People, Land Management and Environmental Change (PLEC)

FINAL EVALUATION

United Nations Environment Programme

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Executive summary

The People, Land Management and Environmental Change (PLEC) project is a largely farmer-driven demonstration project consisting of five ecosystem clusters and spread over eight countries: Ghana, Guinea, Kenya, Uganda, Tanzania, China, Papua New Guinea and Brazil. PLEC was initiated in 1992 by the United Nations University (UNU) as an international collaborative programme of studies on the practices of small farmers in relation to environmental change. After review and revision of the design of the project, the project was relaunched in 1998 with United Nations Environment Programme (UNEP) as implementing agency, UNU as executing agency and with funding from the Global Environmental Facility (GEF).

The four objectives of the PLEC project are to:

1. Establish historical and baseline comparative information on agrodiversity and biodiversity at the landscape level in representative diverse regions;
2. Develop participatory and sustainable models of biodiversity management based on farmers' technologies and knowledge within agricultural systems at the community and landscape levels;
3. Recommend approaches and policies for sustainable agrodiversity management to key government decision makers, farmers, and field practitioners; and
4. Establish national and regional networks for capacity strengthening within participating institutions.

Due to the scope and approach of the PLEC project, evaluation of the project was conducted in two stages. An in-depth field study of PLEC project activities was carried out by two external consultants between April and June 2002, which was followed by a desk study of the project prepared by a third external consultant between November and December 2002. The desk study (i.e., part 1 of this report) provides a brief overview of higher level achievements and discusses future project management and programme issues. The findings of the field study (i.e., part 2 of this report) are based on field visits to the eight project countries and focus on the activities taking place at the demonstration sites.

This evaluation focuses on the execution, performance and delivery of each of the programmed outputs, both in quantity and quality. Project impacts on improved knowledge, capacity building, stakeholder involvement and project sustainability have been assessed in accordance with the indicators specified in the project document. The impact of the project in making recommendations for changing policies and approaches at the national level towards sustainable management of biodiversity has also been evaluated.

Interviews at the demonstration sites with farmers, researchers and administrators were conducted and the mid-term review report, progress reports, publications and other documents were reviewed for this evaluation. Management and supervision of activities during project implementation was monitored continuously by UNU and UNEP in addition to internal assessment continuously done by the Scientific Co-ordinators. The project Advisory Group (AG) oversaw implementation of the overall level. Monitoring helped facilitate informed adjustments to the project design during implementation. Most importantly, the focus of the clusters was narrowed from

landscape to conservation of biological diversity within the participating agricultural systems.

The findings of this evaluation show that PLEC has made significant achievements in successfully planting and nurturing the seeds for global appreciation of the value of landscape level diversity (social and biological) in agriculture. This has been achieved by creating the conditions for agricultural scientists to realise that successful adaptation to change in sustainable agriculture relies on the same basic evolutionary principles that govern evolutionary adaptation at genetic and organism levels. At the higher level, PLEC has laid the foundations for analysing how resource use systems and diversity levels are correlated and how they are influenced by the market and by policies. Higher-scale appreciation of local scale adaptations to ecological and social conditions is essential for ecological and social resilience. PLEC has demonstrated a process for catalysing that appreciation and in turn supporting ecological resilience through cross-scale collaboration. At the local level, PLEC has successfully conserved biodiversity in agricultural landscapes through the replication of good agricultural techniques based on expert farmer experimentation and demonstration.

Central to PLEC's demonstration activities are the so-called expert farmers, particularly skilled in agrodiversity management which, facilitated by the project, have been able to employ local and introduced plant genetic resource to make the best use of their given circumstances and with aptitudes for transfer of knowledge and certain skills to other farmers. The project has been successful in demonstrating scientist-to-farmer and farmer-to-farmer transfer of practices aiming to increase farm income while maintaining or increasing number of crop varieties and useful species in each individual field type.

PLEC focuses primarily on improving yields and sustainability of agricultural lands, through activities concentrated on demonstration sites, made up of farming communities or villages. There are indications that even in the most intensively cropped land, in small mainly poor villages across wide ranging agroecosystems of the different clusters, some biological diversity, native or introduced, is routinely cultivated by farmers. Biodiversity has been cultivated by increasing species and genotype mixes in individual fields, over the different seasons and in mosaics of land use stages and field types over the landscape. Most importantly, the project has contributed much to the growing understanding and dissemination of farmers' biodiversity management models, in the usage and maintenance of many individual species, including wild and semi-domesticated ones.

PLEC's achievements in capacity building and enhancement of knowledge base are plenty. Besides capacity building of individual farmers and agricultural scientists who received training, the PLEC process itself has built capacity by creating the conditions for agricultural researchers to discover 'on their own' the rewarding working with expert farmers. The database developed by the project provides a framework for gathering comparable data for analysis to reveal the conditions (political, social and ecological) in which farmers' knowledge continues to exist, and as a baseline for identifying and following farming system trends into future.

PLEC's role in helping to constitute or strengthen farmers associations is likely to be one of the more important and sustainable outcomes of the project, as these

associations provide an effective platform for future developments. The associations have been found successful in giving farmers negotiating power with banks and governments, and in enabling fruitful exchanges of information and genetic material, and even in the management of biodiversity in neighboring protected land as well as their own productive land (e.g. in China). The evaluation also finds the environmental education programmes of PLEC (e.g. Brazil) very attractive and worth replicating elsewhere in the PLEC and non-PLEC world.

In addition to meetings and coordinators and technical team visits, there are also signs of increasing interaction and collaboration as clusters are becoming technically mature, more confident with making contributions and learning from one another and more synergy coming from interaction between countries. The PLEC process has allowed clusters and centres to evolve along local path based on what is achievable in different environments.

PLEC, although designed as a demonstration and not a scientific project, has begun to shed light on the understanding of how farmers and communities can help to maintain and enhance biological diversity even in intensively cultivated areas. PLEC has advanced scientific knowledge as well as created the potential for expanding sustainable and productive relationships between scientists and farmers. PLEC has moved knowledge into a new realm by linking local resource management systems to agricultural projects and by creating replicable methods for anyone to be trained in how to recognise and support these systems and the people who maintain these systems as well as the knowledge that underlies these systems. The replicable process to empower people who support agrobiodiversity – social and biological, local and individual, at the landscape level is probably the most important achievement of PLEC. Only through insights gained from such an understanding may sustainable management of biodiversity be developed to the extent that it can be recommended at national and regional levels.

