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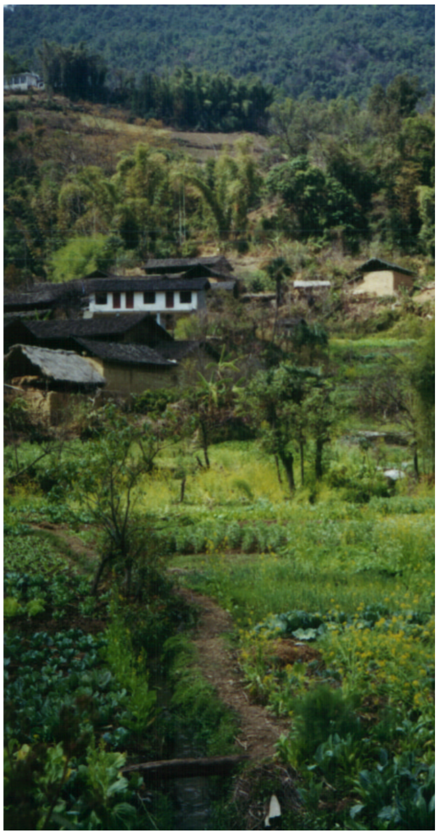

Welcome to the new series

This is the first issue of a new series of ***PLEC News and Views*** that succeeds the old printed periodical that first appeared in July 1993. Twenty printed issues were published and distributed to a large list by September 2002. They are available online at **http://www.unu.edu/env/plec/periodicals.html**.

The new series is published only online, but anyone is welcome to print out and distribute copies. The new series is edited by Harold Brookfield and Helen Parsons, and is published jointly by the United Nations University and the Department of Anthropology, Research School of Pacific and Asian Studies, at The Australian National University. The UNU and ANU also jointly sponsor the scientific information listserv, **PLECserv**, initiated in late 2002 (see page 21). PLECserv is available at **http://c3.unu.edu/plec**.

The PLEC project is currently in a transition stage, described below by the Scientific Coordinator, Dr Miguel Pinedo-Vasquez. We will continue to publish short articles by members of the old and new projects, as well as documents of particular significance. We also include notes on progress and research, and reviews of books of interest to PLEC members and others. Two or three issues will be produced each year.

Further information is available from the editors, **hpar@coombs.anu.edu.au**, and **hbrook@coombs.anu.edu.au** . Items for inclusion in subsequent issues, which are invited both from PLEC members and others, should be sent to either of these addresses.

The Editors

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Looking back with appreciation, looking forward with hope

Miguel Pinedo-Vasquez[1]
Scientific Coordinator

The authors of the Midterm and Final Evaluations both acknowledge that PLEC achieved some globally important goals during the four-year GEF-funded phase. To quote a part of the Final Desk Review:

> PLEC has demonstrated that biodiversity can be maintained in agricultural systems in ways that also improve farmers' livelihoods and reduces their risks across a variety of social and ecological systems. PLEC has demonstrated that farmers and scientists can collaborate to increase the area of land under this type of management. PLEC has developed replicable methods for extending the PLEC approach to new sites and for documenting and evaluating the techniques discovered.

We at PLEC see such recognition as a challenge and a responsibility. We are now dedicating ourselves to the task of building our considerable, although geographically limited successes, into much larger, country-wide, region-wide, and even global initiatives. We are set to upscale and mainstream our methods, strategies, and actions. We feel that the World Summit on Sustainable Development (WSSD) held last September in Johannesburg confirmed that this is an important time for using PLEC approaches to deal with the combined scourges of rural poverty and environmental degradation. We believe that PLEC is in position to contribute in invaluable ways to reaching goals set at the WSSD, even though we are doing this at a time when the resources for any such efforts are severely limited.

PLEC responds to the WEHAB initiative

WEHAB is an acronym for the five key thematic areas that were suggested during WSSD preparations as central to the implementation of sustainable development: Water and sanitation, Energy, Health, Agriculture, and Biodiversity and ecosystem management. Global news coverage of the WSSD introduced the WEHAB initiative to many of us, although it had been proposed before the WSSD was convened. The initiative was proposed by the UN Secretary General not as an entirely new direction, but rather as a strategy for further, less fragmented, and more effective implementation of the long-standing Agenda 21 goals.

Several paths to achieving WEHAB goals were widely discussed at the WSSD. Among the most important was 'capacity development through partnerships'. This is an area where we believe that the new PLEC can particularly excel.

1. Center for Environmental Research and Conservation, Columbia University

Our plan for the future includes a three-track initiative with both capacity development and partnerships as central features. The next four years will see the formation of:

- Regional Programmes for Agrodiversity Training (RPATs);
- Regional Agrodiversity Networks (RANs), and
- a web-based information and news service.

All Regional Programmes for Agrodiversity Training will focus on upscaling and mainstreaming activities that extend the scope of PLEC work to new areas of each region. The RPATs will reach out to other conservation and rural development projects, and build PLEC principles and methods into mainstream regional conservation and development efforts. These central PLEC ideas include valuing and working with locally developed successful farming practices, employing local innovative 'expert farmers' as teachers, and carrying out training in farmers' fields. The full integration of poverty alleviation and resource conservation goals is central to these efforts.

The Regional Agrodiversity Networks (RANs) will be served by the RPATs and in turn will update the work of the regional centres with ever-expanding richness of examples of production systems, expert farmers, and successful demonstration activities. RANs will be based on current active and innovative PLEC clusters in partnership with local, national, and regional institutions. Each RAN will identify, contact and invite members of projects working on similar issues in other localities or countries of the region to join the network. The main mission of the RANs will be to identify, test, promote, and monitor environmentally sustainable and economically rewarding production and management systems using tested demonstration approaches. RANs will base their work on sound knowledge of the area, its resources, environmental, social and political trends, and economic opportunities. The goals will be fully consistent with WEHAB priorities and patterns of working in partnerships and networks.

Early achievements

The third of our new 'tracks' has had the earliest achievements. Under the direction of Harold Brookfield and Helen Parsons, a new electronic era for PLEC has begun. This issue of *PLEC News and Views* marks the debut of ePNV. Although some with poor Internet access may be reading this issue in hardcopy, most of us have received it in electronic form. Many of us have already also enjoyed the informative summaries of important articles on PLECserv.

In the next issue we hope to be able to report on the progress being made in many other PLEC initiatives, including important fundraising achievements. We who have persisted with PLEC since before the GEF period, and those of our Clusters who were never able to benefit from those generous funds, remember well that fundraising takes both long-term and broad-ranging initiatives. Many of us are now engaged actively in multiple efforts to build new partnerships and networks and to find support for our activities and collaborators. Looking back we have much to build upon; looking forward we have much to anticipate.

PAPERS

Synthesizing and evaluating PLEC work on biodiversity[1]

Miguel Pinedo-Vasquez, Kevin Coffey[2], Lewis Enu-Kwesi[3] and Edwin Gyasi[4]

The processes of cataloguing agrodiversity and measuring agrobiodiversity as part of the global PLEC initiative lasted for more than five years.[5] Following the support given by the Biodiversity Advisory Group (BAG) in 1999, the Scientific and Technical Advisory Team (STAT) facilitated activities from 2000. The principal objective of STAT was to aid all participants of the project to use technical and scientific criteria for selecting appropriate methods and techniques for recording smallholder technologies and quantifying the resultant agrobiodiversity (Pinedo-Vasquez et al. 2002). The PLEC-STAT experience provided important technical information that is of use in future efforts to document production technologies and conservation practices in smallholder societies and for measuring the existing on-farm agrobiodiversity (Coffey 2001, 2002).

This paper has two main purposes: synthesis and examination of scientific findings presented in PLEC final reports; and presentation of key findings and suggestions made by STAT based on the analysis of the biodiversity data collected by each cluster.

Each of the 12 countries built its own database and these are currently connected through the meta-database (PLEC database 2002), which was created to provide NGOs, global institutions and governments with the means to access the general information described by each cluster in their database. The meta-database was posted on the web and made public along with contact information for each cluster's database manager. If someone outside of PLEC is interested in the summary of a clusters' data, they can contact the cluster directly and discussions over the release of data are handled by the clusters.

Agrobiodiversity measurement and analysis

Clusters have presented the results of their agrodiversity analysis in final reports as well as in articles for *PLEC News and Views* and other publications. Other PLEC information can be found in the project's two latest books (Brookfield et al. 2002; Brookfield et al. in press). We do not attempt to summarize all of this work, but instead present a brief synthesis of the approaches. The on-line PLEC meta-database should also be consulted for an overview of type of data collected in PLEC demonstration sites. Here we focus in two ways on the type of information each cluster collected and the methods of analysis employed. Firstly, the land-use stages that each cluster sampled are compared. Secondly, depending on the specific goals of each cluster, data were aggregated and analysed at different scales. All scales were organized in a matrix.

STAT decided early that there would be no value in presenting agrobiodiversity indices across different clusters for comparison. This followed discussion with other PLEC members on sampling methodology as well as a review of agrobiodiversity analysis done by each cluster. Each cluster took account of site-specific factors to make decisions at every step of data collection and analysis. Decisions on site selection, land-use stage definition, sampling techniques, and levels of aggregation and analysis make each cluster's analysis unique. While STAT provided a methodology for each of these practices, clusters were given the flexibility to experiment and discover the best method for sampling and analysing that would facilitate each clusters' own work towards the PLEC goals. To enforce a comparable methodology across clusters would have required an inflexible process, and this would have severely inhibited the clusters from making choices. The diversity of methodologies has produced rich quantitative information on the existing agrobiodiversity and other biological diversity that helps cluster members make comparison among land-use stages and among landholdings and communities.

