PLEC NEWS AND VIEWS

NEW SERIES NUMBER 4

MARCH 2004

PEOPLE LAND MANAGEMENT AND ECOSYSTEM CONSERVATION

A joint publication of the United Nations University and the Department of Anthropology, Research School of Pacific and Asian Studies, ANU

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Agrodiversity: scales and values

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As members of PLEC we tend to hear complaints from most smallholder farmers that currently it is hard to make a living by producing crops. Farmers mention that these days what they produce buys less and less sugar, salt, medicines and other household goods. Data collected by PLEC members in the last five years demonstrate that farmers' crops are falling in value; they are not producing less. PLEC-Peru researchers, for instance, have found that in 1995 the families of the Muyuy Sector could buy two kilograms of sugar, a litre of cooking oil and a kilogram of salt with what they gained from selling a bunch of plantain. In December 2003, the same families needed to sell three bunches of plantain to buy the same amount of sugar, cooking oil and salt. These are just some of the data that PLEC can provide to the experts and policy makers who design and implement development and conservation programs. Based on PLEC results we believe that the fundamental challenge for developing countries is not only to increase food production but also to protect the value of what poor farmers are producing. How can agriculture be economically attractive for smallholders? How can the livelihoods of the rural poor improve and ecological vulnerability be reduced in developing countries when industrially produced and cheap grains and other staples are increasingly supplying markets? Are most rural development experts looking at the problem in the best way?

During the last year PLEC members have participated in a series of international, national and regional events that were organized to find the answers to these questions. Most of what was discussed in the meetings was related to increasing food production. We brought to these meetings the complaints of smallholder farmers from twelve countries about the decline in the value of their products, and the dismissal of their production technologies as incapable of meeting

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national goals. Lessons learned in the last five years tell us that smallholders are not simply waiting for somebody to come and solve their problems for them. They are capable of finding their own solutions and solutions they find are as diverse and complex as the socio-economic and political factors that are leading to the losses they are suffering. Their responses tend to fall into several categories; we found two main types of strategies used by smallholders in the twelve countries where PLEC works.

Smallholders are diversifying the crops that they produce and manage in their land holdings in order to make a living in a globalized world where they cannot compete economically with products of 'high tech' industrial agriculture. Farmers in Kenya are responding to the collapse of coffee prices by producing a host of items from vegetables to wood products. Similarly, farmers in Northern Thailand are selling a variety of wild vegetables to make up the income that they lost when the prices of fruits fell precipitously. The large number of contract farmers that have worked for generations in banana plantations in Jamaica and who lost jobs when plantations collapsed are making their living by planting and selling a great diversity of crops including spices, vegetables and fruits. Such smallholder ingenuity in diversifying the crops as alterative income sources is still rarely understood or appreciated by most policy makers and agricultural experts.

Another important class of strategies used by smallholders to deal with the loss of value of their products is diversifying the activities they engage in, or shifting sharply the emphasis they place on particular activities in their broad repertoire of skills and resources. The patchy production landscapes that characterize the land holdings of many poor farmers give a hint of how income sources can change. The truth is that smallholder farmers are also foresters and fishers, livestock producers and wage labourers. PLEC farmers in Brazil have reworked their land holdings to produce timber where once they produced cassava and bananas. When prices of their agriculture crops are very low in the markets, farmers may migrate temporarily, either geographically and/or economically. Such a strategy explains why many smallholders maintain varied patterns, with their household activities and incomes depending on a wide number of resources that are planted, managed and conserved in fallows, forests, edges, streams and other land units that constitute the entire production landscapes. Wage labour is an important source of income for smallholders throughout the world, in both developed and developing countries.

Smallholder agrodiversity strategies have proved to be effective in dealing with widespread declines in the value of agricultural products, yet they continue to be underutilized by most programmes that aim to reduce rural poverty, environmental degradation, erosion of biological diversity, and other problems affecting rural communities. This diversity crosses the sectoral lines of government bureaucracies, as well as of many NGOs. Forestry, agriculture, and fisheries are often assigned to different experts, or to different ministries. Reluctance on the part of the development and conservation communities reflects not only unnecessary dichotomies among production sectors but also inappropriate dichotomies between what is modern, productive and dynamic, and what is traditional. The failure to consider and work with poor farmers' strategies for dealing with changes in prices of their agriculture products, may stem from a view of local practices as low-yielding, antiquated and inadequate in the face of economic, social, and environmental change. Smallholders in the twelve countries where PLEC works have shown they can deal effectively with changes produced by unstable markets, shifting national policies and global trends, as well as with environmental fluctuations. While the issues associated with increasing food production are important, the emphasis on this goal alone offers very limited chances for finding answers to the complex questions of how to improve the livelihood and environment of millions of poor people in developing countries. PLEC continues to find that answers lie within households, villages, and the farmers' own organizations.

Cover photo: Coffee agroforest at a demonstration site in Guinée

Papers

Indigenous knowledge and rural livelihood improvement

Fidelis B.S.Kaihura[1]

Introduction

PLEC has compiled a large amount of information about farmers' production methods, change in their production systems, and the ways they manage their resources for increased outputs (Brookfield et al. 2003; Kaihura and Stocking 2003). Most farmers use locally developed resource management practices to work their farms to feed their families and send their children to school. While many science-based resource management technologies have been developed for tropical areas, only a few are adopted by smallholder farmers. Most scientists spend some time observing farmers if not learning from them, but only some develop technologies based on the indigenous management models they have observed. Moreover, they usually ignore direct interactions with farmers regarding the best ways to develop these models. Others develop completely new technologies outside the local environment of the immediate users and bring them to farmers for adoption. Scientists also often believe that most of what farmers do is inferior and that what the scientists develop for them is superior. For example plant and animal breeders still believe that taking into account farmers' criteria for developing improved breeds or management models is simply perpetuating poverty. The indigenous knowledge that farmers have lived with is either ignored or modified without consultation.

On the other hand farmers, who some scientists call ignorant, may test introduced technologies and find some of them less effective than their own developed technologies. They silently or openly ignore the introduced technologies and continue to work with their own methods. Scientists often think farmers are difficult to understand. These differences between farmers or rural communities and the scientific community make rural livelihood improvement very slow. Scientists and other change agents have failed to recognize the role of indigenous knowledge and practices in rural development. Worse still, the precious indigenous knowledge that is currently in the hands of the elderly is gradually being lost as the elderly pass away. The young generation who should inherit and improve indigenous models from their parents and grandparents are less interested in rural life. They migrate to urban areas in search of quick turnover labour-selling jobs. Yet we continue talking about developing rural communities. Is it likely to happen?

This paper argues that despite continued national and international efforts to eradicate rural poverty, this cannot be achieved unless farmers' knowledge, preferences and practices are recognized by all scientists and taken into consideration when developing improved technologies. Farmers should be the agents responsible for change. Conditions that would attract the younger generation to stay and invest in rural livelihoods have to be developed if sustainability in rural development is to be achieved. Examples of soil and crop improvement from two Sukuma villages, Ngudama and Buganda, near Mwanza, Tanzania are presented. Indigenous knowledge has not been integrated fully into currently developed technologies, and nor, in these communities which are situated very close to the research station, has research knowledge been fully integrated into farmers' technologies.

Methods of improving the fertility of poor tropical soils

Most Tanzanian farmers depend on the natural fertility of their soils and use indigenous methods of soil fertility management centred on organic matter and green manure. Methods include incorporation of weeds before planting, mulching and other forms of biomass application. Inputs are the immediately available resources. Unfortunately they do not have sufficient nutrients to support the desired yield while maintaining fertility for future production. Other forms of indigenous technology include burning and incorporation of ashes, breaking anthills and spreading them before planting, heaping or composting and applying household refuse before planting. Kaihura et al. (1999a; 2001) observed more than 47 indigenous soil management practices in Arumeru District. Most of these methods are inadequate to support desired production.

In order to improve soil fertility, industrial fertilizers were introduced. Industrial fertilizer use is still demonstrated through on-station and on-farm experiments and through political sensitization speeches. Fertilizer recommendations

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were also developed for different soils and crops in the 1980s. Yet fertilizer use remains wishful thinking for most farmers. In 1993 for example, we developed fertilizer recommendations for different soils and crops for the 63 Agro-ecological Zones in Tanzania (Mowo et al. 1993). Follow up studies on the adoption of the established recommendations indicated that only research institutions working on agronomic research were using them (Kaihura 1994). In areas where these recommendations were demonstrated to farmers, they were still not adopted despite giving higher crop yield responses compared with farmer practices. One problem with the use of industrial fertilizers is that the majority of farmers cannot differentiate between sulphate of ammonia, calcium ammonium nitrate and urea as sources of nitrogen, and nor do they know the nitrogen content and ways of efficient use of each. Application rates are usually given in kg/ha which is very difficult for farmers to interpret. To make the situation worse, several of extension staff also have problems interpreting information about fertilizers and their use. Even if farmers could afford to buy them, efficient use would still be a problem. Consequently, introduction of fertilizers has not met the national objective of increasing production of food and cash crops.

Despite low nutritional quality of weeds and other forms of biomass that farmers readily incorporate in the soil, they have many other intended effects that improve production. Besides supplying nutrients, organic inputs sequester carbon, improve the organic matter content, improve the capacity of the soil to hold nutrients and improve the water holding capacity. All these attributes are crucial for improving nutrient availability to plants and the quantity and diversity of soil flora and fauna. With improved soil organic matter, the rate of soil loss through erosion is reduced. Experiments with farmyard manure application have indicated that yield response is in most cases well noticed in the second year after application, has residual effects for three to five or more years (Ngatunga et al. 1998), and improves the pH of acid soils (Kaihura et al. 1999b; Mowo 2000).

