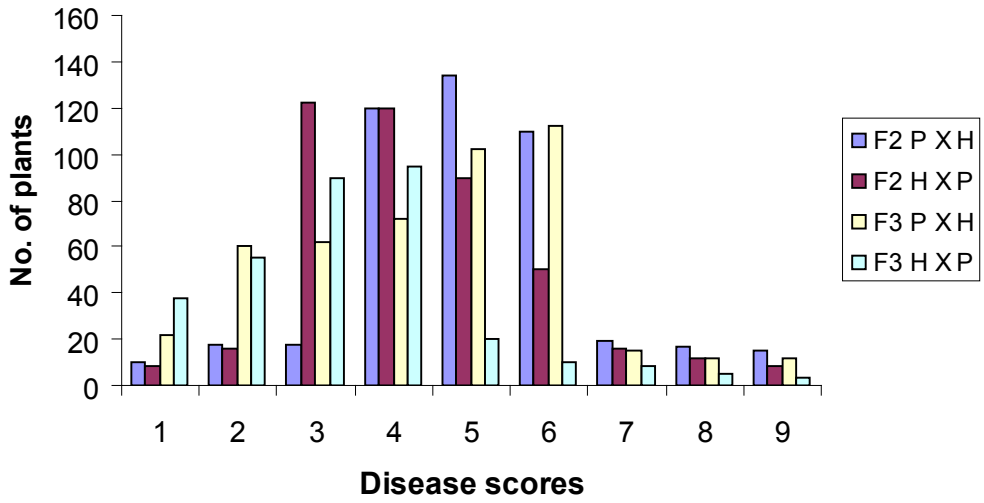

Figure 1. Distribution of disease scores in F2 and F3 reciprocal crosses for Paulista and HAB 433.

Similar results were found when J12 was used as a female rather than a male parent. But in this case in F2 none of the plants scored 8 or 9 when J12 was the female (Figure 1 and Figure 2).

The results in Figures 1 and 2 suggest the presence of resistance genes in the protoplasm. Results similar to these were reported by Musaana et al. (1993a, 1993b) in relation to the inheritance of resistance to CBB in dry beans.

In the crosses between Helda and L 3 the recovery of the resistant plants was skewed towards the left thus confirming the above results, especially when the parent resulting from gene pyramiding was used as a female (Figure 3). In all the three cases whenever the resistant parent was used as a female there were bigger numbers of resistant progeny. This suggested the presence of maternal effects in the inheritance of resistance in beans to CBB. The results also showed that resistant plants can be selected in the early segregating generations if the resistant parent is used as a female parent (Figures 2 and 3).

Progeny from the backcrosses to L 3 are also highly resistant to all available races of rust. This was a result of the previous gene pyramiding (Pastor-Corrales et al. 2004a, 2004b).

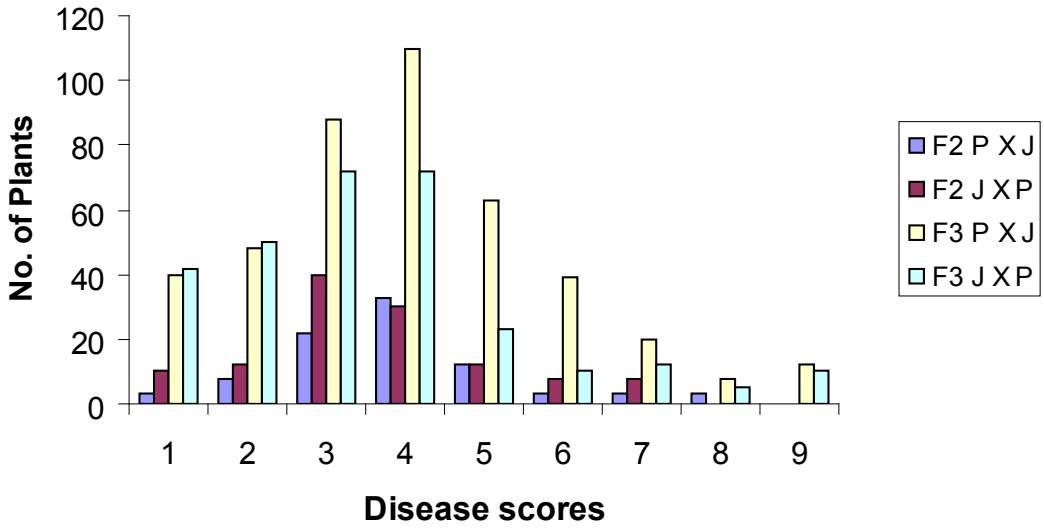

Figure 2. Distribution of disease scores in F2 in F3 reciprocal crosses for Paulista × J 12.

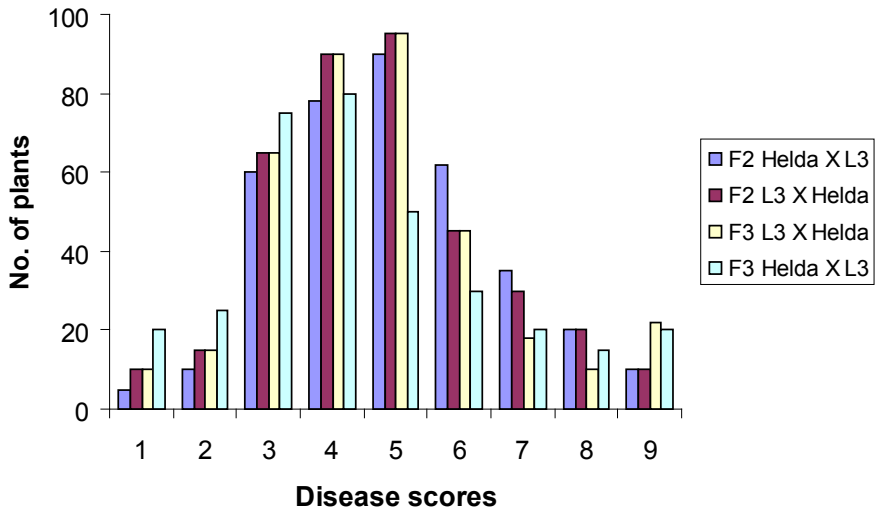

Figure 3. Distribution of disease scores in F2 and F3 reciprocal crosses for Helda × L 3.

In Figure 4 the F1 plants of the cross L 3 × Helda was crossed back to either Helda or L 3. In this case the number of resistant (scores of 1–3) and intermediate (scores of 4–6) lines were doubled when the backcross was to L3. Musaana et al. (1994) and Myres (2000) reported similar results. Good agronomic and yield characters were also transferred to the backcrossed progeny and we are in the process of selecting for them with farmers and consumers. Three of the lines have been found to have stable yield and agronomic characters across several agro-ecological zones. Wortman et al. (1996) reported similar results for dry bean multi-lines.

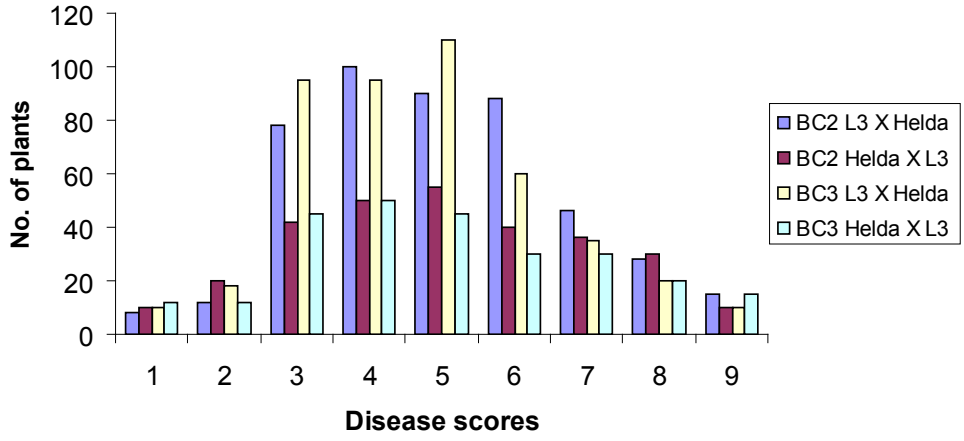

Figure 4. Distribution of disease scores in the selfed backcross populations of the cross Helda × L 3.

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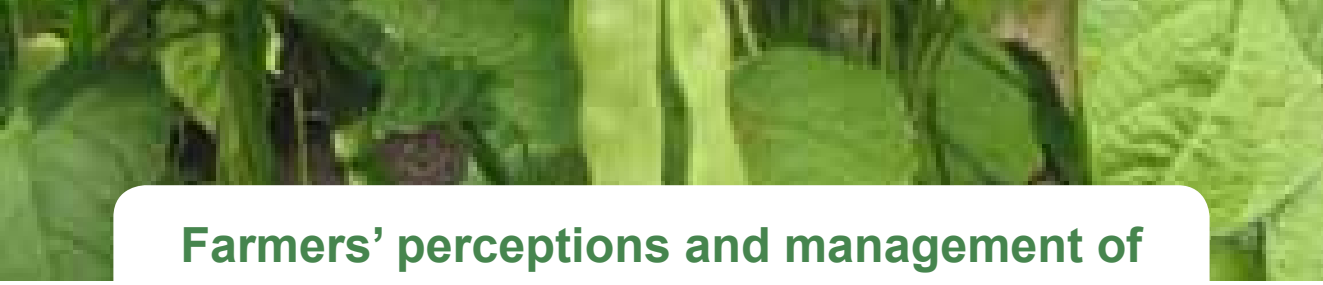

Farmers' perceptions and management of pests and diseases on snap beans in Uganda

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Abstract

Snap bean (*Phaseolus vulgaris* L.) is a relatively new cash crop grown in Uganda for domestic consumption and the export market. Snap bean production is constrained by several factors, including insect pests and diseases. However, no formal investigation has been conducted into the insect pests and disease problem. Consequently, a survey was conducted in Luwero, Wakiso and Mpigi districts to document farmers' perceptions and management of snap bean pests. A structured questionnaire was administered to 53 individual farmers. The questionnaires addressed only pre-harvest pest problems. Ninety-three per cent of the respondents indicated that pests and diseases were the most important production problem. Other problems included unfavourable weather, poor soils and high labour requirement. Seventy-two per cent of the farmers estimated a loss of over 50% of the crop if they did not use pesticides while 19% estimated 25–50% losses, and 9% estimated they would perhaps lose 1–25% of the crop. For that reason, farmers interviewed invariably used pesticides. Farmers identified aphids, bean pod borers and bean fly as major insect pests, while bean leaf rust, bean root rot and angular leaf spot were reported as the major diseases. Most farmers used pesticides based on calendar sprays spraying weekly from one week after crop emergence until the whole crop is harvested. Farmers did not follow the manufacturers' pesticide use instructions and as such some reported that they had suffered from pesticide poisoning symptoms. This paper discusses the implications of the findings and efforts that should be put in place to effectively manage pests and diseases of snap bean, as well as measures to mitigate the undesirable effects of pesticides on people and the environment.

Introduction

Snap (French) beans (*Phaseolus vulgaris* L.) are grown by both small- and large-scale farmers in East Africa for fresh and processing markets (KARI 2004). The crop has great potential to address food insecurity, improve incomes and alleviate poverty in the region (CIAT 2006). In Uganda and elsewhere in Africa, snap bean is an important export vegetable crop and is now widely promoted in domestic hotels. Mairye Estates a farm that produced and exported fresh and chilled snap beans demonstrated that high quality snap beans can be produced all year round in Uganda (UCC 2004).

Smallholder production of snap bean is, however, constrained by many factors including pests and diseases (CIAT 2006; Grubben and Denton 2004). Musaana (1999) reported that rust was the most limiting disease for commercial varieties Paulista and Helda grown in Uganda. The few varieties developed by public institutions are often susceptible to diseases and pests (Wanjiru 1993). Yet the market attaches so much value on the aesthetics of the beans and thus desires blemish-free beans. Due to the high quality demands, smallholder farmers rely on fungicides and insecticides to reduce production losses associated with diseases and pests (CIAT 2006). In Kenya, cases of excessive pesticide use, usually based on calendar sprays, for thrips control were reported (Nderitu et al. 2001). Following this finding, Nderitu et al. (2008) determined a need-based intervention for thrips control where insecticide application should start when there are three thrips per flower. With this, they found that spray application could be reduced from 12 to 2 with a marginal rate of return of 3.8. The over reliance on pesticides is no longer an option because of the drive to protect consumers, farmers and the environment. The maximum residue levels (MRLs) that have been instituted may lead to rejection of products treated with too much pesticide. Meeting the current stringent market standards requires knowledge of pests and diseases attacking snap beans, their importance and management, and defining areas and timing of interventions. This information is, however, lacking in East Africa region as a whole and in Uganda in particular, and yet an effective pesticide usage and regulation is dependent on the availability of accurate data on the use of pesticides and alternatives. Moreover, the success of any intervention would also to large extent depend on farmers perceptions of the constraints and the available mitigation measures. To address this paucity of information, a study was conducted with the following objectives: (i) to determine farmers' perceptions about pests of snap beans in Uganda; (ii) to identify control methods that are currently used by farmers; and (iii) to evaluate farmer safety in regards to pesticides usage on snap beans.

Methods

Survey areas

The survey was conducted in 2006. It covered three major snap bean producing areas in Uganda, namely Wakiso, Mpigi, and Luwero districts. In these districts, sub-counties where snap beans were being grown were purposively surveyed. The sub-counties are: Kakiri and Wakiso in Wakiso District, Kamengo in Mpigi District and Zirobwe in Luwero District. A total of 53 farmers were interviewed in all the three districts.

Farmer selection

One prominent snap bean grower was identified from each district who in turn helped identify other farmers to be interviewed. Farmers were visited at their homes or in their fields by the enumerators. The number of households interviewed in each area was determined largely by the numbers growing the crop, their availability and willingness to participate in the survey.

Interview methods

Interviews were conducted by three experts from the National Crops Resources Research Institute (NaCRRI)-Namulonge and Makerere University. They all had previous survey experience. The questionnaire was first pre-tested and revised. Personal observation was used mainly to obtain data on farmers' knowledge on pests and diseases. This was done through personal judgment of the ability of the farmers to identify the pests and diseases on their fields.

The questionnaire

The questionnaire addressed pre-harvest pest problems of snap beans. Wherever possible, the questions were open-ended to allow the respondents answers to be recorded in full. Responses were coded after the completion of the survey at the data analysis stage. The survey required respondents to provide data on crop acreage, pests and disease problems, pest and disease control measures (pesticides used, number of applications and rate of products applied) and chemical waste disposal. During the survey, the expert completed the questionnaires according to farmer's responses. The questionnaire also provided an option for researchers' record based on observations.

Data analysis

The data were analysed using SPSS package. Chart and graphical figures were produced using Microsoft Excel.

Results

Size of land owned by farmers

Farmers' land sizes varied from 1 to 10 acres with 9.4% owning above 10 acres of land, while the majority had between 1–2 acres of land (Table 1). Most farmers allocated half an acre of the land to snap beans growing (Table 2).

Table 1. Respondents size of land

Size (acres)	No. of farmers	%
0.25	8	15.1
0.50	23	43.4
0.75	2	3.8
0.90	3	5.7
1.00	10	18.9
1.50	5	9.4
2.00	2	3.8
Total	**53**	**100**

Table 2. Land under snap bean cultivation

Size (acres)	No. of farmers	%
<1	9	16.98
1–2	23	43.4
3–5	12	22.6
5–10	4	7.5
>10	5	9.4
Total	**53**	**100**

Farmers also grew other crops apart from snap beans, vegetables being a major income generation source among others (Table 3).