PLEC methodology called for the categorization of the landscape into land-use stages (Zarin et al. 2002). After selection of the land-use stages, PLEC teams surveyed the agrobiodiversity within these land units. Table 1 summarizes the land-use stages that each cluster sampled.[6] No two clusters sampled exactly the same collection of land-use stages. Decisions on the land-use stages sampled by each cluster were based on the importance of the stage in the production systems within the particular demonstration sites, and on the agrobiodiversity that was contained in the system.

Differences and similarities in the level of aggregation are of particular interest. Collected and analysed data on many

1 This paper is edited from the final report of the Scientific and Technical Advisory Team of PLEC, of which the four authors were members.
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5 By agrobiodiversity we mean all of the biotic components of the agroecosystem. We define agrodiversity as all other components of the system including abiotic components as well as techniques and technologies associated with farming practices (see Brookfield and Padoch, 1994).

Table 1: *Seven main categories of land-use stages sampled by PLEC clusters in 12 countries*

Country	Field	Forest	Fallow	House garden	Edge	Agro-forest	Grass-land
Ghana	B	M	E,V	L		A	
Tanzania		M,S,Z	AA	L		A	
China	W,Y,Q	C,T,I				X,H	
Jamaica			V	L	D	P,A	
Peru	F	G	E	L		A	
Thailand	F,Y				D	A	
Uganda	B	J		L	K	R	N,O
Guinea		G	E	L		A,P	U
Brazil	F	G	E	L		A	
Mexico	F	G				P	O
PNG			E,I	L		P	
Kenya	B	S,M	V,E,AA	P		P	

Key: The land-use stages identified by each cluster are represented by: agroforestry (A), annual cropping (B), community forest (C), edge (D), fallow - not specified (E), field (F), forest (G), fruit plantation (H), fuelwood plantation (I), gazetted forest (J), hedges (K), home gardens (L), native forest (M), planted grassland (N), natural grassland (O), orchard (P), paddy (Q), perennial crops (R), planted forest (S), rubber plantation (T), shrub savanna (U), shrub dominated fallow (V), swidden field (W), tea plantation (X), upland rice (Y), water source microcatchments (Z), pasture fallow (AA).

different levels shows the large number of land-use categories used by farmers in each of the 12 countries. A review of the final reports displayed three main levels of analysis: village, land-use stage, and field type. Some clusters decided to analyse their data at the village level, comparing agrobiodiversity in each land-use stage. Other clusters compared the differences in agrobiodiversity at the field level for plots within the same land-use stage. The selection of levels of aggregation was based upon the questions being asked. If the researchers were interested in identifying the land-use stage that contains the greatest amount of diversity as a means of selecting land-use stages on which to focus demonstration activities, the village level comparison show the differences in agrobiodiversity. Working among individual households, if a cluster were interested in finding a farmer who managed a particular land-use stage in the most diverse way, the plot level analysis within the same land-use stage is used. Ideally the clusters used a combination of different scales to answer questions and address the needs of the cluster. Clusters did not present every type of analysis that they performed over the five years in their final reports. Other publications outside PLEC and in *PLEC News and Views* include the different levels of analysis used.

Linking research with action

The PLEC methodology for agrobiodiversity inventories and analysis can only be successful if it serves as a useful link with the other components of the project. In our review of the PLEC literature, it became obvious that the 'quantitative' component of PLEC has aided clusters in two main areas. The first was as a **tool to discover expert farmers and understand the impact of their expertise on the agro-ecosystem in comparison with other farmers in the community**. Examples of this approach come through in reports and publications by many clusters, including China, Amazonia, Jamaica and Thailand.[7]

In Thailand, for example, the PLEC team used interviews and field surveys to determine field types that contained diversity of traditional varieties. After discovering that agroforest edges are an important land-use stage in the village where farmers manage diversity, the team conducted extensive studies of species diversity and management in edges within the village. Some of the results of the agrobiodiversity assessment presented in Thailand's final report are summarized in Table 2.

The combination of household surveys and intuitive fieldwork revealed a part of the landscape that normally would be overlooked as a component feature of the village's agrobiodiversity. The inventory and assessment of agrobiodiversity within the land-use stages using PLEC methodology, uncovered the variation between the agroforest edges within the village. A farmer could be identified who managed an unusual amount of diversity in his landholding (see bold in Table 2). Data such as these can then be used as an aid in the selection of expert farmers and monitoring of the future effects of PLEC activities.

A second important output of PLEC analysis was to display the **importance of agrobiodiversity as a key component in the efforts to conserve biodiversity**. All clusters have made attempts to influence policy makers, non-government organizations, technicians and fellow scientists on its importance. A particular example of the use

Table 2: *Results of agrobiodiversity survey of edge land-use stage in Thailand (expert farmer in bold)*

Edge Manager	Total Individuals	Species Richness	Shannon Index	Margalef Index
Village Average	315	38	2.35	6.39
Saophang	717	114	2.77	17.19
Juk Saehang	332	33	2.29	5.51
Chao/Cheng Seng	315	18	1.54	2.96
Other edges	300	62	3.24	10.69

6 No attempt was made to integrate the classification systems used by each cluster. The authors are aware that some of the categories overlap, while others might be incompatible. The classification systems were left unchanged because the tremendous agrodiversity within each area cannot be classified on a global scale.

7 Edited versions of Cluster final reports are being published in Brookfield et al. in press (2003).

of agrobiodiversity analysis as a tool to help others recognize agrobiodiversity and include it in environmental, development, or conservation policy comes from Ghana. After systematic inventory of biodiversity within house gardens and farmers' fields at PLEC demonstration sites, the team was able to present convincing arguments that the importance of agrodiversity goes beyond its scientific significance. Members of STAT present at the Ghana workshop in 2000 received a first hand demonstration of the power of these numbers.

The PLEC team presented the data on the biodiversity found in farmers' landholdings in the demonstration sites in southern Ghana to the large and influential audience. As the PLEC scientists discussed sample methods and problems associated with plot size, it was clear that the diversity within farmers' fields was an important matter to be discussed in a political as well as a scientific context. Discussion about conservation, species richness, and diversity indices was not new to most of the audience, but in previous cases these assessments had only been conducted in 'natural' lands, such as forests, while agricultural data had most often been limited to assessments of yield per hectare and cropping patterns. The value of farm systems for diversifying habitat for important and critical biological organisms was clearly recognized by non-experts for the first time (Table 3).

Approaches that policy makers, NGOs, and technicians take towards conservation and development are based upon preconceptions about where conservation and development take place, and what kind of science is appropriate. The presentation of the analysis in farmer's fields made everyone in the audience acutely aware that the practice of conservation was not limited to the forest and much of the diversity that Ghana wishes to protect is under the protection of its farmers. These advances, along with some other important presentations at PLEC-Ghana workshops and meetings, have changed the way influential figures think about production and conservation. A mark of this achievement is the award to two PLEC farmers for diversity management. A proposal

Table 3: *A Sorensen similarity matrix comparing land-use stages found in PLEC's southern Ghana demonstration sites*

Field types/Land-use Stages		1	2	3	4	5	6	7	8	9	10	11
Citrus orchard (A/W)	1	85	20	11	21	29	22	29	15	20		
Oil-palm plantation (A/W)	2		66	31	25	48	30	42	30	44		
Native forest 1 (G/A)	3			144	22	55	33	44	33	67		
Tree dominated fallow (S/O)	4				57	42	35	41	28	31		
Shrub dominated fallow (G/A)	5					176	67	84	54	77		
Cassava monocrop (G/A)	6						89	66	50	37		
Emerging Agroforest (G/A)	7							131	47	62		
Cassia siamea woodlot (G/A)	8								73	42		
Native forest 2 (S/O)	9									120		
Maize monocrop (S/O)	10										96	
Secondary forest (G/A)	11											100

		1	2	3	4	5	6	7	8	9	10	11
Citrus orchard (A/W)	1	-	27%	10%	30%	22%	25%	27%	19%	20%		
Oil-palm plantation (A/W)	2		-	30%	41%	40%	39%	43%	43%	47%		
Native forest 1 (G/A)	3			-	22%	34%	28%	32%	30%	51%		
Tree dominated fallow (S/O)	4				-	36%	48%	44%	43%	35%		
Shrub dominated fallow (G/A)	5					-	51%	55%	43%	52%		
Cassava monocrop (G/A)	6						-	60%	62%	35%		
Emerging Agroforest (G/A)	7							-	46%	49%		
Cassia siamea woodlot (G/A)	8								-	44%		
Native forest 2 (S/O)	9											
Maize monocrop (S/O)	10											
Secondary forest (G/A)	11											

Mean/standard error = 38/2%

Key to Demonstration Sites:
Amanase-Whanabenya:A/W
Gyarnfiase-Adenya: G/A
Sekesua-Osonson: S/O

was made that government should systematically award farmers who display an extraordinarily large amount of agricultural diversity in their production systems, in addition to achieving good production.

These two examples show that the PLEC agrobiodiversity assessment model can be very successful when it ties into other components of PLEC initiatives. One of the key problems in making this connection is understanding the relationship between biodiversity and the many political, economic, cultural, and ecological factors that make up the environment in which the agrobiodiversity exists. Simple assessments of biological diversity are not enough to support PLEC initiatives. A list of farmer's plots with diversity indices means very little. One can know which plot has the highest species richness or Shannon index, but little can be done with this information.

Expanding the agrobiodiversity threshold

In agroecosystems there is what might be called an agrobiodiversity threshold. This is the point at which, there being no change in the determining factors mentioned above, the addition of another species would reduce the productivity of the system. While it might take a tremendous amount of expertise to manage species past this threshold, this is not the system that PLEC attempts to disseminate in its demonstration activities. The expert farmer is not simply the farmer who manages the most species per hectare; **the expert farmer is the farmer who manages the environmental conditions so that the agrobiodiversity threshold is expanded** and the diversity on his or her plot represents an expansion in production rather than a net loss in cost-benefit terms.

