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The impact of Bioversity International's African Leafy Vegetables programme in Kenya

Elisabetta Gotor and Charity Irungu

An objective of Bioversity International is to promote income and food security by ensuring that agricultural biodiversity is conserved, characterised and used to improve productivity. The African Leafy Vegetables (ALVs) programme was initiated and implemented to meet this objective but no impact evaluation has been carried out since its conclusion. This study aims to evaluate the role played by Bioversity and its partners in the programme, and to assess the impact of the ALVs programme on the livelihoods of farmers in four regions of Kenya. The study used both primary and secondary data. Information from the survey was complemented by focus group discussions. To assess the role of Bioversity and its partners, all the partners were identified and interviewed. Bioversity was found to have ably acted as catalyst, facilitator and coordinator of the programme. Results also showed that production, consumption and marketing of ALVs had increased since 1997, women still dominated most of the ALVs activities, and those households that marketed ALVs were relatively better off than those that did not.

Keywords: agro-biodiversity, ALVs, *in-situ* conservation, Kenya, poverty alleviation, impact assessment

THE GLOBAL MANDATE of Bioversity International (hereafter referred to as Bioversity) is to conserve and use the world's plant genetic resources for the development and welfare of present and future generations.[1] Thus the purpose of Bioversity's work is to ensure that individuals and institutions are able to make optimal use of agricultural biodiversity to meet the current and development needs of people and society. Bioversity carries out a range of activities to meet several broad objectives, all geared towards agricultural biodiversity, and works through partnerships with other institutions ranging from large international organisations to small community-based organisations (CBOs), with a host of others in between that include national institutions, non-governmental organisations (NGOs), universities, and private entrepreneurs (IPGRI, 2004).

One of the objectives of Bioversity is to promote biodiversity for income and food security by ensuring that agricultural biodiversity is conserved, characterised and used to improve productivity. The African Leafy Vegetables (ALVs) programme is one of the programmes carried out by Bioversity to meet this objective and it falls within the overall Bioversity strategy on neglected and underutilised species.[2]

Since the programme was implemented, starting in 1996, no comprehensive assessment of its impact on nutrition and income generation has been carried out. In Kenya, seemingly significant milestones have been realised. Once relegated to poor man's crop, ALVs are now found in the country's most modern supermarkets, are a major constituent of many dishes of the people living in Nairobi, and seem to

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For acknowledgements see page 54.

have attracted a significant number of research institutions, universities, NGOs, CBOs and even private companies. Past studies on ALVs have tended to be more explorative, and *ex ante* analysis. Since the programme was implemented more than 13 years ago and concluded over five years ago, it is important to conduct an evaluation of its impact and sustainability. Also, many partners have been involved in this programme and it is important to identify the role that Bioversity actually played, and the role played by its other partners.

The aim of this study is therefore geared towards assessing the impact of the project on household budgets and nutrition of target communities' households, and to identify the role of Bioversity and partners in the whole project.

Assessing the impact of agricultural biodiversity research: methodological challenges

At Bioversity impact assessment has a prominent and critical role to demonstrate the link between programme results and human welfare. The impact assessment system put in place over the last few years focuses on assessing the consequences of research-based interventions that build on and/or foster the use and conservation of agricultural biodiversity to improve people's lives.

Assessing Bioversity's impact is thus very challenging precisely because this relationship requires multi-faceted interventions. The complexity is due to the fact that agricultural biodiversity generates different types of benefits, which have different 'social and economic' properties that affect their use and management and occur at different scales, from the local to the global. Another layer of complexity has to do with the way that Bioversity operates, working with a multitude of partners to develop and implement its projects. The links between Bioversity's roles, actions and outputs contribute to wider processes and thus expected impacts follow intricate pathways. Outputs coming from Bioversity's research are diverse; so too are the pathways that connect these outputs to disseminated outcomes that subsequently generate a change. Overall, the changes brought about through Bioversity's research activities manifest themselves in the different ways that agricultural biodiversity can be used to improve human well-being in general, and livelihoods in particular.

The links between Bioversity's roles, actions and outputs contribute to wider processes and thus expected impacts follow intricate pathways

The goods and services that humans derive from agricultural biodiversity are varied and intricate. They include: a diversity of foods needed for a balanced diet; both foods and agricultural practices with a wide array of cultural significance; genetic diversity for adaptation to heterogeneous and variable environments; and the ability to manage agricultural pests and diseases. The complexity and diversity are reflected in the fact that agricultural biodiversity generates many different types of benefits, and hence types of value, for humankind. These goods and services, as well as their associated benefits, have different economic properties that affect how they are used and managed. These have to do with the extent to which their use by one agent reduces (or not) their availability to another (known as rivalry) and the extent to which one agent can (or cannot) exclude others from using or benefiting from the good or service (excludability). The combination of these two properties, rivalry and excludability, creates four categories of goods and services that define how their benefits are accessed and managed by society (Figure 1).

In principle, private goods and benefits can usually be allocated efficiently by markets. However, due to transaction costs and information asymmetries, this is not always the case. Public goods and services (either common or collective) are usually misallocated by markets, creating major externalities,

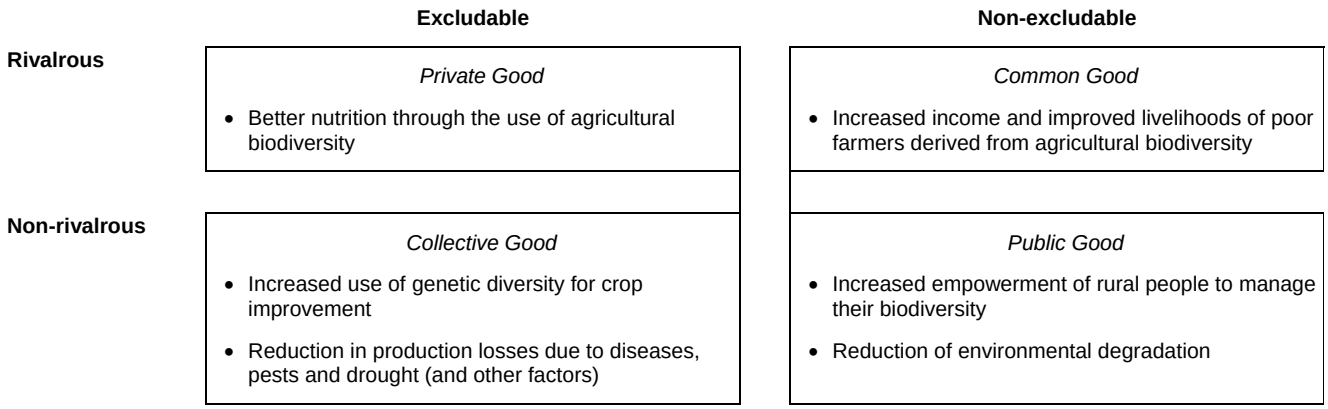


Figure 1. Biodiversity public and private goods

i.e. uncompensated impacts of one agent's actions over the welfare of another. Externalities can be positive or negative depending on whether the impact of the actions of one increases or decreases the welfare of the other. An example of a negative externality associated with agricultural biodiversity is the fact that highly developed markets tend to create strong incentives to specialise in the most profitable crop or variety. This in turn creates extremely uniform crop stands in space and time that translate into high vulnerability to pest and disease outbreaks, which affect those who profit from the uniformity, but also affects consumers who, through no fault of their own, will have a less reliable food supply.

