MANAGING BIODIVERSITY IN AGRICULTURAL ECOSYSTEMS LOCAL MANAGEMENT OF AGRICULTURAL BIODIVERSITY BY COMMUNITIES IN KENYA

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The Intermediate Technology Development Group is committed to finding practical solutions to poverty. It works with the poor to improve their livelihood. It has a number of projects in Kenya, Zimbabwe and Peru. An important aspect of the work is that it is working towards improving the ecological and human condition in the arid and semi arid lands (ASALs). In Kenya, the Rural Agriculture and Pastoralism Programme (RAPP) works with poor communities in Arid and Semi-Arid Lands (ASALs). The activities of RAPP are focused on food security, sustainable livelihoods, technology development and adoption, policy advocacy, institutional development and gender dimension in development. For example, the Marginal Farmers Project (MFP) is one of the projects under the RAPP implementing food security activities. A major component of this project was a two-year Agricultural Biodiversity Conservation (ABC) study. The study, which focused on the conservation and sustainable use of plant biodiversity in agriculture, namely crops and wild foods growing in farmers' fields, field margins and adjacent wild areas.

The first part of this paper discusses; the ABC findings. The second part, focuses on community based tsetse control work, also being implemented under MFP in southern Kenya in areas of conflict between local communities and wild-life conservation.

Part 1

The ABC Study

Bearing in mind the current gaps in understanding and unanswered questions relating to the conservation and sustainable use of plant genetic resources for food and agriculture (PGRFA), the ABC project set out to answer the following three specific research questions:

- To what extent do farmers want to maintain a number of varieties and crops in the farming system? And what are the reasons for this (why/why not)?
- What techniques and strategies do farmers use to maintain a number of varieties and crops on their farms?

- What forces - positive and negative - help or hinder the maintenance of a number of varieties and crops by farmers?

The study was based on the key assumption that on-farm maintenance of a high diversity of crops provides or supports the sustainable use of agricultural biodiversity. The study recognized the need to consider plant biodiversity in agriculture in the context of wider ecological system and accordingly, paid due attention to all other aspects of agricultural biodiversity in agricultural ecosystem; soil organisms, trees, livestock, etc. and the interactions between these components and plant biodiversity.

Historical Development of Plant Biodiversity Conservation for Food and Agriculture

Up until the last decade or so, international scientists generally believed that the best way to conserve plant biodiversity was to collect samples from farmers' fields and preserve these in national and international `gene banks'.

It is now realized that this approach is inadequate for at least four reasons[1]:

- gene banks cannot `store' the farmers' knowledge and experimentation that creates and maintains agricultural plant diversity, so this vital dynamic component of agricultural plant diversity is missing in gene bank collections;
- Gene bank storage is relatively expensive and risky. For example, seeds in gene banks are generally stored in cool conditions, which requires special equipment dependent on power supplies: if there are power failures, the seeds can be irretrievably damaged;
- it is often very difficult for ordinary farmers to obtain seeds from gene bank collections, as the individual seed samples are usually small (the seeds are not intended for general distribution), and the gene banks may be far away;
- Gene banks cannot store all plant biodiversity from a given area or ecosystem, so they tend to focus on material which is easy to collect; remote and rare material may be missed out.

So instead of relying on conservation in gene banks (often referred to as *Ex Situ* conservation), many people now promote `conservation through sustainable use'. There is of course still an important role for gene banks, but it is more limited for the reasons outlined above. Therefore, the general consensus of opinion is that we must now also encourage and support conservation through sustainable use in farmers' fields (also referred to as *In Situ* or on-farm conservation).

In Situ conservation is promoted in the *Convention on Biological Diversity*, which 174 countries, including Kenya have ratified. In this Convention, the world's governments promise to conserve biological diversity, to make sure that it is used in a sustainable way, and to share out the benefits of using biological diversity fairly to everyone. Box 1 [or

[1] For more on this, see van Hintum, 1994.

