THE ROLE OF UNIVERSITIES IN PROMOTING UNDERUTILIZED CROPS: THE CASE OF MASENO UNIVERSITY, KENYA

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The Role of Universities in Promoting Underutilized Crops: the Case of Maseno University, Kenya

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Abstract

The role of African indigenous vegetables (AIVs) in poverty alleviation and food and nutrition security in Kenya has not been fully exploited, even though these crops have several nutritive and agronomic advantages. AIVs have been generally neglected and are facing extinction, unless urgent measures are taken. As a result of this situation, the AIVs Research Working Group was formed at Maseno University in 1996 with the aim of promoting the production, utilization, and conservation of AIVs in Kenya. The activities undertaken so far include: major national, regional, and global multidisciplinary research projects funded by various agencies (e.g., Bioversity International, Swedish International Development Cooperation Agency through Lake Victoria Research Initiative (VicRes) and the International Foundation for Science, and the European Commission). Baseline and market surveys were undertaken through these initiatives and priority AIVs were identified. Also carried out were germplasm collection, evaluation, and multiplication. Development of AIVs seed support system at Maseno University was also established and 77 contact farmers have been trained and provided with AIVs seeds. Agronomic studies for these crops were also undertaken and seed production protocols developed. Capacity building at undergraduate and post-graduate levels, increase in students undertaking AIVs researches at undergraduate level from 20% in 2001 to 70% in 2006, establishment of University Botanic Garden in 2001 resulting in 20 AIVs conserved ex-situ, development of AIVs posters and leaflets for teaching, and organization of workshops, conferences and stakeholder meetings on underutilized food crops are all activities carried out by the University in order to promote the production and consumption of AIVS in Kenya. In conclusion, universities can play a vital role in promoting underutilized crops through research, capacity building, conservation, conferences, exhibitions, field days, and outreach programs.

INTRODUCTION

Food insecurity, manifested through malnutrition and poor health, has been an issue of concern in Kenya (GoK, 1999a). Sixty percent of the rural population live below the poverty line and yet regions along the Lake Victoria are endowed with agricultural diversity which includes AIVs (Schippers, 2002). AIVs refer to vegetables that grow naturally in Africa or that have Africa as their primary or secondary centre of origin (Schippers, 2002). Vegetables that have Africa as their secondary centre of origin may be refered to as African traditional vegetables (Schippers, 2002). Vegetables are vital components of human diet as they provide essential micronutrients that ensure proper development of the human body (Abukutsa-Onyango, 2007a). AIVs have been grown and utilized traditionally by many African communities and possess several advantages and potentials that have not been fully exploited (Schippers, 2002). AIVs have been reported to have high nutritional value, such that consumption of 100 g of the vegetables provides over 100% of the daily allowance of vitamins and minerals and 40% of the proteins (Onyango, 2003).

AIVs also possess medicinal properties and have agronomic advantages over the exotic species and allow the poorest people in the rural communities to earn a living

(Schippers, 2002). Despite the many advantages, farmers realize very low yields (1-3 tons/ha), far below the optimal levels that range from 20-40 tons/ha (Onyango, 2003). AIVs that have medicinal properties are usually bitter and have been known to heal stomach-related ailments according to Olembo et al. (1995). There had been no sustainable production of the vegetables due to neglect and lack of quality seed and appropriate production technologies, leading to low production and poor distribution. Increased and sustainable production and utilization of AIVs can be attained by ensuring supply of quality seed and development of environment-friendly production and utilization technologies. Improved production technologies like spacing, fertilizer rates, and use of organic sources of manure will lead to increased yields and improved nutrition and economic empowerment of the rural communities in Kenya and other parts of Africa, and in urban and periurban regions. It was as a result of the above advantages and value of AIVs, and the constraints that curtail its optimal production and utilization, that AIVs research program was initiated at Maseno University in 1996 with the aim of promoting the production utilization and conservation of AIVs in Kenya.

METHODOLOGY

Maseno University is the youngest University in Kenya which was established through an Act of Parliament with a vision "to be a leading institution and centre of excellence in university teaching, outreach, research and development." The African Indigenous Vegetable Programme, though multidisciplinary in nature, was coordinated by the Department of Botany and Horticulture. Kenya currently has seven public universities and Maseno is one of the five universities that offer Bachelor of Science degree in Horticulture, with a declared capacity of 25 students.