Table 3. Other crops grown by farmers

Crops	Reason	No. of farmers	%
Vegetables	Sale	15	28.3
Dry beans	Food	10	18.9
Maize	Food	09	17.0
Banana	Food	07	13.2
Others	Food & sale	12	22.6
Total		53	100

Snap bean varieties

The farmers grew Paulista and Theresa varieties. Over half (54.7%) the farmers grew Paulista because of its high yield, long harvest duration, early maturity and marketability.

Constraints to snap bean production

About two-thirds (67.9%) of the farmers ranked pests and diseases as the most serious constraints, followed by unfavourable weather (11.5%). Poor soils (7.5%) and labour shortage (5.7%) were ranked as minor (Figure 2).

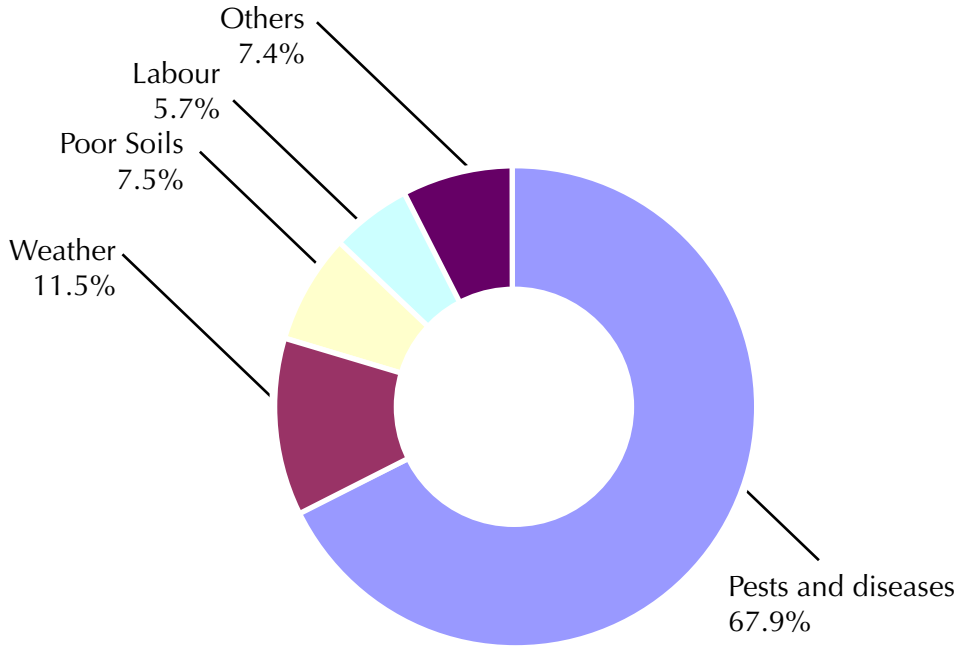


Figure 1. Major limitations to snap bean growing.

Pests and diseases

Various pests and diseases were reported. Aphids were the most common insect pests, while rust was the most troublesome disease (Table 4).

Table 4: Major insect pests and diseases

Pest and diseases	No. of farmers	%
Insects		
Aphid	43	81.1
Bean fly	41	77.4
Thrips	24	45.5
Pod borer	19	35.5
Cut worms	15	28.3
Diseases		
Rust	23	43.4
Leaf spot	22	41.5
Anthracnose	1	1.9
CBB	6	11.3
Halo blight	2	3.8
Root rot	18	34.0

The insect pests were reportedly more destructive during seedling growth stage, and at flowering (Figure 2). Diseases were found destructive before flowering and at pod filling among other growth stages. Most farmers reported yield loss of over 50% due to pests and diseases.

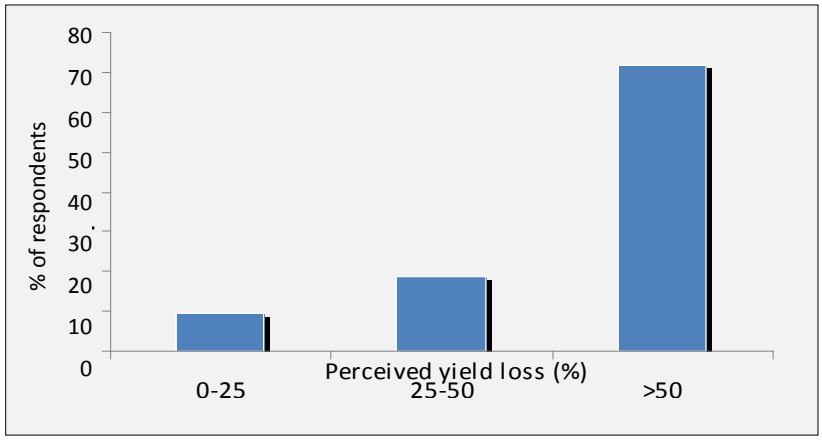


Figure 2. Perceived yield losses when pests and diseases are not controlled.

Control of insects and diseases

The use of agricultural chemical pesticides was the most common method farmers used to control insects and diseases (Table 5). Farmers generally considered pesticides as the most effective control measure. A wide variety of agricultural chemical pesticides were used (Table 6), with more preference for cypermethrin-based and Mancozeb for insects and diseases control respectively. Deliberate use cultural practices and host plant resistance were reported by fewer farmers.

Table 5. Pest and disease control methods

Method	No. of farmers responding	%
Cultural	8	15.1
Varietal	1	1.9
Chemical	53	100
Bio-control	0	0

Table 6. Main pesticides used according to farmer's preference

Pesticides	No. of farmers	%
Mancozeb	53	100
Cypermethrin	43	81.1
Rocket	34	64.2
Dimethoate	10	18.9
Endosulfan	3	5.7
Chloropyrifos	1	1.9
Nimbecidine	1	1.9

Pesticide application

Most of the farmers (86.8%) applied pesticides based on calendar sprays. A few (7.6%) reported that they sprayed their crop based on pest abundance and monitoring. Spraying was mainly done weekly from one week after crop emergence until the whole crop was harvested. Farmer's pesticide application rates were lower than the recommended manufacturers' rates, yet their spray intervals were shorter than the recommended spray intervals (Table 7).

Table 7. Farmer's pesticides rate compared with the label rate

Pesticides	FR[a]	RR[b]	FSI[c]	RSI[d]
Rocket	25	30	7	14
Cypermethrin	25	45	7	14
Dimethoate	25	45	7	14
Chloropyrifos	15	30	7	10
Nimbecidine	45	45	7	14
Mancozeb	60	50	7	7–15

[a] FR = farmers' rate (ml or g/15L); [b]RR = recommended rate, [c] FSI = farmers' spray interval; [d] RSI = recommended spray interval.

Pesticide efficacy

A majority of the farmers appraised cypermethrin and mancozeb as being the most effective insecticide and fungicide respectively (Table 8). Mancozeb was the only fungicide being used.

Table 8. Farmer's appraisal of pesticides

Pesticides	Farmers' appraisal	
	Good	Moderate
Mancozeb	47	6
Cypermethrin	28	15
Rocket	31	3
Dimethoate	3	7
Nimbicidin	1	0
Endosulfan	1	2
Chloropyrifos	1	0

Pesticides abandoned

Just under half (45%) the farmers reportedly abandoned insecticides; ambush, *masso*, fenom, salute and fenkil were the most unpopular agricultural chemicals (Table 9). The farmers gave several reasons for abandoning these pesticides, ranging from strong smell, to high toxicity (Table 9). However, no fungicide was abandoned by the farmers interviewed.

Table 9. Pesticides abandoned and the reasons for abandonment

Pesticides	Reason	No. of farmers
Rocket	Strong smell	1
Cypermethrin	Not effective	5
Ambush	Out of market	9
Masso	Out of market	1
Fenom	Out of market	2
Fenkil	Out of market	1
Dimethoate	Toxic	5
Salute	Out of market	2

Farmers' knowledge on insects and diseases of snap bean

Close to 19% of the farmers lacked knowledge on pests and disease identification, but 37.7% and 24.5% had average knowledge on insects and diseases respectively (Figure 3).

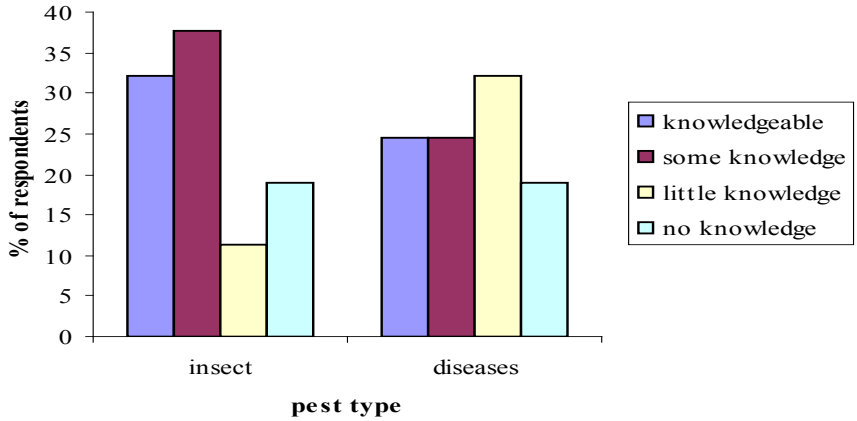


Figure 3. Farmers' level of knowledge on pests and diseases of snap beans.

Recommendations for pesticides usage

Only 17% of the farmers used their own knowledge when deciding which pesticide to use; 43.4% depended on neighbours; and 13.2% made their choice based on the recommendation of extension agents. Others took advice from relatives (11.3%), salesmen (9.4%) and shopkeepers (5.6%).

Overall, 96.2% of the farmers decided when to apply pesticides on their own; only

3.8% relied on their spouses. For spraying, most (86.8%) farmers sprayed their crops on their own, 9.4% used hired labour and 3.7% depended on their relatives.

Combined use of chemicals

The survey revealed that 94.3% of the farmers used mixed pesticides while 5.7% applied chemicals singly. Of those who used mixtures, 73.6% used insecticides, fungicides and urea mixture, 18.9% used insecticides and fungicides mixture, and 7.5% mixed insecticides, fungicides and compost manure. These mixtures were sprayed on snap beans, but also on other crops as confirmed by 77.4% of farmers.

Pesticide safety handling and precautions

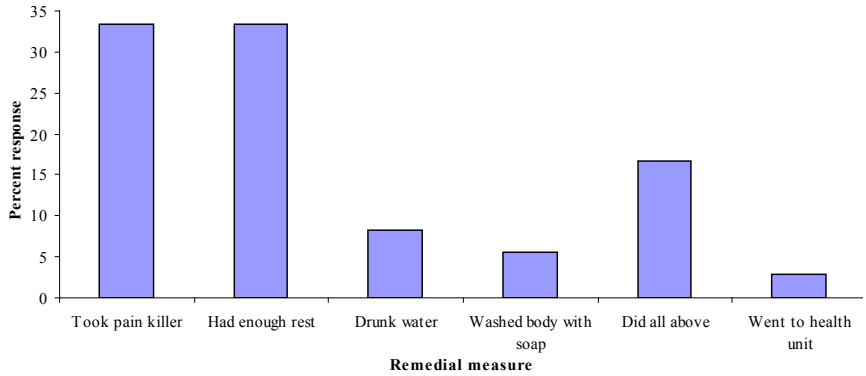
Overall, 56.6% of farmers took precautionary measures. The measures taken included not smoking (98.1%), drinking (75.6%) or eating (79.2%) during pesticide application. A few farmers, 13.2% and 17% had the personal protective equipment (PPE) consisting of masks and gloves, respectively. Washing hands and or bathing after handling chemicals was practised by 83% of respondents.

When asked about pesticide intoxication, 36 farmers (67%) indicated they had been intoxicated. The most common signs of intoxication were headache (27.8%) and skin irritation (16.7%). However, cases of stomach ache, dizziness, and abnormal thirst were also reported. The survey found that intoxicated farmers generally took painkiller tablets (especially paracetamol) and rested and one (2.8%) respondent visited a health unit for medication (Figure 4).

Pesticides container disposal

Less than half the farmers (45.3%) left used pesticide containers in their gardens, 7.5% buried used containers while 5.7% kept them in chemical stores at their homes; 41.5% just threw used agrochemical chemical bottles in nearby bushes**.**

Figure 4. Farmer's action after being intoxicated.



Discussion and recommendations

Snap bean is an upcoming commercial and profitable crop for subsistence farmers in the Central Region of Uganda. However, constraints imposed by pests and diseases, among others, limit the profits farmers derive from their crops. Moreover, extension and research have not addressed any issues to do with snap bean production and post-harvest management. As a first step, this study sought to understand farmers' perceptions and management of perceived major pests and diseases of the crop, the type and extent of use, and handling of pesticides. Pests and diseases emerged as the major factor limiting yield. Other important constraints reported included low nutrient soils, problems related to unfavourable weather and labour shortage. Because of the perceived insect pest and disease problems, farmers frequently used pesticides without heeding instructions on dosage rate, application intervals and safety in handling, and disposal of the left-over pesticides and empty containers. Moreover, they depended on each other for advice. The most commonly used agrochemicals were mancozeb and cypermethrin-based products.

The farmers reported that snap beans are most vulnerable to insects, diseases and weeds during seedling stage and just before flowering. This made the farmers begin early control using pesticides without taking into account the effects of their decision on the environment, the economics of pesticide use and safety of consumers. The interviewed farmers shared the view that pesticides were expensive and associated with environmental pollution, destruction of important non-target insects such as predators, parasitoids and pollinators. Furthermore, the newly instituted maximum residue levels call for reduced and need-based (on-spot) application of particular types of pesticides (Nderitu et al. 2008). Thus, if farmers do not seriously consider these requirements, most of them will not be able to meet the minimum export standards. The interviewed farmers did not report insect pests to be so damaging at fruiting stage probably because the pesticide used effectively controlled them. However, as noted by Nderitu et al. (2008), insecticides may be very effective in reducing pest populations and damage, but occasionally result in negative marginal rate of returns. This state of affairs calls for more research to develop a pest management strategy which is environmentally friendly and cost effective for resource poor farmers coupled with training of farmers on cost-benefit analyses of different interventions.

Pesticides were used at lower rates than the recommended dosages and at shorter spray intervals than those recommended. This difference is possibly due to farmer's perception of economising on the use of pesticides since they are expensive. However, these practices pose serious risks of insect pests developing resistance to the pesticides and of environmental pollution, as earlier alluded to. This risk is even further heightened by the uniformity and consistency in the pesticides used by farmers, whereby a majority used cypermethrin-based products and mancozeb. The farmers only abandon these chemicals when they lose efficacy, are out of the market or appear more toxic (Table 9). There is

therefore a need to up scale the level of sensitisation of farmers and extension agents on the safe use and handling of pesticides, covering basic pesticide science, pesticide selection, application techniques, pesticide label, pesticide toxicity, and diagnosis of pest infestation. The depth of the sensitisation will depend on the audience.

The over-dependence of farmers on each other for advice on pesticide application presents threats and opportunities. The risk of using the wrong pesticides is prominent given the low level of education/knowledge of the farmers. It may also mean that most farmers can be subjected to improper pesticide usage like wrong application rates, target crops and pests. However, the dependence on each other can help bridge the gap of shortage of technical personnel to offer extension services in the country. Thus, farmers must be knowledgeable and aware of the requirements of safe use of pesticides.