Many goods and services provided by agricultural biodiversity are public and in numerous cases even those that are private may not be allocated efficiently by markets, creating very strong negative externalities for society. Since markets are poor at valuing many of the benefits of agricultural biodiversity, market prices tend to underestimate their worth, leading to poor allocation decisions, which can result in a lower current or future supply of these benefits than is socially optimal. Through research and interventions, an important role of Bioversity and its partners is to contribute to documenting and correcting these negative externalities.

A further complication is that the benefits of agricultural biodiversity occur at different scales, from the local to the global, and these scales are linked, but sometimes in complex ways. For example, the costs and benefits of using and conserving agricultural biodiversity may be distributed differently across scales. There tends to be a spatial mismatch between conservation costs and benefits. Economic benefits tend to be limited on a local scale, increase somewhat on a national scale and can be substantial on a global scale. On the other hand, costs, in terms of forgone development opportunities, tend to be locally significant and nationally and globally moderate. Tracing impact from one scale to another presents particular problems that require rethinking or adapting existing methodologies or creating new ways of approaching the assessment of impact across scales. This is one of the main thrusts of the impact assessment system Bioversity is developing (Figure 2).

Cost–benefit analyses, which are traditionally used to analyse allocation decisions and evaluate alternative investments, also present problems for Bioversity because many benefits generated by the organisation, such as the conservation of biodiversity or the development of methods to empower communities to manage their genetic resources more effectively, cannot be as easily measured and monetised as increases in yield or efficiency in input use. The application of both cost–benefit and cost-effectiveness analyses to Bioversity's work hence presents important methodological challenges that require further research, particularly on economic valuation of the benefits of agricultural biodiversity, an area of research currently being developed.

The African Leafy Vegetables programme in Kenya

Since 1992, discussions on the fate and future of ALVs were going on among African scientists, some of whom had been working on these vegetables for a long time. In 1995, Bioversity's Sub-Saharan Africa office convened a workshop in Nairobi on traditional vegetables (Guarino, 1997). The following year (1996), the ALVs programme commenced, with research activities in collaboration with partners in Botswana, Cameroon, Kenya, Senegal and Zimbabwe to increase the understanding and knowledge about the plant genetic resources of traditional vegetables,

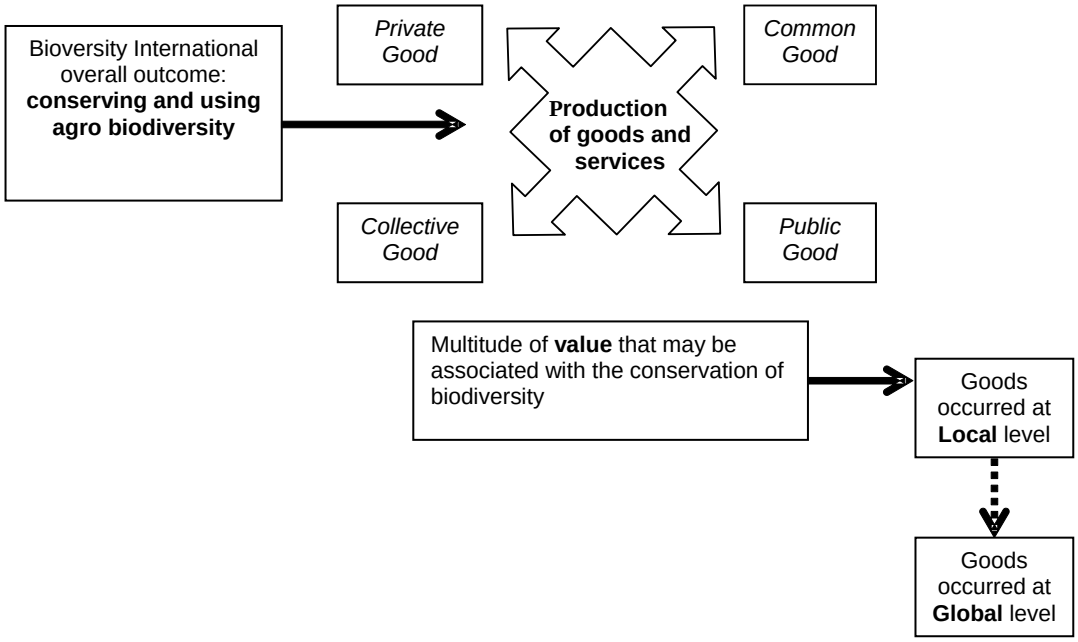


Figure 2. Bioversity International impact assessment structure

their distribution and local use by rural communities. The programme was implemented in two phases. The major focus of phase I (1996–1999) was conservation through use, since collecting and storing these vegetables was not an option as they were too many, too localised and still not much was known about their genetic diversity. The specific objectives included:

- To document the indigenous knowledge on diversity and use of leafy vegetables;
- Identification of species based on use and availability;
- Identification of priority species for further work;
- Germplasm sampling and characterisation;
- Chemical analyses to document variation in nutritional composition;
- Effects of storage and processing techniques on nutritional quality.

The project (phase I) identified a number of constraints in terms of seed quality, availability and supply, and identification of varieties that were easier to prepare and transport. Genetic diversity was found to be a key factor in improving the competitiveness of ALVs. As a result it was found necessary to launch the second phase of the project to follow up on the findings of the first phase. The second phase officially ran from 2001 to 2003, though work continued to much of 2004. The main goal of phase II was to exploit the potential contribution of ALVs towards improving the nutrition and food security of vulnerable groups, namely women and children, in sub-Saharan Africa.

The specific objectives of phase II (2001 to 2004) included:

- To collect, describe, map and conserve germplasm of priority species of ALVs.
- To enhance genetic material of priority ALVs.
- To improve horticultural practices for ALVs.
- To improve seed systems and on-farm management of ALVs.
- To improve handling, marketing and processing of ALVs.
- To disseminate information about ALVs to target groups.
- To increase the capacity of the national agricultural research programme to evaluate, conserve and promote the use of ALVs (IPGRI, 2001).

As a result of the research, over 37 research papers were presented in national, regional and international conferences, over 17 were published in referred journals, and some results led to academic degree awards.[3] A total of 13 MSc and MA students and two PhDs were supported during this phase in Kenya alone. An MSc course on traditional vegetables was also launched at Maseno University during the period. In addition, several staff of the universities and research institutes received technical training in germplasm characterisation, description and mapping. Other scientists gained technical experience as they carried out various projects. Networking among national and international scientists in ALVs was also fostered through the planning meetings, regional workshops and international conferences attended.