A total of eight national, regional, and international research projects were undertaken between 1997 and 2007 on various aspects of AIVs. This was done by writing over 15 research proposals and sending them to funding agencies, with seven of these ultimately receiving funding.

To identify priority AIVs in Kenya and the region, a series of household, baseline, and market surveys have been carried out in various parts of Kenya. Various sampling methods were used including systematic, random, stratified, and purposive sampling schemes. The main tools used in the surveys were checklists and structured questionnaires. Key informants were also used to corroborate the information from the respondents. Through these surveys, preferred AIVs with nutritional and economic potential were identified and selected.

Germplasm collection of the selected priority AIVs was undertaken in eight districts in Western Kenya that included Kisumu, Siaya, Vihiga, Butere-Mumias, Kisii, and Nyamira, Homa Bay and Bondo districts. Collected seeds were subjected to laboratory analysis and field evaluation using Completely Randomised Design (CRD) and Completely Randomised Block Design (CRBD) experimental designs, respectively. Agronomic studies were conducted on organic and inorganic fertilizers, intercropping, and spacing, from which agronomic and seed production protocols were developed and repackaged.

Seed support systems for AIVs were established at Maseno University Botanic Garden in 2000 for the priority vegetables; community seed supply systems were also established in eight districts. At Maseno University Botanic Garden seed bulking, processing, and packaging were done. Seed production was carried out using organic fertilizer with no applied chemicals.

Capacity building in AIVs was achieved by restructuring undergraduate and postgraduate programs, such as the inclusion of AIVs as a topic in Bachelor of Science in Horticulture program in 2001 and as a course in the Master of Science program in 2002. Undergraduate research projects and Masters thesis projects on AIVs were also encouraged and supported. In situ and ex situ conservation of AIVs at Maseno University Botanic Garden and in farms with contact farmers in eight districts in Western Kenya began in 2001. AIVs technologies were promoted and disseminated to all stakeholders

from 2003 through demonstration plots, field days, workshops, research projects, media and students' projects, and theses.

Traditional recipes of AIVs in Western Kenya and their standardization were collected in 2002, while new recipes and nutritious products from AIVs were developed in 2007 by Masters students at Maseno University.

RESULTS AND DISCUSSIONS

Projects Undertaken at Maseno University on AIVs (1997-2007)

Table 1 shows eight projects funded between 1997 to 2007 on AIVs. Of the eight projects, six were funded by international organizations, one by the university, while one was self-funded. University funding has been wanting in most of the African universities and no funds are allocated for research (Akinkugbe and Kunene, 2001). Maseno University was only able to obtain money for this work through personal initiatives of the individual researchers and painstaking lobbying with funding agencies, without much involvement of the university management and authorities.

Priority AIVs with Nutritional and Economic Potential

Table 2 shows that the priority African Leafy Vegetables in Vihiga, Kisumu, and Kisii districts were: spiderplant (*Cleome gynandra*), vegetable nightshade (*Solanum villosum* and *Solanum scabrum*), pumpkin (*Cucurbita moschata*), vegetable cowpeas (*Vigna unguiculata*), vegetable amaranths (*Amaranthus blitum*), jute mallow (*Corchorus olitorius*), slenderleaf (*Crotalaria ochroleuca* and *Crotalaria brevidens*), and African kale (*Brassica carinata*), representing seven botanic families, namely Amaranthaceae, Brassicaceae, Capparaceae, Cucurbitaceae, Fabaceae, Solanaceae, and Tiliaceae.

The main AIVs grown in urban and peri-urban Nairobi and Kisumu cities were African nightshade, vegetable amaranths, vegetable cowpeas, spiderplant, pumpkin leaves, crotalaria, and jute mallow. A market survey revealed that the most important AIVs in the three markets in Western Kenya included cowpeas, leaf amaranth, African nightshade, jute mallow, spiderplant, slenderleaf, African kale, and pumpkin. The list agrees with Schippers (2002) and Onyango (2003), where the above vegetables were reported to be among the most important ones in Kenya and are widely distributed throughout Africa, although the importance of each vegetable varies with regions. Cowpeas seem to be the most popular, as shown by high quantities traded, especially in the municipal market. This is probably due to cowpeas' good keeping quality and long shelf life compared with other vegetables (Schippers, 2002), plus the fact that leaves do not have a bitter taste. Slenderleaf has smaller leaves and its preparation is tedious so it may not be popular with busy working consumers. African kale and pumpkin leaves were not sold in the rural markets, and this is possibly because of the vegetables' perishability. Farmers prefer to sell them in farms or use them for home consumption.