We are aware that integrated soil fertility management approaches of combining organic and inorganic inputs are currently being sought to address soil fertility improvement (Defoer and Hilhorst, 1995). But even with these efforts few or none of the indigenous shrubs and trees used by farmers for soil fertility improvement, like *mihumura (Maesopsis eminii),* are being tested instead of the exotic species like Sesbania and Caliandra. It may make a difference in adoption rates if indigenous shrubs and trees familiar to farmers were tested and improved

Indigenous soil nomenclature in Sukumaland

The Sukuma nomenclature of soils is a typical example of indigenous knowledge that if studied and improved could help in achieving sustainable use of the soils in northwestern Tanzania. While many African smallholder farmers lack a clear understanding of types and qualities of their soils, Wasukuma people have for a long time developed a classification system that takes into account both soil characteristics and the associated land use. Potential and weaknesses of different soils along a catena are reflected in a unique and rich indigenous soil nomenclature (Ngailo et al. 1994). The Wasukuma soil names imply association of soil characteristics with suitability for crop production. *Mashikaranga*, for example, means soils best for growing groundnuts where Karanga means groundnuts. *Itogolo* means soil not good for cultivation and was in former days assigned to communal grazing.

Milne (1947) reported that the naming was based mainly on soil depth, workability and susceptibility to water logging. Acres (1984) indicated that the local terminology of the Wasukuma had much practical relevance and was completely in line with the concept of soil series as developed in the USA. Milne (1936) first described the Sukuma catena in the legend of his provisional soil map of East Africa, following the toposequence from the ridge crest to valley bottom. Ngailo et al. (1994) described the catena as containing three soils, relating the Sukuma names to scientific classification: *luseni* (Eutric Regosols, petroferric phase), *itogolo* (Calcaric Phaeozems, sodic phase) and *mbuga* (Calcic Vertisols, sodic phase). A detailed description of the soils along the catena was undertaken later using both the FAO-ISRIC-ISSS scientific guidelines (FAO 1998; Kaihura and Mulengera 1999) and local approaches following a transect along the toposequence (Hatibu et al. 2000). [2]

The most important criteria used by farmers to categorize soils include colour, fertility status, workability under dry and moist/wet conditions, suitability for certain crops, physiographic position along the toposequence, water movement through the profile, and (in rare cases) previous use (e.g. man-made soils on previous settlements or location of a cattle kraal). In January 2004, the author attempted to compare local and scientific classification and determine to what extent local classification can be used and combined with scientific classification to reduce the high costs of scientific analysis. Table 1 summarizes the soil names according to Wasukuma nomenclature following discussions between farmers and the author in January 2004.

Unlike in Arumeru where soil names and soil uses are known only to the elderly, farmers of all ages in Sukumaland are aware of soil names and uses. Farmers know which soils are fertile and which ones are not. Most Luseni soils are, for example, known to be infertile. They were formerly assigned a crop of cassava, valueless in the old days, although valuable today. Production was and still is without inputs. At that time millet was the most valuable crop and was assigned to the more fertile soils. It is tolerant of dry conditions, and one of its many purposes is making stiff porridge (*ugali*). It was known as 'the rice' of Wasukuma before modest irrigated cultivation of paddy

2. The Wasukuma system is comparable with the Fulbe (Fulani) system in the Fouta Djallon of Guinée (Boiro et al. 2003)

Table 1. Soil names along the Wasukuma catena, their characteristics and land use.

Soil name	Slope position	Characteristics	Land use
Luguru/Itongo soils (Nduha, Ikurusi, Luseni)	Crest	Luguru or Itongo refers to location than the soil name. Includes different dry upland soils at the crest of a toposequence	A fenced enclosure of different soils, fallow and non fallow crops, rock outcrops (matumbi), reserve pastures and natural woodlots at the crest of a hill is termed Igoobe land use system. For different soil types, different crops tolerant of moisture stress and low soil fertility (e.g. cotton, millet, cassava, sweet potatoes, sorghum) are grown.Shigulu and shulughu are manmade soils.
Nyalala/ Shinyere/Ilago	Upper slope	Nyalala refers to a permanently wet place. Shinyere refers to a place where water is coming up from underground, while Ilago is a description for a wet place. They are deep to very deep greyish sandy soils with very low fertility and typically poor drainage vegetation	Previously Ilago was mainly for rice growing. Other crops included sweet potatoes, sugarcane and bananas. Later rice moved to Itogolo soils leaving rice seedling nurseries on Ilago. Other crops include maize on raised ridges and sweet cassava
Itogolo (Mashikaranga, Ibambasi, Ikerege)	Very gentle middle and lower slopes	Dark grey sandy clay topsoils that are hard when dry and soft when moist, and massive and compact clay subsoil. Sometimes forms small cracks. Ibambasi and Ikerege are hard setting soil inclusions	Itogolo is open communal land. Grazing along the middle slope and wetland rice on lower slopes using bunded fields (majaruba), cotton on broad beds or ridges. Maize is normally limited by sodicity and impeded drainage
Ibushi	Lower to toe slope	Very deep and grey silt clay soil, with moderate fertility and texture similar to shilughu and mbuga, sticky when wet and friable when dry	Local tobacco, sorghum, and potatoes. Due to problem of salts potatoes is limited
Mbuga	Bottom lands and valleys	Very deep black poorly drained deep cracking or self mulching clays. Have very narrow moisture range for easy tillage and impeded subsurface drainage	Cotton on cambered beds (black cotton soils). Maize with drainage channels or in bad years, rice on ridges/raised beds, dry season chickpeas dependent on residual moisture and cattle grazing

rice became popular, and because it was sweet and could easily make good porridge without sugar. The different types of soils along the toposequence and associated crops in Sukumaland today form the basis for the observed traditional resources management that PLEC has termed 'agrodiversity'. If this rich knowledge was well studied and improved, current farming systems would have improved and the life of the rural communities of Wasukuma with them.

Farmer desirable rice and cassava varieties

Sukumaland is part of northwestern Tanzania, covering Mwanza and Shinyanga regions. It is dominantly semiarid with average rainfall not exceeding 900 mm annually. Most of the area is covered by sandy soils that are inherently poor in both physical and chemical fertility. Crops grown in the area are those tolerant to drought conditions and include cotton, sorghum, millet, cassava and sweet potatoes. Rice is grown on hardpan soils and clay soils in valley bottoms and plains. The research station at Ukiriguru works towards improved varieties for most crops in the area. Cassava for example has been under development for more than 20 years followed by sweet potatoes. The work on improving rice production started about seven years ago.

During the 2002/03 growing season the author visited some farmers in their rice fields at harvest time. These farmers are in the adjacent villages of Ngudama and Buganda, which are very close to the Institute. The objective was to discuss with farmers the types of rice varieties they are growing and register the spread of research-developed rice varieties in the village. The discussion was extended to cassava and sweet potato varieties. For rice, a total of 21 varieties were found grown by the 22 visited farmers. Out of the twenty, three were obtained from the research station. The improved varieties included Supper and Supper hybrid 85 and 88. Many of the local varieties in Buganda village were from different parts of northwest Tanzania. In an earlier survey in February 2002, 60 varieties in five rice-growing districts in Mwanza and Shinyanga regions were identified (Lussewa, personal communication), and 21 of them were found in Ngudama village.

Farmer preference criteria for different rice varieties was a lot wider than those considered in most plant breeding programmes for increased food production. While scientific breeders address increased yields, drought tolerance, pest/disease control and duration to maturity, farmers consider additional factors which include diverse uses of rice (cooking, making buns, making pastes, etc.), long storage without losing flavour, tolerance to moisture stress or long stagnating water, amount of cooking oil required and lodging. Table 2 summarizes these characteristics for some of the identified varieties. Some local varieties were known to researchers (with germplasm in stock) while others (with star) were new. Varieties at the research institute that were not possessed by farmers included Subarimati and Ngadija. Efforts are under way to interact more closely with neighbouring rice growers and involve them in the selection of varieties to include in the breeding programmes at the research institute. It was noted that despite efforts of research to bring in new varieties (Table 3), farmers individually have parallel efforts to improve the diversity of their rice varieties by collecting and growing 15 new varieties.

Table 3 Improved rice varieties distributed by researchers

Variety	Characteristics
Subarimati	High yielding, palatable with aroma, single grain rice when cooked, early maturity and does not lodge.
Ngadija	High yielding, withstands stagnating water, tall plants and easy to harvest.
Supper India	Tolerant to moisture stress and with similar cooking qualities to Subarimati.

Cassava

Cassava is a favourite food crop for Wasukuma. They may eat other foods like rice, but cassava *ugali* is considered a good and heavy meal. Cassava flour may sometimes be mixed with maize flour to change the colour, flavour and stickiness of the *ugali*. Looking around in the same village of Buganda, 13 varieties were found with characteristics indicated in Table 4.