Although mixing pesticides with other products like fertilisers helped farmers to save time, labour, energy and equipment cost, it should be done with caution since some chemical products are incompatible. Two or more pesticides, or a pesticide and a fertiliser, are compatible if no adverse effects occur as a result of mixing them together. But when the components are incompatible, deactivation of one or more active ingredient(s) often occurs, making the mixture less effective.

The failure of farmers to take precautions when they handle pesticides and dispose of pesticide containers poses serious threats to the health of both the users and the environment. Most interviewed farmers did not report use of protective gear and generally never followed the rules of chemical handling and application. This means that farmers either lacked sensitisation on the dangers of pesticides or were reluctant to use personal protective equipment. This explains why cases of intoxication were reported but farmers did not take serious actions when they experienced symptoms of chemical intoxication. Most of the farmers visited during the survey did not appropriately dispose of used up pesticide containers; most pesticide bottles were just dropped in the bushes or left in the garden. This has implications of contamination of the soils and underground and surface water, causing serious liability problems for the pesticide user, and for the public and the environment.

This survey has established that the interviewed farmers perceived insect pests and diseases as a major constraint to snap beans production. Thus, control is based largely on calendar sprays regardless of the economic importance of the pest or disease. Additionally, most farmers seemed unaware of any control method other than insecticide and fungicide use, and that a reduction in pesticide use is possible under their production situation, without necessarily exacerbating pest problems. Therefore, integrated pest management development and sensitisation on cost-benefit analyses of pests and diseases control interventions are indicated. Farmers need guidance on pest identification, available control options and their cost-effectiveness, plus safe use of agricultural chemicals. At the same time, the government must become more involved

in supporting awareness creation, research on decision-based pests and diseases control measures and implementation of regulations regarding safe use of pesticides. Dissemination of new integrated pest management programmes would require use and strengthening of the hitherto strong farmer–farmer linkages through group mobilisation and trainings, and integrating production to agro-processing and organised marketing of snap beans.

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Common diseases of snap beans in Uganda, their effect on pod quality and management options

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Introduction

Diseases cause severe damage to common beans (snap beans inclusive) yearly. Seedling diseases such as root rots result in poor stands while stem damage, foliage and pod diseases cause severe yield reductions. Thus disease control is necessary to produce the best quality and highest yields of fresh market snap beans. Diseases causing the greatest losses to snap beans in Uganda include rust, angular leaf spot, root rots, bacterial blight, halo blight and bean common mosaic virus.

Rust

Rust is considered the most important disease of snap beans in Uganda. In a recent survey by the National Beans Programme, incidence of rust was observed to be 100% in Kamengo (Mpigi District) and Zirobwe (Luwero District) and 71% in Wakiso (Wakiso District). Rust is caused by the fungus *Uromyces phaseoli* var. *typical*.

The rust fungus is not seed-borne, but overwinters on old bean plants. Spores produced on old bean plants are spread to new bean foliage by wind. Early symptoms of the disease may be seen approximately five days after spores land on the leaves. A new crop of spores is produced about every 10 days. The development of rust is favoured by cloudy, humid and warm weather.

Symptoms

Symptoms of rust are most easily identified on the underside of the leaves. The first foliage symptoms are very small, white, slightly raised spots or pimples, often surrounded by a yellow halo. The spots later become raised, reddish-brown pustules (Figures 1A and B) which rupture and release a powdery mass of spores (seed-like bodies) which give a rust colour to the fingers if rubbed across an infected leaf. Heavily infected leaves become yellow, wither and fall, resulting in premature defoliation.

Figure 1. Rust pustules (A) upper leaf surface and (B) lower leaf surface.

Control strategies

1. Application of fungicides such as Bravo, Evade or Sulfur reduces rust disease development on susceptible varieties. However, the treatment should be applied immediately, if the first sign of rust infection is visible on a few plants. This should be repeated weekly until rust is no longer a problem. However, one to three applications are usually adequate.
2. A two-year crop rotation with crops other than beans (or other legumes) is important to reduce disease pressure in infested field.
3. Use of resistant varieties seems to be the most promising strategy to control rust. However, currently in Uganda, farmer preferred varieties such as Paulista are very susceptible to rust.

Angular leaf spot

Angular leaf spot, caused by the fungus *Phaeoisariopsis griseola*, is a serious disease of beans in many regions. In countries (e.g. USA) where yield loss studies have been conducted, losses of between 10% and 50% have been observed in fields severely affected by angular leaf spot. However, yield losses in tropical and sub-tropical countries may reach up to 80%. The angular leaf spot pathogen can survive for long on infested bean residue left on the soil surface in the field, but dies quickly when infested bean debris is buried in soil and decomposes. The pathogen can also survive between seasons on infested seed (seed-borne), from where it can be introduced into fields. Conditions of high humidity or wet conditions for 24–48 hours cause spores (disease causing particles) to germinate and disease to develop in a field. Spores produced on infested debris or seed are rain-splashed or wind-blown onto healthy tissue after planting. When spores land on susceptible bean tissue, they germinate and infect the plant. Disease develops rapidly during periods of warm temperatures (24˚C) but can occur over a range of moderate to warm temperatures (16–28˚C).

Symptoms

Symptoms develop on all aerial plant parts (leaves, petioles, stems and pods), but are most recognisable on leaves (Figure 2A). Lesions on leaves usually appear as brown spots with a tan or silvery centre that are initially confined to tissue between major veins, which gives it an angular appearance. Lesions develop distinctly on both the upper and under sides of the leaf. In severely infected fields, plants get defoliated (Figure 2B). Lesions on pods are angular, black and sunken (Figure 2C). Yield reduction caused by angular leaf spot is due mainly to a reduction in photosynthetic area. However, the fungal pathogen can also reduce quality by causing lesions on pods.

Control strategies

1. Use of crop rotation.
2. Planting clean seeds and resistant varieties.
3. Deep ploughing to destroy plant remains after harvest.
4. Use of chemical pesticides such as benomyl at disease onset.

Figure 2. (A) Leaf symptom (B) Plant defoliation in the field, and (C) Pod symptoms.

Root rots

Pythium root rot

The most common bean root rot pathogens in Uganda are *Pythium* spp. and *Fusarium solani* f.sp. *phaseoli*.

Pythium root rot results in seed rot and pre- and post-emergence seedling damping-off. Like other root rotting diseases, *Pythium* can cause poor plant stands, stunting, and discolouration of foliage.

Symptoms

Pythium primarily attacks seeds and roots. Infected seeds become soft and discoloured. Diseased roots are characterised by colourless to dark brown, water-soaked lesions (Figure 3A) and an overall collapsed appearance is visible. Infected tissue is soft and watery and easily separated from the central cylinder of the stem by pulling the root between the thumb and index finger. The whole root system dies, resulting in seedling damping-off.

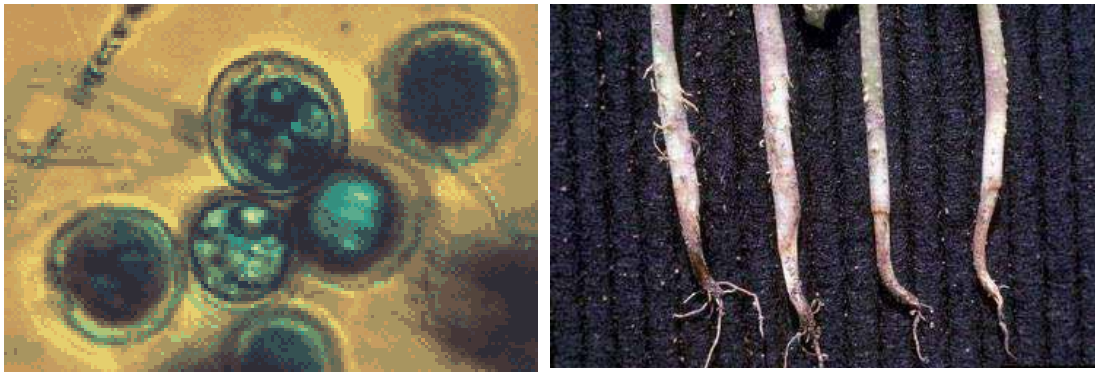


Figure 3. A) Symptoms of *Pythium* root rot on young roots (B) Thick walled oospores.

Pythium root rot is generally most severe in wet soils. The fungus survives in the soil or on crops as thick-walled resistant spores called oospores (Figure 3B). Infected soil and plant material can be moved around the field by wind, rain, irrigation water, farm implements and any other agent soil moving agent. Once soil becomes infested, it is very difficult to remove the pathogen.

Fusarium root rot

Fusarium root rot of snap beans is caused by the fungus *Fusarium solani* f. sp. *phaseoli*. The fungus can attack older seedlings, and is most severe on plants growing under stressful conditions (deep planting, soil compaction, hardpan layers, cool temperatures, high or low pH, low fertility, pesticide or fertiliser injury, and flooding or extended drought). The pathogen survives between seasons as thick-walled chlamydospores in soil and the spores germinate when stimulated by nutrient exudates from germinating seeds and root tips. If beans are grown in succession, pathogen population multiplies and disease may become severe. Fusarium root rot development is reportedly favoured by temperatures between 14°C and 24°C, although the optimum is said to be around 21°C. The spread of the pathogen within and between fields is by wind, rain, irrigation water, farm implements or by any other agent or process that moves soil.

Symptoms

The first symptoms appear 7–10 days after seedlings emerge. They appear as narrow, long, red-to-brown streaks on the hypocotyls and taproot (Figure 4A). The taproot later turns dark brown, and lengthwise cracks often develop (Figure 4B). The taproot may shrivel and die. Fibrous roots then develop, as the plant struggles to survive. These fibrous roots may keep the plant alive, and under ideal growing conditions, few aboveground symptoms will be observed. Infected plants may be stunted (grow more slowly than healthy plants) as poor root function deprives them of nutrients and water, resulting in uneven plant stand and consequently reduced yields.

Figure 4. A) Young lesions and B) Mature lesions showing cracked roots.

Control strategies for bean root rots

Promoting good plant health (vigorous growth) is the first step in controlling bean root rots. This can be ensured by planting in a warm, well-prepared, well-drained, and well-fertilised seedbed, capable of supporting rapid bean growth. Secondly, a crop rotation of at least two years with non-legume crops helps to reduce losses to root rot. Seed treatment or soil drench applications of fungicides containing the active ingredient metalaxyl can bɛ used to control *Pythium*. However, fungicides ɛːe generally not effective in controlling Fusarium root rot. Root rots can also be controlled by using resistant varieties.

Common bacterial blight

Common bacterial blight is caused by the bacteria *Xanthomonas campestris* pv *phaseoli*. New disease development occurs from infected seeds and debris. Infected plant material may stay infective for up to one year. The disease is more severe where temperatures are warm, and is spread within and between fields by wind, insects, humans and splash rainfall.

Symptoms

Symptoms are on both leaves and pods; the disease thus has a severe effect on snap bean yield and quality of pods. The first symptoms on the leaves are on the underside (Figure 5A), and these are small, water-soaked or transparent spots which then grow larger, merge and form brown lesions with yellow margins (Figure 5B). Severely infected plants may lose their leaves, resulting in low yields due to reduced photosynthetic area. Water-soaked symptoms also appear on the pods (Figure 5C) which may shrivel and die.

Figure 5. (A) Water-soaked spot on leaf (B) Leaf lesion with yellow margin, and (C) Water-soaked lesions on pods.

Halo blight

Halo blight is caused by the bacteria *Pseudomonas savastanoi* pv *phaseolicola*, and initial disease development occurs from infected seeds and debris. Unlike common bacterial blight, Halo blight epidemics are favoured by cool temperatures. Thus the disease is most common and severe in mid to high altitude areas. The spread of the disease is similar to that of common bacterial blight, however, differences occur between the two bacterial diseases in the symptoms.

Symptoms

The initial symptoms also appear as small water soaked spots on the underside of leaves, but then develop into numerous small reddish-brown lesions. Greenish yellow halos (patches) develop around the spots (Figure 6A). Pods may also develop water-soaked spots which are surrounded by narrow reddish zones (Figure 6B).

Figure 6. (A) Leaf halos and (B) Water-soaked spots on pods.

Control of bacterial diseases

1. Use disease-free seeds.
2. Use at least two-year crop rotations.
3. Avoid working in the fields when plants are wet. This is because bacterial particles are readily available at such times and therefore will be easily spread.
4. Practise deep ploughing to bury infected plant material; this should be done immediately after harvest.
5. Chemical control can be achieved with copper based pesticides.
6. Treat seeds with streptomycin (antibiotic) before planting.

Bean common mosaic virus

Bean common mosaic virus is seed borne and disease may persist between seasons on volunteer snap bean crops or alternate non-snap bean hosts. Spread within and between fields is by insect vectors such as aphids.

Symptoms

Infected plants are stunted with discoloured and mottled leaves, resulting in irregular light green and yellow patches intermingled with healthy dark green tissue (mosaics) (Figure 7A). These symptoms are more severe in plants that are infected early in growth stages, and such plants become stunted (Figure 7B). Flowers and pods may also become

distorted. Pods curl, thus losing their desired straight appearance, causing loss of quality. Overall, fewer pods are produced due to loss of photosynthetic area, resulting in severe yield losses.

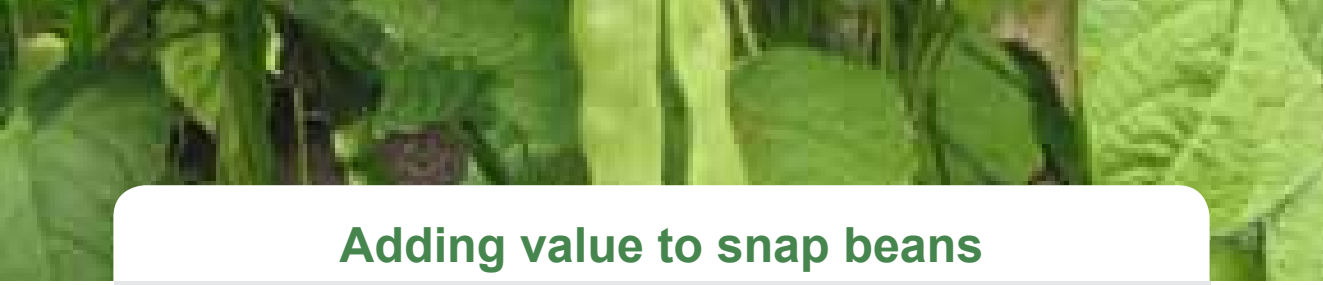
Control strategies for BCMV

1. Control insect vectors.
2. Plant disease-free seeds.
3. Destroy alternate hosts (weeds) in neighbouring fields.

Figure 7. (A) Leaf mosaics and (B) A stunted plant.

Strategies for reducing snap bean diseases in farmers' fields

1. Provide clean planting material (snap bean seeds) to the farmers.
2. Sensitise farmers on production practices that reduce disease incidence and severity on farm.
3. Introduce resistant varieties (particularly those with rust and angular leaf spot resistance), and on-farm testing to allow farmers choose those with desirable traits.
4. Characterise rust and angular leaf spot pathogens in major snap bean growing districts of the country.
5. In the long term, breeding is necessary to introduce disease resistant genes in farmer preferred varieties such as Paulista.



Adding value to snap beans

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Introduction

Fresh fruits, nuts and vegetables play a significant role in human nutrition, as they contribute vitamins, minerals and dietary fibre in the diet. Liberman (1983) states that substantial losses occur in the vitamin C content in fresh agricultural produce due to a combination of several factors such as extended storage, high temperature, low relative humidity, chilling injury and physical damage. Health concerns are prompting many people to eat more fruits and vegetables. With the current emphasis on five to six servings of fruits and vegetables a day, they are consumed widely by a large segment of the population in all the socio-economic categories.