Germplasm Collection, Evaluation, and Multiplication of Priority AIVs

A total of 128 accessions were collected as follows: eight vegetable species at two seed lots per species in each of the eight districts. The selected accessions for each vegetable species were based on the weight, germination percentage, and moisture content. Except for spiderplant (*Cleome gynandra*) and African nightshade (*Solanum scabrum*), laboratory germination was high (>70%) and correlated very well with field germination (>80%). The selected accessions had a weight of more than 15 g per accession to allow for multiplication, while the other accessions with lower seed weight were discarded. Moisture content for all the accessions ranged between 9.5 and 11.2%.

Agronomic Studies

Organic and inorganic sources of fertilizers had a significant ($P \leq 0.05$) effect on growth and yield of cowpea and spiderplant. The leaf yields in cowpeas were consistently higher than spiderplant, which could be attributed to the small leaves in spiderplant. In

cowpeas, the best treatments were manure and tithonia, an indication that cowpeas responded better to organic sources compared with inorganic ones. On the other hand, spiderplant's best response was to the organic-inorganic combination of half tithonia (2.5 tons/ha) and half diammonium phosphate (DAP) (100 kg/ha) dry leaves. The above observation indicates the variability of responses depending on the species (Marschner, 1995).

In the intercropping study, African kale was found to be a suitable intercrop for slenderleaf, cowpeas, spiderplant, and African nightshade, since the land equivalent ratio was found to be greater than one in all the intercrops.

Seed Support Systems

Seed yields of priority AIVs increased significantly after the establishment of seed support systems at Maseno University Botanic Garden. Seed yields per hectare varied slightly with the vegetable species, but ranged from 1,036 (jute mallow) to 1,320 (vegetable amaranths) kg/ha. The 1,000-seed weight of the seven species was also determined which also varied with species.

A total of 77 farmers in eight districts were provided with seed and technical information on the production and seed processing of seven AIVs. The highest coverage of farmers and/or groups was in Vihiga district with 24 farmers reached, while the lowest was in Homabay with two. AIVs that showed a steady demand were nightshade, spiderplant, slenderleaf, jute mallow, and vegetable amaranths. The sales, however, were limited to the seed produced; therefore, there is a need for expanded quality seed production of the identified priority AIVs to meet the demand. The processed seeds were packed in 50 and 100 g plastic bags sealed and distributed to the farmers. A total of 77 farmers in eight districts were provided with seed and technical information on the production and seed processing of seven AIVs. Eighty percent of the monitored farmers were women. All the farmers visited were producing their own seeds and 22% of them, all women, were selling the surplus to the village market.

Capacity Building

Promotion of AIVs at Maseno University through its inclusion in the BSc and MSc Horticulture programs influenced the choice of projects for research. Table 3 shows that the percentage of BSc Horticulture students that undertook projects in AIVs increased from 20% in 2001 to 70% in 2006, and this could be attributed to the promotion of AIVs and restructuring of the programs. However, this proportion declined to 50% in 2008 due to the promotion of indigenous fruits.

Conservation of AIVs at Maseno Botanic Garden

In situ and ex situ conservation of AIVs was implemented since 2001. Maseno University Botanic Garden was established in 2001 and is a home to 200 plant species, in which 10% are ALVs. Ex situ and in situ conservation of AIVs is promoted. This project was funded by the Federal Government of Germany, BIOTA PROJECT. The purpose of the garden is combined research-teaching-conservation-leisure.

Outreach, Promotion, and Dissemination of AIVs Technologies

Promotion and dissemination was made as a component of the research projects, such as IPGRI, VicRes (SIDA), IFS, and PROTA. Several methods were used and some were common across projects. Methods varied depending on the target group. Some methods could be used in more than one target group. The main target groups were students, staff (both local and from other institutions), policy makers, funding organizations, consumers, farmers and farmer organizations, and the public in general. The focus was on identified priority AIVs in Kenya. Venues of promotion included lecture rooms, Maseno University Botanic Garden, agricultural shows, Kenyan universities annual exhibitions, farmers fields, markets, and institutions. Methods used in promotion and dissemination were lectures, workshops and seminars, demonstration

plots, leaflets and brochures, posters, videos/DVDs, and oral media (poems, songs, and dances).