Annex A] summarizes the key decisions regarding agricultural biodiversity made by the Conference of the Parties to the CBD over the years[2].

In Situ conservation also forms a significant part of the *Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture*, which was formulated by the FAO International Conference and Programme on Plant Genetic Resources and agreed in Leipzig in 1996. This provides a detailed 20-point global action plan for the conservation of biodiversity in agricultural plants: see Annex B[3].

Finally and most recently, people have recognized that *In Situ* or on-farm conservation should take into consideration the whole ecological system in which farmers are farming. This is because agricultural biodiversity includes not only genetic and species diversity but also diversity of agro-ecosystems as a whole[4].

An ecosystem consists of a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit. Thus agro-ecosystems need to be considered at several levels or scales, for instance, a leaf, a plant, a field/crop/herd/pond, a farming system, a land-use system or a watershed. These can be aggregated to form a hierarchy of agro-ecosystems. At a higher level still, the full assemblage of ecosystems constitutes the global biosphere.

ABC Research Outputs

The quantitative and qualitative data from the ABC project fieldwork, combined with information from secondary sources, was used to:

- identify the actions farmers take to maintain on-farm agricultural plant diversity;
- identify the core constraints to on-farm agricultural plant diversity conservation and sustainable use at individual household and at community level;
- identify supportive actions that could be taken at community, national, and international level.

Methodology

For this study, Kenya was one of the countries selected where many farmers still actively manage a relatively wide range of agricultural biodiversity on-farm, and where Intermediate Technology Development Group (ITDG) has active programmes relating to food security and sustainable agriculture. the research focussed on experience in what

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[2] For more information on the CBD, see the Convention website www.biodiv.org

[3] Copies of the Global Plan are available from www.ICPPGR@FAO.ORG

[4] For more on the ecosystems approach, see the report on the international workshop on opportunities, incentives and approaches for the conservation and sustainable use of biological diversity in agriculture, held 2-4 December 1998 in Rome, Italy (available from CBD website, as above).

are often called the `marginal lands'[5] for two reasons. First, these areas have characteristics, which support a higher level of agricultural biodiversity, such as low levels of biomass harvesting, crop chemical application, and mechanization, and a diverse landscape[6]. Second, these areas make up a significant percentage of total agricultural land in many countries in the South:
The focus of the ABC Project was on collaborative research involving all relevant stakeholders at local and national level as partners in the information collection, analysis and interpretation process. Country level stakeholders included case study communities and their representatives; local and national level government officials with responsibility for agricultural policy and planning; and staff of non-governmental agencies working on agricultural plant diversity issues at local and national level.

To this end, the Project discussed the research objectives and approach with case study communities at sensitization meetings held before work began, to establish that communities were willing to participate in the research.

Site Selection

The ABC project was implemented in Gikingo and Maragwa Locations, Tharaka District, Kenya- all areas where Intermediate Technology Development Group has good working relations with farmers, and that are representative of `marginal' agricultural lands

`Marginal' is the term used by the UK Department for International Development Environment Research Programme to describe agricultural areas that are less suited to the commercial production of cash crops. However, these areas provide the livelihoods for a significant proportion of the world's farmers and tend to have higher agricultural plant biodiversity on-farm than more commercial agricultural areas, hence are highly relevant for this project.

Two sites with reasonably similar agro-ecological conditions were, selected. Each site included between 20-30 villages as shown in Box 3. Within each site, households were selected to represent variation in the factors assumed to influence on-farm agricultural biodiversity: distance to local market centres; soil quality; and cultivated area[7].

Box 3: site selection

Tharaka District
30 Units (villages) in Maragwa Location
21 Units (villages) in Gikingo Location

[5] Arid and Semi-Arid Lands (ASAL) in Kenya, Natural Regions IV and V in Zimbabwe, and IT-Peru
[6] For more on this, see Edwards, et al pp. 192-200 in Wood and Lenne (1999).
[7] Parameters to define the range in these factors were identified by farmers separately in each country and are defined later in this report.