Beans are tender, warm season vegetables that rank second in popularity to tomatoes in most home gardens in Rwanda.. Beans may be classified by growth habit (bush or pole beans), use (as immature pods, shellouts and dry beans) and type (green and yellow snap and lima beans). Bush beans (also called bunch beans) stand erect without support. They are the most popular because they yield well and require the least work. Green bush beans were formerly called "string beans" because of the fibre development along the top and bottom of the pods. Plant breeders have reduced the presence of these fibres, and green beans are now called "snap beans" (also referred to as green beans or French beans). Snap beans *(Phaseolus vulgaris)* of all types originated in tropical southern Mexico, Guatemala, Honduras and Costa Rica. Their probable area of origin has been expanded to include the Andes regions of South America. Lima beans *(Phaseolus lunatus),* however, are indigenous to tropical America. Scarlet runner beans *(Phaseolus multiflorus)* also originated in South America (Andersen 2009). Snap beans are produced and marketed internationally as fresh, canned or frozen products. Bush beans and pole beans are the two most important types of snap beans that are available on the market.

Snap bean production in Rwanda

In Rwanda, snap beans are grown for the fresh consumer market. However, the Association of East African Growers, a Kenyan-based organisation, works with some farmer organisations in the Rwanda and exports fresh snap beans (Teresa) to Europe. The concept of "value-added" agricultural products is new to farmers in Rwanda. While the country is shifting to a knowledge based economy, farmers must also move from traditional practices to 21st century technical science-based practices. Snap beans are widely grown in the Gasabo District close to Kigali to facilitate easy transportation to the airport. However, snap bean production in Rwanda is not well documented.

Plate 1. Snap beans.

Trends for marketing snap bean in USA

In the USA, a number of factors and trends have affected the market for snap beans (Getachew Abate 2006). First, due to health concerns, consumers are increasingly adding fruits and vegetables to their diets. In particular, low carbohydrate dieters are becoming key consumers of vegetables that include snap beans. A consumer survey conducted by Mintel, a market survey company (Mintel 2004), indicated that consumers on a low carbohydrate diet or who are carbohydrate aware consume more low carbohydrate diet vegetables including spinach, peppers, lettuce, radishes and snap beans. Snap beans are known as a moderate source of fibre, vitamins and minerals. They are low in calories, sodium and fat.

Demographics is the second factor that affects the snap bean market in USA. Although snap beans are generally inexpensive, consumers with high income appear to have the highest per capita consumption. In terms of age distribution, fresh snap bean consumption is highest among older Americans. Increased diversity in the US population has also led to an increase in demand for snap beans. Asian Americans consume the greatest amount of fresh snap beans per capita. It appears that Hispanics have low preference for fresh market snap beans.

Third, recent growth in ethnic-based restaurants (e.g. Mediterranean and Asian cuisines), natural and health food restaurants, and related specialty food service outlets has also contributed to an increase in the consumption of fresh snap beans.

Finally, fresh snap bean consumption exhibits regional variation. The south and north east regions are the highest consumers in the nation. Snap bean consumption is relatively low in the west of the country. This may be attributed to a large Hispanic community in this region.

Overall, key markets for fresh market snap bean products in these regions are large cities that account for nearly more than one-third of the fresh snap bean consumption. The increase in consumption is generally attributed to a greater emphasis on the health benefits of eating fresh produce, an interest in different types of cuisine and a greater ethnic diversity of the population. There is no doubt that such influences can also occur in the East African region, as the entire world is becoming a global village.

Health benefits and nutritive value of snap beans

Snap beans help the human body build strong bones by supplying vitamin K. They also provide vitamins A (Beta-carotene) and C which are important antioxidants that offer cardiovascular protection, preventing blocked arteries, heart attacks and strokes. The dietary fibre, potassium, folate, magnesium and riboflavin also play a significant cardio-protective role. Riboflavin has also been shown to help reduce the frequency of migraine attacks in people who suffer from them. Snap beans promote colon health and may also help prevent colon cancer. The vitamin C and beta-carotene in snap beans help protect the colon cells from the damaging effects of free radicals. The fibre can help prevent colon cancer as well, as it has the ability to bind to cancer-causing toxins, removing them from the body before they can harm colon cells. Snap beans supply anti-inflammatory nutrients.

Snap beans are a good source of iron, an especially important mineral for people who are more at risk for iron deficiency. They are also rich in minerals and in antioxidants that boost the immune system of humans. Snap beans are a very good source of iron, copper and manganese. Iron is an essential part of haemoglobin, but haemoglobin synthesis also relies on copper and copper bonds with manganese in vital body functions. Vitamins A and C and zinc are vital for optimal immune functions of the body. In addition to its antioxidant activity, vitamin C is critical for good immune function. Vitamin C stimulates white cells to fight infection, directly kills many bacteria and viruses, and regenerates vitamin E after it has been inactivated by disarming free radicals

The following table indicates the nutrient content of raw and cooked snap beans.

Table 1. Nutritional value of snap beans per 100 g

Nutrients	Raw (l00 g)	Cooked (1/2 cups cooked fresh green snap beans)
Energy (kcal)	30	-
Carbohydrates (g)	7.1	3.5
Fat (g)	0.l	-
Proteins (g)	1.8	19
Ash (g)	0.5	-
Dietary fibre (g)	3.6	1.6
Vitamin C (mg)	16	7.5
Iron (mg)	1	4
Potassium (mg)	200	94.5
Vitamin A (µm)	690	340
Folic acid (mg)	37	21
Calcium (mg)	37	31.5

Source: USDA nutrient database.

Understanding the concept of adding value to snap beans

Today's consumer is demanding and willing to pay for services and convenience in the market place. The addition of time, place, or ease of consumption to a commodity in order to meet the preferences or tastes of the consumer is termed as adding value. Value-added agricultural products offer farmers a way to increase the value of the products they grow and sell by providing products and services that satisfy consumer needs. The true test of value added is achieved when the after tax return on invested capital used to generate time, place, or form utility exceeds the overall cost of capital. Raw agricultural food products can be processed by the food industry, generating cash just by value addition. Value-added food products are raw or pre-processed commodities whose value has been increased through the addition of ingredients or processes that make them more attractive to the buyer or more readily usable by the consumer. It is a production/marketing strategy driven by customer needs and perceptions. In USA, about 15,000 new value-added products are introduced each year. However, it is difficult to introduce a new product into the highly competitive retail market. The following picture depicts the flow of activities in the processing line and in the sales and distribution line.

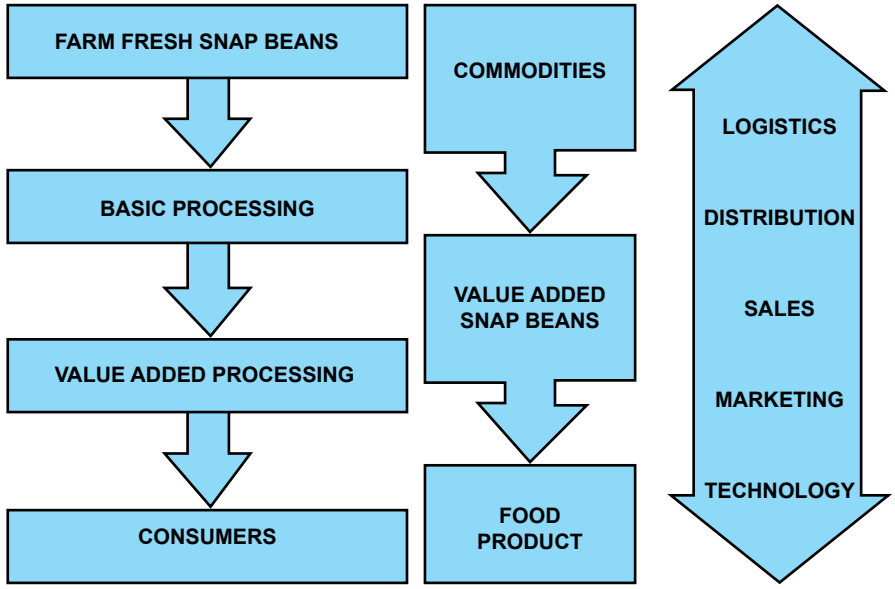

Figure 1. Market network for value-added snap beans.

Value-added produce interconnects well with both an aging population and a young generation attuned to the health benefits of fruits and vegetables. As people age, they use more of such produce in their diets. Pre-packaged fresh-cut fruits and vegetables are easy to use. They are easy to carry and they are popular for time-pressed consumers in this age group. Fresh-cut produce is defined as any fresh fruits or vegetables or their combinations that have been trimmed, peeled, washed and cut into 100% usable product that is bagged or packaged (Jester 2004). But it is imperative that good agricultural practices (GAP) and rigid microbiological protocols should be practised to produce these fresh-cut products.

Ways to add value to snap beans

Several methods can be used to add value to snap beans to obtain better prices for the farmer, supply convenience products for the consumer, prevent post-harvest losses and increase food availability. For processing, snap beans should be harvested at the right time.

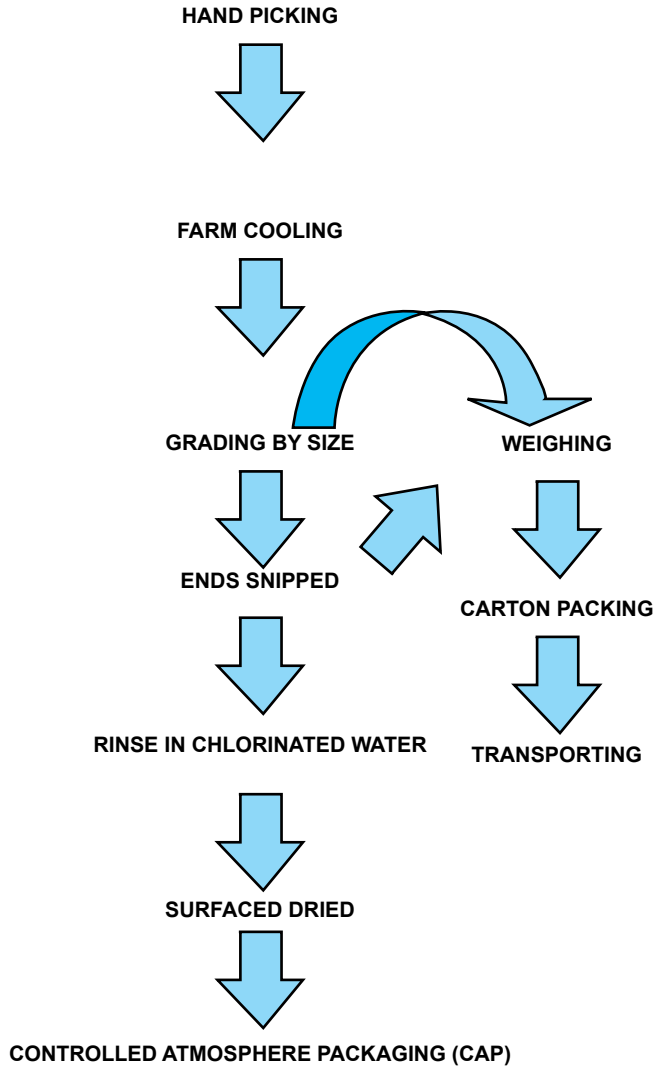

Figure 2. Snipped fresh snap beans.

With emphasis on GAP producing quality green beans starts on the farms. The highest quality of inputs in terms of certified seeds, fertilisers, approved pesticides, uncontaminated water etc. should be supplied or made known to the farmers. This will enable them plant, manage, harvest, grade, and transport to the factory the very best of the beans, tailored to meet the needs of the consumers. Wherever water comes into contact with fresh products, its quality may directly determine the potential for persistent pathogen contamination (Suslow 2006). Therefore water quality too should be stressed.

Hand picking: Trained bean pickers with clean uniforms and protective hand and head covers pick fresh, slender beans and place them carefully in clean containers; these are taken to the farm for storage. The beans are picked in the cool morning hours.

Farm cooling

The beans are placed under a shade in the farm and cooled to remove farm heat. W. Hurst, University of Georgia, conducted a survey in 1982 and found that the more the snap beans stayed on the farm the more weight they lost (Boyette 1994). Table 2 indicates the effect of delayed cooling on the quality of snap beans.

Table 2. Effect of delayed cooling on snap bean quality

Sample	Delay time (hours)	Weight loss (%)
1	1	2.2
2	3	2.8
3	5	10.0

Grading

Quality control staff should carefully inspect and sample the snap beans to check for any chemical pollutants, e.g. pesticide residues, visible spoilage and physical contaminants (e.g. leaves, hair, string, flowers etc.). Thus, only the choicest long, slender, straight, uniform and tender of the raw French beans are selected. Non-conforming shrivelled, spotted, bruised, undersized or oversized bean size batches are rejected. Experienced graders remove all the non-conforming beans. Utmost hygiene is maintained. Continuous quality control analysis is done to ensure conformity to specifications.

Snipping

This involves the proper cutting of the tips of the slender bean by trained snippers. The art of proper snipping assures that the tips are cut evenly and uniformly, and that the product is not bruised or punctured in any way. Snippers also ensure that the process is fast and efficient with minimum possible wastage. Alternatively, when this stage of unit operation is accomplished the snap beans can be weighed, packed in cartons and transported. If not, it continues to the next operation.

Washing, soaking and rinsing

The snipped beans are then soaked, washed and rinsed in three consecutive water tanks to get thoroughly clean beans. A suitable cleaning sanitiser is used when soaking the beans. The water used for these processes is of the highest quality standards. High level sanitation standards are followed and maintained. Antimicrobial chemicals help minimise the potential spread of microbial contamination from the water. Levels of antimicrobial chemicals must be routinely monitored and recorded to ensure they are maintained at appropriate levels.

Visual inspection

Proper washing facilitates further grading to ensure that only the cleanest and the best of beans enter the next stage. Again the same kind of defects as mentioned in grading are checked for through a conveyer belt system by a group of careful graders on both sides of the moving belt. Quality control sampling is stepped up to assure that maximum conformity standards are achieved. Inspectors are extra vigilant and follow the strictest discipline to ensure the best quality possible of the beans.

Surface drying

The snap beans are surface dried on a stainless steel top table with a clean muslin cloth spread on it to remove surface water.

Bagging (Controlled atmosphere packaging, CAP)

The snap beans are bagged in low density polyethylene bags. The bags are filled with suitable gas (carbon dioxide) or appropriately perforated bags are used.

Transportation

The transportation vehicles must be inspected for cleanliness, odours, obvious dirt and debris before loading the snap beans. The trailer or container must be cleaned before loading, if necessary. Transporters, distributors and retailers should also maintain the integrity of the positive lot identification and trace-back systems being used.

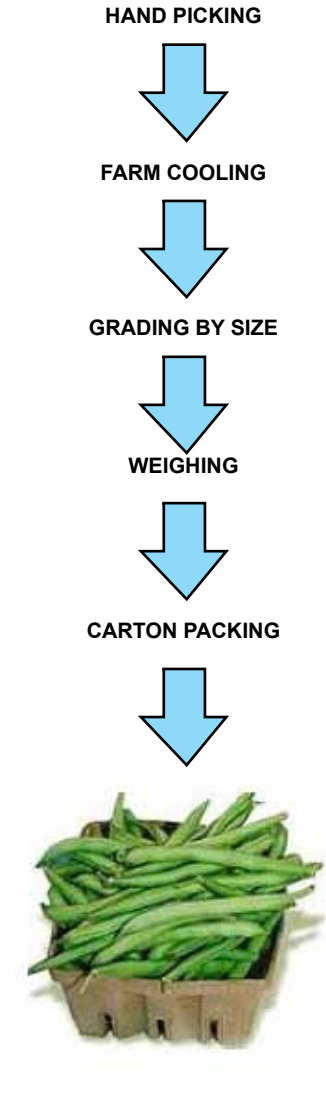

Plate 2. Picture of carton packaging.