Understanding how farmers manipulate this threshold is the key in connecting agrobiodiversity assessment with PLEC initiatives. A farmer who finds a market for secondary crops is an example of manipulating the economic environment to expand the threshold. In the case of the edges in Thailand presented in Table 2, we see an example of this type of expansion. Saophong found a market for traditional Hmong instruments and used the agroforest edge to plant species that were necessary to craft these instruments, thus expanding the agrobiodiversity threshold of the agroforest edge.

A case, from China, provides an example of the extension of this threshold through a farmer's knowledge of the local ecosystem and forestry techniques. In the Baihualing valley, farmers grow a variety of subsistence and cash crops including, rice, sugar cane, maize, pumpkin, squash, and coffee in intensive systems. The Gaoligong Mountain reserve shares a border with this village and much of the land that the farmers own close to the reserve is designated for household timber management. A previous government project provided the farmers with a timber species, *Cunninghamia lanceolata* to plant on their land. Li Dayi, a farmer from Tao Yuan village in Baihualing, owns one of these plots and was excited to show the PLEC-China team his plot when they came to the village to inventory diversity in forestry systems. In contrast to the *C. lanceolata* plantations other farmers had created, an inventory of Li Dayi's plot recorded other timber species such as *Phoebe puwenensis* and *Toona ciliata*. Analysis of the structure and composition revealed important differences between his land and the rest of the village. Li Dayi had collected seedlings of timber species from the nearby reserve, and successfully nurtured them and planted them on his land at intervals to stagger the harvesting time (Guo et al. 2002). This PLEC expert farmer's knowledge of ecology and forestry increased the threshold for diversity on his land.

Placing the quantification of agrobiodiversity into a broader context, which includes the farmer's management of the many factors that influence his/her production scheme, opens up many possibilities for the use of surveys and analysis in PLEC activities (Guo et al. 2002). In our review of four years of PLEC literature, it is clear that the clusters that understood this connection were most successful at turning the results of research into action. The clusters that did not make this connection clearly had two separate components in their project. First, was a research component that yielded lists of species and diversity indices. Second, was an independent development component that had a tendency to fall back on traditional development models because the team did not have a set of useful observations from its research component on which to build.

While the above remarks might seem harsh, they are not meant as criticism of the efforts of any cluster. The crucial element in the formula for success seems to be time spent working with the communities. As noted by Brookfield (2002), working in a single demonstration site over a long period of time has many advantages. For clusters such as Brazilian and Peruvian Amazonia, studies of the diversity within agroecosystems have been conducted for over a decade and researchers have strong working relationships with the community. In other clusters the four years of GEF-funded PLEC work were a chance to establish contacts within the communities and begin to understand the diversity within the system. We believe that all clusters have shown a commitment towards using science to facilitate beneficial interactions between expert farmers and other farmers. By performing basic quantitative analysis, clusters have applied the PLEC approach to better fill the gap between studying communities or agroecosystems and facilitating demonstration activities.

Diversity as a process

In the most recent literature there have been studies looking at the connection between what ecologists term as disturbance and biodiversity. The emphasis on looking on biodiversity as the result of natural process allowed scientists to portray the relationship between disturbance and diversity as a parabola (Molino and Sabatier 2001). Maximum diversity occurs at moderate levels of disturbance and minimum diversity at the extreme levels (most disturbance, and least). While the intermediate disturbance hypothesis has been around since the late 1970's (Connell 1978, 1979), the recently renewed popularity of the hypothesis adds yet another damaging blow to the waning idea of conservation as simply the protection of nature from damaging forces.

As the art of conservation evolves, conservationists have already employed these concepts in the management of reserves against fire and other natural 'disturbances' where intermediate disturbance protects the forest against catastrophe. Recent studies show the relationship between the habitat in these disturbed patches and the diversity within the landscape. Biological diversity is dependent on larger processes and that these processes are required to perpetuate diversity. This stands in direct opposition to viewing biodiversity as a precious gift that must be protected at all costs. Biodiversity is important, and conservationists need to think beyond how to protect diversity itself and understand the processes by which biodiversity is a product of interactions.

In reviewing the scientific component of PLEC, we see PLEC clusters studying this interface between diversity and disturbance. PLEC recognizes that farmers have understood these processes well before they appeared in the pages of *Science* magazine. It is for this reason that PLEC does not look at the relationship between biodiversity and disturbance, but instead looks at the connection between biodiversity and management. PLEC studies display how farmers with agrodiverse landholdings employ an incredible knowledge of the connection between biodiversity and 'disturbance' and manage their landholdings to benefit from this connection. The complexity of this type of management makes understanding it a major challenge. While the results of PLEC agrobiodiversity surveys allude to this type of management, translation of these processes by an expert farmer is necessary to truly understand what is going on. We call particular attention to data from Brazilian Amazonia (Table 4) which show how knowledge of a seemingly ambiguous connection between biodiversity, disturbance, management and profit are brought together on a farmer's landholding. A key component of the PLEC work in Amazonia was the measurement of biodiversity and observation of management practices in fallows.

The age of each fallow was recorded to measure the relationship between management and biodiversity. Fallows managed by farmers contain a higher diversity than fallows that were simply abandoned to natural regeneration. The fallows were all located in a similar habitat near the PLEC demonstration site in Mazagão. Based upon these findings the PLEC team set out to discover what practices led to the increase of diversity in the farmers' fallow. This task is not easy because it requires an investigation of two normally disparate matters: farmers wish to profit from their activities, but they are increasing the diversity of their fallows. So the questions is, how do management practices that increase diversity also lead to an increased in biodiversity at a landscape and regional level (Pinedo-Vasquez et al. 2002).

Understanding the influence of farmers and farm systems on ecological communities is a difficult endeavour that requires careful questioning of spatial and temporal scales. Practices that might appear to diminish diversity (e.g. fire) in the short term might lead to an increase in diversity in the long term. Data collected also show that practices that reduce diversity on a small scale (e.g. a forest patch) actually increase diversity on a large scale (habitat diversity). All of these factors must be taken into account when studying farmers' interaction with the biodiversity in the landscape. The use of biodiversity survey was crucial in that it gave solid evidence of the relationship between management and diversity as well as giving PLEC researchers specific locations to observe these practices.

Table 4: *Species richness in 3, 4 and 5 year-old managed and unmanaged fallows in the Amazonian PLEC sites in Brazil. (DBH>2.5)*

	Number sampled fallows	*Avg. area per fallow*	*Total sampled area (ha)*	*Avg. number of species*	*Shannon Index*
Managed fallow					
Three years	24	0.25	6	56	2.14
Four years	18	0.35	8	68	2.09
Five years	12	0.60	8	74	2.36
Unmanaged fallow					
Three years	24	0.25	6	18	1.17
Four years	18	0.35	8	27	1.56
Five years	12	0.60	8	32	1.64

References

Brookfield, H. 2002. The message from PLEC. In H. Brookfield, C. Padoch, H. Parsons and M. Stocking (eds) *Cultivating biodiversity: understanding, analysing and using agricultural diversity*, pp. 256-60. London: ITDG Publishing.

Brookfield, H. and C. Padoch. 1994. Appreciating agrodiversity: a look at the dynamism and diversity of indigenous farming practices. *Environment* 36(5):6-11, 37-45.

Brookfield, H., H. Parsons and M. Brookfield (eds) 2003. *Agrodiversity: learning from farmers across the world.* Tokyo: United Nations University Press. (in press)

Coffey, K. 2001. PLEC Agrodiversity database manual. Report for PLEC. United Nations University, Tokyo.

Coffey, K. 2002. Quantitative methods for the analysis of agrodiversity. In H. Brookfield, C. Padoch, H. Parsons and M. Stocking (eds), *Cultivating biodiversity: understanding, analysing and using agricultural diversity*, pp. 78-95. London: ITDG Publishing.

Connell, J.H. 1978. Diversity in tropical rain forests and coral reefs. *Science* 199: 1302-1310

Connell, J.H. 1979. Intermediate-disturbance hypothesis. *Science* 204: 1344-1345

Guo, H., C. Padoch, Y. Fu, Z. Dao and K. Coffey. 2002. Household-level agrobiodiversity assessment. In H. Brookfield, C. Padoch, H. Parsons, and M. Stocking (eds) *Cultivating biodiversity: understanding, analysing and using agricultural diversity*, pp. 70-125. London: ITDG Publishing.

Molino, J.F. and D Sabatier. 2001. Tree diversity in tropical rain forests: a validation of the intermediate disturbance hypothesis. *Science* 294: 1702

Pinedo-Vasquez, M., C. Padoch, D. McGrath and T. Ximenes-Ponte. 2002. Biodiversity as a product of smallholder responses to change in Amazonia. In H. Brookfield, C. Padoch, H. Parsons, and M. Stocking (eds) *Cultivating biodiversity: understanding, analysing and using agricultural diversity*, pp. 167-178. London: ITDG Publishing.

PLEC database, 2002 http://www.unu.edu/env/plec/database/metadata/a-index.doc.

Zarin D, H. Guo and L. Enu-Kwesi. 2002. Guidelines on the assessment of plant species diversity in agricultural landscapes. In H. Brookfield, C. Padoch, H. Parsons, and M. Stocking (eds) *Cultivating biodiversity: understanding, analysing and using agricultural diversity*, pp. 57-69. London: ITDG Publishing.

What does PLEC farmer-to-farmer demonstration offer that other participatory methods lack?