Most of these local varieties have been collected to create a breeders' germplasm bank. Msongoma variety, for example, is tolerant of cassava mosaic virus (CMV) and is being multiplied for wide distribution. With a clear understanding of farmer-desirable characters in food crops, researchers have recently started looking around to collect desirable

Table 2. Diverse rice varieties grown by farmers in Buganda village

Rice variety	Characteristics
Kilombelo	Ripens earlier than other varieties like Supper, high yielding per unit area, cooks well even without adding oil, good for making vitumbua (rice buns)
Katani*	Cooks well, can be used to make rice or ugali and flour is similar to maize flour, good for making vitumbua, provides a lot of energy when eaten, good flour, needs a lot of water for high yields
Kalolo*	High yielding, used for ugali and vitumbua, not good as cooked rice as it is not sweet unless there has been a lot of rain
Sukari sukari*	Early maturing, high yielding and sweet. Needs little cooking oil, easy to mill using the kinu[1] , women prefer it for its low demand for machine milling.
Kalamata*	High yielding and recently introduced from neighbouring districts
Moshi*	Good aroma on the plate and good smell in the field, sweet, single grain, very tall tillers, drought susceptible, compares with the favourable Tule na Bwana variety of Morogoro
Kahogo	Good grain colour, high yielding, sweet and requires very little cooking oil
Kanada*	High yielding, still under test; introduced this season
Malomo gambiti*	High yielding and newly introduced
Tuliani/Supper	High yielding, early maturing, sweet and requires less cooking oil
Supper hybrid 85 and hybrid 88	High yielding, matures in two months, sweet with little cooking oil requirement
Tondogoso	Higher yields than supper, requires little cooking oil, needs adequate water supply
Soga*	High yielding, good flavour, sweet, little cooking oil required but high water requirement
Rangi mbili	High yielding, good grain filling, good flavour
Pisholi*	Average yields, good flavour, low requirement for cooking oil, commercial variety
Sindano*	High yielding, good flavour, low oil requirement, not attacked by birds
Magigongava*	High yielding, good to eat, requires little cooking oil
Buholo*	High yielding with good milling qualities, maintains full grain after milling, good cooking qualities, very sweet with good flavour
Selemwa Moro*	Average yields, matures in 75 days, low grain weight with good flavour
Buruburu*	Red rice with poor commercial value, no flavour, not sweet, does not require oil for cooking and makes pasty/heavy cooked rice
Supper	High yielding, good cooking qualities and commercial value, most preferred variety
Kabudye*	Very high yielding with big grains, used mainly for ugali, needs adequate rainfall

[1] Kinu is a traditional wooden pestle used for milling rice, grinding groundnuts and mashing dried cassava into flour.

varieties for multiplication and distribution. Farm fields, however, are still dominated by farmer collected and developed varieties. Table 5 indicates cassava varieties currently widely distributed to farmers in the Lake Zone. These varieties principally address the problem of cassava mosaic virus currently wiping out cassava in most parts of northwest Tanzania and parts of neighbouring Uganda. Of these varieties only Liongo was found in Buganda village. The variety is prone to cassava mosaic attack but farmers still grow it and let nature make it extinct. It is a much-preferred variety for most farmers.

Ukiriguru Research Institute has bred and released potato varieties that are currently widely cultivated by farmers instead of multiplication and distribution of farmer's germplasm.

Table 4. Cassava varieties found in Buganda village near Ukiriguru Research Institute

Variety	Characteristics
Mwitamachela	Good taste, matures in one and half years, good roasted, boiled and for ugali, white peel with red leaves and stem
Ngalabuto	Good cooking and boiling qualities, sweet, matures in one year, whole plant is red
Kabuhaya	Good cooking and boiling, good for ugali and sweet chewing, matures in one year, whole plant is white
Msongoma	Makes good ugali, pest and disease tolerant, matures in two years, red peel with green leaves and stem
Lumala Mhunu	Good cooking and ugali similar to maize, matures in two years in fertile soil but up to five years in poor soil, tolerant of diseases
Kimbumba	Good cooking and milling, matures in one year, whole plant is red
Ngalabuto	Good cooking and milling, red peel and grey stem
Misitu	Good cooking and milling, matures in one year, entire plant white
Njem	Good cooking and boiling qualities, matures in six months, tiny dark green leaves and white peel
Mwana shija	Good cooking and boiling, matures in one year, green leaves and grey stem
Milalu	Good cooking, boiling and milling, matures in one and half years, white root, leaves and stem
Rangi mbili	Good cooking, and milling, matures in one year, grey leaves and white stem
Liongo	Good milling, matures in one year, high yielding, red stem and peel with green leaves

Table 5 Cassava varietiies distributed by researchers

Variety	Characteristics
TMS 4(2)1425 (Nigeria)	Tolerant of CMV, high yielding, early maturing, bitter (for ugali only)
TMS 81983	As above
TMS 60142	Tolerant to CMV, high yielding, early maturing, sweet (can be boiled)
83/01762(6) (Ukiriguru)	Tolerant to CMV, high yielding, early maturity, bitter (for ugali only)
Liongo Kwimba	Most preferred variety but susceptible to CMV. Currently discouraged by researchers
UKG 94/146	Tolerant of CMV, high yielding, early maturing, sweet (can be boiled)

Sweet potatoes

Sweet potatoes are among the major food crops of the Wasukuma. They are preferred mostly by women because they are easy to prepare and cook. They can be harvested and cooked piecemeal. They have a lot of starch and quickly fill the stomach, lasting well in the pot without spoiling and can be eaten at any time after cooking. Children who stay at home while parents are at work can feed on boiled sweet potatoes in their own time until evening meals are prepared. Sweet potatoes can also be left in the field for more than a season. If an entire field is harvested, they can be processed, by peeling, chipping into slices and sun drying, to make *michembe*, and then they can be stored for future use. As indicated earlier most Sukumaland soils are sandy and appropriate for sweet potato production. Table 6 summarizes some of the varieties grown by two farmers in Ngudama village.

Looking into farmers' criteria for variety selection of staple foods indicates that they go beyond scientific breeders and national desirable variety qualities. Farmers take into account primarily their own situation, like labour availability. For example, if a variety lodges at maturity, it would take a farmer more time to harvest and some of the harvest would be lost. Varieties that take too long to cook or which need a lot of cooking oil would cost them money that they do not have. They therefore prefer varieties that can be cooked without additives or spices yet maintain good flavour and taste, varieties that are multipurpose and address both household needs and income generation. This includes rice that can be cooked for food, buns, pastes, and *ugali* and which have attractive market prices.

Because of cash shortage, farmers and most women prefer milling the rice at home using local wooden pestles (*kinu*) instead of visiting powered milling machines that cost money. They go for varieties easy to mill whose grains do not break when *kinu* are used. In most cases local varieties occupy larger areas of farms than improved varieties. This practice frustrates scientists and national efforts to increase food production as few local varieties give high yields. With cassava, farmers consider tuber size, and multiple services like boiling, roasting, cooking, chewing and flour milling qualities. Some farmers like cassava because the roots can be eaten, the stem can be used as firewood when dry and the leaves can make soup for eating with *ugali*. Other criteria include taste of the root when chewing or as *ugali*. They also look at *ugali* quality — if sticky or similar to maize flour.

Table 6. Sweet potato varieties in two fields of Ngudama village

Varieties	Characteristics
Polyster **	Very sweet creeping variety, a lot of starch and can be eaten from 2 months after planting; last long in the field, stored sun dried slices fast attacked, high yielding, good for roasting, commercial variety
Tonic	Creeping, very sweet, less starch than polyster, high yielding, good for sun dried slices and chips
Njugu/Suguti **	Very big tubers but not as high yielding as above, upright stem, leaves used for soup, difficult to process as dried slices, attractive commercial variety
Bilagara/Dagaa **	Sweet moderate yielding creeping variety, low starch, good for chips, rots easily and needs early harvesting, only grown to occupy relatively small areas, leaves make soup
Ng'ikulu wabundaga bulogo	High yielding
Mwana'mulwa	Low starch, creeping, high yielding, good for making dry slices which store well
Mwejigumo	Tubers harvestable after one month, very long and big tubers, good for dry slices, best to eat when fully mature although can be eaten early
Mashashi	From Ushashi in Tarime, bears fruits from one month old, high yielding, good for dry slices and cooking
Sinia **	Similar to polyster, grows erect and later creeps, coiled tubers
Nhtale	Sweet yellow starch, sweeter than polyster, high yielding with coiled tubers, dry slices easily attacked in store.

** Varieties obtained from Ukiriguru Research Institute

For sweet potatoes multiple use is basic criteria. Varieties are chosen for boiling, roasting, and chewing qualities, and for eating the tuber as *ugali* and leaves as soup. Others qualities include market value, tuber size, ease of processing air-dried slices, length of period in the field before first harvest, ability to keep in the field without rotting, and ability to make long-storing dry slices. In recent years, farmers have been educated on eating yellow potatoes as a potential source of vitamin A, especially for children. Most of these other food qualities are ones that research has not bothered much to consider in the breeding programmes. They are the key reasons why farmers are sceptical of what research brings to them as 'improved' varieties or technologies. Indeed they are the reasons limiting expected speed in achieving national objectives of food security and poverty eradication in rural communities. Similar experiences were observed with beans, bananas and maize in Arumeru (Kaihura et al. 2000). Experiences from discussions with Ngudama farmers underpin the need to develop technologies that take into account farmers' knowledge, practices and preferences in order to fast realize desired rural livelihood improvement.

Conclusion

We have many examples where technologies developed by research and learning institutions are not being adopted by farmers in villages very close to these institutions. Most farmers maintain traditional practices without adopting improved technologies available from only a short distance away. Are we be able to transform the nation if the masses of neighbouring farmers are developing at such a limping pace? To answer this question, we have seen the role farmers play in enhancing and managing agricultural biodiversity and use their knowledge of soils and crops for their own livelihood improvement. We also notice that production risks due to uncertainties in production levels, access and availability of basic resources like labour and cash, and production limitations like land pressure make farmers develop intricate ways of managing resources. They do this for their own development and that of the entire community around them. This is one of the reasons why agricultural biodiversity is greatest asset in potentially fragile ecosystems and where people are poor. It is the evidence that addressing agricultural diversity or agrodiversity with farmers and on farmers own farms is actually perpetuating and improving indigenous knowledge and rural livelihood improvement. Real rural livelihood improvement can only be realized if outsiders respect farmers' knowledge and practices and build on it together with them.