Drying snap beans

Dried vegetables and fruits provide convenient and delicious additions to family meals. They can be used alone, in combination with other foods, or to add flavour. Most users require that the food be rehydrated before use, usually referred to as "refreshing".

Refreshing is done by soaking or cooking (or a combination of both) the dried food in water until the desired volume is restored. The amount of water and the length of time needed to refresh a cup of dried fruit or vegetable varies with the type of food. For snap

beans, Willenberg (2003) indicates: to 1 cup dried beans, green snap, add 21/2 cups of water and soak for a minimum of 1 hour. If properly pre-treated with steam or water blanching before drying, vegetables need a minimum of "refreshing" treatment. After soaking, they are simmered until tender, and excess water is allowed to evaporate. If dried vegetables are added to boiling water, it takes less time to refresh. Dehydrated vegetables are best used as ingredients for soups, casseroles, sauces and stews. However, they may be served alone with butter, cheese sauce or herbs added to enhance flavour. Dried vegetables that have been refreshed take less time to cook than fresh vegetables. Vegetables should be simmered to the desired degree of firmness.

Freezing green snap beans

The easiest way to freeze snap beans is to freeze young tender beans that have been water blanched for 3 minutes. Blanching stops enzyme action that continues the ripening process which can make the beans tough even when frozen. After blanching, beans need to be plunged in cold water to cool, drained thoroughly and packaged leaving a 2-inch head space. The individual quick freezing method of placing the beans on a tray to freeze before packing them is the best approach. This makes it easier to take the amount needed from the package and the beans cook more quickly because there is no large mass that has to thaw before the centre can cook.

Canning green beans

Some people prefer the taste of canned green beans. Cut snap beans into 1-inch pieces or leave whole.

Beans may be hot or raw packed. To hot pack, cover beans with boiling water and boil for 5 minutes before packing into hot jars, leaving a 1-inch head space. If desired, add l teaspoon of salt per pint. Fill jars with boiling hot cooking liquid to within 1-inch from the top of the jar. To raw pack green beans, pack the beans tightly into hot jars, leaving a 1-inch head space. Add salt, if desired, and fill jar to 1-inch from the top with boiling water. Remove air bubbles. Wipe jar rims. Adjust lids and process in a pressure canner at 10 pounds for a weighted gauge or 11 pounds for a dial gauge canner. Process in a 1 litre pot for 50 minutes.

Conclusion

Snap beans are tender, warm season vegetables that rank second in popularity to tomatoes in most home gardens in Rwanda. They are classified by growth habit, use and type. They were formerly called string beans because of the fibre along the top and bottom of the pods. Plant breeders have reduced the presence of these fibres, and green beans are now called snap beans (also referred to as green beans or French beans). Adding value to highly perishable food products such as snap beans is inevitable. Snap beans are processed to avoid post-harvest losses, to ensure availability during off season, to increase consumption and to generate income. Currently, most of the snap beans are grown in open fields and depend on weather conditions.

Consumption of fresh snap beans has been on the rise over the past few decades. Most of the fresh snap beans are currently bought at supermarkets and consumed at home. When buying fresh snap beans, the consumer looks for product attributes such as firmness, colour and crispiness or whether it snaps when broken. Snap beans can be served in several ways: as a main dish, a side vegetable, in casseroles and soups, in salads with other vegetables, or in blends and mixes with other foods. Convenience is the other market driver that determines the future market growth of fresh snap beans. Consumers are increasingly willing to buy pre-prepared, pre-washed or pre-packaged vegetables and salads so that preparation time is reduced at home. Fresh market snap bean growers who can develop new packaging methods that enable the product to keep fresh for several, days and make it easier for the consumer to buy, transport and prepare food within the shortest possible time will have better success in the fresh snap bean market.

Fresh snap beans are priced on daily spot markets while most of the processed snap beans are sold under contract between growers and processors. Price variations for fresh snap beans affect growers from developing countries. In this regard, product innovation is a key area that needs special focus in order to expand the market for snap beans. Adding or blending snap beans with other healthy food products will increase the market potential for snap bean growers and processors.

The quality of the product is also important in marketing snap beans. In terms of marketing channels, fresh snap bean producers can use different market outlets to sell their products. Small-scale producers can use farm and roadside stands, customer-harvesting operations or small specialty food retail shops to sell their products. Medium-size and large producers can sell their products through wholesale markets and processors, food service outlets or supermarkets. Growers and processors who can work with institutional food service providers such as schools and hospitals can increase their sales. As is the case with some other vegetables, to date, snap bean producers and processors have had little success in expanding their market share through the fast-food restaurant channel. Overall, growth in consumer interest in healthy lifestyles and foods, product development

and packaging innovations will support future growth in the fresh snap bean market. However, with the shift towards the consumption of fresh snap beans, market growth for processed snap beans will be limited.

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Status and challenges of snap beans value addition and marketing in Tanzania— A brief review

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Abstract

Snap beans (*Phaseolus vulgaris* L.) are produced in some areas in Tanzania and are mainly exported to European markets. Only a small proportion is consumed in the domestic market although the beans were introduced in the country by the first missionaries and explorers. Most popular varieties include Amy, Monel, Alexandra, Teresa and Samantha. Snap beans are consumed sparingly most probably because a substantial segment of the population has never accepted them as part of African dish. Beans have always been perceived as grains in the African context rather than as vegetables. Customers are mainly hoteliers, foreigners, caterers in institutions, conferences, and in various occasions such as weddings. To add value and promote domestic consumption of snap beans, creating awareness is crucial. Several recipes with nutritional and or medicinal benefits may help to spread the message. Large- and medium-scale commercial farms are located in Arusha and Moshi/West Kilimanjaro; small-scale producers are found in Mbeya, Morogoro, Tanga and Iringa regions. The window for value addition with regard to processing before export is minimal as most consumers prefer fresh snap bean deliveries. Steaming the snap beans and canning them and freeze-drying might be options for value addition although it might prove too expensive.

Introduction

Snap bean (or French bean) is a strain of the common bean *Phaseolus vulgaris* L. and is grown in a few places in Tanzania by large-scale and medium-scale commercial farmers for export and mainly as income generation for small-scale farmers. It is a fairly a new crop in Tanzania although it was introduced in some locations as far back as in the 18th century by European missionaries and early travellers. These locations are Arusha, West Kilimanjaro, Tanga (Lushoto District), Morogoro (Mgeta area, Uluguru Mountains), and Iringa and Mbeya (southern Tanzania). Alongside snap beans, crops such as cabbages, cauliflower, apples, peaches and plums were introduced in these areas (Temu and Temu 2006). This is why, to date, most of these fruits and vegetables are still produced in these areas which are the sole sources of supply in national urban markets, especially Dar es Salaam. While the other vegetables and fruits have become very popular in most

communities, snap beans have not. Most Tanzanians understand and perceive beans as grains that are produced and harvested in either fresh or dried form before consumption. The tender bean leaves are a popular green relish in most ethnic communities that produce beans. The green pods are, however, not popular to many.

Snap beans are slowly gaining importance in the socio-economic systems of East and Central Africa (ECA), especially Kenya, Rwanda, Burundi and Democratic Republic of Congo (Minot and Ngigi 2000). It is envisaged as a crop with great potential for addressing food insecurity and improving income and alleviating poverty in the region. The crop ranks first among export horticultural crops in Kenya. For example, Xinshen et al. (2003), reports that smallholders produce 60% of the exported vegetables and fruits in ECA. Other ECA countries with increasing production of snap beans are Uganda, Tanzania and Rwanda; in most of these areas production is dominated by rural small-scale farmers sub-contracted by large commercial farmers (Hallam, et al. 2004).

At regional urban markets in Tanzania, most of the people who purchase snap beans are hoteliers, caterers for various occasions like weddings, workshops conferences and the like, and non-Africans (Hallam 2004). While snap beans are still gaining pace in Africa, in America and Europe the fresh market snap bean output began to rise in the early 1940s. Spurred by strong demand, fresh market snap bean production in 1998–2000 was 90% higher than in 1988–1990 (Bill 2004).

Tanzania has three categories of producers of snap beans: small-scale outgrowers, medium-scale farmers and large-scale farmers who are mainly exporters. Gomba Estate Limited and Serengeti Fresh are the main exporters. They sub-contract small-scale farmers, provide seed and other inputs, inspect the crop, collect produce, finalise grading, pack and export the snap beans. The most popular snap bean varieties produced in Tanzania include Amy and Monel; others include Alexandra, Teresa and Samantha. Exports in the last 8 years reached over 4,000 metric tons.

The challenges faced by the snap bean sub-sector in Tanzania

Although snap bean is becoming one of the export crops in Tanzania, small-scale farmers who are many and could supply a large chunk of beans to the market face several challenges and stringent standards in the international market (Temu and Temu 2006). This calls for farmers' capacity building to adhere to stipulated specifications in the whole spectrum from production to marketing:

Production challenges

During production a relatively heavy capital injection is required in order to meet high cost of various inputs. The production challenges the farmers face are:

- Currently, seeds are purchased at high cost from commercial seed companies, thus narrowing net income returns to the farmers.

- Chemicals for prevention and control of pests (Bujulu et al. 1986) are required as snap beans are prone to many diseases such as rust, common bacterial blight and angular leaf spot. Insect pests such as leafhoppers, mites, bean stem maggots, foliage beetles, flower thrips, pollen beetles, pod borers, pod bugs and snap suckers such as aphids (Abate and Ampofo 1996) also inflict significant damage and thus yield loss.
- The snap beans require stable, adequate and consistent water supply, made available through irrigation.
- The crop has high fertiliser requirements and fertiliser prices rise every year.
- Growing snap beans is labour intensive and hence expensive: in some areas hiring labour and, in this case skilled personnel who have some know-how of snap bean husbandry, is difficult and, if available, they are expensive.

All these production challenges have an implication on the expected quality of the beans and hence in the marketing chain as every kilogram of snap bean sold, apart from covering the cost incurred, has also to meet the set standard.

Post-harvest processing challenges

Post-harvest processing and handling to meet quality requirements especially on:

- Residual chemicals on products is an issue that is beyond the farmers reach.
- Timing of harvest needs adequate skills and long term experiences.
- Handling to deliver quality product that is acceptable in the market.
- Acceptable packaging material to protect the beans from damage in order to reach the final destination in stable condition.
- Some stakeholders are too "protective", they are unwell to share information.
- Transportation to markets is not as reliable as required.

Marketing challenges

- Efficiency of the marketing systems for the local consumption and export requires:
- Sufficient quantities for export.
- Reliable and efficient freight options for timely delivery such as air freight although it is expensive. For consignments that are destined for Europe and other areas air freight is the only option; for in-country markets options are wider in that buses and trucks are used.
- Adhering to laid down standards, as there is always stiff competition from other producing countries on the international market.

- Production schedules synchronised with market requirements in Europe since the beans are primarily for export to Britain, Belgium and the Netherlands.

Large- and medium-scale commercial producers are faced with similar or even more challenges. However, their capacity for resilience is relatively high as their operation capital is comparatively high.

Window for value addition

The window for value addition with regard to processing before export is minimal, as most consumers prefer fresh bean deliveries. Alternative value addition options are:

- Familiarise people with snap beans by mounting aggressive promotions, especially with recipes that many consumers are known to like. This can be achieved by documenting how communities that consume snap beans prepare them.
- Developing new recipes including their nutritional benefits and possibly medical benefits. This might stimulate domestic consumption and hence the snap bean market.
- Adhere to laid down standard packages in order to win the market.
- Steaming the beans and canning them, although this will require building a processing factory. This may be a long-term plan.
- Freeze-drying the snap beans. The method is good though it might require heavy capital investment and hence might be too expensive. This option does not demand quick and timely delivery and therefore may be the best one for small-scale farmers.

Conclusion

Most people in Tanzania are not used to snap beans as they are a "non-African dish. To them beans are grains and have to be shelled before consumption. To encourage consumption of snap beans at household level, stimulating the domestic market by promoting snap bean recipes is required. This can be done by advertising and preparing leaflets giving nutritional, economic and possibly medical advantages and by developing recipes that will help popularise snap bean consumption.

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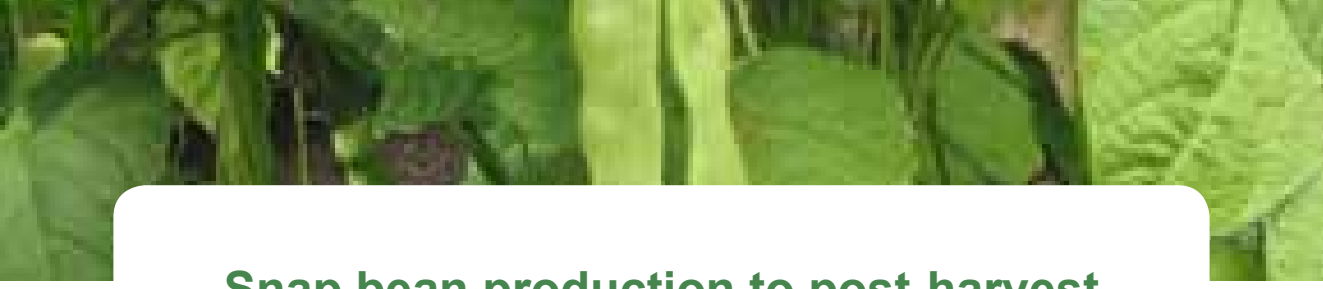

Snap bean production to post-harvest practices and constraints: A case study in Kirinyaga and Machakos districts, Kenya

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Abstract

Snap bean (*Phaseolus vulgaris* L.) is a crop with great potential for addressing food insecurity, income generation and poverty alleviation in the East and Central African region. In Kenya, the crop ranks first among vegetables produced for the export market. A baseline study was undertaken to identify and document production to post-harvest practices and key constraints in the snap bean value chain in Kenya, as part of a regional initiative to enhance competitiveness of snap beans for domestic and export markets in the East and Central African region. The baseline survey was conducted in four major snap bean production areas in Kirinyaga and Machakos districts of Kenya and targeted snap bean farmers and other key players in the snap bean value chain. The purposively random sampling technique was used to sample respondents who were interviewed using structured questionnaires specific to target group. Information collected included background, snap bean production practices, gender profiles, post-harvest practices, utilisation, marketing, exporter practices and processing. Data were analysed using SPSS program. Snap bean was the main horticultural crop grown in the target areas with a staggered intensive schedule of 3–10 cycles per year. Average total farm size across the target areas ranged between 2 and 5 acres defining snap bean production as a prerogative mainly for small-scale farmers. The most commonly grown varieties were Monel in earlier years, later replaced by other varieties like Amy, Samantha, Paulista, Julia, Teresa and Alexandra for either fresh market or processing. Over 70% of the farmers in all the target areas were aware and adhered to the recommended crop and pest management practices. Over 90% of the snap bean farmers interviewed were affiliated to groups contracted by major exporters and were at various levels of compliance to EUREPGAP (GLOBALGAP) with 10% of the groups in the process of receiving certification. Post-harvest loss at farm level during sorting and grading ranged between 1% and 20% attributed to overgrown pods, pest, disease and physical damage or physiological defects. Processing losses were estimated at 25%. Local consumption of snap beans was minimal. Critical points for research intervention identified included training and sensitising farmers on farm-level post-harvest handling practices and adherence to set regulations, development of locally adapted varieties with acceptable post-harvest characteristics for fresh export or processing market and promotion of snap bean utilisation locally.