The project has demonstrated that agricultural scientists can overcome biases instilled by their educational formation, learn from master farmers, and use that knowledge to develop a “learning environment” as well as new techniques based on the empirical observations and experiments of local farmers. PLEC has created a global network of agricultural scientists and has operationalised an approach that demonstrates the value of broadening the concepts of agricultural biodiversity from meaning simply genetic resources (i.e., genetic level diversity of crops) to meaning the landscape level biodiversity and the local social organisations and technologies that support that biodiversity to reduce agricultural and ecological risks, and ecosystem diversity.

There are important lessons to be learned for the future of this project. In four years the project of this kind cannot be expected to generate, test and disseminate land use innovations. The optimum mixture of species, and their arrays and densities are the subject of involved academic studies, or the result of long trials and errors in the field. China provides an example of achievements that can be made in project like PLEC when scientists have sufficient time to gain an understanding of local conditions and can collaborate effectively with farmers. PLEC associated scientists in China began to look for diversity in local agroforestry before 1995, when they started on participatory work with farmers of the demonstration villages that later evolved into PLEC.

The strength of PLEC in helping to shape agrodiversity polices has been affected by the overall weakness in design between and within clusters. Clusters have little in common besides the goal of improving yields and increasing biodiversity.
The project approach has been flexible enough to make the best out of the clusters according to their capacities. Sharing of the agrobiodiversity information collected and knowledge that farmers share with the project could be stored at local level through the compilation of information in a simple booklet in local language and serve many purposes. It would begin to store local knowledge that can be built upon and used by everyone from farmers to schoolchildren.

While the main focus of PLEC should be to continue work at each cluster, a more visionary goal of how to develop a way to reach agricultural researchers and extension agents around the world would enhance the impact of PLEC. This could be achieved through three processes: 1) Curricula development for use in agricultural universities around the world; 2) Regional training centres; and 3) Policy analysis and reform that removes the incentives for unsustainable land use.

This evaluation concludes that, while goals and progress varies among clusters, PLEC as a whole has successfully achieved all four original project objectives. PLEC should not be mistaken for simply being a successful farmer-driven demonstration project networked around the world. PLEC demonstrates that it is possible for scientists to collaborate with agriculture advisors and "endusers" of agricultural technical advice. A continuation of PLEC into the next phase offers the promise of radically reforming agriculture and landscapes in "marginal areas" to nurture ecologically and socially sustainable agricultural systems that create a landscape that in turn supports the conservation of biodiversity.

The long-term databases, started or continued under GEF support provide an excellent resource and opportunity for analysis of dynamics and trends over time. It may be fruitful to relate biodiversity data, between varieties of individual species as well as between species, to strategic determinations of the physical environment, and that a more critical analysis of the project and individual field types and land use stages and of social, financial as well as biophysical conditions that promote and limit biodiversity would give some insight into long term sustainability of agrodiversity. PLEC's contributions to the understanding and pioneering approaches for the management of agrobiodiversity may be found useful for GEF as a whole, especially when implementing its Operational Program on biodiversity of importance for agriculture (OP13).

Part 1: People, Land Management, and Environmental Change (PLEC) -

Final Desk Evaluation

December 2002

by

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1.0.0 Overview of Key Findings[1].

PLEC (People, Land Management and Environmental Change) meets GEF interests in developing ways to conserve biodiversity in agricultural landscapes outside protected areas, particularly in corridors and transitional buffer zones, while meeting local needs for social and economic development. With this methodology, it may be possible to achieve the vision of "biosphere reserves" where protected areas become centers for transforming landuse at ecoregional levels.

PLEC was initiated in 1992, and received GEF support from 1998 to 2002. With GEF support, PLEC developed successful pilot programs in twelve countries and, more importantly, a foundation for replicating the PLEC approach in other countries as part of their national agricultural education system, and as a component of other GEF biodiversity projects.

PLEC consists of a unique network of scientists, farmers and extension workers linking local clusters into a global framework that assists all clusters to advance through collaboration. An international team of scientists work with farmers and local counterparts to facilitate identification and replication of "best practices" for maintaining biodiversity within agricultural landscapes.

By building on locally adapted agroecosystems and locally adapted management practices, PLEC offers ecologically sustainable alternatives to extractive and destructive practices that degrade lands and threaten forests, grasslands, and/or arid lands that surround or are located in areas under protected status because of their high natural biodiversity.

PLEC uses a unique concept of "agrodiversity" that frames "agrobiodiversity" within its broader social and natural context (see rationale and distinctions elucidated by H.Brookfield in the PLEC book 'Cultivating Biodiversity'). Agrodiversity includes not only crop genetic diversity and its continuing evolution, but also the landscape diversity that incorporates natural vegetation, as well as farmers' practices and the social organization that supports the continuation and regeneration (evolution) of those practices that maintain agrodiversity.

PLEC is an ideal development program, because it primes the pump that then continues to work with minimal investment. Following the PLEC approach, farmers demonstrate to others that agrodiversity is a solution for farmers' problems. Agricultural scientists and extension workers learn that agrodiversity and the PLEC process offer them solutions to offer to farmers elsewhere, and a process to discover, evaluate, and disseminate new solutions in the future with little outside investment or inputs.

PLEC has created and demonstrated a way to reform agricultural research in order to reverse global trends toward monoculture, land degradation, and biodiversity loss. PLEC should not be mistaken for simply being a successful a farmer-driven demonstration project networked around the world. PLEC demonstrates that it is

[1] This section highlights the key findings. The body of the paper is organized according to the TOR (see Appendix 1).

possible for scientists to collaborate with agriculture advisors and "endusers" of agricultural technical advice, beyond 'integrated pest management'. A continuation of PLEC into the next phase offers the promise of radically reforming agriculture and landscapes in "marginal areas" to create and nurture social and ecological landscapes that support the conservation of biodiversity.

2.0.0. Achievements and Impact.

2.1.0. Broader Achievements.

PLEC has reached significant achievements at local levels but the purpose of this evaluation is not to recapitulate those, but rather to review the program for its global significance.[2]

2.1.1. Increased agricultural scientists' appreciation of agricultural landscape diversity and social diversity as inseparable prerequisites for sustainable biodiversity conservation and sustainable agricultural production.