Many organisations reported some work on ALVs before the Bioversity programme, but Table 1 shows that most of the collaborative activities started after 1996, with the mode being 2003, towards the end of the programme.

Bioversity involved many partners in the implementation of the ALVs programme. A number of questions which call for detailed empirical investigation arise from these partnerships: What role did Bioversity actually play? What is the role played by these other partners? How did these partnerships contribute to the achievement of the objectives of the programme? Over the years, and since the end of the programme, answers to these questions have remained undocumented. Understanding the way such a partnership or a delegated approach worked would be helpful to future implementation of research and development activities, not only by Bioversity but also by other international research institutes of the Consultative Group on International Agricultural Research (CGIAR).

Moreover, exploring the impact of the programme on ALVs conserved and consumed would also give useful insights to successful promotion of other crops to improve living standards in Kenya and other developing countries.

The attribution analysis

To assess the role played by Bioversity, this study adapts the Ego, Alter and Researcher (EAR) instrument (Arts and Verschuren, 1999). The concept

Table 1. Onset of collaboration within various organizations working on ALVs

Year	Frequency	%
1980s	2	2.3
1990s (all before 1996)	4	4.5
1997	5	5.7
2000	4	4.5
2001	20	22.7
2002	10	11.4
2003	19	21.6
2004	12	13.6
2005	7	8.0
2006	2	2.3
2007	3	3.4
Total	**88**	**100.0**

implies triangulation of findings from three different perspectives: the EAR's perspectives. The ego perspective consists of views of Bioversity staff that were involved in the programme. Staff interviewed included the team leader, the project coordinator and three other members involved in the programme. The external partners (alter perspective) are those individuals and their organisations who worked with the ALVs programme in various capacities. A list of main partners was obtained from Bioversity and the contacts were visited for a detailed interview. Members of staff were interviewed about their role in the programme on three different occasions. During each interview session, there was more than one person, for validation sake. In some organisations, particularly those with several centres, more than one individual was interviewed. Most of the collaborators were in management, in research or in both (83.9%). A few respondents were in administration or in private enterprises. In terms of geographical distribution the country was well represented: Western Kenya (19.3%), Eastern Kenya (12.9%), Coast (12.9%), Central Kenya (6.5%) and Nairobi (45.2%). Nairobi had the highest representation as this is where most of the organisations' headquarters are located. The collaborating organisations ranged from CBOs to national research institutions. Table 2 shows the main collaborating organisations in the ALVs programme and the key areas of responsibility they assumed during the programme.

Data were then validated. This was done either through the analysis of secondary data collected, such as project reports, peer-review journals or documents issued, or by confronting the interview's outcome with the researcher's point of view. 'Researchers' in this case were one of the external partners who participated in the promotion of ALVs without establishing a formal partnership with Bioversity. These included international organisations such as the World Vegetable Center (AVRDC), the International Potato Center (CIP), the International Centre for Research in Agro-Forestry (ICRAF), Farm Africa, the International Development Research Centre (IDRC), and Plant Resources of Tropical Africa (PROTA). Other local organisations that acted as researchers included Kenya Industrial Research Development Institute (KIRDI), Sacred Africa and Kenya Seed Company.

Reasons given for starting to work on ALVs are summarised in Table 3. These range from academic research (either financial support or through supervision) to community and rural development. About 34.5% (see bold) were influenced directly by the Bioversity programme or its primary researcher then, the late Professor Chweya.

Even organisations that were not directly influenced to start work on ALVs (e.g. Rural Outreach Program [ROP], Kenya Agricultural Research Institute [KARI], the Ministries of Agriculture and Health, and universities) had their programme activities directly influenced by Bioversity through partnerships in funding and information sharing. Thus Bioversity played a key role in influencing work on ALVs; it played both a catalytic and enabler role. About (93.3%) of the partners reported that ALVs work has been on the increase since they

Table 2. Main collaborators in the ALVs programme

Name of institution	Type of ALV work
Farm Concern International	Marketing
FORMAT	Community development
Nairobi Friends Club International (NFCI)	Community conservation
Rural Outreach Program (ROP)	Rural development/seed banks/recipe development
KARI (Thika, Kisii, Genebank, Head Office)	– Agronomic research, selection – On farm trial – Collection, mapping, characterisation and conservation
Jomo Kenyatta University of Agriculture and Technology	Nutrition value analysis
University of Nairobi	– Agronomic research – Nutritional value analysis – Nutraceutical analysis
Kenyatta University	Nutrition and promotion awareness
Maseno University	– Agronomic research – Standardisation of recipes – Community seed banks
Kenya Medical Research Institute	Medicinal value research
Kenyatta National Hospital	Nutrition promotion awareness
Ministry of Agriculture (MOA)	Extension, nutrition awareness creation
CBOs	– Production and marketing – Awareness creation – Research/documentation
Private individuals	– Awareness creation – Production and marketing – MSc research

Table 3. Reason for involvement with ALVs

Rank	Activity	Frequency	%
1	**Encouraged/introduced/funded by Bioversity**	**8**	**27.6**
2	Part of organisation's mandate	5	17.2
3	Academic research	4	13.8
3	Dietary diversification concerns	4	13.8
4	**Association with Prof. Chweya, Project coordinator**	**2**	**6.9**
4	Income generation	2	6.9
4	Association with others (not Bioversity)	2	6.9
4	Poverty alleviation and food security concerns	2	6.9
	Total	29	100.0

Table 4. Partners' perception of Bioversity's role

Role evaluated	N	Maximum possible points	Lowest possible points	Maximum points given	Rating	
Technical knowledge	25	125	25	80	3.2	Average
Research	22	110	22	77	3.5	Somewhat important
Mobilising collective action	24	120	24	98	4.08	Somewhat important
Advocacy	21	105	21	76	3.61	Somewhat important
Catalyst	23	115	23	89	3.87	Somewhat important
Facilitator	23	115	23	90	3.91	Somewhat important
Enabler	23	115	23	81	3.52	Somewhat important
Exposure	21	105	23	84	3.65	Somewhat important

started. Only two respondents answered otherwise: one had researched on ALVs as a student of Prof. Chweya and thereafter took a different line while the other reported that the work had not changed significantly.

Bioversity's staff provided the main avenue for partners to learn for the first time about involvement with ALVs. About 80% of collaborators said they learnt about ALVs from Bioversity staff, while the rest learnt from secondary sources (i.e. publications or from other collaborators). Of these partners, 64% rated the collaboration with Bioversity as very beneficial, 16% as fairly beneficial and 8% as beneficial. Only 12% felt that they had not benefited from the collaboration. Those who responded negatively felt that Bioversity had benefited immensely from their efforts without reciprocating the same. Others perceived the role of Bioversity to be that of a donor and felt it had failed to fund them to adequate levels.