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PLEC, Tanzania

Editors' introductory note

Participatory approaches to rural development have gained much popularity since failure of 'transfer-of-technology' became apparent in the late-1970s and 1980s. The then-recent innovation of 'Rapid Rural Appraisal' soon became 'Participatory Rural Appraisal' and, with a distant input from the activist study of poverty in Latin America, 'Participatory Learning and Action'. There is now a host of participatory programmes, each with its own acronym. They cover a range of development activities not only in the agricultural field but also in water supply and sanitation, public health, and gender issues, among others. All are concerned to involve people, as holders of important knowledge but more importantly as participants in decision-making and action that will lead to amelioration of their own condition. In many, however, the process is still one in which the agenda is drawn up externally.

An important stage was the emergence, in Indonesia, of the Farmers' Field School (FFS), or 'school without walls' (Winarto 2003), for the implementation of integrated pest management in the late 1980s. To achieve the aims of the IPM programme it was necessary that farmers themselves become experts in the ecology of their agriculture, its pests and their predators. The farmer is not simply an end-user of technology, but has to become the master of local diversity and opportunity (Röling 2002). A similar outcome, but at community rather than individual level, is claimed for Participatory Learning and Action Research (PLAR), also a structured yet adaptable system, aiming to build up long-term engagement in farming communities (Defoer 2002). Both FFS and PLAR have recently been applied to what is now termed 'integrated soil fertility management'. Both are continuing to gain in popularity, but with 'training of trainers or facilitators' necessarily taking the place of old-style 'transfer of technology'.

While PLEC comes broadly out of the same 'anti-transfer of technology' stable, it is also the product of a research tradition of seeking information from farmers. It depends primarily on what scientists learn from farmers about their resource management, and the observation and evaluation of farmers' practices by the scientists. Not dissimilar methods have been followed by the Cosecha movement originating in Central America. In PLEC, successful and conservationist methods are then promoted through farmer-to-farmer instruction and contacts. PLEC does not press any single package or formula. The scientists' role is essential in selecting the farmers and their practices, and in validating the effectiveness of these practices. But the key person in the demonstration process is the expert farmer.

It is not easy to upscale any of these methods to large populations, because they are knowledge-intensive, and an important part of the knowledge concerns the specific site conditions. A follow-up study of FFS in the Philippines showed that while most 'schooled' farmers retained their knowledge, comparatively little of it has been diffused through the wider village population (Rola et al. 2002). Moreover, all these methods have substantial costs. In FFS, the largest cost is in the demanding 'training of trainers', and the rather elaborate structure of PLAR implies substantial additional costs. In PLEC, the role of scientists is indispensable. Writing for the World Bank, and specifically about FFS in Indonesia and the Philippines, where some of the largest benefits of IPM through FFS have been claimed, Quizon et al. (2000) seriously questioned whether participatory methods would, in the long run, be cost-

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effective without substantial external support. Yet there is general agreement that farmer-to-farmer training is the key to resolving the weaknesses that arise from widespread incapacity in the increasingly under-funded extension services. How is this best achieved?

Comparative evaluations of different approaches, by participants, are rare in the literature. Fidelis Kaihura, leader of PLEC in Tanzania, has experience of all three, and his comparative evaluation is presented below. The context of his comparative discussion is Tanzania and Kenya, and he does not try to extend any generalizations beyond this frame.

Introduction

During four years of demonstration site activities using expert farmers as trainers of other farmers and scientific experts as facilitators, PLEC developed an approach that offers rapid and participatory technology development, adoption and dissemination. It gives farmers control over technology development and strengthens farmer-farmer and farmer-researcher interactions and knowledge exchange.

Other methods currently being used include Participatory Learning and Action Research (PLAR) (Defoer 1985) and Farmer Field Schools (FFS) approach by the Food and Agriculture Organization (FAO). All three methodologies employ farmer participation in different ways. The author has used the three methodologies with farmers in different parts of Tanzania, and compares the PLEC methodology with FFS and PLAR methodologies.

PLEC farmer-to-farmer demonstration

The PLEC methodology involves participatory appraisal methods to identify and prioritize resource management systems of farmers and the constraints they face. Farmers with particularly successful management techniques are identified. These expert farmers use their own fields as sites for training other farmers. There is considerable interaction between the farmer audience, the farmer trainer, researchers and extensionists. Farmers have the opportunity to assess the performance of the technology and can either adopt, modify or reject all or part of the management technique. There are a number of distinct advantages of the methodology.

Farmer control

Farmers are fully empowered to demonstrate good practices to other farmers with researchers and extension staff acting as facilitators. Demonstrated technologies address existing land-use practices in the diverse land-use types of a given landscape. They originate from the farmers and from what they are doing in their own fields. The demonstrations are fully managed by farmers and the developed technologies with researcher facilitation are felt by farmers' to be their own technologies for which they are responsible and accountable.

Intimate interaction between farmers and scientists

Researchers and extension staff spend time in close discussion with farmers. This enables researchers to understand the farmers' perspective in resource management and establishes mutual trust between them. Farmers sometimes disclose the secrets behind their successes, which would not be released without mutual trust.

In-situ demonstration of successful management models

No new experimental sites are required. Technology development is built on farmer's on-going successful management. Assessment of the developed technology is also *in situ*. Participating farmers may modify the technology to suit their own situations according to such things as the availability of inputs, position and land form of the farm in the landscape, size of the farm and the kinds of crops grown by the farmer. Other farmers may decide not to adopt the technology at all. Testing, adoption or rejection and dissemination are simultaneously carried out. Many farmers and experts are involved at the same time, thereby up-scaling the demonstration process.

All farmers become involved including those normally left out by other participatory approaches

Most participatory methods involve farmers who are most able to access information and take advantage of project benefits. The old, the poor and women are often left out. Since PLEC methodology demonstrates good management practices using expert farmers on farmers' fields and emphasizes knowledge exchange, all farmers in the village and neighbourhood get involved. There are also cases where good management practices originate from the very resource poor.

Researchers and extension staff are exposed to farmer initiated research on farms

Due to inadequate advisory services, farmers carry out experiments on their own farms to address the perceived constraints. The outcomes of these experiments are mostly not known to researchers or to neighbouring farmers with similar constraints. Sometimes these experiments parallel those conducted by researchers at research centres. Through intimate discussions between scientists and the farmers, farmers' experiments are recorded, and may be modified or stopped where technology already exists. Little was known about individual farmer experiments before PLEC, but now knowledge of those normally quiet experts is shared.

Many different stakeholders participate in demonstration site activities

Unlike other methodologies, demonstration site activities have involved village leaders, district-level leaders, community development officers, members of other local projects, and even politicians. After being convinced of the relevance of the technology during the farmer training sessions, the leaders of other community development projects and politicians often become instrumental in dissemination of the technology and the methodology. The expert farmers may also be invited to train farmers in other projects, thus demonstrating a high potential of technology dissemination.

Scepticism is reduced

Training by expert farmers reduces the scepticism that farmers often have of scientists, who conduct training in what they do not practice. While solutions to problems identified by most participatory programmes are from research institutions, solutions to problems using PLEC methodology are found in the field.

Filling the gap created by inefficient extension service

Farmers communicated to researchers that extension services often do not meet the farmers' expectations of them. The use of expert farmers as trainers improves training compared with a poorly facilitated and inefficient extension service.

Farmer groups or associations are instrumental in technology development and dissemination

Through the PLEC approach, farmer groups with a common interest in resource management are initiated and mobilized by the farmers for exchange of knowledge. Implementation is maintained at individual farmer level. Through the groups even those less able will pull up their socks in fear of being left behind.

Farmer field school approach

Farmer Field Schools (FFS) are schools without walls where experimental learning is carried out. The methodology is based on the belief that a demonstration plot managed by outsiders may not convince a farmer to try something new. Farmers need opportunities to experiment with new technologies, to learn how to evaluate options more systematically and to decide which are worthwhile. Learning by doing adds to farmers' knowledge and experience, and improves their capacity as farm managers in a way that the passive exposure to extension messages cannot.

The FFS model requires adaptation of technology to suit specific environmental, agronomic and socio-economic conditions. The training is organized for a specific subject, such as Integrated Pest Management (IPM) or Integrated Nutrient Management (INM). Initially farmers and researchers work together to analyse problems related to a given ecosystem and identify problems. Some problems may not be addressed easily, but side problems often can be. Training manuals are designed for the specific subject as tools for facilitators and to enable replication of activities with other farmer groups.

Farmer Field School activities contain elements of observation, analysis and experimentation. Participatory evaluation of both the technology and the process is an integral part of the approach. They run for a season with the field used as a class and a crop as a teacher, and are moderated by a technically strong facilitator. The training follows crop developmental stages. The technologies are tested and validated and farmers graduate with certificate awards.

Weaknesses of the methodology relative to PLEC methodology

- There is a low level of empowerment of farmers. After participatory analysis of the ecosystem, experiments are designed by experts and carried out at a site outside farmers' fields. Farmers learn about a solution to the problem at the end of the experiment. There is no obvious mechanism for scientists and extension staff to learn from farmers.
- Full ownership and accountability of the experiment by the farmers is lacking.
- Farmers' scepticism of what is advocated by scientists and extension staffs as an appropriate resource management technique still exists.
- Farmers who form experimental groups are usually those who can access information, opportunists who expect to benefit from the project and those with greater ability to communicate. The poor, quiet, old, most women and those unable to access information are mostly left out.
- Planning and monitoring is by experts and implementation is by farmer groups. There is more learning than practice.
- The success of the methodology mainly depends on the level of understanding of the subject by facilitators (usually extensionists) rather than expert farmers.

Participatory learning and action research

Participatory Learning and Action Research (Defoer and Hilhorst 1995) enables farmers, together with researchers and extensionists, to analyse and understand farmer strategies and practices for soil fertility management. The results are used to identify the adapted (often existing) technologies which will result in more sustainable management of soil fertility. It aims to guide farmers in improving soil fertility management practices. The key elements of the approach include:

- diagnosis/analysis of farmers' strategies;
- planning activities including training;
- implementation including assistance, training and advice;
- evaluation of activities and follow up planning.