Amazingly, in the face of globalization and transformation of Earth's landscapes into monocultures accompanied by the loss of biodiversity, PLEC has successfully planted and nurtured the seeds for global appreciation of the value of landscape level diversity (social and biological) in agriculture, by creating the conditions for agricultural scientists to realize that successful adaptation to change in sustainable agriculture relies on the same basic evolutionary principles that govern evolutionary adaptation at genetic and organismal levels.

Like genetic diversity in populations and communities, social diversity and individual knowledge must be accessible to the forces of evolution, as the future is always unpredictable. Farmers' dependence on seeds from distant breeders, herbicides, pesticides, and external expert advice can lead to disaster if access to those distant sources is cut. Survival through droughts and famines and war depends on system's ability to adapt based on local diversity that has been respected and maintained.

2.1.2. Demonstrated successful reversal of global trends toward loss of ecological resilience at specific local sites, and developed a replicable process for extending its impact to ecoregional and global levels.

[2] It is important to reflect on the general significance of this project to orient readers before they enter the labyrinth of reports and reviews. The extensive documentation from the project sites and the analysis of site data describe and measure specific local and cumulative achievements against milestones. It is not the purpose of this evaluation to summarize those achievements. This paper was commissioned to provide a brief STAP expert opinion that provides a broader reflection on the project's value derived from a desk review of the existing volumes of reports and evaluations of the project. Many of the existing documents and reviews focus on 'the forest' as a 'sum of its trees', and as a consequence generally ' fail to see the forest for the trees'. This review offers an outside perspective on the PLEC 'forest' as more than the sum of its parts.

PLEC has conserved biodiversity in agricultural landscapes through the replication of good agricultural techniques based on expert farmers' experimentation and demonstration at 21 'demonstration sites' around the world. PLEC has demonstrated how a global project can reverse the global trends of loss of ecological resilience and catalyze a transition toward renewed resilience. Agricultural and landscape ecological resilience is essential for longterm sustainability and adaptation to unpredictable changes. PLEC is built on a sophisticated understanding that cross-scale collaboration can produce change.

PLEC not only demonstrates the valuable results of cross-scale collaboration but also provides a replicable method for mobilizing other agricultural scientists and policymakers to support ecological resilience through cross-scale collaboration appropriate to local circumstances within weak or strong states. PLEC demonstrates a successful alternative to the standard 'blueprint' project 'top-down' implementation approach, by offering a flexible project design that does allow locally adapted solutions to emerge. At local on-the-ground levels, PLEC has successfully created sustainable local processes appropriate to each site.

PLEC has demonstrated how it could be possible to replicate and expand efforts to conserve and nurture the social and biological diversity in agricultural systems in different conditions around the world. The most important achievement of PLEC is its creation of a smart process that is replicable and can proceed alone after initial investments to empower people who support agrobiodiversity – social and biological, local and individual, at the landscape level. PLEC shows the way to identify master/expert farmers – people who are generally not political leaders and who are not likely to trust agricultural extension agents but rather their own skills. PLEC also shows the ways to empower these farmers by working with scientists, within the structure and framework of agricultural research and extension (found in almost every country on Earth).

PLEC demonstrates the value of broadening agricultural scientists' concepts of diversity from meaning simply genetic resources (genetic diversity of crops) to meaning the landscape level biodiversity and the diversity of local social organizations and technologies that support that biodiversity and reduce agricultural and ecological risks (i.e., the agrodiversity that supports genetic, organismal and ecosystem level diversity).

PLEC has demonstrated that agricultural scientists can overcome biases instilled by their educational formation, learn from master farmers, and use that knowledge to develop a "learning environment" as well as new techniques based on the empirical observations and experiments of local farmers.

One of the keys to the success of the PLEC process can be found in the excellent book Cultivating Biodiversity - Chapter 10 – PLEC Demonstration Activities: A review of procedures and experiences. This chapter clearly lays out the fundamental process for identifying and working with master farmers – something that sounds simple but in reality can be difficult for local agricultural research agents to do without understanding the information in that chapter. The book – with all its chapters - should be used in agricultural universities.

2.1.3. Improved basis for assessing market and policy environments as barriers or facilitators for agrodiversity.

PLEC's new database has laid the foundations for data collection and scientific analysis of how resource use systems and diversity levels are correlated, and how they are influenced by the market and by policies.

2.2.0. Evaluation with reference to the impacts expected in the GEF project document.

PLEC has achieved the expected impacts as measured against the indicators laid out in Table 5.3 in the original project document.[3]

2.2.1. Improved Knowledge.

At the local level, farmers and agricultural agents have gained new, useful knowledge. At the national and international level, systematic data collection has improved during the course of the project with the assistance of international advisors, and a database has been created, although it is so new that it has not yet used as the basis for analysis that can be confirmed by independent review.

2.2.2. Capacity Building.

In terms of Capacity Building indicators, there is ample evidence for success in all six indicators. The 'Consolidated Report on Capacity Building' provides a detailed description and analysis of the project's impacts on human and social capital.

2.2.3. Stakeholder Involvement.

In terms of stakeholder involvement, there was ample evidence that multiple stakeholders are involved in the demonstration sites and that some other resources (UNU, government resources, local committees) are being allocated to support and continue some of the PLEC activities. The documents did not provide sufficient information about the level of interest generated in other countries.

2.2.4. Project sustainability.

Regarding longterm sustainability, it is too early to evaluate whether PLEC participants will sustain the PLEC methods after the project has ended assuming some level of continued local investment. It is not clear how many clusters have identified adequate funds for continuing their work. Clusters have produced plans for continuation, according to the last annual project report.

Policy impacts (not well documented) may improve the environment for sustainability and expansion of impacts. In some cases PLEC technical and policy recommendations have been incorporated into national development and conservation

[3] The reader is referred to this table and accompanying text in the GEF original project document, in order to interpret the meaning of the specific indicators.

planning processes (e.g., Ghana Strategic Plan for Conservation and Use of Genetic Resources, Brazilian State of Amapa Sustainable Development Plan, KARI strategy in Kenya). In other cases, PLEC methods have been picked up by other projects (e.g., SRMP in Ghana, Pro-Varzea and Pro-Manejo programs in Brazil).