To evaluate the rating of the role of Bioversity by partners all responses were valued (with a value of one for least important and five for most important, with the others falling in between). Since not all the interviewed responded to all categories (some could not place a value on some of the categories) a separate analysis was done for each, as shown in Table 4.

These results show that Bioversity was rated highly in all of these roles. The highest rating was mobilising collective action, followed by facilitator. Most partners felt Bioversity's role in providing technical knowledge and in doing primary research was roughly average. On the technical knowledge aspect, many partners felt that Bioversity should have done more to impart technical knowledge to the partner organisations through short-term training, workshops or even long-term training through sponsorship for further education.

Respondents were also asked to name the two most important organisations in performing various tasks with respect to ALVs promotion. Using multiple sets analysis, the results presented in Table 5 were obtained. For brevity sake, only the first three organisations are reported. According to these results, partners seem to regard Bioversity as the single most important organisation with respect to many ALV activities. It was ranked the highest in identification and evaluation. This was attributed mainly to the first phase of the programme, and in a lesser magnitude to phase II in which it also facilitated the National Museum of Kenya (NMK) and Genebank of Kenya to continue with the work. Bioversity was also rated top in promotion of

Table 5. Ranking of partners according to roles they are perceived to have played in the ALVs programme

Activity	N	Rank 1	%	Rank 2	%	Rank 3	%
Identification/ evaluation	34	Bioversity	32.4	NMK	26.5	Universities	11.8
Promotion of production	41	Bioversity	24.4	KARI stations	14.6	MOA	14.6
Promotion of usage	44	Bioversity	31.8	ROP	15.9	NMK	13.6
Awareness creation	45	Bioversity	44.4	NMK	20.0	MOA	8.9
Capacity building at the organisational level	16	Bioversity	43.8	MOA	18.8	Several	
Capacity building at the grassroots level	26	ROP	26.9	MOA	19.2	Farm Concern	15.4
Genetic conservation	29	KARI Genebank	34.5	Bioversity	20.7	NMK	17.2
Marketing/market development	24	Farm Concern	37.5	ROP	16.7	MOA	16.7

Notes: 1. N is the number of responses. For every category, each respondent was supposed to name the two most important organisations in performing that role. In some case no organisations were mentioned as the respondents said they are not aware/are unsure/or simply do not know any organisation in involved in a particular activity.
2. The ratings for the Ministry of Agriculture (MOA) seem relatively high. This could be partly attributed to the large number of respondents from the Ministry who believed their organisation had done a lot.

production and usage, though the highest rating was given in awareness creation.

Awareness creation was attributed largely to the Dietary Diversity project, which followed immediately on the ALVs programme. This would explain why the follow-up position went to NMK, which was very much involved in this project. Ministry of Agriculture extension staff reported that in their day-to-day activities they were involved in creating awareness of the value of traditional foods including ALVs. The Home Economics division was reported to have held cookery demonstrations whenever farmers' field days were taking place.

Only a few partners rated the capacity-building role at the organisational level, but out of the few that did Bioversity topped the list. This involved short trainings, workshops, exhibitions and any learning fora for the staff of the partners. At the grassroots level, Bioversity was conspicuously missing from the list, in which ROP was leading, followed by MOA and Farm Concern International respectively. With actual conservation and especially *ex situ*, NBK was the leading organisation, followed by Bioversity and KARI Genebank. Farm Concern was considered the force behind the development of markets for ALVs. As other studies have shown, Farm Concern was instrumental, even after the cessation of funding from Bioversity, in linking up the urban and peri-urban farmers to formal and informal markets (Mwangi and Kimathi, 2006; Irungu *et al*, 2007). ROP was instrumental in market development in Western Kenya directly, and in other areas indirectly through the provision of seeds. Farm Concern collaborated with ROP in provision of seeds to the farmers within Nairobi, before they later started acquiring the same from AVRDC. Without access to seeds, farmers would not have increased their production for marketing, and hence the indirect role of ROP.

A very important issue in the research was to find the counter-factual, i.e. what would the situation be if Bioversity was not involved in ALVs at all. To assess this, all respondents were asked what, in their opinion, the situation would be for ALVs work if Bioversity had never got involved. The responses were analysed and shown in Table 6. These results indicate that most of the partners (78.2%) acknowledge the positive and important role played by Bioversity in the promotion and utilisation of ALVs in Kenya. As Table 1 shows, there was some scattered ALVs activity going on, but it was not until Bioversity came in that a momentum was built and sustained for greater impact. Before then, scientists worked in an uncoordinated manner, not knowing what others were doing. This often resulted in duplication of activities and resources, with little impact.

Bioversity demonstrated a keen ability in keeping several ALVs researchers working together delivering different outputs belonging to the same overall framework. One of the key informants metaphorically pointed out that, just as an orchestra needs a capable conductor to produce a harmonic sounds, partners involved in the ALVs work in different capacities needed a conductor to achieve tangible results that would otherwise have been scattered.

Table 6. Alter perception of ALVs work without Bioversity's involvement

Response category	n	%	Valid %
Bioversity was able to mobilise resources (financial and human) to speed up and upscale the work, and give it an international image	11	36.7	47.8
ALVs work would have continued but at a much slower pace	7	23.3	30.4
ALVs work would have continued with or without Bioversity	5	16.7	21.8
No response	7	23.3	-
Total	30	100.0	100.0

It was in this recognition that an attempt was made by the late Prof. Chweya and colleagues to document scientists and practitioners who were involved in ALVs during the first phase in the late 1990s (Mnzava, 1997). Once it was established who was in the field of ALVs and what they were doing, then it was easy to convene a meeting and discuss how these scattered efforts could be strengthened, and hence the increased number of partners in the second phase of the programme.

The impact analysis

The impact of the programme is measured using an analysis of conservation and consumption of ALVs conducted in four regions, namely the Kisii district in Nyanza Province (now Masimba and Kisii districts), the Tharaka-Nithi district in Eastern Province (currently Tharaka and Meru South districts), the Kilifi district in Coast Province (currently Kilifi and Kaloleni districts) and peri-urban Nairobi. The first three areas were purposely chosen based on their perceived richness in ALV biodiversity and diverse cultural backgrounds. In phase II the programme concentrated a lot of efforts around the city of Nairobi and so it was considered necessary to include it as the fourth region.

Specifically, the study covered two sites in each of the four research areas:

- Kisii region: Suneka and Keroka, as high and low potential areas respectively.
- Tharaka region: Chuka and Ciakariga, as high and low potential respectively.
- Kilifi region: Kaloleni and Maiakani, as high and low potential respectively.
- Peri-urban Nairobi region: Kiambu and Thika districts as high and low potential respectively.

In each site 13 households directly involved in the programme and 13 households not involved in the programme were randomly sampled. In peri-urban Nairobi the criteria used involved randomly selecting households from villages where Bioversity and/or its partners had worked and households from villages with similar characteristics but where no work on ALVs had been done by Bioversity and/or its partners.