A multidisciplinary team of researchers and extensionists use PRA tools including resource mapping, use and management of natural resources at village and farm levels, analysis of fertility management techniques by different farmer groups (old, young and women), assessment of management practices using resource flow models and transect walks, and restitution of findings. Researchers and extension staff give some feedback on the concepts and technical implications of the suggested improvements for each farmer category. Restitution aims at stimulating other farmers of the same category to consider similar improvements.

Test farmers and other interested farmers, scientists and extensionists plan activities and develop an implementation plan. During implementation, a farmer workshop, exchange visits and participation in demonstrations are organized to expose farmers to new technologies and experiences of other farmers. Success is improved by the intensive involvement of farmers in the analysis of their own situation. At the end of the season farmers evaluate performance of the tested technologies and effectiveness of their implementation plan, and plan for the next season.

Weaknesses of the methodology relative to PLEC methodology

- There is dominance by experts (researchers and extension staff) in the technology development process rather than farmers.
- The grouping into young, women and the old implies diversity in soil management by age and gender. The rationale behind this grouping is not clear.
- Planning is by experts and implementation is by individual farmers.
- The methodology is addressing only one problem of soil fertility using resources available to the farmer.

Discussion

All three participatory methods employ farmer participation in technology development. They also try to bridge the gap caused by the inefficient extension services. Unlike the PLEC method, the other two methods emphasize training farmers to better manage resources - they are more top-down. The success of the FFS methodology greatly depends on the competence of the facilitators (usually trained trainers of farmers) and on the particular season.

The many advantages of the PLEC approach over other participatory methodologies are summarized below.

- It has the highest level of farmer involvement in technology development.
- The methodology recognizes and builds on farmers' successful management practices often developed through a long period of observation, trial and error – it is a purely bottom-up approach.
- The likelihood of adoption of the technologies is very high due to the full involvement of farmers as owners of developed technologies, and farmers gain confidence in their own capacities to overcome constraints.
- The methodology involves many farmers and stakeholders at the same time.
- The extent of dissemination compares well with other methods.
- Using expert farmers strengthens the gap that normally has been created by an inefficient extension service.

With *in situ* demonstration and evaluation of the techniques by all farmers with fellow farmers as lead persons, ownership of technologies is by the farmers. These technologies are open to modification according to farmer's individual resources endowment, and the nature, size and position of the farm in the landscape. Farmer scepticism of problem solving based on book knowledge is greatly reduced. Farmers who have used the PLEC approach find it very appropriate in addressing their daily life problems, with high chances of its replication to other areas.

References

Anonymous, 1998. An introduction to the Farmer Field School for Integrated Crop Management. Ms.

Defoer, T. 2002. Learning about methodology development for integrated soil fertility management. *Agricultural Systems* 73(1): 57-81.

Defoer, T. and T. Hilhorst. 1995. In search of farmer participatory approaches for research and extension in southern Mali. Unpublished paper prepared for the ETC International Work Week, Kericho town, Western Kenya.

Kaihura, F.B.S. 2001. Participatory Technology Development and Dissemination (PTDD). Experiences from PLEC Tanzania. Ms.

Quizon, J., G. Feder and R. Murgai. 2000. A note on the sustainability of the Farmer Field School approach to agricultural extension. Washington D.C.: The World Bank.

Rola, A.C., S.B. Jamias and J.B. Quizon. 2002. Do farmer field school graduates retain and share what they learn? An investigation in Iloilo, Philippines. *Journal of International Agricultural and Extension Education*, Spring 2002.

Röling, N. 2002. Issues and challenges for FFS: an introductory overview. Paper presented to the International learning workshop on Farmer Field Schools (FSS): emerging issues and challenges. Yogyakarta, Indonesia, 21-25 October 2002.

Winarto, Y. 2003. *Seeds of knowledge: the beginning of integrated pest management in Java.* New Haven and London: Yale University Press (forthcoming).

Reports

Adding value to forest conservation by bee-keeping at Sekesua-Osonson demonstration site in Ghana

Edwin A. Gyasi[1] and Emmanuel Nartey[2]

Introduction

One strategy to achieve conservation of a forest is to add value to the forest being conserved. If economic benefits are generated, awareness of the value of conservation is enhanced. Activities such as rearing of the giant African snail, cultivation of yams and other shade-loving crops, and bee-keeping within the conserved habitat, notably a biodiverse forest patch , have been encouraged for this purpose at demonstration sites in Ghana (Blay et al. forthcoming). This report focuses on the Sekesua-Osonson demonstration site where the bee-keeping industry has gained the most popularity.

Bee-keeping is a sustainable, low-cost, environmentally low-impact activity that has the added ecological advantage of enhancing pollination and providing a dietary supplement through the honey – hence the perception of bee-keeping as 'a perfect model of responsible, sustainable agriculture' (Elize Lundall-Magnuson, quoted in Illgner et al. 1998:349). With minimal facilitation or support it could be expected that rural communities would conserve forest and other suitable ecosystems to use their floral diversity for gainful honey bee-keeping as is happening in Sekesua-Osonson.

Sekesua-Osonson demonstration site is situated in the eastern region of Ghana within the forest-savanna transition zone. Soils are predominantly ochrosols. The bi-modal rainfall averages 1,200 mm per annum. A mosaic of forest species represents a transition from the reported original thick semi-deciduous forest. Despite monoculture, there still is high agrodiversity. The ecosystem favours growing a diversity of crops and other plants adapted to the humid and dry conditions. High agrodiversity also reflects the cultural imprint of migrant Krobo cocoa farmers.

PLEC-inspired development of bee-keeping in Sekesua-Osonson

Traditionally in West Africa, the most popular practice is harvesting honey of the wild bees, *Apis mellifera* (Illgner et al. 1998). In Ghana, hunters comb for hives of wild bees in branches of trees, dead tree trunks, caves and eaves of houses. However, honey from this source is uncertain in supply and tends to be poor in quality. Traditional apicultural practices were developed to ensure better supply and quality (Blay et al. forthcoming). They involve the use of bees wax, palm wine, perfume and various other substances as bait to attract bees into pots, dugout logs, baskets and other improvised honeycomb housing units. The use of specially constructed wooden hives is a later development.

Plate 1. Emmanuel Nartey, the expert farmer, standing in front of a wooden beehive in his agroforestry home garden
Source: PLEC collection

During the course of field work in 1998 in Sekesua-Osonson, research scientists encountered two farmers, Sackitey Akor and Emmanuel Nartey (co-author of this paper), who use traditional earthen beehive pots in combination with wooden hives for keeping bees. Akor has a conserved secondary forest and Nartey has an agroforestry patch in their back yard at Bormase village. Noting the promise of their enterprise for forest conservation and biodiverse farming generating supplementary income, PLEC sought to encourage involvement of a larger number of farmers in the adjacent housing compounds. With PLEC financing, in 2000/01 twenty-five wooden hives were constructed by a local carpenter and distributed through the PLEC farmers' association. Fifteen were distributed to six households, and 10 were for a pool managed by the association to enhance its financial sustainability. Initial results with hive maintenance, their colonization by bees and popular expressions of interest were encouraging. This prompted further support by PLEC but, above all, by the Heifer Project International (HPI), a collaborating PLEC partner NGO. HPI provided training and equipment including boots, protective clothing and approximately 300 wooden hives.

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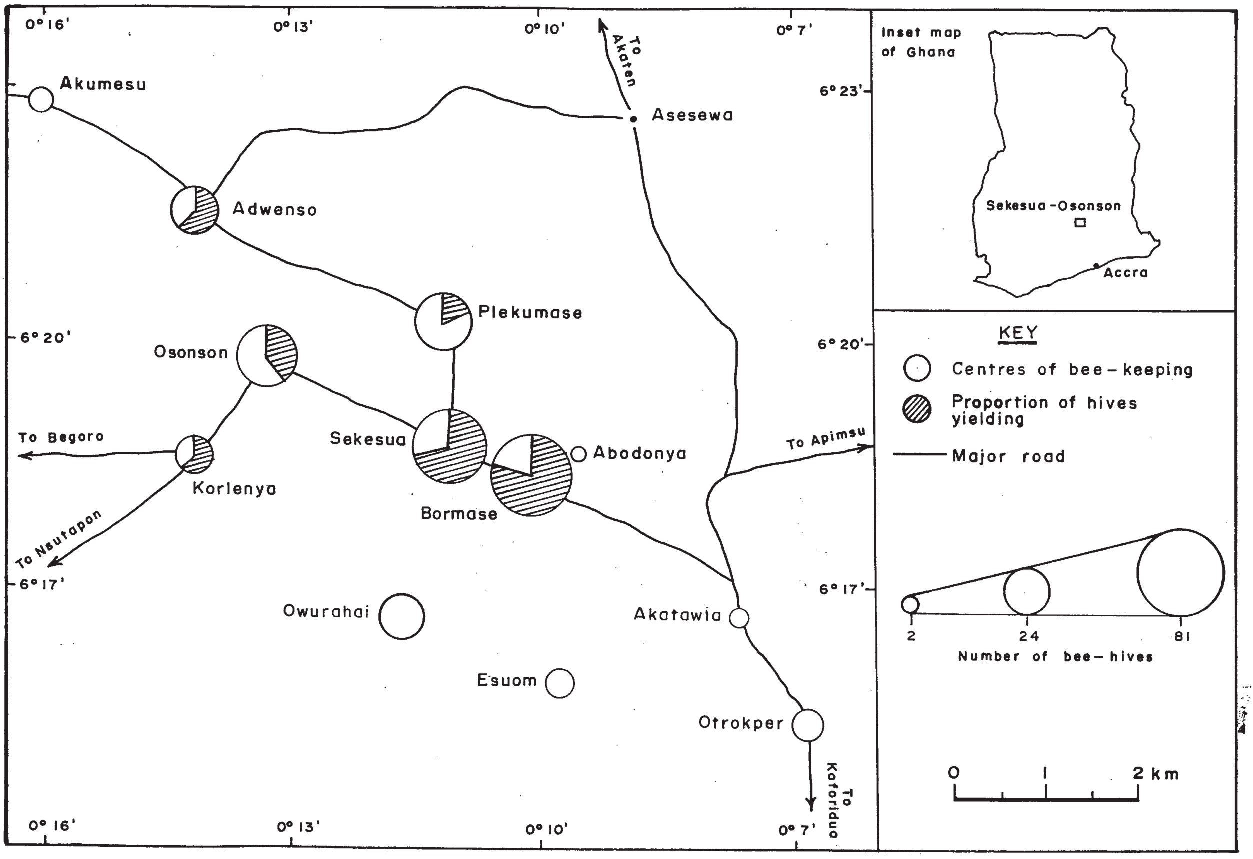