Introduction

Snap beans, *Phaseolus vulgaris* L., are important in the socio-economic farming systems of East and Central Africa (ECA) and notably so in Kenya. The crop has great potential for addressing food insecurity, income generation and poverty alleviation in the region (Ugen et al. 2005). In Kenya, the crop ranks first among vegetables produced for the export market and accounts for an average of 18% value of total horticultural exports (HCDA 2006). In 2007 6358 of land ha were under snap beans and 63,580 metric tons valued at KES 1.9 billion were produced and marketed to various destinations (Ministry of Agriculture 2007). Other ECA countries with an increasing potential for snap bean production are Uganda, Tanzania and Rwanda (Ugen et al. 2009). Snap bean production is dominated by rural small-scale farmers, especially women and the youth and this forms a major source of their income. Some of the major snap bean production areas in Kenya are located in Kirinyaga and Machakos districts of Kenya (KARI 2005). Compared to dry beans, snap beans have a high market value, mature much earlier and have a longer harvest duration (Ugen et al. 2005). They require less energy to cook since they are consumed as vegetables and are rich in vitamins, minerals and dietary fibre.

Promotion of snap bean production and supplying snap beans with quality characteristics demanded by target markets is vital to increasing consumption and export value (Ndegwa et al. 1999; Muchui et al. 2006; Ndegwa et al. 2008; Kimani et al. 2009;). Prevalent constraints need to be identified to provide a basis for appropriate interventions. A baseline study was undertaken to partially address the objectives of a broader regional project under the auspices of the Association for Strengthening Research in Eastern and Central Africa (ASARECA) geared towards enhancing the competitiveness of snap beans for domestic and export markets in the ECA region. The specific objective for the in-country study was to identify and document production practices and key constraints to snap bean production in Kenya with particular emphasis on post-harvest aspects to provide a basis for research intervention.

Materials and methods

Site selection

A baseline survey was conducted from May to August 2006, in four major snap bean production areas in Kirinyaga and Machakos districts of Kenya. The specific areas were Mwea Irrigation Scheme, Kibirigwi Irrigation Scheme, Baricho catchment and Yatta Furrow Irrigation Scheme. The survey was conducted by a multidisciplinary team comprising an agronomist, a socio-economist, a post-harvest/food scientist, a technical officer and extension agents.

Sampling

In each area, farm households were stratified as snap bean producers and non-producers. Samples of 25 to 28 farmers were randomly selected from the stratum of snap bean producers, resulting in a total sample size of 81 farmers. In addition, information was collected from farmer groups, especially in cases where they had collective marketing. The survey also targeted other key players in the snap bean value chain (exporters, processors, affiliated institutions) as key sources of additional pertinent information. Interviewees included Njoro Canners, HCDA-Nairobi Depot, Inter Veg Company Ltd., Ukulima E.A. Ltd., Tuna Horticultural Produce and Products Ltd., Vegpro Ltd., Frigoken Ltd. and Mboga Tu Ltd. A structured questionnaire specific to each category of respondents, was used to collect data from the households (farmers), farmer groups, fresh market exporters and processors.

Data collection and analysis

Information was collected on area and farmer/institution background, snap bean production practices, post-harvest practices, utilisation, marketing and gender profiles, exporter practices and processing. Baseline information generated was summarised using appropriate descriptive statistics which included frequencies and averages for pooled sample and for different groups related to variables of interest. Data was compiled and analysed using SPSS program.

Results and discussion

Background information

The general characteristics of the study area are presented in Table 1.

In all three target areas, snap bean farmers were located in close proximity (within a distance of up to 3 km) to an "all weather road" This was important for access to markets since farmers relied on the exporters to pick produce at strategic collection centres in their vicinity. Poor road infrastructure usually impedes opening up otherwise highly potential areas for snap bean production which cannot be easily accessed by exporters. Distance to the nearest market was also within a range convenient for farmers to access inputs from stockists. Average total farm size across target areas ranged between 2 and 5 acres which confirms the basis for defining snap bean production as a prerogative mainly for small-scale farmers. Farmers described the area allocated to snap beans in terms of quantity of seed per planting. Small units were planted at established intervals to maintain continuous production as per market requirements. The number of such crop cycles per year ranged from 3–10 which is descriptive of a highly intensive production system.

Table 1. General characteristics of study area

Characteristic	Mwea			Ndia			Yatta		
	Mean	Mode	STD	Mean	Mode	STD	Mean	Mode	STD
Distance from farm to all weather road (km)	2.58	0.5	2.61	1.62	0.50	2.25	2.86	3.00	1.69
Distance from farm to nearest market (km)	3.32	4	2.66	1.8	1.00	2.05	3.35	3.00	2.03
Distance from farm to nearest agricultural extension office (km)	5.88	10	3.04	1.57	1.00	1.67	8.05	5.00	7.58
Total farm size in acres	3.0	1	2.22	2.11	0.50	1.86	4.17	5.00	1.79
Kg of snap beans grown	7.34	10	3.58	3.73	2.00	4.39	11.39	12.00	5.14
Number of crop cycles per year	10.53	4	10.25	4.55	3.00	2.70	6.61	3.00	7.74

Horticultural crops grown in target areas

The main horticultural crop grown in the target areas was snap beans. Other horticultural crops grown either in rotation, relay or alley cropping with snap beans were tomato, kales, cabbage, baby corn, passion fruit, bananas, capsicum, pumpkins, and Asian vegetables (karella, tindori and okra) specifically in Yatta. Some of the farmers, especially in the Mwea area, leased additional land ranging from 1–3 acres to grow snap beans (Figure 1).

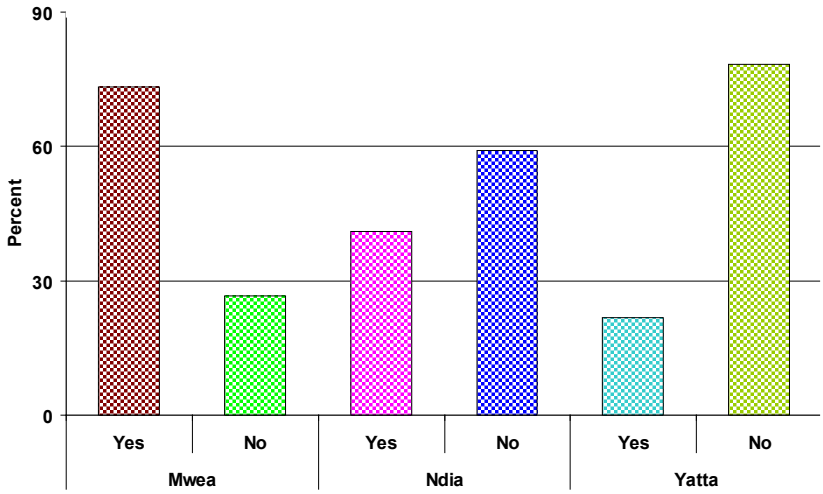

Figure 1. Per cent of snap bean farmers who leased land.

Characteristics of respondents

Education level

On average, Yatta Division of Machakos District had the highest percentage of respondents that had passed through the formal educational system up to secondary or tertiary level compared with Mwea and Ndia divisions of Kirinyaga District. Mwea Division had the highest percentage of respondents who had informal education or no form of education (Figure 2). The overall indication was that the snap bean enterprise was an attractive option for school leavers who were unable to secure formal employment in other sectors.

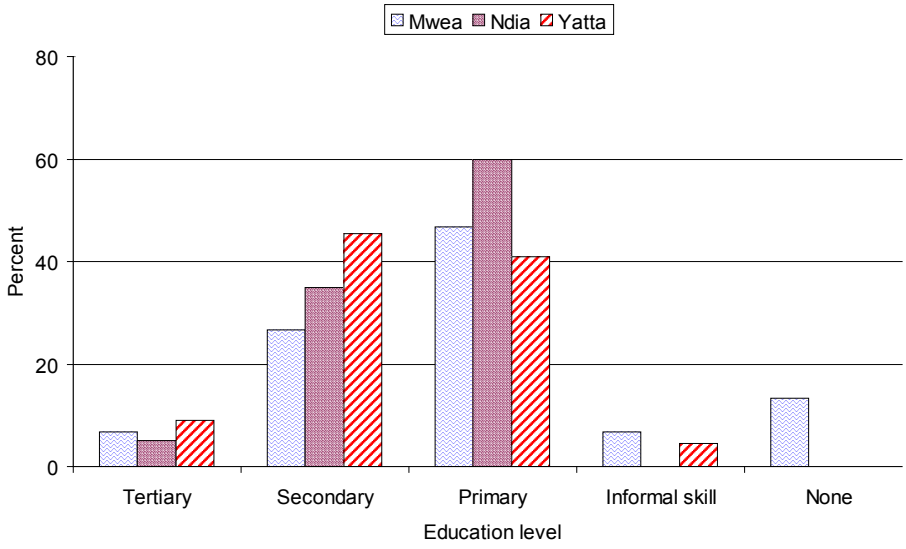

Figure 2. Education level of respondents in target snap bean production areas.

Crop production profile

Farmers interviewed started to produce snap beans in the mid1970s to the early 1980s. The most commonly grown variety then was Monel, but in later years was replaced by other varieties like Amy, Samantha, Paulista, Julia, Teresa and, the latest introduction, Alexandra. The varieties were grown either for fresh market or processing (Table 2).

Over 70% of the farmers in all the target areas were aware of the recommended crop and pest management practices and adherence to these was noted with some exceptions. Some farmers made modifications, especially on spacing and fertiliser application methods to accommodate prevalent circumstances like opening planting furrows with ox-drawn implements and furrow irrigation mode in Mwea.

Table 2. Major snap bean varieties grown and uses

Variety	Grade	Uses
Samantha	Extra fine	Fresh export
Amy	Extra fine	Fresh export
Teresa	Extra fine, fine	Fresh export, processing
Paulista	Extra fine	Fresh export
Alexandra	Fine	Processing
Julia	Fine	Processing

Post-harvest practices on farm

Over 90% of the snap bean farmers interviewed were affiliated to groups (community based organisations), or contracted by major exporters or both). The farmers were conversant with EUREPGAP requirements for post-harvest handling of the produce. They were at various levels of compliance with10% of the groups in the process of receiving certification. In some areas, farmers did not strictly adhere to the regulations. Groups had constructed holding/packing sheds that were utilised communally by members (Plate 1). The facilities varied in quality across the sites, but were equipped with basic requirements like charcoal coolers (Plate 2), washroom, farm input store, soak-pits and records office)

Plate 1. Sorting, weighing and packing/re-packaging snap beans for export in Mwea.

Plate 2. Charcoal cooler on farm in Yatta.

Post-harvest losses at farm level during sorting and grading were in the range of 1–20%, and were attributed to overgrown pods, pests, disease and physical damage or physiological defects. A majority of the farmers (over 80%) reported less than 5% post-harvest loss due to the factors in Table 3.

Table 3. Snap bean post-harvest losses in major production areas in Kenya

Per cent loss	**Causes of post-harvest loss**			
	Size (%)	**Pest damage (%)**	**Physical damage (%)**	**Other causes (%)**
Less than 5%	80	86.7	80	100
5–20%	10	14.3	20	-
More than 20%	10	-	-	-

Post-harvest practices off farm

Pack house losses incurred by the exporters were estimated at 10–20%. All the exporters interviewed sourced their produce from their contracted growers and most of the smaller export companies utilised the HCDA horticultural produce pack house depot which was fully equipped with cold chain facilities. The big export companies, e.g. Vegpro Ltd. had their own refrigerated trucks for transporting produce from the farms and pack house with cold chain facilities. Packaging and grading for fresh export was determined by client demand and ranged from loose packs in corrugated fibreboard cartons to ready to prepare or cook pre-packs in various grade (extra-fine, fine and bobby) and weight categories. The exporters were compliant to set standards (e.g. EUREPGAP, TESCO and BRC) and specific packaging and labelling requirements, as determined by their respective clients mainly from EU countries (France, UK, Germany, the Netherlands and Belgium). Critical factors for processing were pod size (length 8–12 cm and width 5.5–6.5 mm), low fibre content, and absence of curvature, disease/insect pest infestation symptoms and foreign matter. Processing losses were estimated at 25%. Processors interviewed were compliant to international good manufacturing practices (GAP) and quality standards, e.g. Hazard Analysis and Critical Control Points (HACCP), ISO-2000.

Marketing

Mwea area had no distinct peak season since production was throughout the year. However, some farmers only produced snap beans during certain months of the year, e.g. January–June, April–September or July–December. The farmers sold their beans twice a week (46.7%), 40% sold three times a week and the rest once per week. Sale was mainly to exporters and processors with 14.2% selling to brokers or agents. The buyers demanded specific varieties, grades, hygiene observance, and compliance to EUREP GAP requirements. Up to 50% of the farmers were paid fortnightly and 28.6% had contractual agreements with the exporters or processors. Prices across areas ranged from KSh 15 per (USD 0.19) kg in the low season to close to KSh 105 (USD 1.31) per kg in the peak season. Generally prices were higher in Yatta than in Mwea and Ndia (Table 4). Reasons for price fluctuations included forces of demand and supply, export company decisions, poor quality of beans and competition between exporters. Majority of the respondents (93.3%) did not sell the beans in the local rural markets since there was no ready demand for the beans. In addition, 45.5% of the farmers were organised in groups bound by regulations forbidding sale in the local market. Others had contracts with companies that did not permit sale of their produce outside the contract. Snap beans were also considered highly perishable and therefore not convenient for sale in local markets.

Table 4. Average snap bean farm gate price (KSh per kg), 2000–2006

Year	Average lowest price (KES/kg)			Average highest price (KES/kg)		
	Mwea	Ndia	Yatta	Mwea	Ndia	Yatta
2000	19	23	20	41	54	60
2001	18	15	35	37	31	40
2002	25	16	35	34	57	40
2003	21	18	50	31	33	60
2004	29	17	53	39	47	87
2005	25	25	72	42	50	104
2006	22	19	57	68	59	96

Table 4. Average snap bean farm gate price (USD per kg), 2000–2006

Year	Average lowest price (USD/kg)			Average highest price (USD/kg)		
	Mwea	Ndia	Yatta	Mwea	Ndia	Yatta
2000	0.24	0.29	0.25	0.51	0.68	0.75
2001	0.23	0.19	0.44	0.46	0.39	0.50
2002	0.31	0.20	0.44	0.43	0.71	0.50
2003	0.26	0.23	0.63	0.39	0.41	0.75
2004	0.36	0.21	0.66	0.49	0.59	1.09
2005	0.31	0.31	0.90	0.53	0.63	1.30
2006	0.28	0.24	0.71	0.85	0.74	1.20

Marketing channels

The study found three distinct snap bean marketing channels: through brokers, directly to the processors or to the fresh market exporters (Figure 3). Similar observations were made by Muthoka et al. (2006).