A total of 211 households were selected, with Kisii, Tharaka and Kilifi having 52 households each. Peri-urban Nairobi had 55 sample households. To randomly sample households in selected villages, the research team acquired a list of all households from the village administrator and used it as the sampling frame. Where such an existing frame was lacking, the research assistants had to draw up one with the village heads. There were also cases where it was completely impossible to come up with a sampling frame due to the limited knowledge of the village head of the households in their areas. In such a case, a random walk through the village was used to randomly sample the required households.

The household survey instruments were pre-tested and adjusted several times before administration. The research assistants were then trained on sampling and questionnaire administration. They were encouraged to use direct observation and informal interviews to complement the questionnaire. They were also encouraged to note extra information in their notebooks and later submit a written field report alongside the questionnaires. The field report explained in depth some of the issues that were not well captured in the questionnaire and those issues that were not specific to particular households but whole communities or villages which were considered important in the interpretation of data. Communities in different regions have peculiar languages and this meant that the enumerators had to be native-speakers of the respective regions.

Focus group discussions (FGDs) were also conducted by the research team (comprising the authors, assisted by each of the three research assistants in Kisii, Tharaka and Kilifi when the team was in their respective research area). No FGDs were held within peri-urban Nairobi as it was felt that there was already a wealth of information concerning the area, given that a number of studies had been done. These include studies done by Irungu *et al* (2007).

In total, three FGDs were conducted in Kisii, two in Tharaka and four in Kilifi. The FGDs were intended to provide qualitative data on some of the cross-cutting issues in the communities as well as for cross-checking the quantitative data collected through the semi-structured interviews. The topics included types of ALVs known in the community, those that have disappeared, reasons for disappearance, gender issues in production, consumption and marketing, preparation methods, and stakeholders involved.

In each FGD, gender, age, cultural knowledge and socio-economic class representation was considered; however, due to the cultural context and other household issues sometimes one gender outnumbered the other. For example, in Tharaka men were generally fewer than women, while in Kilifi women were under-represented. This was not a big problem since for each community more than one FGD was conducted, as stated earlier. In Kisii, FGD groups were generally well balanced.

The household poverty level was used as a proxy for welfare. A poverty index was created using the Principal Component Analysis (PCA) statistical procedure. A set of seven simple, reliable, verifiable and quantifiable poverty indicators from the study regions were used following Irungu (2002) and Zeller *et al* (2006). One principal component was extracted, which explained over 52% of the total variance in the seven variables and was interpreted as measuring poverty. The lower the score the poorer the household was. Table 7 summarises the variables selected in the final model alongside their respective communalities and component loadings.

To assess the impact of the ALVs Bioversity programme we first specified a probit model for the household's decision to grow and market ALVs using the maximum likelihood method. The model for the household's decision to produce and market ALVs is specified as:

$$Y^* = \sigma + \beta_i \chi_i + \varepsilon_i$$

where $Y = 1$ if $Y^* > 0$ and $Y = 0$ otherwise.

The β_i is the set of parameters to be estimated that

Table 7. Communalities and component matrix of the poverty index model

Variable	Communalities		Component 1
	Initial	Extraction	
Structural condition of the main house	1.000	0.599	0.774
Type of roof of main house	1.000	0.454	0.674
Main source of lighting for main house	1.000	0.546	0.739
Type of floor for main house	1.000	0.566	0.752
Assets: whether household owns TV or not	1.000	0.553	0.744
Mean education level of adults	1.000	0.490	0.700
Subjective ranking of the household within the village	1.000	0.417	0.646

Notes: 1. Extraction method: Principal Component Analysis
2. The model had a Kaiser-Meyer-Olkin (KMO) value of 0.881 and the Bartlett test of specificity was significant at less than 1% level. KMO statistics represent the ratio of the observed correlation between variables to the squared partial correlation between variables. The closer the value is to one the better, since it indicates that patterns of correlations are relatively compact and should yield distinct and reliable components.

reflect the impact of change on the explanatory variables χi, and ε_i is a standard normally distributed error term (Greene, 2000).

Since we assume that there are unobservable characteristics that drive the decision process of whether or not to grow and market ALVs, we constructed a selectivity term, the inverse mills ratio (IMR), to capture that aspect. This variable is added to the second stage model where it confirms or otherwise rejects the hypothesis that the process is governed by unobservable characteristics.

The second stage OLS (Ordinary Least Square) model involves adding the IMR to the welfare performance equation and estimating the equation as follows:

$$C_i = \beta_o + \beta_1 W_i + \beta_2 Y_i + \beta_3 \lambda_i + \varepsilon_i$$

where the error term $\varepsilon_i = 0$, C_i is the performance indicator (poverty index), W_i is the vector for households characteristics and λ_i is the participation (Bioversity program) variable.

The variables and their descriptive characteristics are presented in Table 8.

The dependent variable in the first equation (ALVSOLD) is a proxy for participation in ALVs production and marketing. This model estimates the parameters that influence households to participate in ALVs production and marketing. Due to the small size of sample, only a few variables could be used. Since the households self-select themselves to do this, the equation includes estimations of IMR that is used in the second equation. The second equation estimates the variables determining the poverty level of households. The dependent variable in this equation is the poverty index derived in the previous section, which is a proxy for welfare performance. The model incorporates IMR obtained from the first equation alongside other response variables. A negative IMR shows that those who chose to grow and sell ALVs are more predisposed to poverty than the general population, while a positive one shows the opposite. From the results the effect of various factors, among them the role of the ALVs programme are estimated.

Results

Different regions were found to have different priority ALV species. A total of 27, 31 and 33 different species of ALVs are known in Kisii, Tharaka and Kilifi. Of these seven and two species are no longer available in Kisii and Kilifi respectively. This is because they were gathered in the wild, near river banks and such ecosystems are rare due to population increase and climate change. Between 1997 and 2007, the number of ALVs used in the community had increased by three and four in Kisii and Tharaka through new introductions from other areas. This shows that agro-biodiversity with regards to ALVs in regions had been increasing with time. In the Tharaka area most ALVs, with the exception of cowpeas and pumpkin leaves, are gathered from the wild. With decreasing idle land coupled with the drying effect of climate change on watershed areas where some ALVs were prevalent, the availability is severely affected.