Figure 1 Distribution and production of bee-keeping at Sekesua-Osonson demonstration site at the end of 2002

Figure 1 shows the distribution of hives at the end of 2002. The total number of hives had increased to 316 in 70 compound households in 12 village communities distributed across the demonstration site. The highest concentration of hives was at Bormase, the home village of Sackitey Akor and Emmanuel Nartey, the expert bee-keepers whose exemplary enterprise inspired the PLEC support. Over 50 percent of the hives were yielding.

Table 1. *Recorded harvest of honey in January – April 2002 in five village communities in Sekesua-Osonson demonstration site*

Village or Community	Production (litres)	Market value ($US)
Bormase	145.5	237
Sekesua	45.5	74
Korlenya	22.7	37
Plekumase	18.2	30
Adwenso	13.6	22
Total	245.5	400

Source: Records of Sekesua-Osonson Association of PLEC Farmers

The total initial harvest was reported to be 113.5 litres valued at ¢1,250,000 (=US$170 approximately). Between January and April 2002, harvested honey in only five of the 12 village communities had more than doubled to 245 litres, which was equivalent to ¢2,970,000 or, approximately US$400 (Table 1). As may be expected, output was highest at Bormase, the centre of diffusion.

In anticipation of further growth, there are plans to establish a central processing facility at Sekesua with the support of HPI, to refine and package the honey to enhance its marketability. Following the initial success at Sekesua-Osonson, bee-keeping is spreading to Amanase-Whanabenya, the PLEC demonstration site in southern Ghana, with Emmanuel Nartey, playing a leading facilitating role. A similar process is on the threshold of starting in Gyamfiase-Adenya, the third demonstration site.

Factors encouraging growth

A major factor in the growth of bee-keeping in back yard forests and gardens in Sekesua-Osonson is the support provided by PLEC and HPI. A second factor has been the strategy of building on the traditional practices and knowledge of local expert farmers. This has minimized developmental and demonstration costs, and also engenders local self-reliance and confidence. A third factor is the central role of women. Bee-keeping takes place near the house and the labour requirements as a supplementary occupation is not excessively demanding. It combines very well with the women's traditional primary responsibility of household chores. Success also stems from the system of reserving part of the proceeds of individual PLEC honey farmers for sustaining collective farmer activities. Finally, the Association of PLEC Farmers facilitates the growth of the bee-keeping by:

- mobilizing farmer conservation and development knowledge;
- accessing external support for farmers;
- carrying out demonstrations; and,
- co-ordinating bee-keeping and related conservation and development activities (Gyasi, Forthcoming)

Based on the Sekesua-Osonson experience, it is evident that bee-keeping provides an effective instrument for both conserving biodiverse forests and generating new or additional income from farmers.

References

Blay, E. T., B. D. Ofori, J. Heloo, J. B. Ofori and E. Nartey. Value addition: bees, snails and yams in conserved forests and prospects of integrating ruminants into the conservation process. In E.A. Gyasi, with G. Kranjac-Berisavljevic', E.T. Blay and W. Oduro, *Managing biodiversity: the traditional way in West Africa - methodological and policy lessons for sustainable resource use*. Tokyo: UNU Press, forthcoming.

Gyasi, E. A. 2002 Traditional forms of conserving biodiversity within agriculture: their changing character in Ghana. In Brookfield, H., C. Padoch, H. Parsons and M. Stocking (eds) *Cultivating biodiversity: understanding, analysing and using agricultural diversity*, pp. 245-255. London: ITDG Publishing.

Gyasi, E. A. Demonstration sites and expert farmers in conservation of biodiversity. In E.A. Gyasi, with G. Kranjac-Berisavljevic', E.T. Blay and W. Oduro, *Managing biodiversity: the traditional way in West Africa - methodological and policy lessons for sustainable resource use*. Tokyo: UNU Press, forthcoming.

Illgner, P. M., L. Nel and M. P. Robertson. 1998 Beekeeping and local self-reliance in rural southern Africa. *The Geographical Review* 88(3): 349-262

Rijal, D., R. Rana, A. Subedi and B. Sthapit. 2000. Adding value to landraces: community-based approaches for *in situ* conservation of plant genetic resources in Nepal. In Friis-Hansen, E. and B. Sthapit (eds) *Participatory approaches to the conservation and use of plant genetic resources*, pp. 166-172. Rome: IPGRI.

Plate 2: A set of modern bee-keeping equipment presented to PLEC farmers by HPI, a PLEC-affiliated NGO
Source: PLEC collection

Tanzanian farmers continue PLEC work

Fidelis B.S.Kaihura[1]

External financial support for PLEC demonstration site activities in Tanzania ceased in February 2002. It has been gratifying to observe that farmers, extension staff and district administration staff have continued PLEC work without the scientist's facilitation and financial support. The district-level administration has continued using expert farmers to train other farmers and newly established groups within and outside demonstration sites. There are many new farmers adopting better resource management practices learned from neighbouring expert farmers. Non-PLEC farmers also continue to invite expert farmers to their own farms for follow up on training. In this way PLEC is being anchored further in most of the resource management activities at community level in Arumeru. We hope this will continue and also expand to cover more areas over time. Various other activities previously supported by PLEC have also continued and are described below.

Farmer-to-farmer training

Farmer training was carried out in both Olgilai/Ng'iresi and Kiserian. In Olgilai/Ng'iresi training covered good husbandry of bananas including better storage and application of kraal manure. Other training sessions were on vegetable production for local and regional markets, establishment of tree nurseries and raising seedlings including both introduced and indigenous endangered trees.

In the Kiserian site, farmer-to-farmer training covered traditional woodlot conservation and management, and mixed cropping under semi-arid environments. At the traditional woodlot site, farmers also evaluated the performance of a farmer-led experiment on water harvesting and soil fertility improvement techniques using a maize/bean intercrop. The woodlot conservation group introduced commercial flower production, and increased the area under sorghum and lablab (Dolichos lablab) crops. These had been agreed upon by PLEC and the farmers as dependable risk aversion crops under conditions of drought stress. Through PLEC initiatives of conserving and managing endangered plant species, farmers have developed this interest on their own. They have discovered that *oloropil*, a plant previously used as a deodorant, had disappeared in the area. They planned ways of searching for it in its natural habitat away from the area to begin regeneration.

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Mixed cropping in Kiserian was mostly limited to experimenting with different proportions of maize and beans, with a few lines of pigeon peas, millet or chickpeas. Improved mixed cropping was adopted from the sub-humid Olgilai/Ng'iresi site by Kiserian farmers. Through on-farm discussions during PLEC farmer field days, exchange visits and visits to research institutions, several farmers were inspired to try different drought tolerant crops besides maize and beans.

Maria Ebeneza is a widow who was keen to find ways to increase income and meet her costs for children's school fees, uniforms and basic domestic requirements. After two years of participation in exchange visits, farmer field days and capacity building workshops, and indeed two years of serious practice in diverse mixed cropping on her farm, she is now a model to other farmers on improved mixed cropping. Besides maize/beans, she now grows lablab, sorghum, finger millet, soybeans, sweet potatoes, groundnuts and onions. She is also experimenting with soil fertility improvement using manure from her livestock and biomass from the agroforestry trees she planted before and during PLEC involvement. It was a big lesson to note that sorghum yield (previously a neglected crop) was outperforming maize under conditions of drought stress. Although sorghum is considered a famine crop by many farmers, it can be used to make feed for the livestock that are now kept in stalls, or can be sold to brewers in towns. Ebeneza also appreciates increased income through crop/livestock diversification and sales of agroforestry tree seedlings to other farmers. As a woman, she rarely used to take an active role in community development activities. With PLEC experience, she is now among pioneer women mobilizing other women to be active. Two field days were organized at her farm in 2002 to demonstrate to other farmers the importance of mixed cropping and crop/livestock integration for smallholder livelihood.

Maglan Simon is Ebeneza's neighbour who copied good management practices from her, and he is currently inviting other farmers to also learn from him. One field day was organized at Maglan's farm where he received many compliments from fellow PLEC farmers. Maglan has also started conserving an indigenous woodlot of 0.8 ha after attending farmer-training programmes at the site of the woodlot conservation expert. In his woodlot he conserves different tree species for firewood, pastures, roofing grass, traditional medicine, and also conserves endangered traditional woodlot biodiversity. He is experimenting with soil fertility improvement and adding value to his soybean crop by processing it for different uses.

Activities of the farmer groups

Besides farmer-to-farmer training, farmer-initiated biodiversity and household income enhancing groups continued. One new group was formed in March 2002. The group, 'Male Youths Group', established a piggery unit with 8 piglets. They sold 4 pigs in October and 24 more were born.