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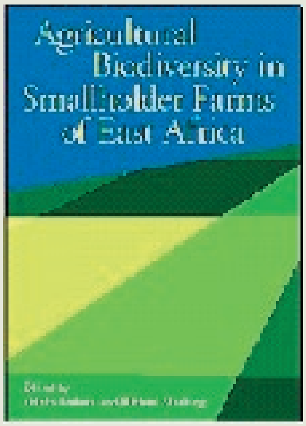
Agricultural Biodiversity in Smallholder Farms of East Africa

Edited by Fidelis Kaihura and Michael Stocking with over 30 contributors

ISBN: 92-808-1088-X Paperback 2003 304 pages US$32.00

This book documents how smallholder farmers of East Africa, in Kenya, Tanzania and Uganda, are playing their part in the global agenda for the conservation, sustainable use and equitable sharing of the benefits of biodiversity. The rich biodiversity of plants found on their farms is a storehouse of food, fuel, fibre, beverages and marketable produce, but also supports communities by producing a range of valuable resources from medicines to construction material.

Smallholder farmers are the guardians as well as the beneficiaries of a greater diversity of biological species found in protected areas. The farmers' diverse practices are conserving these species for the benefit of future generations. In turn, agricultural biodiversity is a primary way for poor farmers to cope with difficult biophysical environments and precarious social and political circumstances.



The United Nations University PLEC project, funded by the Global Environment Facility under the provisions for the Convention on Biological Diversity, is showing how the accumulated knowledge and experience of smallholders and their diverse practices leads to clear benefits for both biodiversity and society. This book draws on lessons learned from farmers, researchers, extension staff, policy-makers and aid agencies co-operating and actively supporting PLEC demonstration sites in East Africa. It shows the very real potential of learning from farmers and basing policy on tried and tested ways of managing complex agricultural systems.

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Reports

Ongoing activities in Guinée

Abdoul Karim Barry, Amirou Diallo and Ibrahima Boiro

This short report provides an account of how the PLEC demonstration sites have progressed since 2001.

Demonstration site activities

The core members of PLEC correspond regularly with expert farmers who have provided short reports on how the farmer associations are managing.

Cowsheds

The eight cowsheds built during PLEC 1 phase are still functioning. Another eight are under construction: two at Missidè Héïré, three at Goloya, one at Foulasso Beguia, one at Pellel and one at Niafouya. The former breeder Associations formed by PLEC are gathered with others to form a Breeder Federation of Bantignel. Twenty-one breeders have been trained in the management of animals and technical base by the Centre de Formation d'Élevage de Labé (CFEL).

Preparation of compost

Compost making to fertilize fields is practised in a number of villages outside the PLEC demonstrations sites like Petel Brurun and Niafouya. Two groups, Bhantal Dyama Bantignel and Labaya, are using this technology for improving their production. They learned the composting methods through PLEC expert farmers.

Vegetable gardening

More than four neighbouring villages are requesting PLEC expert farmers' training for market gardening, in particular the methods of onion, tomato and potato production. Production is increasing within demonstration sites. For example, at Dar ès Salam the groups have made a profit valued at 200,000 GNF during 2002, and for 2003 they planted 1 ha of fonio millet, 2 ha of groundnut and 1 ha of potato.

Agroforestry

Agroforestry is the most successful activity. Village forests have been developed around a number of villages and hamlets, plant nurseries have started and reforestation of degraded areas is practised. The villages of Goloya, Lary and the grouping of Dara Kethioun are now specialized in plant nursery production.

Expert farmers are putting in great efforts in this activity. During 2002, Mody Mamadou Aliou Kane (Missidè Héïré) established a plant nursery composed of 500 coffee trees, 1000 Acajou trees, 1000 *Acacia auriculiformis*, and 250 avocado plants. He sold 1150 plants including some of each species, and with other farmers from his village planted 1600.

For 2003, he planted 750 coffee trees, 1450 *Acacia auriculiformis*, 100 orange trees, 200 avocado trees, 400 *Parkia biglobosa* and 1000 'spin' plants. He had already sold 660, reforested 440 plants, and 2800 including some of all species were still in the nursery at the time PLEC scientists went to evaluate the demonstration sites. In their locality plants are sold for 250 GNF each.

At Dar ès Salam, Mody Oumar (the second expert farmer from PLEC 1 phase), has a nursery of 9700 plants according to a report (in Arabic) and sent to PLEC members in Conakry at the end of July 2003. Among these plants, 5100 (valuing to 1,275,000 GNF) were sold to farmers from 6 villages of the Sub Prefecture of Mombeya Prefecture of Dalaba and from one village of the Sub Prefecture of Dara Labé, Prefecture of Labé as well as from three neighbouring villages of Bantignel.

Coffee plants in a nursery at Dar ès Salam

Dyeing cloth

During 2002, the different groups have gained a profit amounting to 1,540,000 GNF. Five branches have been established within neighbouring villages. According to the respondents during our visit in June 2003, two branches have already established in Conakry and Kankan and another two in Bissau Guinea (Bissau) and Sénégal (Dakar). Currently five groups continue in Bantignel Missidè, Gaggal and Koggi villages. However, since 2002, they are facing a shortage of some raw materials due to the civil war in the Ivory Coast, and a number of the groups have requested support from UNICEF and other NGOs operating in Pita and Labé. Each group is still managing to continue production in order to maintain their clients.

Soap making

During 2002 the group of Missidè Héïré made a profit of 220,000 GNF on soap produced above their household consumption. This activity is also continuing at Dar ès Salam and Hindè. Three new groups have been created and in Niafouya, Horoya, Hindè, Roundè Héïré and Bantignel Missidè villages groups are starting.

A live fence of *Pedilanthus tithymaloides* with wire

Establishment of live and wire fences

Expansion of live fences continues. Since the end of the PLEC 1 phase, expert farmers are supplying villagers with forest plant species that are planted alongside the edges and fences. Wire is getting more expensive year after year since it has to be imported.

Farmer to farmer meetings

This activity is also continuing well. Farmers are meeting with their neighbours to discuss issues relating to many aspects of farming technologies and management of natural resources. Although many colleagues living far away solicit support, the expert farmers are limited in their movements because of lack of transport such as motorcycles.

Both the expert farmers of Bantignel are providing assistance to many organizations and farmers associations as well as NGOs operating in Pita or neighbouring Prefectures like Labé and Dalaba. This year the two farmers helped UNICEF and the NGO AmiDEP (Amical pour le développement de Pita) to reafforest more than 10 ha in Bantignel with exotic plant species and train farmers from other villages to do so.

According to the expert farmers, they are putting much of their efforts into the plant nursery, reafforestation, developing live fences, rearing cows and small ruminants as well as producing compost for improving agricultural production. They are launching a campaign to get support from NGOs and international organizations operating in Pita, Labé and Dalaba or elsewhere in order to maintain better what was achieved during PLEC 1 phase. They are also expecting support with PLEC 2 phase by keeping in close contact with core PLEC members in Conakry.

Demonstration sites of Moussaya, Kouroussa

At Moussaya, among the activities developed during PLEC 1 only beekeeping is in progress. In 2002, 55 hives were constructed and harvested in 2003. The honey production amounted to 75 litres. Besides this activity, farmers are producing carpets from biodiversity products. Correspondence with the collaborative farmers is not regular since the end of the project due to the restriction of distance.

Looking at the evolvement of the demonstration sites of Pita Prefecture (Bantignel), one can realize that the farmers were very interested in the project implementation and motivated in putting much of their efforts in conserving and sustaining their achievements. Both agrodiversity and biodiversity are positively impacted on year after year. Fallow lands, agroforestry, live fences, watercourses and village forests are significantly improving compared with the beginning of the project.

The activities for generating income are increasing in number and quality every year and the local population learned much about the management of their life. The developed models are spreading within the rural areas. The local and government authorities are using the PLEC demonstration sites at Bantignel as a model for developing rural areas. They also help to replicate some models (like cowsheds, compost preparation, agroforestry, cloth dyeing technique) elsewhere in the country.

Employment during the whole year is also improving with the diversification of activities. Alleviation of poverty is in progress within former PLEC demonstration sites particularly in Bantignel. External associations of farmers and the authorities solicit the expert farmers to solve a number of specific agricultural and natural resources management issues. They are participating in all meetings and workshops organized in the Prefecture and the region of Fouta Djallon.

Participation in the regional project proposal writing workshop

A project proposal was drafted with Prof. Michael Stocking acting as facilitator during 3 days in September 2002 at Cape Coast in Ghana. The workshop brought together 8 participants from the WAPLEC Sub clusters, three from Ghana and the Guinean's. Two days were spent writing and one day visiting potential collaborators and international institutions in Ghana. This proposal, entitled 'Agricultural biodiversity for sustainable environmental management and poverty alleviation in West Africa' was sent to a UNDP reviewer, who suggested the proposal be separated into two national projects.

A project proposal entitled 'Enhancing the traditional tapade cultivation system: development of live fences and agroforestry around the tapades in Fouta Djallon Highland' was prepared by June 2003 and submitted to the FAO/Globally-important Ingenious Agricultural Heritage Systems (FAO/GIAHS) Programme (PDF-B phase). The Sub Cluster is waiting for the response from FAO. The proposal is available on the FAO web site: www.fao.org/ag/ag1/ag11/giahs/default.stm.

UNU seed money was requested for monitoring demonstrations sites and preparing the national project proposal. Obtaining the seed money from UNU has given the Sub Cluster good breathing space because visits to former demonstration sites and to select new ones had been paralyzed.

Evaluating the adoption of agrobiodiversity conservation model practices in Uganda

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Introduction

During 1998-2002, UNU/PLEC in Uganda established a demonstration site at Bushwere in Mwizi Sub county, Mbarara district, south western Uganda and together with farmers developed several model agricultural practices for sustainable conservation of biodiversity on smallholder farms. The aim was to enhance the capacity of local communities to deliberately and sustainably conserve agrobiodiversity, promoting integration of agrobiodiversity conservation approaches into existing smallholder farming practices, with special emphasis on added value to socio-economic benefits and resource management (Tumuhairwe and Nkwiine 2003). Technologies were disseminated through farmer to farmer training.