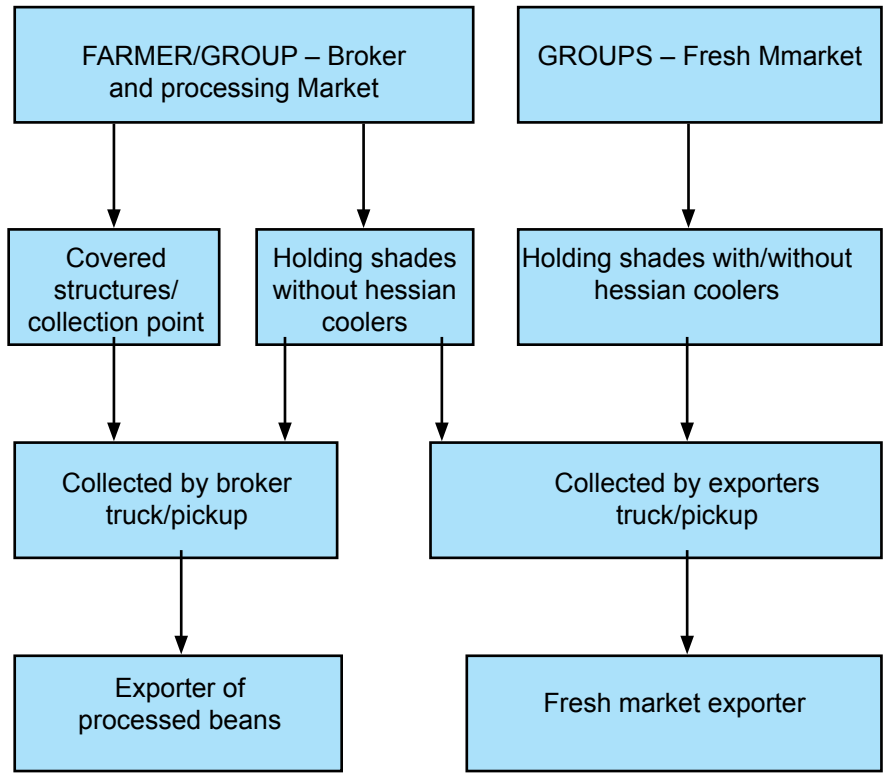

Figure 3. Snap bean marketing channels.

Gender issues in the snap bean value chain

Gender roles were apparent in the snap bean value chain. Activities that were manually demanding, e.g. land preparation, irrigation and spraying were dominated by males while females handled activities requiring precision like planting, picking pods, sorting, grading and packaging (Figure 4). These observations were in line with an earlier study by Ndung'u et al. (2004a, 2004b). There was generally equal participation by males and females in making decisions about snap bean production, but marketing logistics were male controlled. There was equal consultation between men and women on modalities of utilising the proceeds from the snap bean sales (Figure 5). The benefits were used to pay school fees, buy food provisions and clothing, fund homestead construction work while some farmers invested in different projects at the nearest shopping centres. At the pack houses, gender roles followed a similar pattern to field activities with men undertaking heavy duties like loading and off-loading and women dominating handling sorting, grading and quality control (Figure 6).

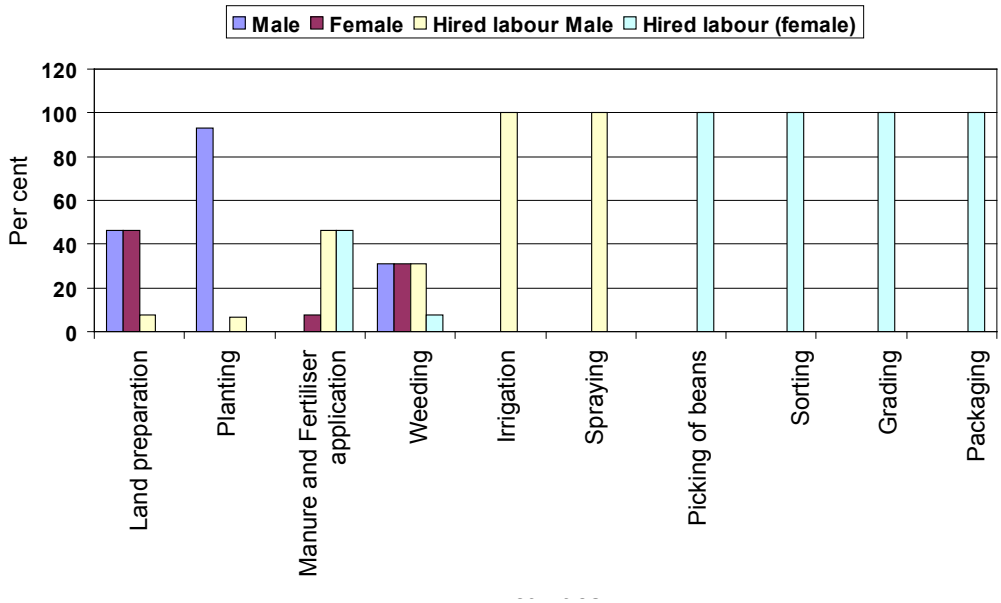

Figure 4. Gender roles in snap bean production and post-harvest handling.

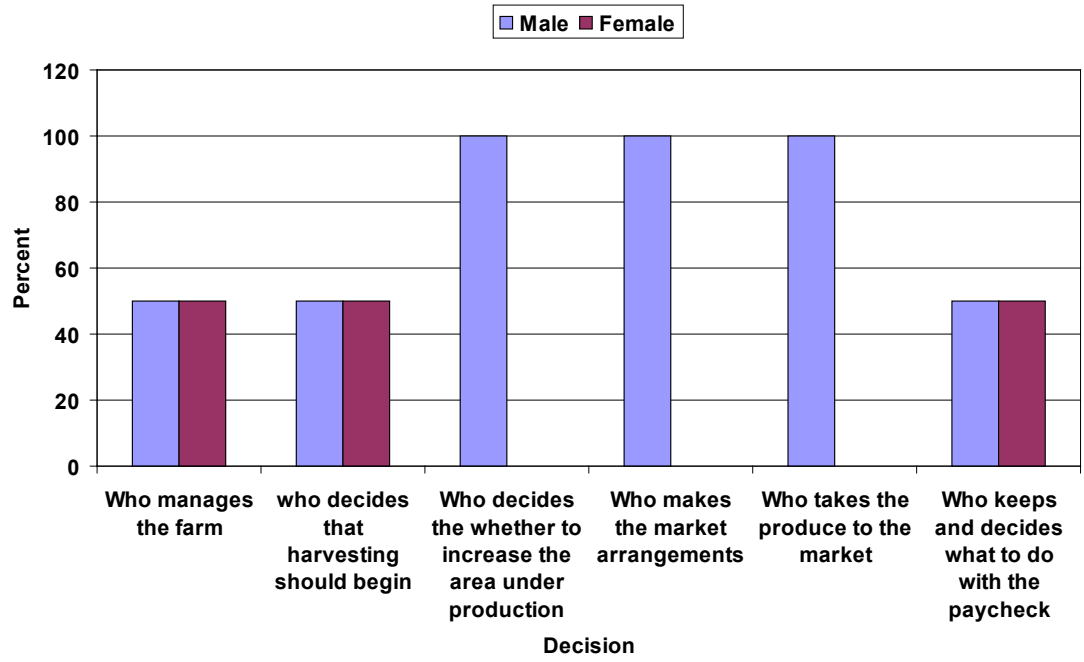

Figure 5. Access and control profile.

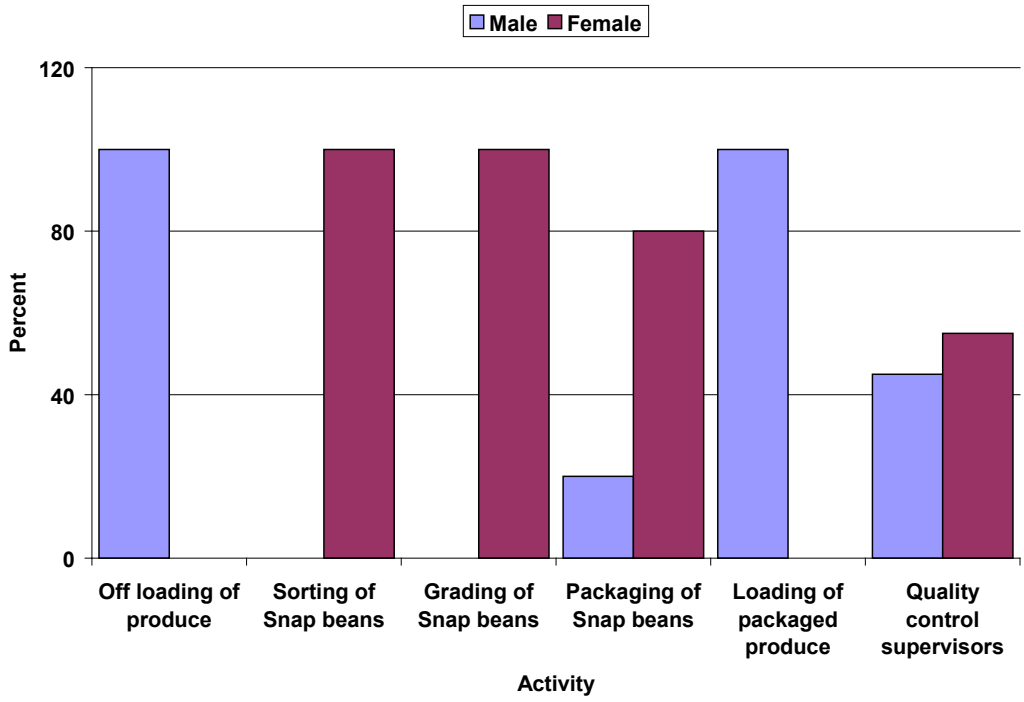

Figure 6. Gender roles at pack house level.

Snap bean utilisation

Half the respondents (up to 50%) consumed snap beans at least once a week with the rest eating them occasionally. However, the beans were not the preferred vegetable of choice for most (over 60%) of the respondents. Reasons given for this were tedious preparation methods and the need to add expensive condiments to the snap beans to prepare a tasty dish. The beans were boiled and then fried with tomatoes and onions or mixed with other ingredients in other dishes like rice, meat stew, and maize–dry bean mixture. Over 60% of the respondents did not know the nutritive value of snap beans. Close to 80% of the respondents reported that they would not buy snap beans in the market for home consumption since other vegetables options were available and more delicious. Snap beans that were not marketed were used as livestock feed by 70–95% of the respondents across the target areas.

Conclusion

Pre-harvest crop management and post-harvest handling both contribute to the quality of snap bean produce and products channelled to the market. Snap bean post-harvest losses account for a significant decline in marketable yield at farm level and along the marketing chain. The commodity is highly perishable and consequently, proper handling and preservation is crucial to maintain high quality of produce and products. The baseline

survey resulted in identification of critical points for research intervention which included: training and sensitising farmers in farm level post-harvest handling practices and adherence to set regulations to maintain product quality, development of locally adapted varieties with acceptable post-harvest characteristics for fresh and export market and promotion of snap bean utilisation locally.

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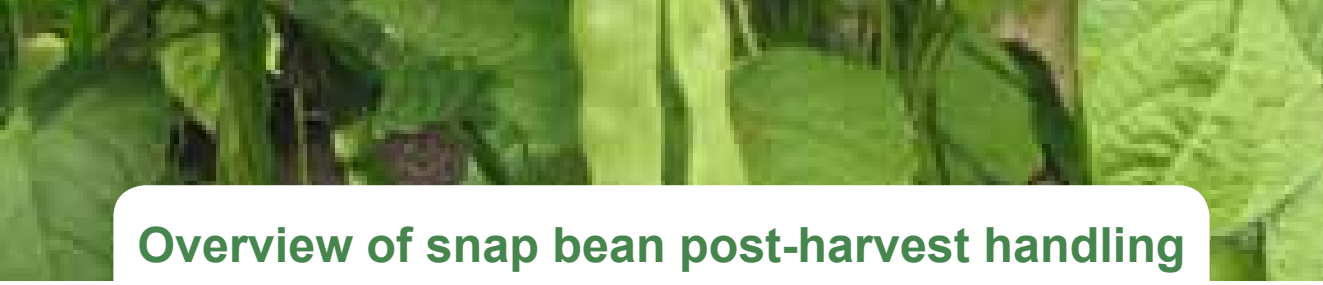
Ugen MA, Ndegwa AM, Nderitu JH, Musoni A, Ngulu F. (2009). Enhancing competitiveness of snap beans for domestic and export markets. ASARECA CGS Revised Full Proposal Document. ASARECA/ NARO/KARI/UON/ RAB/SARI.



Overview of snap bean post-harvest handling and product development in Uganda

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Introduction

Snap bean is a high value legume crop, produced worldwide. In East and Central Africa, the crop is fairly new, its target consumers are the upper class market in the urban setting and it is rarely consumed by rural farmer households. This has been attributed to many factors including lack of sufficient methods of preparation, lack of information on its nutritional benefits, its being an alien crop and sufficiency of other substitutes like common beans.

The green snap bean pod is consumed when it is young. It is known to be rich in different nutrients including vitamins A and C, folate, potassium, manganese and iron; it is also rich in dietary fibre. Furthermore, it matures quickly: snap bean pods can be harvested at 8–14 days after flowering. Even when the pods are harvested at the dark green tender age, the quality of the pods deteriorates with time. This is due to the physiological growing processes which actively continue. As a result, seeds develop and pods become yellow.

A survey conducted in 2006 in Uganda revealed that the snap bean post-harvest sub-sector was still very underdeveloped due to:

- Lack of appropriate processing and products development technologies for snap beans.
- Widespread low consumption of snap beans in rural areas.
- Lack of uniform quality snap beans suppliers.
- Limited knowledge on pre- and post-harvest handling of snap beans among farmers.
- Poor agricultural practices.
- High losses of snap beans due to pest infestations and diseases.
- Lack of appropriate storage facilities and techniques for harvested produce.
- Poor commodity value chain.
- Inadequate modes of transportation of harvested produce to the market: harvested produce is often delayed at the roadside awaiting collective transportation.

- Poor packaging facilities and techniques compounded by lack of cooling systems and knowledge.
- Poor hygiene in handling: handlers fail to wash their hands.

Together, these factors led to poor quality snap beans and lack of uniformity of the product.

Methodology

Studies were undertaken to:

1. Evaluate snap bean post-harvest constraints
   A survey was conducted using a questionnaire approach that involved obtaining information on general constraints and opportunities related to snap bean production, crop management, crop harvest and post-harvest handling practices.
2. Establish maturity indices of snap beans
   Snap beans were grown and subjected to varying harvest days, and other quality characteristics like snapping quality, pod filling, appearance, pod size, pod length, and pod shape subjectively examined to identify factors that determine the quality and edible standard of harvested snap beans.
3. Evaluate promising packaging, storage and processing technologies on snap beans
   Storage and packaging of harvested snap bean pods in Uganda is still a problem. Farmers store harvested produce in gunny bags by roadsides, in the scorching sun. Due to this, relevant packaging and storage technologies, including woven nettings, plastic crates, wooden crates, and other storage technologies like the grass thatched shelter were tested.
4. Develop recipes for snap beans

Research in product development was geared at processing a range of products based on existing local food recipes (household or hotel based). Recipes for fresh snap bean consumption have been developed and tested for acceptability at rural level by snap bean farmers.

Commonly, snap beans are consumed in fresh form after boiling, frying or steaming. Snap bean pods are perishable and it is therefore essential to process the pods to prolong their shelf life and diversify snap-bean based products. Therefore, in addition to the fresh-consumable products, shelf-stable products including pickles and canned beans should be developed.

Work progress

Maturity indices of snap beans

Studies have established harvest quality of snap beans is influenced by time of harvest and (harvest or) maturity indices. Maturity indices including pod size, pod length, pod filling (invisible seed), bulginess and days after flowering were found to be more important subjective measures in determining the harvest time of snap beans than stringiness, glossiness or shape of pod.