The established active groups include KUMO, Umoja and Family in Olgila/N'giresi. KUMO continues with regeneration and conservation of endangered indigenous economic trees, rehabilitation of water sources, training other farmers and children in the value of trees and techniques for raising indigenous trees.

There is an increase in the number of training sessions organized by the district leadership for farmers and other natural resource management groups outside the PLEC sites. Some of the group members have been earmarked to train other farmers outside Arumeru on topics such as regeneration and conservation of indigenous economic trees. This is particularly important because most NGOs put emphasis on introduced-tree production and multiplication. Along with conservation of indigenous trees, the group has embarked on construction of energy saving stoves to reduce tree cutting for firewood. Use of biogas is also being promoted by the KUMO group.

The Umoja women's group continues to keep local chickens. The women in this group indicate that they have reduced dependence on their husbands in meeting ordinary household requirements including for salt, paraffin, matches, besides improving household nutrition by eating eggs and chickens. Other women are visiting and holding discussions with Umoja group and several have started keeping chicken at their homes.

The 'Family group' keeps bees. They are a group of two families with 16 beehives, which began with 8 beehives in 2001. Two types of bees (the small and big size bees) are kept. Honey from four of the beehives was collected and sold in September while honey from another four will be collected in March 2003. The beehives are placed in planted woodlots along steep slopes. They prevent people from burning and cattle from grazing in the established woodlot. In this way both land and biodiversity are conserved. The two types of honey are both eaten and sold, and are also used to cure different diseases.

In Kiserian four groups continue to be very active. The Women and Environment group at Oldenderit continues to raise indigenous and introduced trees for sale, planting around their homesteads and rehabilitating a demarcated area of degraded land. Sheep also continue to be kept and sold. Sheep oil is cooked specially for women to ensure quick recuperation after delivery of babies. For that reason they have very high price compared to goats. The Environmental Conservation group in lower Kiserian continues to manage the rehabilitation of 1.2 ha of degraded land. More than 1800 trees, both indigenous and introduced, are being managed by the group and are growing very well. Like the Umoja group in Olgilai/Ng'iresi, the Jitegemee Women Group keep local chicken. This group has not progressed as much as others, because there were disease problems that affected the chickens, and extensionists were not timely to address them.

Primary schools have also continued environmental conservation activities. Ng'iresi Primary School planted 200 grevillea trees in their school compound and each of the PLEC children is assigned three trees to manage to full establishment. At Muungano Primary School in Kiserian, children are raising trees and distributing seedlings to individuals to plant at their homes. About 1.2 ha of the school compound are also planted and maintained by the PLEC children. A follow up to the performance of the trees planted by primary school children at their homes is planned for 2003.

Farmer-led experiments

Farmer-led experiments on soil fertility improvement and water harvesting were continued by 12 farmers in Kiserian. In 2002, the area under experimentation per treatment was trebled. They used an improved maize seed variety (Pioneer) intercropped with local bean varieties of soya and Nyayo. Beans are more dependable for many of the households and they still value local varieties more than improved ones. Although Lyamungo 90 is an improved bean variety available in the market it is not as popular as the local varieties. Water harvesting involves deep tillage to break the plough pan and to increase plough depth for easy and thorough mixing of manure with the soil. Manure is used for water retention improvement and soil fertility improvement. Crop production in 2002 was the most successful compared to other years during PLEC project. There was more total rainfall with very short inter-season dry spells. Water harvesting and fertility improvement had a larger impact on yield than ever before. In previous years there was so little rain to conserve that it did not last the entire period of water demand for the test crop growing season.

Seven farmers in Olgilai/Ng'iresi continued experimenting with potato production. They apply farmyard manure and NPK fertilizer to their local varieties, Rongai and West Kilimanjaro. Potatoes are an important commercial crop that farmers depend on for income. Through PLEC-facilitated experiments with fertilizer application, crop yield increased and income was significantly above their costs. Today even very poor farmers save some money to buy fertilizer for application to potatoes.

The Women and Environment group in Oldenderit visited a non PLEC womens' group in Mduruma (south of Kiserian village) in July 2002. The Mduruma group (Naramat-Endium group) raises seedlings of a number of trees species and watermelons which have high market demand in Arusha town. The Oldenderit group was impressed with the watermelon production. They were promised land in Mduruma where they will begin growing watermelons in February 2003.

Improved varieties of cassava and sweet potatoes brought from Ukiriguru in Mwanza, (north western Tanzania) to

Arumeru (northern Tanzania) are progressing very well. The sweet potato varieties, Jitihada, Vumilia, Mavuno and SPN/O, were multiplied and distributed to twenty farmers who in turn multiplied them, for distribution to forty more farmers. The cassava varieties MZ TM 4/2, 1425 and TM 30337 are performing well but have not reached a stage for distribution. Based on knowledge gained and exposure to new ideas through the PLEC project, farmers have gone further to introduce more biodiversity-enhancing and income-generating projects including fish-ponding and turkey-raising.

Many farmer groups from outside Arusha region have visited different PLEC farmer groups for training, particularly in environmental conservation and income generation activities. Students have also visited PLEC farmer groups for training. Students came from Sokoine University of Agriculture and were trained in environmental conservation, and Makerere University students also visited for training. District Development Directors from Arusha, Kilimanjaro and Tanga regions were familiarized with the organization and functioning of the PLEC farmer groups and other specific conservation and income generating activities. The KUMO group in Olgilai was specifically asked to train farmers on conservation of water sources to commemorate the 'National Water Week' that was organized regionally in Olgilai village from 16-22 March, 2002. Another training visit was made to women covering various income-generating activities during the International Women's Day on 18 March 2002. The International Women's Day was also commemorated in Olturoto village within the Olgilai/Ng'iresi site. They participated as an active farmer group in the Nationwide Uhuru Torch Rally in Arusha region in October 2002.

Summary and conclusion

By the time PLEC project terminated in February 2002, it had set up a programme of activities considered by farmers to be important in contributing to their livelihoods while also conserving the environment. The ongoing programme of activities is led by farmers and facilitated by extension staff. The outcomes are summarized below.

- Expansion of the area of farmers' fields used for experimentation of more successful technologies. Experimental fields for water harvesting and soil fertility improvement have been expanded using deep tillage and incorporation of well-managed farmyard manure. Soil fertility, soil water holding capacity, and crop yields have improved. The practices are working very well with the ox-plough commonly used in Kiserian.
- Increased awareness of the disappearance of the economic plant species from the ecosystem. Strategies were developed to regenerate and conserve endangered species.
- Increased adoption of production systems that both conserve the environment and produce goods with high market demand and price. Introduction of crops such as flowers in Kiserian, and using fertilizers to improve yield and quality of potatoes in Olgilai/Ng'iresi, are indicators.
- Increased diversification of crops that enhance agrobiodiversity and improvement of smallholder food security and livelihoods.
- Expansion of local improved resource management technologies to more farmers through farmer-to-farmer or group interactions.
- Increase in the number of functional farmers' groups organized around common interest resource management activities. Group activities, particularly those involving youths, are reducing the flow of youths to towns in search of work.
- The district-level government leadership used PLEC expert farmers and farmer groups to train farmers outside PLEC project sites, and invited farmers and community leaders interested in establishing farmer groups to learn about how PLEC groups are set up and their activities.
- The number of women claiming to have reduced dependence on their husbands in meeting costs of household and school requirements (fees, uniforms and books) has increased. An increased number of women are involved in rural development activities with clear contributions to planning and implementation of programmes, and also take leadership positions compared with the time before PLEC.

Finally, farmers in Arumeru were indeed grateful to note that the future project will still bear the name of PLEC whose identity they do not like to lose.

Pada (*Macaranga denticulata* (Bl.) Muell. Arg.), a fallow enriching species and its mycorrhizal fungi[1]

Narit Yimyam[2] and **Somjit Youpensuk**[3]

The fallow enriching property of pada (*Macaranga denticulata*), a pioneer species of a small tree belonging to the Euphorbiaceae family, is well known among shifting cultivators throughout the mountainous mainland Southeast Asia. The use of pada by farmers in Tee Cha in northern Thailand to enhance the yield of upland rice in the rotational shifting cultivation cropping system has been previously reported (Rerkasem et al. 2002). In recent research, to be published shortly in *Agroforestry Systems*, the fallow with dense stands of pada accumulated much more phosphorus, potassium, calcium and magnesium than those with sparse pada patches. In the full seven-year rotation, upland rice following dense pada yielded three times more than rice following sparse pada. However, upland rice yielded poorly when it was grown after a dense pada fallow that was slash-and-burned after only three years of regeneration.

We found some 30 species of mycorrhizal fungi, in six genera, associated with the roots of pada trees growing in farmers' field in the village of Tee Cha, in Mae Hong Son in northern Thailand, close to the border with Myanmar. These included the genera of *Acaulospora, Archaeospora, Gigaspora, Glomus, Paraglomus* and *Scutellospora*. In two experiments with a sterilized acid soil, low in available phosphorus (about 2 ppm by Bray II) with pH 4.9, we clearly demonstrated the effect of mycorrhiza in increasing plant dry matter and nutrient accumulation. There was a strong interaction between the effect of mycorrhiza and that of nitrogen and phosphorus fertilizer, but in different directions. Where soil phosphorus was limiting, mycorrhiza inoculation doubled dry weight of the pada plant, and its content of nitrogen, phosphorus, potassium, calcium and magnesium. Mycorrhiza inoculation had about the same effect as phosphorus fertilizer application. When phosphorus supply was no longer limiting, by the application of phosphorus fertilizer, the effect of mycorrhiza declined greatly. On the other hand, the effect of mycorrhiza was small when nitrogen was limiting but increased when nitrogen fertilizer was applied. We postulate that mycorrhiza helped to alleviate phosphorus deficiency in pada in the phosphorus deficient acid soil. It seems clear that the mycorrhizal fungi play an important role in nutrient accumulation of pada, and thus its effect in enhancing upland rice yield in the rotational shifting cultivation system. Apart from nitrogen, the nutrients that had been accumulated would have been released and made available to the upland rice crop by burning. The first author is now investigating how upland rice following dense pada patches is able to accumulate more than twice as much nitrogen than that in sparse pada patches. The second author is comparing the efficacy of different mycorrhizal fungi species on nutrient accumulation by pada.