Focus Crops

In order to keep information collection and analysis manageable, it was decided to focus the Project on the on-farm conservation and sustainable use of diversity in a limited number of crops. The criteria used for focus crop selection were that they should:

- Play a significant role in local farming systems in the case study areas;
- Retain significant genetic (i.e. within-crop) diversity within the case study areas.

It was decided to focus on sorghum (*Sorghum bicolor)*, pearl millet (*Pennisetum vulgare)*. Cowpeas (*Vigna unguiculata)* and gourds were also studied because, whilst they may not play a significant role in local farming systems, diversity is keenly preserved for cultural and social reasons: it was therefore felt that studying them may provide useful insights.

Field Work Tools

The Project set out to answer the research questions set out in Chapter 1 by using a mixture of participatory rural appraisal (PRA); individual household questionnaires; focus group discussions; and seed sampling. Fieldwork was spread over 18 months to two years

PRAs were conducted at village level at each case study site to gather information on the topics outlined in Box 4, in order to provide general background to agricultural plant diversity use in the area and to set the scene for subsequent household interviews. The methods used included mapping, brainstorming, scoring, ranking, flow diagrams, transect walks and time trends in detailed group discussions, key informant interviews, and direct observation. As PRAs on general community resource issues had been conducted relatively recently in a number of the sites, secondary information from these PRAs was also incorporated where appropriate.

Box 4: Topics covered in PRAs in case study villages

- **Village resource map**, showing types of land, boundaries, physical and infrastructure features.

- **Farming practices**: soil fertility management, planting systems, post-harvest processing and crop storage, sources of seed, availability of wild fruits and food.

- **Crops and varieties grown**: lists of crops and varieties grown; for what purpose (food security, income, etc); reasons for growing a number of different crops and varieties.

- **Biodiversity time line**: factors affecting biodiversity over time, and local variety history, including the time and means of introduction of key varieties in the area.
- **Key criteria** (see *First round interviews* below): community definitions of large and small-cultivated area; good and poor quality land.
- **Seed specialists**: key informants within the village on seed keeping and maintenance of agricultural plant diversity (farmers known for their specialist skills in seed care)

Individual household interviews

The purpose of the individual household interviews was to be able to compare the impact of the three different influential factors on the management of agricultural plant biodiversity by households within countries and also between the three case study countries. To what extent are these different factors important; and in what way do they influence agricultural plant biodiversity management?

In this section, we outline three key issues in agricultural plant diversity conservation that require further research and the experience of other researchers and projects in dealing with them. The first question is; is agricultural plant diversity important to farmers?. The second question is; what skills and techniques do farmers have for managing agricultural plant diversity? The third question is; the impact of national policies and programmes.

Is agricultural plant diversity important to farmers?

It has sometimes been suggested that conserving agricultural plant diversity and using it sustainably does little to contribute to farmers' immediate livelihood needs, and therefore farmers cannot be expected to give high priority to agricultural plant diversity conservation, especially if this carries costs to the farmer.

The evidence so far is that many farmers in the South *do* value having agricultural plant diversity in their farming system, and in fact complain that they do not have enough. For example, this has been the experience with millet farmers in Rajastan, India; with sorghum and millet farmers in Zimbabwe, and with sorghum farmers in Tharaka, Kenya[8]. This is for a mixture of economic, socio-cultural and environmental reasons.

However, the evidence so far also suggests that farmers do not simply conserve the same collections of plants year after year like a gene bank. Rather, they adjust the mixture of plants they use all the time - one researcher therefore describes farms as `dynamic

[8] For more on this, see Woods and Lenne, 1996; Witcombe et al, 1998; and Cromwell and van Oosterhout, 2000.

conservation reserves'[9]. These adjustments can be in response to market prices, climate changes, etc.

What skills and techniques do farmers have for managing agricultural plant diversity?