3.0.0 Intercluster cooperation – success and value in terms of harmonization of methodologies, outreach and communication.

3.1.0. Harmonization of methodologies

The concept of harmonization of methodologies is very interesting, because it recognizes the necessity of building on local variation. Instead of seeking to use a network to "standardize" rigid blueprints and "packages of practice" to be followed by researchers wishing to collaborate with farmers (blueprints which would not be possible or advisable), PLEC has developed a process that allows clusters and centers to evolve along a local path (based on what is possible as much as on what might be achieved in their particular environments). But PLEC also used guidelines and recommendations to nurture cluster scientists toward reflection on their methods and how they differ from others, and how they could be improved.

Successful harmonization in a global project that was built upon local, independent clusters in diverse countries requires both strong oversight at the global level and cooperation between clusters (see below).

Successful harmonization, however, is also highly dependent on the calibre and orientation of the researchers at each site and cluster, in the same way that the success of the demonstration plots depended on the calibre and orientation of the master farmers and their colleagues at each site and cluster. The process for selecting and managing expert farmers is well-articulated in the documents. However, there does not seem to have been any rigorous method for selecting agricultural researchers and cluster centers. The various reports seem to indicate that some cluster centers and scientists were stronger than others.

On the one hand, this apparent lack of 'selection' criteria for 'master agricultural scientists' was wise, because it enabled the project to test how the PLEC process would work in reality, where many (possibly most) agricultural researchers and extension agents are not "masters" at their trade. On the other hand, it made harmonization more difficult. The lack of 'selection' challenged the global level scientists to devise ways to encourage local agricultural scientists to reorient their data gathering and analysis to enable their research to incorporate more global analytical questions in addition to those of local interest and direction. The global scientists were forced to work harder to develop replicable mechanisms for working with the full range of agricultural scientists that exist around the world.

3.2.0. International coordination: Oversight by global management.

The international coordination activities made PLEC much more than a sum of its clusters. PLEC management vigorously pursued their objectives and sought the review and advice from other scientists.

International coordination has been essential for PLEC, not only to provide oversight, but also because PLEC is designed to jumpstart global change. PLEC addresses two global crises -- falling biodiversity in landscapes, and the crisis of land degradation which not only increases poverty but also forces people to move into lands that have been reserved for maintaining forests, wild ecosystems, and other types of biodiversity.

Under GEF, PLEC matured as a global network through improved international coordination with attention to constantly improving performance. PLEC's international coordination work achieved many milestones, despite the challenges of coordinating activities in such a diverse set of countries. The PLEC project's Scientific Coordinators developed guidelines and assisted clusters to prepare their annual workplans. They also assisted the clusters to standardize their financial and personnel management. The PLEC Biodiversity Advisory Group created methods and frameworks to improve data collection and analysis. And PLEC's Demonstration Activities Advisory Team developed guidelines for working with master farmers and stimulated change by visiting clusters to work with farmers and researchers in each cluster.

There was inadequate information for the desk review to evaluate the degree to which information in the PLEC bulletins and publications influenced the activities in other clusters or outside the network. PLEC presented its methods and results to others outside the network through presentations in many conferences and other fora, but the impact of presentations is always difficult to measure. PLEC produced several valuable books on methods, but it is difficult to measure their impact yet. The PLEC bulletin was distributed to many researchers around the world, but it is difficult to judge what impact it has had in a world full of bulletins or how the PLEC information might have influenced agricultural research in other parts of the world that lie outside the clusters.

3.3.0. Intercluster cooperation.

Intercluster cooperation, as fomented by international coordination and local direction, is at the heart of PLEC. Respectful two-way communication amongst scientists, e.g., extension agents, and farmers -- listening, responding, sharing problems and the results of experimentation -- provides the energy and the means for collaboration. Collaboration between clusters requires the same level of communication across cultures and ecological zones, looking for principles that transcend the ecological and cultural specifics of the sites.

Intercluster communication has been an important method used to try to move the slower clusters forward. However, the calibre of scientists and their interests varied within and between clusters, making it more difficult for them to 'speak the same language' when they met. The impact of intercluster cooperation was limited in some clusters by the lack of openness of the researchers and extension agents. Unless

researchers are open to understanding the benefits of farmer-researcher communication, cooperation will remain low, as it has been traditionally – with agriculture experts telling farmers what to do based on their training in university and attitudes as elite researchers. Nonetheless international networking proved to be a viable strategy to reach researchers and change their way of thinking about their work.

Visiting other clusters provides opportunities to see things in another context. This did not necessarily lead to copying the same methods 'at home' but it started researchers thinking about their own methods and how they could adapt them to incorporate insights from other cluster demonstration sites. Hence over time the methods employed in different sites became more "harmonized" as they progressed.

It is important to note that the success of intercluster cooperation also depended on the success and experiences of each cluster's own outreach efforts. Project documents illustrate the impact of outreach in influencing other projects and activities in China, Tanzania, Guinea, Ghana and Brazil. In some cases, university curricula were developed. These local outreach activities enabled those clusters to better represent the value of their approaches to visitors from other clusters. Likewise, where the master farmers engaged in wider outreach, they were better prepared to influence activities in other clusters through exchanges between clusters.

4.0.0. Scientific progress and rationale as a joint project of people and scientists, and its relationship to the sustainability of the project approach.

Over the past fifty years, individual researchers -- ethnobotanists, ethnoecologists, anthropologists working in agricultural systems -- have documented thousands of local resource management systems that include biodiversity and natural processes in all ecosystems around the world. PLEC has moved that knowledge into a new realm by 1) linking it to agricultural projects and 2) creating replicable methods for training anyone to recognize these systems and support the people whose actions and choices maintain these systems and the knowledge that underlies these systems.

The "peoples' science" approach is not new in developing countries. The value of master farmers' knowledge has been recognized and promoted by activist NGOs who network this knowledge among farmers and support local gene banks. Agricultural researchers, however, tend to view these NGOs are ideological activists, and tend to ignore the farmers' knowledge. PLEC recognized this attitudinal gap was hindering the evaluation and support of good local farmers' knowledge. By working with scientists to evaluate agrodiversity and its maintenance, rather than only supporting farmers, PLEC has advanced scientific knowledge as well as created the potential for expanding sustainable and productive relationships between scientists and farmers.