An increase in production of ALVs was reported in all the research areas. In most cases they are intercropped with other crops along the fences, but in

Table 8. Descriptive statistics of variables used in the model

Variable name	Variable label	Kisii n = 52 Mean(std dev)	Tharaka n = 52 Mean(std dev)	Kilifi n = 52 Mean(std dev)	Peri-urban n = 55 Mean(std dev)
ALVSOLD	Whether household sells ALVs or not: 1 = yes, 0 = otherwise	0.87(0.35)	0.33(0.47)	0.17(0.39)	0.44(0.50)
POVINDEX	Poverty Index (continuous)	0.725(0.87)	-0.016(0.68)	-1.20(0.56)	0.393(0.65)
AGE	Age of household head in years	46(9.99)	50.6(14.6)	49.9(14.89)	47.5(14.6)
EDUC	Education of household head in years	10.6(3.0)	7.0(4.4)	3.04(3.95)	8.4(4.2)
HHSIZE	No. of members in a household	6.25(1.68)	4.48(1.7)	6.73(2.44)	4.96(2.0)
OCCUP_F	Whether main occupation is farming or not: 1 = yes, 0 = otherwise	0.19(0.40)	0.51(0.51)	0.56(0.50)	0.51(0.50)
PERCEPTI	Change in perception of ALVs since 1997: 1 = yes, 0 = otherwise	0.49(0.51)	0.51(0.51)	0.19(0.4)	0.35(0.48)
SOCCAP	Whether involved in groups or not: 1 = yes, 0 = otherwise	0.83(0.382)	0.73(0.45)	0.33(0.48)	0.78(0.4)
EXPERIEN	No of years ALVs grown	22.9(9,8)	19.96(14.5)	22.38(17.7)	8.92(9.7)
PARTICIP	Whether household is from treatment or not: 1 = yes, 0 = otherwise	0.48(0.51)	0.50(0.51)	0.75(0.44)	0.47(0.50)
ALVINFO	Whether received any information on ALV: 1 = yes, 0 = otherwise	0.49(0.51)	0.69(0.47)	0.08(2.69)	0.81(0.4)
FARMSIZE	No. of acres	3.67(2.16)	3.14(2.47)	3.91(2.69)	1.95(1.53)

cases where they are grown purely for commercial purposes they are increasingly being grown in small, pure-stand plots. The plot sizes are small, usually less than an acre (0.4 ha). Results showed that the majority of households grow ALVs (87%), with the figure going to as high as 98% and 96% in Kisii and Tharaka.

Many older households reported that they have grown ALVs for along time. However, the younger generation had abandoned them for exotic vegetables and only started growing them in the last 10 years. Results showed that on average 27% of households growing ALVs have been doing so for more than 20 years, 27% have grown them for between 20 and 10 years, while over 25% started growing them in the last 10 years. The results are more pronounced in areas where traditionally ALVs were not a delicacy, particularly in peri-urban areas of Nairobi where only 4.1% were growing ALVs 20 years ago, in comparison to about 51% having started within the last 10 years. This clearly shows that the culture of growing ALVs is spreading to even the areas where growing had stopped or where they were not being grown in the past. The main reason given for this trend was increased knowledge of the nutritional value that led to demand in the urban markets and increased home consumption.

In rural Kenya there is virtually no refrigeration, as lack of electricity and high poverty levels would not permit it. Despite this about 15% of the households do store ALVs for future use. The most common preservation measure across the regions was sun-drying. The results further indicated that for those who do store, 45% had increased their storage amounts relative to their 1997 levels while about 42% had retained the 1997 levels. Only priority ALVs such as spider plant and cowpeas are stored. The reasons for storage included increased knowledge of the nutritive value of ALVs (and thus they did not want to miss them when out of season), increased yields and need to satisfy relatives in distant areas who do not have access to them. Those who had decreased storage attributed it to increased availability and access in the markets, and availability of substitutes.

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Of those growing ALVs, only slightly over half of them (52%) participated in marketing. This differed from region to region, with Kilifi and Tharaka having lower figures compared to Kisii and Nairobi. In Kisii almost all households grow ALVs (98%) and an equally high percentage also market (86%) compared to the survey mean of 87% and 45% for growing and marketing respectively. Kilifi and Tharaka regions were relatively poor in terms of marketing of ALVs. Lack of awareness, problems in transportation and distance from Nairobi (the epicentre of ALVs promotion campaigns — 1997 to 2007) were the main reasons for the low market involvement of the farmers. Farmers usually sold their product to direct consumers in the markets (39%), middlemen in the markets (22%), middlemen in the farm (20%) and direct consumers in the farm (17%), and the rest was sold to institutions. Compared to 1997, the results showed that only 2.5% of the respondents felt that their monthly net income from ALVs had declined. The rest, 62.5% and 35%, reported that their monthly net income from ALVs had increased and remained constant respectively relative to their 1997 levels. The two main uses of the income were to supplement kitchen budget and for school expenses in that order.

Over 40 different species are consumed in the regions. The priority ones in order of importance are amaranth, African nightshade, cowpeas, pumpkins, spider plant, bitter lettuce and vine spinach. As much as 10% of the consumed ALVs are gathered from the wild. About 45.2% of the households were found to have increased their consumption of ALVs relative to 1997 while 44.3% had retained their consumption at the 1997 level. The main reason for increased consumption was reported to be increased awareness of their nutritive value. When available, ALVs are consumed in the two main meals per day (midday and evening) and are always cooked. In the past, most communities would cook the ALVs for long periods but in recent years these traditional methods have been abandoned for those that preserve most of the vitamins and other nutrients. Because of this, consumers now derive more nutrients from ALVs than previously.

In addition, about 38.6% of the households had changed their perception of ALVs to a more positive one while 37.5% reported positive health aspects with regards to household members who consumed ALVs regularly. Positive changes are associated with increased awareness of the nutritional value of these vegetables which were otherwise relegated to 'food for the poor'. Information on the nutritive value of ALVs was attributed to various sources. In order of importance, these included the Ministry of Health, social networks, NGOs, Ministry of Agriculture and KARI. Almost all these organisations were operating under the Bioversity International programme on ALVs.

ALVs have remained predominantly a preserve of the women. These results are similar to those

Table 9. Survey regions versus relative poverty groups cross-tabulation

Survey region		Relative poverty groups			Total
		Poorest	Poor	Not so poor	
Kisii	Count	4.0	15.0	32.0	51.0
	% within survey regions	7.8	29.4	62.7	100.0
Tharaka	Count	12.0	26.0	13.0	51.0
	% within survey regions	23.5	51.0	25.5	100.0
Kilifi	Count	44.0	2.0	1.0	47.0
	% within survey regions	93.6	4.3	2.1	100.0
Peri-urban Nairobi	Count	7.0	24.0	21.0	52.0
	% within survey regions	13.5	46.2	40.4	100.0
Total	Count	67.0	67.0	67.0	201.0

obtained ten years earlier (Maundu *et al*, 1999), where work on ALVs was found to be dominated by women. A few men were reported to be growing ALVs for market but the trend has not gained enough momentum to equalise with women or reverse the situation. Furthermore, decision-making on how cash from the ALVs was being used was mainly a woman's prerogative.

Using the poverty index values, all households were ranked and then categorised into three terciles: poorest, poor and not so poor. Table 9 represents the distribution of households into the three groups according to regions. Kilifi region is rated the poorest region, followed by Tharaka, peri-urban Nairobi and Kisii in that order. These results reflect the national statistics of the integrated household budget survey conducted by the government (GoK, 2007).