The evidence so far[10] is that agricultural plant diversity is affected by five aspects of farmer decision-making: what morphological characteristics to select for (note that farmers cannot distinguish molecular characteristics); what farming practices to use; where to plant; size of population to plant; and seed source(s).

We do know that farmers vary in how they manage agricultural plant diversity. For example, according to the 1998 *State of the World's Plant Genetic Resources* report[11], some potato farmers in Cusco, Peru, manage 150 varieties; whereas in Iringa, Tanzania, no farmer maize varieties are maintained any more.

The International Plant Genetic Resources Institute (IPGRI) project *Strengthening the Scientific Basis of In-Situ Conservation*, involving 9 countries, will hopefully tell us more about the biology and socio-economics of the use of farmers' varieties. In particular, the project hopes to synthesize information about how to counteract the economic and other forces that contribute to the loss of farmers' varieties[12].

The impact of national policies and programmes

There is some research evidence available that suggests national policies and programmes have a big impact on how farmers use agricultural plant diversity. However more work needs to be done to identify exactly how these policies and programmes could be adjusted to make them more supportive for on-farm conservation of agricultural plant diversity.

For example[13]:

- **input subsidies** and **rural credit programmes** are usually tied to seeds of `modern' varieties and chemical inputs, which pushes farmers to use these inputs instead of using agricultural plant diversity to sustain their agricultural systems;

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[9] Louette et al 1997.

[10] Jarvis and Hodgkin, 2000.

[11] FAO, 1998.

[12] Devra Jarvis at IPGRI, Rome (d.jarvis@cgiar.org), is managing this project.

[13] This list is taken from Cromwell and van Osterhout (2000) based on experience in Zimbabwe, but similar experiences have also been documented in a number of other countries.

- policies that promote the **cash economy** and **modernization** push farmers to simplify their farming systems, including agricultural plant diversity, in favor of selling crops in the market to buy factory-made goods;
- **drought relief hand-outs** often only contain seed of `modern' varieties of the main crops, which makes it very difficult for farmers to maintain biodiversity of local crops and minor crops after a drought;
- Countries often want to sign up to **international agreements** like those under the World Trade Organization in order to get trade benefits, but this can also require them to sign up to intellectual property rights systems that could jeopardize local communities' rights to protect and develop their indigenous agricultural biodiversity.

Conclusion and Recommendations

Farmers need support that releases them, especially women farmers from time consuming reproductive workloads such as grinding by use of stones and mortaring the maize so that they can spend more time on activities that promote conservation of agricultural biodiversity.

National governments and the international community should make conservation of agricultural biodiversity the top priority not only ex-situ but also on farms (in-situ).

A measure that recognizes and protects farmers from activities that denies them the rights to control and own their traditional knowledge and agricultural resources such as seeds.

Protection from processes that make small-scale farmers to be dependent on seed companies.

Measures that ensure benefits to communities of small-scale farmers involved in maintaining agricultural biodiversity.

Extension activities to provide forums such as seed fairs for farmers to disseminate their accumulated traditional knowledge on agricultural biodiversity."

Build capacity of organization and farmers to enable protection of indigenous knowledge, through training and provision of resources.

Strengthen community capacity and build indigenous knowledge in agro-biodiversity management and strengthen seed exchange mechanisms at community level. These include traditional medicine, seed specialists, herbalists and paravets.

Promote farmer's initiatives in diversity management through incentives

Support disadvantaged groups (women and youth) who play a major role in diversity management through trainings and provision of resources

Regular awareness workshops should be held for the local communities on indigenous knowledge, farmer' rights and other issues which affect the agricultural production and may hinder sustainable use of plant genetic resources for food security

Coordinate and integrate National policies, strategies, programs and action plan at all levels in order to enhance conservation and sustainable use of agro-biodiversity.