Participatory approaches were employed during the development of the site and selection of the 12 expert farmers who, through good agricultural or land management practices, conserved biodiversity on their farms. The expert farmers were encouraged to demonstrate the practices to collaborating farmers (PLEC farmers), the local community and other stakeholders (Tumuhairwe et al. 2003). Through the process of demonstrations and evaluations by farmers and leaders at parish, sub-county and district levels, these good practices were developed into models called Agrobiodiversity Conservation Model Practices.

The practices included:

- maximization of land productivity by staking beans
- using modern cribs for drying and storing crop harvests
- enriching biodiversity in home gardens with special emphasis on local vegetables, fruits, trees and other useful plants
- promoting banana diversity by adding value through other uses besides food and sale of bunches
- farm record-keeping and cost-benefit analysis of enterprises
- conserving plant species for livestock feeding
- conserving plant species for improving apiculture
- growing traditional potato varieties
- using selected plant species as stabilizers of soil and water conservation bands
- enhanced sprouting of seed potato.

PLEC-Uganda used the following strategies to facilitate adoption, spread and sustainability of the practices in Bushwere and beyond:

- widespread encouragement through community workshops and exhibitions
- strengthening common interest farmer groups
- training for groups and selected individuals in appropriate skills
- facilitating linkages of expert farmers and Bushwere community with other stakeholders, at sub-county, district, national and international levels.

From February 2002 until August 2003, there was no follow-up activity in the demonstration site. This study during December 2003 was undertaken to monitor and evaluate the adoption, dissemination and sustainability of model practices developed and demonstrated at the Bushwere demonstration site.

Methodology

PLEC scientists held a one-day workshop at Bushwere with key informants and the sub-county agricultural extension officer, members of local councils and the Uganda Land Management Project (ULAMP) coordinators at parish and village levels. The workshop was to monitor the progress and impact of the PLEC initiatives in the area and design further surveys.

A semi-structured questionnaire was designed and interviews were conducted in the 12 villages of Bushwere parish. The 8 or 9 households per village were purposefully selected to include the 12 PLEC expert and other collaborating farmers as well as non-PLEC farmers. Data were analysed using the statistical package for social sciences (SPSS).

Adoption was defined as 'using the innovation versus not using it' (Rogers 1995). Age, gender, education level of household head, land acreage, accessibility to credit and whether farmer is a PLEC collaborator was recorded. These characteristics were selected based on results of earlier studies (Busingye et al. 1999; Manzi et al. 2003) which showed that these factors influence farmers' decisions about whether to adopt management technologies.

Success and failure of the model practices was based on whether the intended purpose of adopting the model was fulfilled or not, the proportion of adopters who abandoned the practice, and the farmers' ranking of percentage improvement in productivity associated with the model practice.

Results

Farmers' adoption levels

The overall mean adoption level was more than 5 practices (5.7). Of the 104 respondents, 76 respondents (73%) had adopted more than 6 practices out of the 10 promoted by PLEC, while 26 respondents (27%) had adopted more than 3 practices. All respondents had adopted at least one demonstrated practice.

Among PLEC farmers, the most adopted practice was enriching home gardens (63 respondents), growing of local potato varieties (62) and making use of banana plants in other ways besides food and sale of bunches (59)(see Table 1). There were more than twice as many farmers who adopted growing livestock fodder, and planting grass on trenches and growing or conserving plants for apiculture than did not adopt. The three least adopted practices were improving potato sprouting (28 respondents), farm record keeping and cost-benefit analysis (24), and modern storage cribs (17).

Table 1 Distribution of respondents according to adoption of ABC-MPs by farmer category

Model	PLEC farmers		Non-PLEC farmers	
	Adopters	Non-adopters	Adopters	Non-adopters
Enriching home gardens	63	3	32	7
Growing of local potato varieties	62	4	35	4
Other banana uses	59	7	34	5
Growing fodder for livestock	47	19	19	20
Planting grass on trenches	46	20	20	19
Planting/conserving plants for bees	33	33	14	25
Bean staking	30	36	18	21
Improved potato sprouting	28	38	9	30
Record keeping	24	42	8	31
Modern storage cribs	17	49	8	31

Most adopted models by non-PLEC farmers were growing of local potato varieties (35), and other banana uses (34), while home gardens ranked third (32). Modern storage cribs and record keeping were also least popular. The adoption of the demonstrated practices was generally higher among PLEC farmers than non-PLEC farmers, particularly for home gardens, livestock fodder, soil and water conservation stabilizers and improved potato sprouting.

Farmers were questioned on whether they already used the management practice or where they had found out about it. Their responses were categorized as originally practised, PLEC demonstrations, neighbour(s), extension officer, and others (e.g. Uganda Land Management Project, training outside the parish or external visits (Table 2).

Growing of local potato varieties, other banana use and enriching home gardens were frequently 'originally practised'. Farmers reported that they were adopting the other practices from PLEC demonstrations and they spread through to neighbours. Mostly farmers indicated that they did not adopt the model practices from the agricultural extension worker except for growing fodder, planting grass on trenches, and enrichment of home gardens to a lesser extent. The PLEC project had worked closely with the extension worker throughout the development of the demonstration site. After PLEC left Bushwere, the extension worker concentrated on these three practices more than the rest, most likely in response to farmer demand. There is only one extension worker for the entire Mwizi sub-county of which Bushwere is only a fifth, and the terrain is so rugged and difficult, he gives priority to demand-driven technologies such as home gardens, livestock fodder, grass on trenches and apiculture (Mpeirwe, personal communication). These practices were also the focus of the three farmer groups established in Bushwere during the PLEC project phase: Bushwere Nursery and Home gardens Farmers' Association (BUNUHOGAFA), Bushwere Zero Grazing-Crop Integration Association (BUZECIA) and Bushwere Development Group (BUDEG).

Other sources of adoption were low except for bean staking. Ten farmers, including Kadiya, the expert farmer who demonstrated it, had attended a farmer training session in a neighbouring district.

Factors influencing farmer adoption

PLEC farmers on average adopted more practices (mean 6.2) than non-PLEC farmers (mean 5.1). This suggests a significant positive impact that PLEC has had on ability of Bushwere farmers to deliberately conserve agrobiodiversity. Of the 107 farmers interviewed, 85 percent were from male-headed households and they adopted more practices (5.9) than female-headed households (4.8). Women in Uganda have multiple roles at home and it could be that they are constrained in terms of time and other resources required for adoption of different management practices (MGLSD 2000).

Fifty-five percent of the heads of the interviewed households were middle aged (31-45 years), followed by the old (28% 46 years and above) and the young farmer categories (16.8% 16-30 year old). The older farmers adopted the highest number of practices (mean 6.0), followed by middle aged (mean 5.9) and the young (mean 4.8). Younger farmers often have limited access to resources such as land and capital, and their negative attitude towards agriculture is cited in the National Situation Analysis (MGLSD 2001). The correlation between farmers' age and mean adoption level is statistically significant.

Table 2 Source of knowledge for adoption of the management practices

Management practice	Responses per source of management practice				
	Originally practised	PLEC demonstration	Neighbour	Extension worker	Other
Growing local potato varieties	69	5	5	2	1
Home gardens	38	25	29	13	4
Other banana uses	52	15	26	5	
Growing livestock fodder	13	27	9	17	2
Planting grass on trenches	5	25	13	20	2
Bean staking	6	11	21	1	10
Conserving plants for bees	5	13	16	8	1
Improving potato sprouting	6	18	4	1	
Record keeping	2	22	1		
Modern cribs	1	10	1	1	1
Total responses	197	171	135	68	13

Of the 105 respondents, 46 had education to the level of Primary 5 and less, while 59 had attended Primary 6 and above. Those with a higher level of education adopted more practices (6.1) compared with those who had Primary 5 level education and below (5.3).

Most farmers in Bushwere have small plots of land. Of the 100 respondents 56 own less than 1.21 hectares per household while 44 own more than 1.21 hectares. Land size significantly influenced adoption ($p=0.037$) as farmers with more land adopted more practices (mean 6.2) than those with less (5.4).

Access to credit also influenced the number of practices adopted. Of 106 respondents, 88.7% have access to credit and on average they adopted 5.9 practices while the 11.3% without access to credit adopted 4.6 practices. Credit is used for many purposes like paying school fees, medical expenses and buying household goods. The major sources of credit reported by farmers are small local community self-help groups and this implies that the amount of credit available most likely is too small to invest in land management and biodiversity conservation while there are other pressing basic needs. External sources of credit like the village bank and commercial banks are very recent and only a few individuals have accessed them. It is hoped that as the benefits of adopting different management practices emerge, more farmers will make use of village banks (micro-finance) which the Uganda government is promoting as part of the national 'Plan for Modernisation of Agriculture' (MAAIF and MFPED, 2000). This way, more farmers will be able to invest in sustainable conservation practices.

Farmers' views of the benefits of the demonstrated management practices

When farmers were asked which were the most beneficial of the adopted practices, 33% ranked other banana uses first (Figure 1). This may be attributed to the fact that almost every household owned a banana plantation for food and income before PLEC. When PLEC demonstrations showed the value of other uses using the different parts of the banana plant and from the different varieties, it was cheap, easy and immediate for almost everybody to recognize the benefits and utilize the potential resource. Farmers admitted that they traditionally used bananas without attaching value until PLEC made then aware of the value of biodiversity and an economic analysis of farm activities was done. This enabled them to deliberately look out for certain qualities in the different banana varieties and make good use of them. Some have even used these criteria for selection of varieties to plant or remove from their plantations.

Planting grasses on bands and trenches as a soil and water conservation measure was ranked the second most useful practice. This grass provides fodder and mulch and serves as a soil stabilizer. Growing of local potato varieties ranked third. Local potato varieties existed in Bushwere before the PLEC project but they were grown by only a few farmers because majority had abandoned them in favour of two commercial varieties (Kawongolo et al. 2003). It is after PLEC showed the value of sustaining local varieties that more farmers adopted them.