Using the three variables related to ALVs production, marketing and access to information, a cross-tabulation analysis showed that there were significant differences at 5% confidence level or less between the three poverty categories. These results also showed that, although most households grew ALVs, it is the poorest category that had the highest presentation of the non-growers. In terms of marketing, the differences were even more pronounced as the poorest group failed to market what they produced (Table 10).

The results of the econometric models (with dependent variables ALVSOLD (Probit) and POVINDEX (OLS with IMR)) are presented in the Appendix. The statistical validity of the probit models is supported by the log likelihood results which indicate that the null hypothesis that all response variables are jointly zero can be rejected at 10% probability level or less. The OLS models, with the exception of peri-urban Nairobi, have a very low adjusted R^2, which shows the variance of the dependent variable explained by the response variables. This is expected since the sample size is quite small.

The results for Kisii identify the number of years farmers were engaged in growing ALVs (EXPERIEN) as a determinant of the decision to grow and market ALVs. The longer the household has been growing ALVs, the higher the likelihood for getting involved in marketing. Other variables that had positive but weak effect were the number of household members (HHSIZE variable) and the level of awareness on ALVs (ALVINFO variable). The participation or not in the programme (PARTICIP variable) had a positive coefficient that was not significant; thus the effect of the ALVs programme cannot be deduced in Kisii. This is because the number of years farmers were engaged in the programme was so high that the treatment and control group could not be clearly differentiated, hence

Table 10. A comparison between households that produced and marketed ALVs and those who did not with respect to relative poverty groups

Relative poverty groups	Grow (n = 170)	Do not grow (n = 30)	Market (n = 92)	Do not market (n = 105)	Have information (n = 99)	No information (n = 90)
Poorest	51	16	13	54	18	48
Poor	58	8	33	32	40	21
Not so poor	61	6	46	19	41	21
Chi-square value	6.493**		35.618***		25.636***	
Cramer's V value	0.180**		0.425***		0.368***	

Note: *** significant at 1% level
** significant at 5% level

the binomial variable on the programme participation was not significant.

In the second equation, the results show that IMR was negative but insignificant. Only the number of household members (HHSIZE), which has a negative coefficient, is significant. This shows that the larger the household size, the more likely it was to be poor. These results are not unexpected as a larger household means resources are usually overstretched. The participation or not in the programme (PARTICIP variable) has a negative coefficient but not much meaning can be attached to it since it is not significant. The programme does not seem to have a significant influence both in deciding to grow and sell ALVs and in improving poverty level of households in Kisii. Other factors not studied are probably more important. Only one group indicated that they had worked with Kenya Agricultural Research Institute (KARI), Kisii, in some trials, and that someone had been sent to them from the Kenya Resource Centre for Indigenous Knowledge of the National Museums of Kenya (KENRIK-NMK).

Results for Tharaka identify participation or not in the programme (PARTICIP variable), the education level of the household head (EDUC variable) and the occupation of the household head in the farm or not (OCCUPA_F variable) as determinants of a household's decision to grow and market ALVs. The positive and significant variable related to the participation or not in the programme implies that those households from the areas designated as treatment areas were more likely to grow and market ALVs than otherwise. Most households in this region, including those in the treatment areas, said they had not got any information on ALVs from any other source except through the Kameme FM radio station. The radio broadcast through Kameme FM was being done by Farm Concern International which was a partner with Bioversity. The education level of the household head (EDUC variable) was positive and significant, showing that those households who had more educated heads were more likely to grow ALVs than lowly educated households. This shows human capital is important in enabling people to appreciate, grow and market ALVs. The variable on the occupation of the household head in the farm or not (OCCUPA_F) also showed a positive and significant coefficient, meaning those farmers whose main occupation is farming were more likely to grow and sell ALVs. This is to be expected, since respondents whose main source of livelihood is farming are likely to try to market whatever is at their disposal to earn some income.

The second model showed that the participation or not at the programme (PARTICIP variable) and the marketing of ALVs (ALVSOLD variable) were determinants of the level of poverty, although in different directions. The participation or not in the programme (PARTICIP) variable had a negative coefficient, meaning that those households from areas taken as treatment were more likely to be poorer. This is not surprising given the significant negative sign of IMR, which indicates that those households who grow and market ALVs in Tharaka are more likely to be poorer. The marketing of ALVs is positive and significant at 5%, showing that production and sale of ALVs has a positive effect on their livelihoods or increases the likelihood of improving the poverty levels.

For the Kilifi results, the probit model showed that the level of awareness on ALVs (ALVINFO variable) and the number of household members (HHSIZE variable) were among the determinants of a household's decision to grow and market ALVs. The level of awareness on ALVs had a positive and significant coefficient, meaning those who had got some information on ALVs were more likely to grow and market them. The number of household members variable had a negative and significant coefficient, which is a rather unexpected result. A probable explanation would be that large households are less likely to grow enough ALVs to both consume and market. In the second model, only one variable, the education level of the household head (EDUC), was negative and significant at 5% level. This expected result shows that those households whose household head had less education were more likely to be poorer.

The results of the first equation in the peri-urban Nairobi model show the education level of the household head (EDUC), the numbers of years farmers were engaged in growing ALVs (EXPERIEN) and the occupation of the household head in the farm or not (OCCUPA_F) as major determinants of the likelihood to produce and market ALVs in this region. The longer the household had been growing ALVs, the higher the likelihood for getting involved in marketing, and also the more the education the household heads had, the more they were likely to grow and market ALVs. Farming as the main source of income, experience in growing ALVs and education also increase the likelihood of producing and marketing ALVs. In the second model there were no significant response variables. However, the IMR was positive and significant, implying that households which grow and market ALVs in peri-urban Nairobi are more likely to be wealthier than those who do not.

Discussion

In general, results point to the fact that between 1997 and 2007 there have been notable positive changes in growing, consumption, marketing and nutritional awareness of ALVs in the study areas. There has also been a noted increase rather than decrease in ALV biodiversity through more awareness of the nutritive value of ALVs.

Women have continued to be the main actors in ALV production and marketing. This is a positive aspect in women's economic empowerment that can

In general, results point to the fact that between 1997 and 2007 there have been notable positive changes in growing, consumption, marketing and nutritional awareness of ALVs in the study areas

be capitalised on. The threats posed by the ensuing commercialisation need to be considered. This could be through capacity building for the women to take up production and marketing of ALVs even more seriously, given that the ALVs are more and more becoming marketable.

The poorest section of the community was found to be lagging behind in growing and marketing ALVs. This could be as a result of low resource endowment (land, labour and other inputs) but could also be due to lack of exposure as they were also found to have the highest number who had no access to information on ALVs. These results show the poorest group is still disadvantaged in as far as ALVs issues are concerned. The results also do not support the proposition that ALVS is a poor man's crop.