Recipes at farm level

Snap beans recipes were evaluated at farm level and the results were as shown in Figure 1. Vegetable and meat-based recipes for snap beans were overall acceptable to farmers. Apart from the green bean/okra recipe, all other recipes were generally liked for their appearance and taste.

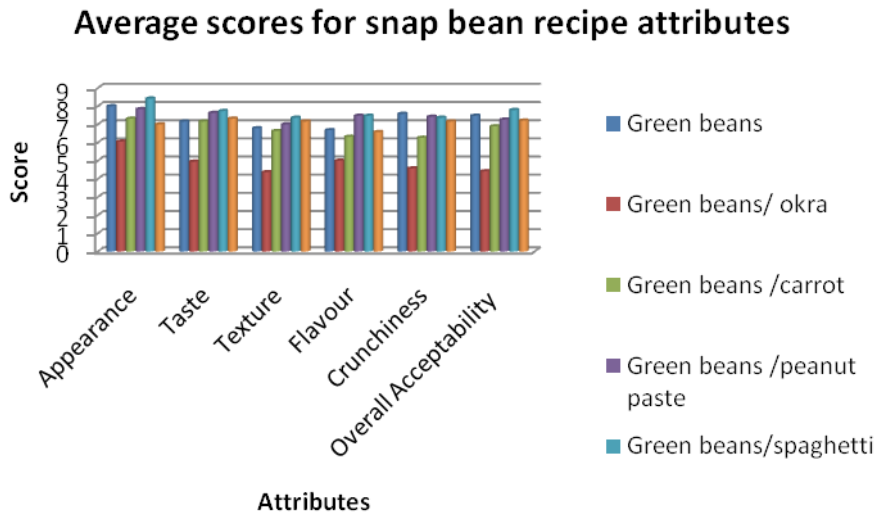


Figure 1. Snap beans recipe evaluation at farm level.

Future plans

Continue with the adaptive research on improved packaging options for snap beans (wooden crate, plastic crate and woven nettings).

Test and evaluate improved storage techniques for snap beans at rural level (charcoal cooler, grass thatched shelters etc.

Gaps

As a result of the constraints still faced by the snap bean post-harvest sub-sector immediate intervention are needed in areas like storage, processing, packaging and transportation. In order to achieve these it is deemed necessary to:

- Develop and adaptively test snap bean recipes at rural/farm household level.
- Adaptively test improved packaging technologies on snap beans (wooden crate, plastic crate and woven nettings/bagging).
- Adaptively test and evaluate improved storage technologies for snap beans (charcoal cooler and grass thatched shelter).

Challenges

Participatory research with farmers is beneficial because farmers give their opinions and make suggestions. In most cases the farmers help fill in the gaps of incomplete data. Unfortunately, this requires more frequent supervision, but the programme lacks the necessary logistics.

Challenges to and possible solutions for marketing snap beans

1. Lack of appropriate infrastructure leading to high post-harvest losses and deterioration of quality of produce.

2. Financial challenges—varying from government to government. These influence the following:
   a) Production capacity and meeting demand.
   b) Crop financing—cost of borrowing money from commercial banks is high and emphasis that the money is made cheap to ease availability.
   c) In Rwanda there is no strong private sector so government is backstopping the priority sectors. It also provides guaranteed funds to the sector, sensitising insurance companies to cover the agriculture sector. The sector is still in its infancy.

   Solution
   Equity bank has partnered with the Ministry of Agriculture in different countries and gives loans to the farmers which are offset against the crop schedule—crop life cycle. Uganda is revisiting the formation of cooperatives; these will be a viable venture in future.

3. Lack of capacity and skills to respond to opportunities and global competitiveness

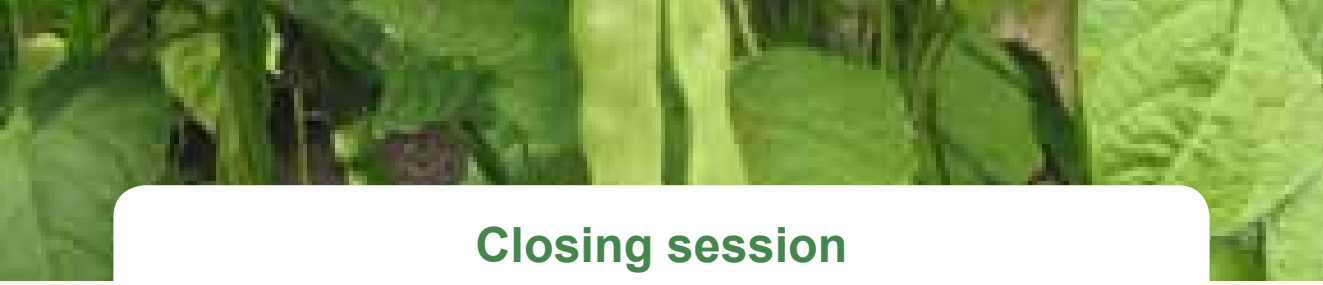
   Solution
   a) Need to develop an effective association of people involved in the value chain of snap beans—cohesion to include all partners from the four snap bean project countries (Uganda, Kenya, Rwanda, and Tanzania). Associations would be very vital in achieving this.
   b) Strengthen capacity building for the regulators in the different countries.
   c) Cultivate a culture of doing things right in terms of quality standards for the local market.
   d) Change the way government institutions work particularly involving extension.

4. Subsistence mentality

   Solution
   a) Create awareness/avail as much information that the product can be sold/product feasibility study.
   b) Help SMEs overcome their fear about going into commercial business.
   c) Eliminate the mentality of looking at export agriculture as a business for rich people/mobilise the middle class that understands the business and the small-scale farmers become outgrowers.
   d) Attitude/mindset change.
   e) Lack of focus on priority enterprises. NOGAMU organises the group to specialise in one to two crops to obtain a large a quantity so as to attract buyers.
   f) Market segmentation.
   g) Strategies to adopt different requirements.
   h) Change the local standards.
   i) Global GAP, e.g. in Kenya they improved the transportation system for horticultural crops and phased out open trucks as a means of transport.
   j) Consumer empowerment.
   k) Supportive government policies
      - Seed policy.
      - Trade policy.
      - Germplasm exchange policy etc. to be revisited to favour trade.

5. Unstable markets and very long market chain.

6. Poor access to innovations and lack of value addition and post-harvest techniques.
7. Production challenges
    - High costs of inputs.
    - Pests and diseases.
    - Lack of export quality varieties.
8. Poor public and private sector interactions.
9. Lack of manpower in government ministries.



Closing session

Closing remarks

Dr Michael Ugen, the principal investigator of the snap bean project, thanked participants for their useful contributions and active participation. He expressed satisfaction with the fact that the objectives of the workshop had been achieved and requested the project members to send their full papers for publishing in the workshop proceedings document. Dr Ugen thanked ASARECA for funding the workshop. He elaborated that the project was supposed to organise the workshop, but had no budget. He also mentioned that Dr Mcharo, Manager, High Value Non-Staple Crops Programme (HVNSC), he was very receptive to the idea of holding the workshop. He concluded by urging participants to keep in touch with one another and requested Ms. Maureen Katafiire the programme assistant of HVNSCP to circulate the list with detailed contact information. Dr Ugen then wished everybody safe travel.

Manager, High Value Non-Staple Crops Programme

Dr Mcharo, on behalf of Dr Tukahirwa, thanked participants for honouring the invitation and for their productive participation during the workshop. He informed them that this was the first meeting HVNSCP was organising for stakeholders and expressed satisfaction that the workshop objectives had been achieved. The manager expressed gratitude to the stakeholders who made presentations for an excellent job done. He encouraged the scientists to publish their papers in the proceedings. He appreciated the efforts of Dr Michael Ugen and Ms Maureen Katafiire to make the workshop a success and of Ms Ruth Nankinga the administrative assistant of the programme for providing all the necessary logistics. Finally, he urged participants to continue communicating with the programme management and with one another and networking so as to strengthen the snap bean sector and wished them a safe journey back home. He then declared the workshop closed.

Appendix I: Workshop programme

The programme for Snap beans Stakeholders Consultative Workshop scheduled to take place in Imperial Resort Beach Hotel, Entebbe, 9–10 December 2009

Time	Activity	Person Responsible	Chair person
08/12/2009	**International Participants Arrival**	**Dr Michael Ugen and Ms Katafiire Maureen**	
Day 1: 09/12/2009			
08.00–08.30	Registration	Ruth and Maureen	-
08.30–08.50	Welcome and participants' introduction	Dr Michael A. Ugen	-
8.50–9.10	Opening remarks	Dr Michael A. Ugen	Ms Katafiire Maureen
09.10–9.35	Overview of ASARECA	Dr Seyfu Ketema	Dr Mwamburi Mcharo
9.35–9.50	Overview of ASARECA Non-Staple Crops Program	Dr Mwamburi Mcharo	Dr Michael A. Ugen
9.50–10.15	Presentation of workshop Objectives and Outputs	Dr Michael A. Ugen	Dr George N. Chemining'wa,
10.15–10.20	Group photograph	All	Ruth and Maureen
10.20–10.50	**TEA/COFFEE BREAK**	**ALL**	**HOST**
10.50–11.10	Project presentation – Objectives, Outputs and Activities	Dr Michael A. Ugen	Dr George N. Chemining'wa,
11.10–11.55	The progress report on snap beans variety breeding, Challenges and progress so far.	Mr Augustine Musooni/ Dr Musaana Sophie/Mr S. Kweka/ Dr George N. Chemining'wa	Dr George N. Chemining'wa
11.55–12.15	The role of National Seed Certification Services/DUS in snap bean production, export and seed trade and seed policy issues in the ECA region.	Ms Grace Akao	Dr George N. Chemining'wa

Time	Activity	Person Responsible	Chair person
12.15–12.35	Common Insect pests of snap beans in EA and their effect on snap beans export quality	Dr Michael H. Otim	Dr George N. Chemining'wa
12.35–1.30	Discussion	All	Dr George N. Chemining'wa
1.30–2.30	**LUNCH**	**ALL**	**HOST**
2.30–3.15	Common diseases of snap beans in EA and their effect on snap beans export quality	Dr Pamela Paparu /Mr. Festo Ngulu (Kweka)/ Dr. Sseruwagi	Mr S. Kweka
3.15–3.35	Role of MAAIF and EAC in regulation and use of Agrochemicals, currently banned agrochemicals for Export market (snap bean) and recommended botanicals, effects of MRLs on the produce for export market.	Mr Michael Odong	Mr S. Kweka
3.35–4.00	The role of Phytosanitary Services and GAP in the snap bean production, storage and transportation and their effect/impact on international trade within EA and overseas	Mrs Carol Murekezi	Mr S. Kweka
4.00–4.30	**TEA/COFFEE BREAK**	**ALL**	**HOST**
	Importance of Global GAP standards on snap beans trade	Ms Cate Nakatugga	Mrs Carol Murekezi
4.30–5.30	Discussion	All	Mr S. Kweka
05.30–7.00	COCKTAIL	ALL	HOST

Time	Activity	Person Responsible	Chair person
Day 2: 10/12/2009			
8.30 – 8.45			
8.45 – 9.15	Farmers Experiences in production, transportation and marketing of snap beans	Ms Jacqueline Mkindi/ Chantal/Maina	Mrs Carol Murekezi
9.15–10.00	The overview of snap beans product development in EA	Ms Hegwig, Dr Mamiro, Agnes and Hilda	Mrs Carol Murekezi
10.00–10.30	The role of "Commodity value addition Project" in enhancing domestic and international trade of fresh produce (Snap beans) and seeds	Dr Peter Ngategize	Mrs Carol Murekezi
10.30–11.00	**COFFEE/TEA BREAK**	**ALL**	**HOST**
11.00–11.30	The contribution of UIRI to commodity value addition, for enhancing domestic and international trade of fresh produce (Snap beans)	Mr Joseph Rubalema	Mr Augustine Musoni
11.30–12.00	Overview of UEPB and its role promotion of the export of snap beans. Possible international buyers.	Dr Paul Gitta	Mr Augustine Musoni
12.00–12.30	The overview of AMA and their role in the trade of Snap beans both domestic and international	Mr Fred Ssango	Mr Augustine Musoni

Time	Activity	Person Responsible	Chair person
12.30–1.00	Overview of NOGAMU and its role promotion of the domestic and international export of snap beans. The organic products recommended for use in OA within EA	Mr Charity Namuwooza	Mr Augustine Musoni
1.00–1.30	Discussion	All	Mr Augustine Musoni
01.30–2.30	**LUNCH BREAK**	**All**	**HOST**
02.30–3.30	Individual Group Discussion on problems and possible solutions	Production, transportation, storage and marketing	Mr Kweka/Mr Musoni/ Dr Chemining'wa/ Hilda
03.30– 4.30	Way Forward	Presentation by group leaders	Dr Ugen Micheal
04.30–05.00	COFFEE/TEA BREAK	ALL	HOST
5.00–05.30	Closing Remark	Dr Mwamburi Mcharo	Ms Katafiire
Day 3: 10/12/2009	**Departure**	**All**	**HOST**

Appendix II: List of stakeholders to the Snap Beans Workshop 9–10 December 2009

Name	Position	Contact
Dr Seyfu Ketema	Executive Director ASARECA	PO Box 765, Entebbe, UGANDA Tel: + 256 414 320 438 Fax: + 256 414 322 593 Cell Phone: +256 772 641 403 Email: s.ketema@asareca.org
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Dr Mcharo Mwamburi	Program Manager High Value and Non Staple Crops Programme ASARECA	PO Box 765, Entebbe, UGANDA Tel: + 256 414 322276 Fax: + 256 414 321777 Cell Phone: +254 735 298 623 0755 912 884 Email: m.mcharo@asareca.org
Dr Lydia Kimenye	Program Manager Upscaling and Knowledge Management Programme ASARECA	PO Box 765, Entebbe, UGANDA Tel: + 256 414 322594 Fax: + 256 414 322593 Cell Phone: +254 722 748 495 Email: l.kimenye@asareca.org
Dr Joseph Methu	Head Partnerships and Capacity Building Unit ASARECA	PO Box 765, Entebbe, UGANDA Tel: + 256 414 323314 Fax: + 256 414 322593 Cell Phone: + 254 722 765 809 Email j.methu@asareca.org

Name	Position	Contact
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Dr Fina Opio	Program Manager, Staple Crops Programme ASARECA	PO Box 765, Entebbe, UGANDA Tel: + 256 414 322 227 Fax: + 256 414 322593 Cell Phone: +256 772 423 907 Email: f.opio@asareca.org
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About ASARECA

The Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) is a non-political organisation of the national agricultural research institutes (NARIs) of 10 countries—Burundi, Democratic Republic of Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania and Uganda.

The ASARECA mission is to enhance regional collective action in agricultural research for development, extension and agricultural training and education to promote economic growth, fight poverty, eradicate hunger and enhance sustainable use of resources in Eastern and Central Africa.

ASARECA has seven programmes:

- Staple Crops Programme
- High Value Non-Staple Crops Programme
- Livestock and Fisheries Programme
- Agro-Biodiversity and Biotechnology Programme
- Natural Resource Management and Biodiversity Programme
- Policy Analysis and Advocacy Programme
- Knowledge Management and Up-Scaling Programme

Partnerships: Through ASARECA, agricultural scientists in the 10 countries work together and in partnership with farmers, extension, private sector, scientists of regional and international institutions and development partners to come up with new innovations that could lead to agricultural-led economic growth, poverty eradication and improved livelihoods.



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