Some farmers enthusiastically adopted stall-feeding of livestock as a better option than the free range grazing that had already become constrained by land shortage. In order to effectively and economically practice stall-feeding, high value fodder has to be deliberately grown. PLEC farmers learned this through study tours organized by PLEC to other sub counties and projects within the district.

Both record keeping and modern cribs were considered least useful. Modern cribs require technical expertise and materials which makes traditional storage methods such as hanging, smoking, wrapping and local granaries more accessible. Bean staking is laborious and stakes are not easy to obtain. Although bean staking was adopted only by a few people, they all ranked it among the most beneficial practice citing a large yield increase and reduced disease incidence and damage. Potato sprouting has traditional methods that are cheaper in terms of time and materials required.

The most common constraints associated with adoption of the practices were increased labour requirements, water stress, lack or shortage of appropriate materials and crop pests and diseases. Increased labour was required for bean staking, cribs and planting grass. Technical knowledge was needed for integrating fodder species in crops and for bee keeping. Access to sources of appropriate planting materials was important for adopting agroforestry, fodder species, and improved varieties of fruits for enriching home gardens. Appropriate grass species that could stabilize soil without competing with crops for water (causing water stress) are also lacking in the area. That is why some farmers refused to adopt or abandoned grasses on trenches despite the fact that many had dug the trenches. Poles or timber

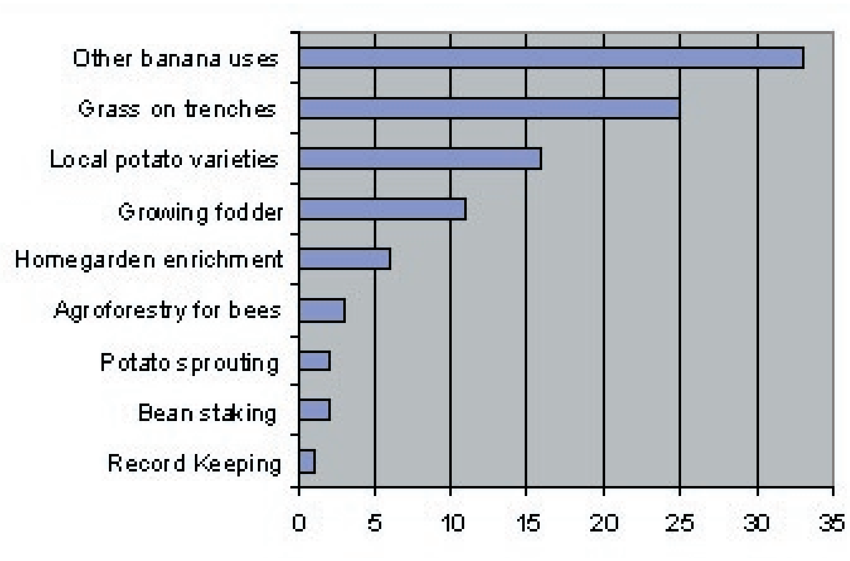

Figure 1 Rank of management practices by benefit

for bean staking and cribs are difficult to obtain due to shortage of trees for farmers with small land holdings who lack cash to purchase them. Water stress due to the gravely soils, low rainfall and desiccating winds in this mountainous landscape constrained adoption of some practices. Other constraining problems were lack of a market especially for local potato varieties, fruits, vegetables and medicinal plants. Despite the problems experienced, each of the adopters reported that the practices they used met their intended purpose. Only a few (1%) abandoned grasses on trenches and record keeping, mainly due to time and labour constraints or lack of skills.

Attributes of management practices

Farmers reported that for a practice to be suitable for demonstration through farmer to farmer training it should have the following attributes:

- generate income
- increase food supply
- provide manure
- conserve soil and water
- contribute to availability of mulch, fodder, or building materials
- increase yields
- have products that can be shared with friends and neighbours
- have available seeds for replanting and
- generate employment opportunities.

Generating income was scored as an important attribute by the highest number of respondents (19.5%) followed by increasing food availability for the family at 14.8%. This is a good indicator motivation for farmer participation in the national 'Plan for Modernisation of Agriculture' whose ultimate goal is improved household welfare through increased income and food security (MAAIF and MFPED 2000). Provision of manure and soil/water conservation ranked third and fourth respectively. Other attributes mentioned included medicinal properties, preserve disappearing varieties, source of entertainment, control pests and diseases, ornamental, nutritional improvement, affordable, fast maturing plants, and sources of seed, mulch, building material, fuel or wind breaks.

Conclusions

The ten practices were disseminated to many farmers irrespective of whether they were PLEC collaborators, although adoption and dissemination of practices were relatively higher among farmers who had collaborated with PLEC. It was good news from adopters that they had already realized success through achievement of the intended purposes. Many adopters have gone ahead to train other farmers and spontaneous diffusion of the demonstrated practices is evident, with a high multiplier effect. The number of farmer to farmer trainers recorded has risen from the 12 expert farmers of PLEC to 220 in the last three years.

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Acknowledgements

Authors would like to express their sincere gratitude to the United Nations University, the Makerere University Faculty of Agriculture, the six field assistants, Allan Muhereza, Jairus Muhehe, James Warugaba, the Mwizi Extension worker, Emmy Mpiirwe and all Bushwere farmers for their continued co-operation and enthusiasm.

Reviews and News

Land rotational agriculture in Yunnan: a book review

Yin Shaoting. 2001. *People and forests: Yunnan swidden agriculture in human-ecological perspective*. Kunming: Yunnan Education Publishing House in 2001, translated by Magnus Fiskesjö with support of the Ford Foundation. 561 pp. ISBN 5415-1599-6. 29 yuan.

Not many readers of *PLEC News and Views* outside China will find this splendidly produced book easy to locate. Yet it is an abundantly worthwhile read for all concerned with land-rotational agriculture and the people who practice it. Yin Shaoting is Professor of Anthropology at Yunnan University in Kunming.[1] He has spent twenty years on the study of ethnic minority people in Yunnan, their history, livelihood, culture and agriculture. This book brings together two decades of work and a substantial amount of historical material as well. It offers important discussion on policy issues in relation to the future of the minority peoples. From the outset, Yin rejects views that shifting cultivation is 'backward' or 'primitive': it is the farming culture of the forest, created by the forest-dwelling people.

A detailed historical section traces the migrations of the people through several centuries, into the uplands along Yunnan's borders with Vietnam, Laos and Burma. By the period of the Qing dynasty (1644-1911) the record becomes sufficient to understand their livelihood. In earlier times, many were principally hunter-gatherers or pastoralists, but some had practised quite intensive forms of agriculture. They became shifting cultivators only when they were driven into the forests by aggressive newcomers, especially Dai and some others, including Han Chinese.

This is followed by a discussion of the typology of shifting cultivation in modern Yunnan. Distinctions are drawn between systems in which

- only a single crop is taken after fallow clearance (described as farming 'without continuous cultivation');
- swiddens are cropped for two or three years, usually with hoeing and/or ploughing after the first year (called 'swiddening with short-term continuous cultivation'); and
- cropping continues for several years ('swiddening with long-term continuous cultivation', but not usually fixed-field farming).

Continuous cropping has the consequence that forest fails to recover in the fallow years, so that the systems become grassland farming, depending on crop rotations and livestock. It has also led to creation of large degraded areas which take many years to recover.

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Following this, those systems which depend on naturally regenerating fallow are distinguished from a minority in which there is active tree planting, especially of the alder (*Alnus nepalensis*) which fixes nitrogen and provides rapid soil restoration by heavy littering. The majority of shifting cultivators live in permanent villages and farm defined territories, but there has been an important minority who move readily from place to place, a practice increasingly unviable as little unoccupied land remains. However, it has continued and there is an interesting account of a community which settled in a state forest in the 1980s and have only been enticed out of it by the offer of land which could be irrigated and had good access to the market.

The core of the book is five detailed accounts of the agriculture, society and beliefs of people among whom Yin has worked (the Jingpo, Bulang, Wa, Jinuo, Dulong), followed by comparative chapters drawing lessons both from these studies and from less intensive inquiries among other groups. The key to successful forest swidden farming has been the division of village territories into blocks which are cultivated by the concentrated efforts of all farmers, and then fallowed as wholes for as long as is necessary. Where this system operates, and where cultivation is restricted to a single year, the weed problem is small, there is no need for ploughing and little for hoeing, and both production and ecology are sustainable. The system is practised only by a minority, and in most cases it did not survive either the planning directives of the collectivization period or the very substantial growth in population that has taken place since the 1950s. Even among people of the same ethnic group there has been much contrast in how the systems are put in operation. Among the frequently migrating Hani, for example, some practice shifting cultivation with only one crop, some grow a series of crops, and yet others have developed what is arguably China's most elaborate terracing, with irrigation, for permanent cultivation. Some Hani develop complex home gardens on the model of their Dai neighbours, while others do not. This reviewer has seen a patchwork of methods in use in the territory of one Hani village in southern Yunnan.

Information on these different systems draws not only from field work in the 1980s and 1990s. In about 1950, the new Chinese government sought information on the minority people within its jurisdiction, and in particular on their systems of agriculture, social organization and land tenure, with the object of developing distinctive policies that would be sensitive to their culture and needs. The resulting reports, though they have been criticized as colonial documents, had an intendedly benign purpose. Most were published in the 1980s. In practice, chiefly systems of local organization were quickly swept away, and cadres took their place. The collectivization of the 'great leap forward' in 1958 was applied in all parts of China, including the remotest hills and valleys of the borders in the southwest. Most villages, or parts of villages, became production brigades (*dadui*).