PLEC systematically demonstrated the scientific value of farmers' empirical knowledge to researchers. The recent book 'Cultivating Biodiversity' and the PLEC newsletters are replete with wide-ranging specific examples. As agricultural researchers and extensionists observed the positive results of local cultivation

techniques and landscape management, the scientists were able to analyze the reasons why the farmers' empirically-based methods worked.

The new PLEC database (initiated in response to S.Brush's midterm report in 2000) is providing a framework for gathering comparable data for analysis to reveal the conditions (political, social and ecological) in which farmers' knowledge continues to exist, and as a baseline for identifying and following farming system trends into future. The STAT led meta-database development initiates the basis for quantifying and comparing agrodiversity situations among sites.

5.0.0. Capacity Building

At the level of skills transferred as a measure of capacity building, both farmers and scientists benefited. Agricultural researchers had the opportunity to learn basic scientific approaches to research as well as specific scientific techniques used in the project. As would be expected, all researchers did not emerge with equal capacities since this change depends on the person's personal attitude to embrace change vs relying on whatever they had learned in their previous training and "status quo" of agricultural research in their environment.

Farmers learned new techniques from each other and became more open to learning values of old methods as a result of legitimacy conferred by the research program.

The farmers associations nurtured by PLEC are an especially important aspect of the capacity building strategy. Associations enable farmers to interact with each other and share observations, as well as represent themselves to the project personnel and agricultural extension agents in the future. Working with associations is a much more effective way to expand and sustain project impacts. In some cases, the associations were created specifically for PLEC (village committees to chicken breeders club) and in other cases existing associations incorporated a new focus on agrodiversity and local knowledge (women's nursery groups to labor unions). Details of association activities and impacts can be found in the Consolidated Report on Capacity Building.

PLEC included many training activities that were designed to ensure use of knowledge gained during training (and thereby reinforce adult learning). They were primarily focused on transferring skills for project implementation (listed in annual reports and analyzed in the Consolidated Report on Capacity Building). Many focused on the tasks necessary for implementing the research. Others were designed to bring local officials and bureaucrats on board to support PLEC objectives. Others were training courses run by farmers and farmers' associations. In addition, undergraduate and graduate students gained valuable skills and experience by working with PLEC activities in most clusters.

Aside from the expected capacity building via training for individual farmers and agricultural scientists, the PLEC process itself built capacity by creating the conditions for agricultural researchers to discover 'on their own' that working with expert farmers was rewarding. This discovery created an incentive for researchers to take a 'learning approach' to their work in the future – something that might not be fully appreciated by many reviewers. The embrace of a learning approach, more than

any specific new skill transferred to PLEC participants via training, is key for projects attempting to achieve sustainable transformation of agricultural landscapes.

6.0.0. Recommendations for the future

PLEC is poised to upscale and mainstream its approach globally – something that remains to be achieved. PLEC has demonstrated the 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. Continued work at each cluster is an admirable goal, but to enhance the impact of PLEC, a more visionary goal is to develop a way to reach agricultural researchers and extension agents around the world. This is essential if agricultural landscapes are to become more compatible with biodiversity conservation.

This could be achieved through three processes – (1) curricula development for use in agricultural universities around the world; (2) regional training centers; and (3) policy analysis and reform that removes the incentives for unsustainable land use.

6.1.0. Develop curricula for agricultural universities around the world.

Curricula development is the basic next step because agricultural universities are continually producing new generations of researchers and extension workers who follow the old model of agriculture which is useful in some areas where intensive agriculture is appropriate, but not appropriate in most of the marginal lands that generally comprise the landscapes of concern for biodiversity conservation, and serve as the resource base for millions of impoverished farmers.

PLEC should develop curricula for training scientists, agricultural researchers and extension agents in the ‘agrodiversity’ approach and the techniques developed by PLEC.

6.2.0. Establish Regional training centers.

One way to start mainstreaming would be for PLEC to establish regional training centers that would build interest among more established universities, as well as provide specific types of training. These centers (along the lines of what RECOFT has offered for community forestry perhaps) could offer different courses for different audiences - policy makers, expert farmers, scientists, conservationists, etc. Some of the clusters, such as the one in Ghana, include the idea of regional centers in their future workplans – an indication that this is a natural next step given that there is already enthusiasm for this approach among PLEC participants.

6.3.0. Establish links to policy analysis and reform component or partner.

Finally, to remove disincentives for more ecologically sustainable agriculture, PLEC should be supported by a policy analysis and reform component or partner. Without policy reforms that remove incentives for converting land into other uses, the more ecologically sustainable agriculture, and the biodiversity it sustains in the larger landscape, will be overcome by economic/financial driving forces that result in homogenization of the landscape. But simply removing disincentives will not be sufficient to change loss of biodiversity. Mainstreaming PLEC approaches into agricultural research and farmer-based promotion of sustainable alternatives will be the essential companion to economic reforms to support biodiverse landscapes.

Documents Reviewed[4]

- PLEC Brief (= Project Document),
- Project Reports from year 1 to year 4,
- Final Report of PLEC,
- *'Cultivating Biodiversity*'
- '*Land Degradation: Guideline for Field* Assessment'
- Copies of PLEC News and Views.
- Copies of the Database files
- Final Cluster Reports
- Annual Project Implementation Review (PIR) reports 1999-2002
- A copy of the PLEC Scientific and Technical Advisory Team (STAT) report
- Consolidated Report on Capacity Building
- Field evaluation report by E. Fuentes & B. Rerkasem

[4]. The reader can peruse the full extensive, detailed documentation from each cluster in order to appreciate the many achievements, the diversity of experiences and the overall elegance of the PLEC approach. PLEC has created many different specific local cluster models by virtue of its flexible approach. No single cluster can be used as an example to capture the experience of the whole.

APPENDIX 1. **Terms of Reference (TOR) for the Desk Evaluation of PLEC**

In accordance with the PLEC Project agreement an external evaluation of the project is to be carried out at the end of the project. Accordingly, the Consultant is to carry out a desk review and evaluation of project's outputs, their correspondence with the outputs envisaged in the original project document and their impacts. A copy of the full original PLEC project document, copies of progress reports, publications and databases, and copies of the draft final report and the field evaluation report will be provided separately.