Part 2

Community based Tsetse Control

The Intermediate Technology Development Group- East Africa (ITDG-EA) is facilitating the implementation of a community based tsetse control project-the Kathekani Mbung'o initiative. The initiative is funded by DFID through the Kenya Trypanosomosis Research Institute (KETRI) to enhance the capacity of Kathekani community to sustainably control tsetse through transfer of the KETRI developed technologies, specifically tsetse trapping technology. The Mbung'o initiative is being implemented within the framework of ITDG's on-going food security work- the Marginal Farmers Project which is funded by DFID-JSF and the European Union (EU).

Kathekani area is a marginal farming area in agro-ecological zone 5 and 6. The area borders Tsavo East National Park. The park is a suitable habitat for tsetse flies because of the presence of wild ungulates, particularly the buffalo. The tsetse flies re-invade Kathekani area causing a lot of harm on livestock. Tsetse flies bite livestock and transmit nagana (trypanosomosis) disease. The damage caused to livestock production by tsetse flies and nagana is ranked top livestock problem in Kathekani. Tsetse re-invasions and transmission of nagana threatens livestock production-an important source of food and income for about 3,500 households (about 7 members per household).

By the beginning of this project in December 1999, livestock numbers had been drastically reduced due to disease rather than drought (Fiona Percy, Kathekani baseline report, 1996). This resulted in the need for food relief almost every year. A review of the MFP has revealed that, the community has been able to control the tsetse numbers and they have been reduced from 1000 per trap in 1997 per year to 100 in 2000. This has encouraged the community to introduce more livestock.

The purpose of the initiative is to increase livestock production for farmers in Kathekani through reduced incidences of tryponosomosis. To achieve this purpose the Kathekani Mbung'o project seeks to accomplish the following objectives;

- Establish community capacity for sustainable control of tsetse flies through transfer of tsetse-trapping technology;
- Reduce incidence of tsetse flies and therefore tryponosomosis;
- Increase national and international actions for supporting transfer and wider uptake of tsetse control technologies;
- Develop participatory approaches of community tsetse control; and

- Develop appropriate monitoring and evaluation systems of community based tsetse trapping technology.

The intervention of ITDG-EA/MFP in tsetse fly control in Kathekani has brought about significant reduction in the number of tsetse flies and incidence of trypanosomosis. The reduction is leading to the revival of the livestock industry that had virtually collapsed. The complementary activity of decentralised animal health that trains and equips community based animal health personnel will play a big role in the revival of the livestock industry. It is evident that this intervention is bearing fruit. There is a wide range of technological innovations and adoptions in the project sites. These include: livestock breed improvement; animal feed improvement; intergration of ethnoveterinary knowledge into animal health care system; revival of cattle dips; adoption of drip' furrow and pump irrigation; soil conservation; adoption of drought tolerant short cycle crops and apiculture.

The intervention has focused on institutional development and technological development. Committes have been set up to co-ordinate and plan the Mbung'o (tsetse fly) project activities. There are three main committees: village committees, locational committees and Mbung'o Central Committee (MCC).

The major outcome that was anticipated of tsetse fly control is increased livestock production due to reduced incidence of nagana that has previously led to heavy losses of livestock (Omwega 1999). Benefits related to improved livestock health and production include:

- Increased milk production for better family nutrition and sales accruing to women;
- Increased market sale price from healthy and higher sale weight of the animal;
- Increased numbers of livestock' therefore more income opportunity;
- Savings on treatment and tryps prevention costs;
- More land, previously highly infested with tsetse flies released for grazing;
- Increased local supply of meat to butchers and improved cash economy; and
- Improved long term security through investment in healthy herds.

If the above benefits are realized and sustained, it can be anticipated that poverty will be reduced in the long run. The evaluation of this project revealed that there are already some gains. Respondents to the interviews reported that they are no longer bitten by tsetse flies on their way to fetch water. Most respondents indicated a willingness and rediness to restock cattle even though they had previously lost their herds due to tsetse fly-related diseases.