The old land tenure systems were swept away, and livelihood came to depend on the acquisition of work points, based principally on days of work. This was imposed from above, without the preparatory eight years or more of mutual aid teams and local production cooperatives that paved the way to collectivization in much of central and northern China. Land quality was allowed to deteriorate, and harvests declined, leading to the opening of large new areas of forest mainly for grain monoculture. At the same time, state farms were established in the lowlands and on the lower slopes, staffed mainly by Han immigrant workers, growing rubber in the lower country of southern Yunnan, and sugar cane in the west. One former cash crop, opium, important since the late nineteenth century, and grown in long-term fields by some south-western groups, was eliminated in a few years.

'Reform and opening', reversing 20 years of collectivization, began in the late 1970s in central China, and reached the minority group lands of the southwest in the early 1980s. After a period of great uncertainty over future policy, leading to further extensive forest clearance in order to establish claims to land, this settled in the 1990s into a tenure system often similar to that of pre-communist times. Land still belonged to the collective and the state, as it had to the clan in most of these societies before the 1950s, and it could still be redistributed, but households had increasingly secure rights of cultivation and decision-making.

For good reasons, but with rather insensitive implementation, the reforms were accompanied by increasing regulation of forest use, and the declaration of substantial areas as state forest and nature reserves. For the Jinuo people of Xishuangbanna, in southern Yunnan, these changes reduced the available arable area by more than half causing considerable problems for certain villages. One such, Baka, was a study site of Professor Yin in the 1980s and it was also a study and development-aid site for the PLEC China group in the period after 1993 (Dao et al. 2003). In 1999 some Yunnan University anthropology students joined PLEC in both southern and western Yunnan, but until then there was little contact. Both reports recount the manner in which Baka village divided after 1960, with progressive concentration into the lower-altitude site, as happened elsewhere. Yin describes these relocations as largely voluntary, although in the presence of no small degree of persuasion; he does, however, emphasize the growing attractions of the lower-lying sites for the Jinuo people, with greater access to education, market and assistance.

During the collective period, and for some years after it, the thrust of development policy in these marginal areas of southern China has been in two directions. First was in provision of infrastructure, especially roads, schooling, medical aid, and assistance with developing irrigation and cash crops, which has continued to increase. Second was a less successful persuasion to adopt modern fixed-field farming, using chemical fertilizers and pesticides – 'having two chemicals come up the mountain' to deal the death blow to swidden fallowing. Most of the mountain farmers tried these innovations, but found them costly and far from wholly satisfactory.

With the rise of ecological awareness in the later 1980s and 1990s, the drive for chemicalization has given way to a renewed emphasis on ecologically sound management, including re-adoption (or discovery by the authorities) of old practices now brought together collectively as 'agroforestry'. It includes re-discovery of the use of *Alnus nepalensis* for soil improvement, and recovery of commercial tea cultivation under trees as has been practised for several hundred years. Yin finds this trend encouraging, and with it also an increasing emphasis on growing 'green' products for the market. The term 'green' in China refers to low external-input systems, rather than disciplined, fully organic systems which are nowadays uncommon in the country. PLEC's own efforts in southern and western Yunnan were also in these directions (Dao et al. 2003).

This review covers only a small part of the rich fund of material in Yin's book. Among other topics he offers a detailed discussion of the highly-skilled agriculture of the valley-dwelling Dai people, and provides a great deal of information on the hunting practices of all the people studied, on their rituals and beliefs, pre-1950's social organization and land tenure. There are many descriptive vignettes among the analysis and many excellent and informative photographs. If the book has a fault, it lies in the lack of reference to a wider literature, including that on people of the same ethnic groups elsewhere in Southeast Asia. Some of the discussion on ecological aspects of particular practices and cultivated plants could have been improved by a wider search. The maps are valuable, even if the method of simply listing in pinyin names which on the maps appear only in characters is not always easy to follow for those unable to read Chinese. But there is a wealth and depth here that few writers on the topic of swidden cultivation have been able to match. The translation is excellent and, although complex, this book is very readable. Those interested in the topic, or in the minority people of China and neighbouring countries, who are able to get hold of the book, and read it, will be richly rewarded.

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Dao, Z., Guo, H., Chen, A. and Fu, Y. 2003. China. In H. Brookfield, H. Parsons and M. Brookfield, eds, *Agrodiversity: learning from farmers across the world,* pp. 195-211. Tokyo: United Nations University Press.

The book can be obtained from the publisher: Yunnan Education Publishing House, 16th-18th Floor, 609 West Huancheng Road, Kunming 650034, Yunnan, China.
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The ancient significance of tree crops

Jean Kennedy and William Clarke 2004.
Cultivated landscapes of the southwest Pacific.
Resource Management in Asia-Pacific Working Paper No. 50, Canberra, Resource Management in Asia-Pacific Program, Research School of Pacific and Asian Studies, The Australian National University. 47pp. ISSN 1444-187X.
Available on request or at http://rspas.anu.edu.au/rmap/workingpapers.php

The care and cultivation of trees for the food and other useful products is an ancient part of agriculture in almost all lands. Often the trees are elements in polycultural cropping systems of considerable diversity, becoming dominant when the shorter-lived crops have been harvested, but still tended and themselves harvested for periods of years. This form of agroforestry – possibly the only general English-language term that can be used to describe it – has been analysed and described most comprehensively in Central and South America, especially since the 1980s. There are isolated earlier accounts from the Asia-Pacific region, one of the earliest being that of Firth (1936: 332) concerning Tikopia at the eastern end of the Solomon Islands. More recently, Clarke and Thaman (1993) wrote a general discussion of these systems in the Pacific islands, and now Kennedy and Clarke have undertaken an in-depth analysis, focusing particularly on five taxa of which four are trees (*Metroxylon* or sago palms, *Canarium*, *Pandanus*, and *Artocarpus* or breadfruit), and the fifth is the banana (*Musa*). The ecology and genetics of these plants are analysed in considerable detail. The authors also discuss the archaeological record, which establishes that these and other trees were in use providing human food and fibre at least as early as the first agriculture anywhere, and probably also in the Pleistocene. Macrobotanical remains of useful trees in the Wallacea-Pacific region extend back to between 12,000 and 15,000 years ago.

While the detailed presentation will be of particular interest to specialists in the Asia-Pacific region (the discussion extends from eastern Indonesia into the north and south Pacific), the evidence of early and sustained use of stands of wild, cultivated or feral trees is of more general importance. Similar use and management of trees is of pan-tropical and even global significance, though it has rarely been analysed in this depth. The habitual separation of tree-farming from crop-farming in the literature is thrown into question. Scientists make this separation, but farmers do not. Yet 'just as foraging, cultivation and agriculture may be represented as a continuum, so wild, tended, planted and cloned may represent stages in a continuing process of plant domestication' (p. 6).

Tree-crop management is certainly less intensive in terms of its management of the land than is arable farming. It involves weeding, the control of competing vegetation, and only some planting. Essentially, it is management of the landscape within which a complex shifting of crop fields or patches, orchards, managed fallows, and individual trees are all elements. This 'modest activity carried out by people circulating through the landscape … keeps the productive processes working' (p.31). It also provides a wide range of goods, within which emphasis can readily be shifted through time, as has been clearly demonstrated in Mexico by Alcorn (1989). While the authors are probably right to be concerned that the insidious pressure on farmers to specialize in monocropping will erode biodiverse agroforestry, there is evidence to the contrary–agroforestry can be more rewarding (Dao et al. 2003; Yin et al. 2003). Kennedy and Clarke do put weight on the resilience of agroforestry systems, but do not stress the potential for income diversification that in times and places outweighs the value of short-term income maximization strategies.

The paper is well produced and most of it is very readable. The main problem for non-specialist readers will be the use of technical terms in the genetic and botanical fields without explanation, even in footnotes. Fortunately, there are not too many of them.

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New Initiatives in smallholder natural resource management: Prolinnova

In addition to the Ecoagriculture Partners initiative, with which we collaborate in distribution of information, there are several other organizations that are involved in work on resource management by smallholder farmers. One such initiative is Prolinnova, and the following statement about it came to us from Ann Waters-Bayer of ETC Ecoculture, an NGO in the Netherlands that has been involved in it from the outset. As readers will note, it resembles PLEC in several respects, not least in its financial problems. Edited down a bit, the statement is presented here in the interests of networking and neighbourliness. Some PLEC readers might like to take up the invitation in the final paragraph.

Editors.

Prolinnova (**PRO**moting **L**ocal **INNOVA**tion in ecologically-oriented agriculture and natural resource management) was conceived in December 1999 by NGOs in Africa, Asia, Latin America and Europe as a global programme for learning through action and analysis. The focus is on ways to promote local people's innovation in ecologically-oriented agriculture and natural resource management. Activities include:

- documenting local innovations and innovation processes by resource-poor farmers and communities;
- strengthening farmer-advisor-scientist partnerships to further develop and scale up promising local innovations;
- creating wider awareness of and skills in Prolinnova processes through a variety of learning mechanisms; and
- integrating Prolinnova approaches into mainstream institutions of agricultural research, development and education.

Financial support from the International Fund for Agricultural Development was obtained for the participatory design of programmes in Ethiopia, Ghana and Uganda. In each country, multi-stakeholder steering groups have collected local experiences in recognizing farmer innovation and experimentation and promoting participatory technology/innovation development (PTD/PID). They have convened workshops to analyse their experiences and have developed action plans to improve and scale up the participatory approaches.

Recently, the Netherlands Directorate General for International Cooperation agreed to give partial support to Prolinnova as an international network convened by civil-society organizations for institutionalizing participatory approaches to environmentally-sound use of natural resources. This will allow the start-up of programmes in Cambodia, Nepal, Niger, South Africa, Sudan and Tanzania. Prolinnova has found that it is not easy to obtain several years of funding for activities that, in large part, still have to be identified in a participatory planning process. National plans that have been developed differ, depending on the experience and self-identified strengths and weaknesses in recognizing the dynamics of indigenous knowledge, engaging in PTD/PID and institutionalizing the approach. Common elements include inventory of initiatives and organizations promoting local innovation, national multi-stakeholder learning platforms, capacity building in identifying and documenting local innovation and implementation of PTD/PID activities.