In view of the above the Consultant is more specifically to:

2.1. Review the progress of the implementation / achievement of outputs (ref. annex 4 and 6b of PLEC project document) and impact of the project (ref. annex 5, table 5.3 of PLEC project document) as appropriate;

2.2. In particular, as PLEC is largely a farmer-driven demonstration project operating in eight countries in three continents, the consultant is to evaluate the success and value of international co-ordination and inter-Cluster co-operation in terms of harmonisation of methodologies, outreach and communication;

2.3. Review also the scientific progress of the project and evaluate it's scientific rationale as a joint project of people and scientists as well as the sustainability of the project approach;

2.4. Review also the degree to which PLEC has built human resource capacity;

2.4. Make recommendations for possible follow-up for consolidation and/or building on the project results;

2.5. The evaluation consultancy will take place in October - December 2002 and will be for four weeks (total time);

2.6. Consultant is to prepare a review report in line with the above TOR paragraphs 2.1 to 2.4.

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Part 2: People, Land Management, and Environmental Change (PLEC)

Final Field Evaluation Report

29 June 2002

by

Benjavan Rerkasem and Eduardo Fuentes

1. SUMMARY AND CONCLUSIONS.

The main focus of PLEC was on improving yields and sustainability of agricultural lands. Activities were concentrated on demonstration sites, which were made up of farming communities or villages. At many sites, e.g. throughout Africa, the landscape have been more or less completely converted to agriculture. Very little of the original vegetation remained. Brazil and China were notable exceptions. Near Macapa in the Amazon delta farmers live in the forest and manage the landscapes mostly by altering the density of original trees. In addition to their crop fields, demonstration villages in China either had their own land use stages such as community forests, head-water forests or fallow fields in which cultivation and management were limited or they were situated near protected nature reserves.

The agrobiodiversity assessment, which still remains to be much further analyzed, has shown that even in the most intensively cropped land, in small mainly poor villages across wide ranging agroecosystems of the different clusters, some biological diversity, native or introduced, is routinely cultivated by farmers. Biodiversity has been cultivated by increasing species and genotype mixes in individual fields, over the different seasons and in mosaics of land use stages and field types over the landscape. Most importantly, a new body of knowledge has begun to emerge. The project has contributed much to the growing understanding and dissemination of farmers' biodiversity management, in the usage and maintenance of many individual species, including wild and semi-domesticated ones as well as those considered "weeds" by agronomy textbooks, and occasionally even a few on the national endangered list. Some of the main findings have been published in peer-reviewed journals but many more are still in internal project reports.

Central to PLEC's demonstration activities were the so-called expert farmers, identified variously by different clusters. Some were particularly skilled in agrodiversity management, able to employ local and introduced plant genetic resource to make the best use of their given circumstances. Some were keen on experimentation and some possessed certain specialized skills. Some clusters chose as their expert farmers those with aptitudes for transfer of knowledge and certain skills to other farmers. Some clusters worked with experts with combinations of these attributes. The project has been generally successful in demonstrating scientist-farmer and farmer-farmer transfer of practices aiming to increase farm income while maintaining or increasing number of crop varieties and useful species in each individual field types.

At most sites PLEC played an important role in helping to constitute, strengthen or make official existing farmers associations. This is likely to be one of the more important and sustainable outcomes of the project. These associations provide an effective platform for future developments. The associations are already successful in giving farmers negotiating power with banks and governments, and are enabling fruitful exchanges of information and genetic material. Support in local biodiversity management was provided through the farmers' associations and the expert farmers. In some clusters, the model was extended to include local government agencies responsible for conservation, e.g. Nature Reserve Bureau in China.

In most cases the net result of PLEC at the field level was to increase biodiversity through crop management and to increase productivity through various agronomic management from new cropping systems to nutrient recycle and soil fertilization. More sophisticated models were developed and tested by some clusters, e.g. Brazil and China. In the Amazon delta, for example, scientists are only now starting to understand the complex and very dynamic interactions of farmers with the forested landscapes and they are far from being able to suggest improvements.

Brazil has developed a very attractive environmental education program. In this program they assessed the needs of elementary school teachers and then provide them with very attractive materials and trained them in their use. This program may be worth replicating elsewhere in the PLEC and non-PLEC world.

China has demonstrated the role of farmers' association, in the management of biodiversity in neighboring protected land as well as their own productive land. The PLEC supported farmers' association became the model for some 30 new farmers associations in villages surrounding the Gaoligongshan Nature Reserve, a biodiversity hotspot of global significance. The effective model for biodiversity management involved a tripartite collaboration between PLEC, the farmers' association and the Nature Reserve Bureau, a local government office responsible for protected areas. A PLEC recommendation that the model should be further tested in other areas have been favorably received by provincial governments in Yunnan and neighboring provinces of Guizhou and Guanxi in Southwestern China.

Interaction between groups and clusters has been associated largely with the annual meetings, limited regional meetings and visits and the scientific coordinators directed development and dissemination of methodology and guidelines. There were, however, signs of increasing collaboration, as clusters were becoming technically mature, more confident with making contributions and learning from one another. More synergy from between countries interaction might be expected in the future, e.g. should there be the next phase of PLEC.

In conclusion, while goals and progress varied among clusters, PLEC as a whole has successfully achieved all four original project objectives. Furthermore, although designed as a demonstration and not a scientific project, PLEC has begun to shed light on the understanding of how farmers and communities can help to maintain and enhance biological diversity even in intensively cultivated areas. In the reviewers' opinion, only through insights gained from such an understanding may sustainable

management of biodiversity be developed to the extent that it can be recommended at national and regional levels.

It would seem that more critical analysis at the project and individual field types and land use stages of social, financial as well as biophysical conditions that promote and limit biodiversity should give some insight into long term sustainability of agrodiversity. Long term databases that started or continued under GEF support provide an excellent resource and opportunity for analysis of dynamics and trends over time.

The systems approach may be brought in to examine other interactions among various components of local agrodiversity, specifically at the household, village, valley, provincial and regional level. It may also be fruitful to relate biodiversity data, between varieties of individual species as well as between species, to strategic determinations of the physical environment, including ones that are measured and those estimated or "known" by farmers. Obviously only some clusters are equipped for such in depth studies.