From the econometric analysis, the main factors influencing the growing and marketing of ALVs were the numbers of years farmers were engaged in growing ALVs, the education level of the household head, and the occupation of the household head in the farm or not. This shows that experience in growing ALVs, farming as the main occupation of the household and the education level of the household head all had a positive influence on a household to market ALVs. Other factors included the level of awareness on ALVs (ALVINFO variable) and the number of household members (HHSIZE variable), the second one having a negative influence. Those households that had received information on ALVs were more likely to grow and market them than otherwise, while those with large household sizes were less likely. By creating awareness of the nutritional value of ALVs, the programme may have influenced many people to grow, market and consume ALVs.

Factors determining the likelihood of households being poor included low education level of the household head (EDUC), large number of household members (HHSIZE) and whether or not they sold ALVs (ALVSOLD), which was positive in Tharaka indicating that those who sold ALVs were more likely to have a higher welfare status than otherwise. Coming from either the treatment area or not did not seem to have much effect in areas except in Tharaka, where it was significant, showing that those households from treatment area were more likely to grow and market ALVs than from the control areas.

Conclusions

This study has provided a detailed analysis of the role of Bioversity and its partners in the promotion of ALVs in Kenya. The study analysed the impact of ALVs into rural budgets, nutrition and culture. It was found that although research and promotion of consumption of ALVs has been going on for a long time, Bioversity's entry into the scene boosted these scattered efforts. Bioversity was found to have played its roles as a catalyst, enabler, advocate, and facilitator very ably and as a result five local universities, one national agricultural research institute, several national organisations, NGOs and CBOs are presently active in ALVs activities. In Kenya, the programme invigorated an otherwise slow and disorganised process that had begun a long time ago. Currently ALVs are prized delicacies in Nairobi and many other parts of the country.

Bioversity was able to perform its catalytic role effectively given its international status which it delicately balanced by putting on a local face. It effectively employed local human resource as much as possible and this led to wide acceptability of the project as well as building local capacities for the sustainability of the research work. As a consequence, a number of organisations including Farm Concern International, Kenyatta University and KARI have continued to mobilise resources for ALVs work independent of Bioversity. Farm Concern International was particularly instrumental in the increased demand for ALVs in Nairobi markets, having started off with a simple funding from the ALVs programme.

Production, consumption and marketing of ALVs were found to have increased over the ten-year period. The number of cultivated and consumed species also increased in Kilifi and Kisii but had decreased in Tharaka. Market demand for these ALVs has also developed over the last ten years. This is as a result of many factors including more awareness creation by the project and other players. The hitherto negative perception, even in rural areas, has positively changed. Access to information on ALVs was found to decrease as the distance from Nairobi increased. This shows that awareness creation was concentrated in urban areas as planned, and by default to higher socio-economic groups that have access to mass media channels of communication.

Further qualitative impact assessment results show that households growing and marketing ALVs were largely better off in terms of welfare than otherwise. Furthermore, it showed that women still dominate the ALVs production activities, and are responsible for appropriating funds that come from ALVs sales. It would be important for those promoting ALVs to recognise the role of women, work with them and continue to build their capacity, as they are the ones driving the production process, especially in the rural areas.

Appendix.

	Variable	Probit analysis		OLS analysis with IMR	
		Coeff.	**t-ratio**	**Coeff.**	**t-ratio**
Results for Kisii region	ONE	-0.3041	-0.2337	117.303	1.0514
	PARTICIP	0.0945	0.1845	-29.3081	-0.7690
	ALVINFO	0.0008	1.3686	58.213	0.3971
	HHSIZE	0.2928	1.3269	-27.5343	-2.0648**
	EXPERIEN	0.0012	1.7188*		
	ALVSOLD			58.213	0.397
	IMR			-32.4909	-0.3760
	Number of cases 52				
	Log likelihood -16.3122				
	Chi-squared 8.462*				
	Cases correctly predicted 86.5%				
	Adjusted R^2 0.04				
	Durbin Watson 2.0307				
Results for Tharaka region	ONE	-5.2370	-2.9118***	39.6936	0.7885
	PARTICIP	0.7696	1.7942*	-81.6939	-1.8206*
	SOCCAP	0.7028	1.4244	-58.1029	-1.2635
	PERCEPTI	-0.004	-0.4749		
	EDUC	0.1351	2.3963**	-7.2558	-1.3818
	OCCUPA_F	1.63811	1.9016*		
	EXPERIEN	-0. 0001	0.0484		
	Number of cases 52				
	Log likelihood -24.3549				
	Chi-squared 17.016**				
	Cases correctly predicted 75%				
	Adjusted R2 0.02				
	Durbin Watson 2.174				
Results for Kilifi region	ONE	0.3487	0.504696	-23.9613	-0.2203
	PARTICIP	-0.1262	-0.25131	73.8648	0.7817
	ALVINFO	1.12561	1.65635*		
	EDUC	-0.0715	-0.987637	-26.7497	-2.4606**
	HHSIZE	-0.1757	-1.6894*		
	FARMSIZE	0.00322	0.179434		
	ALVSOLD			-273.324	-1.0563
	Number of cases 52				
	Log likelihood -18.8862				
	Chi-squared 10.1437*				
	Cases correctly predicted 78.2%				
	Adjusted R2 0.05				
	Durbin Watson 1.898				
Results for peri-urban Nairobi Region	ONE	-2.64546	-2.4873**	-16.2111	-0.1173
	PARTICIP	-0.0518616	-0.126655	15.6955	0.2599
	SOCCAP	0.585952	1.11134	-30.7306	-0.3844
	EDUC	0.149581	2.4571**		
	OCCUPA_F	1.44852	2.8455***	-76.9863	-1.0016
	EXPERIEN	0.0015	2.9852***		
	AGE	0.0091	0.62631	1.8468	0.8558
	Number of cases 55				
	Log likelihood -26.96592				
	Chi-squared 21.421***				
	Cases correctly predicted 72.7%				
	Adjusted R2 0.09				
	Durbin Watson 1.886				

Notes: ***, **, * significant at 1%, 5% and 10% levels respectively
Similar variables could not be used in all models as some did not have enough variance due to the smallness of the sample.

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Notes

1. For convenience, we use 'Bioversity International' in the text even though the activities to which we refer may have occurred during the time of one of its predecessor organisations: 'The International Board for Plant Genetic Resources' (IBPGR), from 1974 to 1991 and 'The International Plant Genetic Resources Institute' (IPGRI), from 1991 to 2006. With effect from December 2006, IPGRI and INIBAP have operated

under the name 'Bioversity International', or Bioversity for short. This new name echoes the strategy of Bioversity International, namely improving people's lives through biodiversity research. For further details on Bioversity's work visit http://www.bioversityinternational.org/.

2. For a definition of neglected and underutilised species see IPGRI (2002: 12).
3. Titles of mentioned publications are available upon request.

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