The next international event is a workshop to share experiences in developing country-level partnerships, to discuss national action plans and to decide on international activities and governance. The workshop will be hosted by AgriService Ethiopia (ASE), the Secretariat of the partners in Ethiopia, at the Furra Institute of Development Studies in Yirgalem (Southern Ethiopia) in March 2004. Financial contributions have come from CTA, Misereor, the World Bank IK Initiative and the GFAR. Also in 2004, an international Prolinnova workshop for training-of-trainers will be held at IRRI in the Philippines.

Other organizations involved in developing the Prolinnova concept have raised funds to undertake activities at national and regional level. For example, PELUM (Participatory Ecological Land Use Management), in collaboration with GRAIN, organized case studies and a workshop on farmer innovation in Eastern and Southern Africa. The GFAR Secretariat provided funds for a person within the Prolinnova initiative to attend meetings with donors and members of regional and subregional fora for agricultural research for development. Recently, Amanuel Assefa from ASE was invited to attend the GFAR meeting in Nairobi, Kenya, where he presented the experience of building up PROFIEET–PROmoting Farmer Innovation and Experimentation in Ethiopia (available in the GFAR and Prolinnova websites). Likewise, Monica Kapiriri of the Aga Khan Foundation, the NGO member of the GFAR Steering Committee and now Vice-Chair of the GFAR, presented Prolinnova at the GFAR conference in Dakar, Senegal.

InterDev and a sister programme InterSARD have also been developing over the years. In collaboration with these and other electronic databases and networks with similar interests, such as the PNRM website (www.prgaprogram.org/natural.htm), they will be building up discussion platforms on concepts and experiences in promoting local innovation in ecologically-oriented agriculture and NRM. At the moment, most exchange is in English, but they will seek ways to overcome the language divide. Brochures, posters, books, and circulars will be compiled and disseminated and other media, such as radio and video, developed.

Prolinnova partners are keen to communicate with other groups promoting local innovation. This is most easy via the Prolinnova emailing list. Anyone who would like to be on the mailing list should contact prolinnova@etcnl.nl. It is open to all interested in Prolinnova. The programme is gradually gaining momentum and has established a firm basis for building NGO-convened multi-stakeholder partnerships from the bottom up. More information can be found on the Prolinnova website (www.prolinnova.net) and on the GFAR website (www.egfar.org).

Gateways and websites

Collaboration with Ecoagriculture Partners

Visit the Ecoagriculture Partners website at **www.ecoagriculturepartners.org** for information on ecoagriculture, relevant publications and information about conferences, workshops and upcoming events.

ILEIA - Call for contributions to LEISA magazine

ILEIA (Centre for Information on Low External Input and Sustainable Agriculture) website is at **www.ileia.org**. The LEISA magazine is published quarterly. Upcoming themes are: **The next generation of farmers** Issue 20 (2), June (Contribution deadline March 1) and **Post harvest management** Issue 20 (3), September (Contribution deadline 1 June) LEISA invites contributions of articles, suggestions of possible authors, and information about publications, training courses, meetings and websites related to the themes. Editorial support is provided by ILEIA. Authors of published articles receive a standard fee of USD 75.

Eldis Gateway to Development Information at http://www.eldis.org/ provides free access to wide range of online development resources, with summaries and links to many documents. The website offers a directory of useful websites, databases, library catalogues and email discussion lists. Resource guides offer access to information on a wide range of subjects.

Livelihoods Connect at http://www.livelihoods.org/ is a gateway for information on sustainable rural livelihoods for the elimination of poverty and is sponsored by DFID and IDS.

The Science and Development Network (**SciDev.Net**) aims to enhance the provision of reliable and authoritative information on science- and technology-related issues that impact on the economic and social development of developing countries. The free access website, at http://www.scidev.net/, with a weekly email alert allows access to relevant journal articles. A recent addition is the indigenous knowledge dossier (http://www.scidev.net/indigenous/protecting), which provides an overview of the debates surrounding traditional knowledge protection in relation to genetic resources.

Recent Publications

The following publications may be of interest to PNV readers. Information about them has been adapted directly from the publications.

Meilleur B.A.; Hodgkin T. 2004 In situ conservation of crop wild relatives: status and trends *Biodiversity and Conservation* 13(4): 663-684

Recognized as a priority three decades ago, in situ conservation of crop wild relatives has developed theoretical and methodological focus and achieved significant on-the-ground progress in the last 10 years, most notably under the impetus of the plant genetic resources community. Literature and Internet searches and interviews with experts were undertaken as a basis for reviewing the current status and trends of this effort worldwide. Country-by-country summaries on in situ crop wild relatives conservation activities are presented, and recommendations are made for future action. Principal recommendations include 'flagging' of appropriate taxa as crop wild relatives in botanical and conservation databases, undertaking gap analyses to locate crop wild relatives hotspots, and enhancing cooperation between the plant genetic resources and plant conservation communities. Email:brienmeilleur@aol.com

Boyle, T. (2003). Conserving forest biodiversity: threats, solutions and experiences. Lessons for the Future. United Nations Development Programme/Global Environment Facility.

This publication focuses on conservation of biodiversity in forest ecosystems, the threats and their underlying causes, and possible solutions based on actual experiences. This study analyses experiences of 40 forest biodiversity conservation projects funded by the GEF and implemented by UNDP between 1992 and 2002. Specific characteristics of the environmental threats are identified for each region, providing useful strategic guidance on conservation of forest ecosystems and biodiversity. http://www.undp.org/gef/undp-gef_publications/publications/conserving_forest_biodiversity.pdf

Conservation and sustainable use of agricultural biodiversity (2003) published by CIP-UPWARD in collaboration with GTZ, IDRC, IPGRI and SEARICE

http://www.eseap.cipotato.org/upward/Abstract/Agrobio-sourcebook.htm This sourcebook promotes management of agricultural biodiversity within existing landscapes and ecosystems, in support of the livelihoods of farmers, fishers and livestock keepers. It is a compilation of field-based experiences by scientists, development specialists, academics, policy-makers and donors around the world. It consists of three volumes: 1) understanding agricultural biodiversity, 2) strengthening local management of agricultural biodiversity, and 3) ensuring an enabling environment for agricultural biodiversity. It is designed for use by rural development practitioners and local administrators, as well as trainers and educationalists.

AAAS 2003. Traditional knowledge and intellectual property: a handbook on issues and options for traditional knowledge holders in protecting their intellectual property and maintaining biological diversity. Available in PDF format at http://shr.aaas.org/tek/handbook/ This handbook attempts to make intellectual property protection options more understandable and readily available for traditional knowledge holders. Its goal is to help local communities understand and identify potential protection mechanisms already present in current intellectual property rights (IPRs) regimes and the public domain for traditional knowledge.

Editors invite suggestions for featuring in PLECserv

PLECserv, at **http://c3.unu.edu/plec/index.html,** provides an introduction to recent articles or other publications of interest to people working among developing-country farmers, and concerned about development and conservation. Send suggestions to harold.brookfield@anu.edu.au.

Recent titles are:

21. Upstream and downstream: water resources in a Thai valley (Andrew Walker 2003. Agricultural transformation and the politics of hydrology in northern Thailand. RMAP Working Paper 40. ANU.)

22. The tortuous path toward better resource management at a national scale (Jussi Ylhäisi 2003. Forest privatisation and the role of community in forests and nature protection in Tanzania. Environmental Science and Policy 6: 279-290.)

23. Old fields under the 'pristine' rainforest (Bayliss-Smith, T. et al. 2003. Rainforest composition and histories of human disturbance in Solomon Islands. Ambio 32 (5): 346-352.)

24. A fertile error is better than a sterile truth: an IPM project in Malawi (Alastair Orr and J.M. Ritchie. 2003 Learning from failure: smallholder farming systems and IPM in Malawi. Agricultural Systems 79(1) 31-54)

25. A more hopeful view of Africa (Tiffen, M. 2003. Transition in Sub-Saharan Africa: agriculture, urbanization and income growth. World Development 31 (8): 1343-1366.)

26. Old practices are the best for conservation in highland Peru (S.M. Swinton and R. Quiroz 2003. Is poverty to blame for soil, pasture and forest degradation in Peru's altiplano? World Development 31(11): 1903-19.)

27. Mobilizing social capital: finding workable strategies for sustainable development (Akin L. Mabogunje and Robert W. Kates, Sustainable development in Ijebu-Ode, Nigeria: the role of social capital, participation, and science and technology. CID Working Paper No. 102, January 2004. Center for International Development, Harvard University, Cambridge, Mass.)

28. Virtuous goals and ignoring history can lead to trouble (Margarita Serje 2003. Malocas and barracones. Tradition, biodiversity, and participation in the Colombian Amazon. International Social Science Journal 55 (4): 561-71)

29. What happens to households and their crops when working people die of AIDS? (Takashi Yamano and T.S. Jayne 2004 Measuring the impacts of working-age adult mortality on small-scale farm households in Kenya. World Development 32(1): 91-119)

People Land Management and Ecosystem Conservation (PLEC), a UNU project, involves a collaborative effort between scientists and smallholder farmers from across the developing world to develop sustainable and participatory approaches to conservation, especially of biodiversity, based on farmers' technologies and knowledge within the agricultural systems of the farmers.

PLEC NEWS AND VIEWS is published about twice yearly by the United Nations University and the Department of Anthropology, Research School of Pacific and Asian Studies, The Australian National University. Subscriptions are free of charge. Please send your subscription request to the editors. Contributions of articles are very welcome.

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