PLEC's contributions to the understanding and pioneering approaches for the management of agrobiodiversity may be found useful for GEF as a whole, especially when implementing the rather recently approved Operational Program on biodiversity of importance for agriculture (OP13).

2. INTRODUCTION.

The People, Land Management and Environmental Change (PLEC) project had its origins in 1992, before GEF funding became available. Originally it was designed as a research project to study management of land resources in the context of changing environmental and socio economic conditions. The GEF-funded phase had a more restricted agro-biodiversity conservation and management emphasis. It started in 1998 and ended in February 2002. Individual PLEC groups are now thinking of additional phases. In this final evaluation for the GEF-funded phase of PLEC, reviewers will attempt to separate as much as possible the accomplishments under GEF funding.

The goal of PLEC was defined in the Project Brief:

PLEC has *the overarching goal of the project is to develop sustainable and participatory approaches to biodiversity management and conservation based on farmers' technologies and knowledge within agricultural systems at the community and landscape levels. The method is to do this through 'demonstration sites' where sustainable and conservationist resource-use strategies are worked out and implemented in participation with stakeholders, and specifically with the farmers themselves. The project is organized into Clusters of countries and representatively diverse regions. Selection of Cluster composition was influenced by: (a) critical regional biodiversity importance in areas undergoing rapid change and land-use pressures; (b) critical ecosystems with important life support functions as well as national development potential, based upon national priorities and national plans; and (c) known examples of local agrodiversity management practices, or the strong likelihood of discovery of adaptive resource management. Each Cluster has selected*

its own focus areas within which adaptive conservation technologies will be identified and evaluated in the demonstration sites.

The Project Brief explained the four main objectives as:

Project Objective 1. *To establish historical and baseline comparative information on agrodiversity at the landscape level in the 6 regions.*

Project Objective 2. *To develop participatory and sustainable models of biodiversity management based on farmer's technologies and knowledge, at the community and landscape levels.*

Project Objective 3. *To establish national and regional networks for capacity strengthening within participating institutions.*

Project Objective 4. *To recommend policies and approaches to sustainable agrodiversity management to key government decision makers, farmers and field practitioners.*
The overall objective is largely contained under Project Objective 2. It must be noted, however, that in the Incremental Costs section of the Project Brief, the goal of the project is defined as providing *strategic and timely recommendations to governments and local communities for achieving world food security while protecting global biodiversity and conserving resources*. This statement of the overall goal is much closer to Project Objective 4.

PLEC was considered eligible for Global Environment Facility (GEF) support under the biodiversity focal area in the following countries: Brazil, China, Ghana, Guinea, Kenya, Papua New Guinea, Tanzania, and Uganda. In PLEC parlance each one of these countries constitutes a geographical "Cluster" or is part of one. Within the overarching goals just mentioned, it is recognized that clusters had somewhat independent objectives and dynamics.

The United Nations Environment Programme (UNEP) was selected as the GEF Implementing Agency, and United Nations University (UNU) as the executing agency. The project officially started on 1 March 1998 and ended in February 2002.

During April and May 2002, and following standard GEF practice, PLEC was required to have an independent final evaluation. Prof. Benjavan Rerkasem (BR, Thailand) and Dr. Eduardo Fuentes (EF, Chile) were hired to carry out the evaluation. This report presents the outcomes of these reviews.

3. SCOPE OF THE EVALUATION.

Mr. Timo Maukonen, the UNEP task manager for the PLEC project provided the following Terms of Reference:

Terms of Reference for PLEC final evaluation and how it is to be carried out:

In accordance with the PLEC Project agreement an evaluation of the project by external consultant(s) is to be carried out at the end of the project (a copy of the full

project document and copies of progress reports will be provided separately). In view of this the consultant(s) should:

Review the progress of the ***implementation*** *and* ***impact*** *of the project (ref. impact indicators as per PLEC document annexes 5 and 6, copies annexed below);*

In particular, review ***the scientific progress****: As PLEC is a ground-breaking joint project of people and scientists, the consultant(s) therefore is/are to review the scientific progress made and project's scientific rationale, as well as to evaluate its* ***engagement with local communities and sustainability*** *of the project approaches (rather than to prepare an audit on procedures, accounting etc.);*

Review also the degree to which PLEC has built (and has the potential to build) ***human resource capacity****. As PLEC is largely a farmer-driven demonstration project, the evaluators are, in particular, to review the success of PLEC Clusters in* ***demonstration, outreach, training and communication with various local players and in making an impact locally and/or nationally.***

Make ***recommendations for possible follow-up for consolidation and/or building on the project results*** *after the present project phase;*

The evaluation consultancy will take place in April - May 2002 and will be for one month (total time per consultant);

The consultant(s) is/are to review PLEC progress reports, to attend the PLEC final general meeting in April 2002 and thereafter to visit some of the PLEC country level programmes;

Consultant(s) is/are to prepare a review report in line with the above TOR paragraphs.

Attachment 1

Indicators of project impact (ref. Project document: Annex 5, Table 5.3.)
See also Annex 6 of the Project document)

1. Indicators of improved knowledge:

1.1. Systematic data collection and observation, according to project methodology, are effectively done.

1.2. Regular reviews are made of the adequacy of the measurement and experimental methods, and the data sets used, and appropriate actions are taken to improve the design of data collection and presentation.

1.3. Useful project information, especially on agrodiversity, biodiversity and comparative management methods, are included in global databases.

1.4. The technical soundness of reported and synthesised results is confirmed in independent reviews.

2. Indicators of capacity building

2.1. The number of students and practitioners-in-training skilled in PLEC methods increases year by year in all Clusters.

2.2. The responsibility of junior participants, and the quantity and quality of their reported work, is enhanced year-by-year in all Clusters.

2.3. Participating farmers adopt effective management strategies, and spontaneously experiment with appropriate agrotechnological methods.

2.4. Technical results, reports on models and experiments are used in national agricultural and environmental decision-making.

2.5. Researchers, policy-makers and other stakeholders are able to access all relevant technical information, methodologies and data in a useful format.

2.6. Specific training courses and workshops are successfully completed in collaborating institutions.

3. Indicators of stakeholder involvement

3.1. Governments and their institutions, farmers' groups, NGOs and other stakeholders are involved in the development of demonstration sites and in the conduct of the work.