Development of AIVs Recipes and Products for Commercialization

It has been demonstrated that high quality products can be developed from AIVs. The high iron recipes developed from AIVs can alleviate anaemia which is a serious problem in Kenya. The recipes include vegetable recipes and vegetable product recipes with high iron content (Habwe, 2008).

CONCLUSIONS

Eight research projects on AIVs were carried out at Maseno University between 1997 and 2007. The identified priority AIVs with nutritional and economic potential include vegetable cowpea, vegetable amaranths, African nightshades, jute mallow, spiderplant, slenderleaf, African kale, and pumpkin. Germplasm of six of the identified AIVs was collected, evaluated, multiplied, packaged, and distributed to 77 farmers in eight districts in Kenya. Agronomic studies on AIVs indicated that these vegetables have a short growth period, thrive as intercrops, and respond well to both organic and inorganic fertilizers. The inclusion of AIVs in horticulture programs substantially increased the number of students pursuing research projects on AIVs between 2001 and 2006. Universities can play a vital role in promoting underutilized species through research, capacity building, conservation, and outreach programs. Financial and infrastructural support should be provided to universities in Africa by their governments for science, research and technology development, and innovation.

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Tables

Table 1. Projects on AIVs at Maseno University between 1997 and 2007 under Principal Researcher M.O. Abukutsa-Onyango.

Title of project	Funding agency	Year
Response of priority African traditional vegetables organic and inorganic fertilizer application	African Highland Initiative	1997
Effect of nitrogen rates on growth and yield of slenderleaf (*Crotalaria brevidens* Benth)	Maseno University	1997
Market survey on African indigenous vegetables in Western Kenya	Self Funding	2001
Germplasm management of African leafy vegetables for the nutritional and food security needs of the vulnerable groups	IPGRI/Bioversity International	2001-2005
Intercropping African kale with other selected African indigenous vegetables for sustainable production in the Lake Victoria region	International Foundation for Science	2004-2008
Development of appropriate farming technologies for sustainable production and utilization of AIVs for improved land use in the Lake Victoria basin	SIDA (Lake Victoria Research Initiative)	2005-2009
Networking to promote the sustainable production and marketing of indigenous vegetables through urban and peri-urban agriculture in SSA	European Commission	2006-2008
Assessment of water use efficiency of bambara groundnut (*Vigna subterranea*) for food and nutrition security	CHE	2008-2009

Source: Maseno University, 2008a.

Table 2. Priority African indigenous vegetables (AIVs) in three districts in Kenya (Vihiga *n*=30; Kisumu *n*=20; Kisii *n*=30).

African indigenous vegetables	Botanical family	Vihiga (%)	Kisumu (%)	Kisii (%)	Total points[2]
Spiderplant (*Cleome gynandra*)	Capparaceae	100[1]	100	100	300
African nightshade (*Solanum villosum*)	Solanaceae	100	100	90	290
Pumpkin leaves (*Cucurbita moschata*)	Cucurbitaceae	100	100	45	245
Cowpeas (*Vigna unguiculata*)	Fabaceae	100	100	40	240
Vegetable amaranths (*Amaranthus blitum*)	Amaranthaceae	90	100	40	230
Jute mallow (*Corchorus olitorius*)	Tiliaceae	100	100	25	225
African nightshade (*Solanum scabrum*)	Solanaceae	90	100	30	220
Slenderleaf (*Crotalaria ochroleuca*)	Fabaceae	100	100	6	206
Slenderleaf (*Crotalaria brevidens*)	Fabaceae	90	100	0	190
African kale (*Brassica carinata*)	Brassicaceae	50	60	0	110

Source: Abukutsa-Onyango, 2007.

[1]Numbers are % of respondents.

[2]Last column provides a point scoring: 1%=1 point.

Table 3. Fourth year Maseno University BSc Horticulture students with AIVs projects in their final year of study.

Year	No. of students taking projects in their final year of study	
	Total no. in class	% students taking projects on AIVs
2001	10	20
2002	29	34
2003	14	28
2004	14	71
2006	25	70
2007	14	42
2008	6	50

Source: Maseno University, 2008b.