Pada seedlings in rice
Photograph: M. Cairns

Reference

Rerkasem, K., C. Thong-Ngarn, C. Korsamphan, N. Yimyam, B. Rerkasem. 2002 Intensification and diversification of land use: examples from the highlands of northern Thailand. In H. Brookfield, C. Padoch, H. Parsons and M. Stocking (eds), *Cultivating biodiversity: understanding, analysing and using agricultural diversity*, pp. 220-232. London: ITDG.

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News and Reviews

Forthcoming PLEC publications

Brookfield, H., H. Parsons and M. Brookfield (eds) *Agrodiversity: learning from farmers across the world*. Tokyo: UNU Press.

Gyasi, E.A., G. Kranjac-Berisavljevic', E.T. Blay, and W. Oduro (eds) *Managing biodiversity: the traditional way in West Africa. Methodological and policy lessons for sustainable resource use*. Tokyo: UNU Press.

Kaihura, F. and M. Stocking (eds) *Agricultural biodiversity in small-holder farms of east Africa*. Tokyo: UNU Press.

Two invited reviews of PLEC publication

Cultivating biodiversity: understanding, analysing and using agricultural diversity. Edited by H. Brookfield, C. Padoch, H. Parsons and M. Stocking. London:ITDG. 2002.

The editors invited Conny Almekinders and P.S. Ramakrishnan to review *Cultivating Biodiversity.* These are published in full here.

A welcome addition

Conny Almekinders[1]

This book is a very welcome and timely addition to the many ITDG publications that have come to light over the last few years, and have Biodiversity in the title in one way or another. The majority of people who are active in the field of biodiversity and agriculture do realize now that conservation of (agro) biodiversity just cannot be in conflict with development. However, documentation of win-win situations has so far been relatively meagre. This book, which is the output of 10 years of work in the PLEC programme, contains a whole range of them.

The book is divided in three parts. The first and second parts are contributions that deal with the concepts, approaches and methodologies used in the PLEC programme. The third part of the book contains the case studies.

The contributions in the first part spell out in a clear way the concept of biodiversity, and the related concept of agrodiversity, and how these are used by PLEC researchers. Other contributions describe in a very understandable manner the methodologies used for systematic comparison of diversity inventories. The information collected with these methodologies shows in the case studies how the use of diversity indices and related measurements can contribute to understanding the use of biodiversity by farmers, for example by using them in combination and linking them to farmers' income.

The third part of the book contains 11 case studies of the abundance and importance of biodiversity in farmers' livelihood systems. The case studies are from China, Thailand, Ghana, Guinea, Tanzania, and the Peruvian and Brazilian Amazon. They are work of a wide range of researchers who participated in the PLEC programme. The cases are well edited so as to make them enjoyable reading: uniform in style and balanced in the information they contain.

The reported work does not pay attention to crop and animal genetic diversity on the farms, something which by now can almost be called a conventional way of looking into biodiversity in farming. PLECs' work focused on plant species diversity, both 'natural' and cultivated – actually showing that the line between these types of biodiversity is artificial in the livelihood of the farmers they worked with. One of the strengths of the book lies undoubtedly in showing the relation between the historical context, market developments and environmental conditions and the way farmers try to make a living through using biodiversity. No wonder, considering that the background of the editors is a combination of anthropology, botany and natural resource management! The cases are powerful in showing how rapid changes - in remote corners of China as well as in the Amazon or Africa - have impressive impact on the diversity grown in and around farmers' fields and used of for a wide range of purposes. The approach of the PLEC-programme was to spot the exceptional and innovative farmers who are the ones that can best adapt to these changing conditions through deployment of biodiversity. It is relevant to note that PLEC researchers found in many cases these biodiversity-farmers are 'outliers' in the community, because they did not follow the mainstream development, but resisted and looked for alternatives. PLEC-strategy was based on researchers trying to identify and understand such farmers, and bringing other farmers in contact with them in order to support the spreading of their effective practices. The idea being sound (of building on successful innovation in the communities), the experiences of the PLEC-programme can not tell yet how successful this approach is in diffusion of practices that combine use and conservation of biodiversity. Success will

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depend, among other things, on how much others, like the PLEC-researchers, can spot the exceptional farmers and be willing and able to work with them. This book will certainly help us to reduce the blind spot that we as formal researchers have for farmers' expertise and livelihood based on biodiversity management. This, in addition to the pleasant reading of these well-edited and interesting texts, makes the book a recommendation for all scholars and researchers in the field of agriculture and biodiversity.

Cultivating biodiversity: a review

P.S. Ramakrishnan[1]

In recent times, natural ecosystems have been altered and/or degraded in a variety of different ways resulting in rapid loss of natural biodiversity. Extensification of agriculture and intensive management of what exists, have contributed to rapid loss of both natural and human managed biodiversity. Subjected to large-scale deforestation from a variety of proximal and remotely placed key drivers (Lambin et. al., 2001), natural forest biodiversity, which forms part of the life support system of traditional societies, is also getting depleted rapidly. This is the context in which cultivating biodiversity assumes great significance.

A variety of complex multi-species agroecosystems operate as part of a highly diversified landscape. Thus, the People, Land Management and Environmental Change (PLEC) initiative in many countries of the tropics shows micro-level spatial adaptations of agroecosystems to capitalize upon available resources. Such a diversification could also arise from socio-economic and cultural diversity in human populations, as is seen from a north-east Indian study (Ramakrishnan, 1992). PLEC analysis also brought out changes made in crop mixtures and cropping patterns even within the same agroecosystem, depending upon the soil fertility gradient of the soil. Thus, it is suggested in Ghana that nutrient use-efficient cereals, yam and cassava, are being emphasized at the top of the slope and less efficient and water demanding crop species such as rice at the base. This is similar to crop organization on the hill slope in response to nutrient gradient in the north-east Indian shifting agricultural system.

What one sees through all these case studies is spatial and temporal adaptations being made all the time by local communities, to cope with environmental uncertainties, and linking productivity to long-term sustainability of these agricultural systems. The fact that traditional agricultural systems are dynamic, making adaptations all the time, adjusting to market pressure (the case studies of Brazil, Kenya, etc.) and/or trying to cope with ecological uncertainties suggest that an understanding of the ways in which these systems operate has a lot to offer us towards sustainable agriculture, in the context of global change in an ecological sense and globalization as an economic phenomenon. Understanding the agroecosystem level adaptations could form the basis for their redevelopment, with the twin objective of in situ conservation of crop biodiversity, and improved quality of life for local communities.

One of the clear messages that comes through expert farmer to farmer interactions that the scientists have had, is that any developmental paradigm that considers community participation, has to be based on a value system to which the local communities can relate. The connecting link to this value system is Traditional Ecological Knowledge (TEK), which operates at a variety of spatial scales. Species and sub-specific level crop biodiversity within a given ecosystem has to be related with adaptations operating at higher scales - pastoral-agricultural linkages, compound farms where animal husbandry stands integrated with agriculture, crop-fallow rotational systems, etc. operating at the landscape level. Building upon TEK in an incremental fashion with appropriate input of the formal knowledge based technologies seems to be the solution for sustainable agricultural development with community participation. Indeed, this formed the basis for finding a solution to the vexed problem of shifting agriculture, through appropriately created institutional arrangements, involving over 1200 villages in the State of Nagaland in north-east India, based upon a value system that they understand and appreciate (Ramakrishnan, 2001).

Whilst working across geographical regions, we have shown that socio-culturally valued species by local communities often follow a very similar social selection pathway (Ramakrishnan, et. al., 1998). The PLEC study on Kenya where Ficus sp. (Fig trees) considered to be important for soil fertility and for shade for coffee plantations, confirms what was earlier demonstrated, namely, socially valued species are invariably ecologically important keystone species in an ecosystem! Such a linkage between ecological/social keystone value of the same species offers immense possibilities to use such species for rehabilitation of degraded ecosystems, biodiversity cultivation and management, with community participation.

References

Lambin, E.F., B.L. Turner II, H.J. Geist, S.B. Agbola, A. Angelsen, J.W. Bruce, O.T. Coomes, R. Dirzo, G. Fischer, C. Folke, P.S. George, K. Homewood, J. Imbernon, R. Leemans, X. Li, E.F. Moran, M. Mortimore, P.S. Ramakrishnan, J.F. Richards, H. Skanes, W. Steffen, G.D. Stone, U. Svedin, T.A. Veldkamp, C. Vogel, J. Xu. 2001. Our emerging understanding of the causes of land-use and land-cover change. *Global Environmental Change* 11:261-269.

Ramakrishnan, P.S. 1992. *Shifting agriculture and sustainable development: an interdisciplinary study from north-eastern India.* Paris: UNESCO-MAB Series and Carnforth: Parthenon.

Ramakrishnan, P.S. 2001. *Ecology and sustainable development*. New Delhi: National Book Trust.

Ramakrishnan, P.S., K.G. Saxena and U.M. Chandrashekara (eds). 1998. *Conserving the sacred: for biodiversity management.* New Delhi: UNESCO, Oxford and IBH.

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Our companion enterprise, PLECserv, can be found at **http://c3.unu.edu/plec/**. It reports recent articles or other publications of interest to people working among developing-country farmers, and concerned about development with conservation. Issues appear twice in each month. They provide means of obtaining these documents and corresponding with the authors. Since December 2002, seven issues have appeared, entitled:

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