3.2. National and regional resources are allocated or leveraged to support and continue PLEC activities.

3.3. Interest is generated in other countries in the development of work along the lines of PLEC.

4. Indicators of project continuity/sustainability

4.1. PLEC methodology and objectives continue to be followed by Cluster participants beyond the conclusion of the project.

4.2. Each Cluster has plans for the continuation of its activities, in collaboration with national authorities and other stakeholders, beyond the end of the project.

4.3. The technical and policy recommendations of PLEC are integrated into national development and conservation planning processes.

4.4. Appropriate sources of funding are identified for the continuation of PLEC work.

5. Review progress on stake holder involvement and information dissemination in accordance with the PLEC Project document and its annex 6: Stakeholder involvement and information dissemination plan [annex 6a: Stakeholder involvement and annex 6b: Information dissemination plan]

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Agreements on the ToRs.
EF participated on behalf of the two consultants in the Final General Meeting of PLEC. The meeting was held in New York between 23 and 26 April 2002. During this Final PLEC meeting in New York it was agreed with both PLEC cluster participants and with Mr. Timo Maukonen on behalf of UNEP that:

a) **Project implementation** would be reviewed on the basis of reports submitted by the clusters and having in mind the list of outputs indicated in Table 5.2 of Annex 5 of the Project Brief.

b) It was also agreed that **project impacts** would be assessed based what the reviewers could verify during the field visits, and not on existing reports. It was agreed that the list provided in Addendum 1 of the ToRs, is not a list of indicators of impacts and that it could not be effectively verified during the relatively short time available for the consultancy.

It was also agreed that PLEC's goal was to produce changes in the behavior of individuals, institutions and social systems leading towards sustainable and species-rich agro-ecosystems and agro-landscapes. Behavioral changes associated with preventing land degradation and supporting land rehabilitation are also within the scope of PLEC, and are consistent with the cross-cutting nature of these activities within the overall GEF goals. These behavioral changes, rather than impacts n biodiversity itself, would be the assessed impacts of PLEC.

c) It was also agreed that **scientific progress** would be assessed based on publications in peer-reviewed journals and attitudes of scientists towards the PLEC approach and an appraisal of how the PLEC approach works in practice.

d) **Follow-up recommendations** would be based on the potential of the PLEC approach in the various regions. These recommendations would be cluster-related and no attempt would be made to suggest a global follow-up proposal.

Essentially, the final evaluation would focus on the added value of having the two evaluators emit expert opinions based on visiting the clusters and having had direct access to the project. Hence no attempt would be made in the final evaluation report

to repeat information already available in existing project documents. (All Final Cluster Reports are available in a single CD and describe with a fair amount of detail all achievements, as perceived by the project proponents).

4. EVALUATION PROCESS.

The evaluators had access to the initial project document, reports prepared by the various clusters, and the mid-term evaluation. In addition, the evaluators had an opportunity to conduct short visits to these clusters.

In the short time available, the two consultants were assigned the evaluation of different clusters. BR was assigned China, Kenya, Papua New Guinea, and Uganda. EF was assigned Brazil, Ghana and Guinea. The consultants evaluated Tanzania jointly (29 April-2 May), agreed on standards, procedural, and formal matters, and on 3 May 2, 2002 departed for their respective assignments. Given the global and rural nature of the project, a considerable fraction of the time was spent traveling between and within countries.

EF returned to Chile on 24th May and BR to Thailand on 2nd June 2002. Reviewers shared drafts of their own reports and worked jointly on the rest.

Scientific progress was evaluated for PLEC as a whole. Notwithstanding the overarching general common PLEC approach, it was mentioned clusters had from the start somewhat independent objectives and dynamics, and will probably have separate trajectories in the future. Therefore, this report was prepared containing separate chapters for each one of them.

For each cluster a similar pattern of inquiry and report was followed in agreement with the interpreted ToRs.

5. SCIENTIFIC PROGRESS.

Although designed as a demonstration project, PLEC has contributed significantly to the growing understanding of farmers' biodiversity management, in the usage and maintenance of individual species, including wild and semi-domesticated ones and those considered "weeds" by agronomy textbooks, as well as diversity within crop species. Evidence from PLEC has shown that biodiversity may often continue to be cultivated by farmers in spite of market accessibility or commercial success of any particular crops or varieties. This is a significant addition to the growing body of evidence among the literature focusing largely on cultivated species that biological diversity can often be found to exist along side with improved, modern varieties and cropping systems.

Main findings have begun to be published in peer-reviewed journals. Many more can be expected after further in-depth analysis and interpretation. Publications such as the PLEC Book (Cultivating Agrobiodiversity, edited by Brookfield, Padoch, Parson and Stocking, published by ITDG Publications, London.) and the continuation of the in-house PLEC News and Views will help to significantly increase the contribution from

PLEC to the global body of knowledge. Still more new knowledge can be expected to come out of further analysis of the PLEC agrobiodiversity database. Most promising would be from those clusters in which the database has been updated annually and where the long-term database went back even before the GEF phase.

The PLEC's idea of agrodiversity is increasing being incorporated into the mainstream agronomy and crop science. An introduction of papers on Crop Diversification in the Northern Great Plains Cropping Systems, a symposium of the Annual Meeting of the American Society of Agronomy, Crop Science Society and Soil Science Society, Lake Tahoe, 1999, quoted from Brookfield the idea of, "dynamism" of agrodiversity as constantly changing patchwork of relations between people, plants and the environment…. always coping with new problems, always finding new ways……..." (Blake et al, 2002: Agronomy Journal 94: 173-174). PLEC's contributions to the global body of knowledge and understanding on the subject is significant and timely.

6. OVERVIEW OF THE MAIN FINDINGS.

Clusters differ in their compliance with implementation milestones. All clusters submitted their final reports, although for Brazil and China, for example, the reviewers got it only during the visit.

Some clusters submitted all their reports, including those biodiversity and agrodiversity inventories (parts where local intellectual property rights would not be jeopardized, the rest is maintained in the countries), root causes analyses, social analyses, management regimes, experimental work, replication potential and policy recommendations. Others have been less compliant and have submitted fewer reports. Final reports, however, tend to be comprehensive, well written and informative of achievements of the clusters.

In general, the field visits confirmed our first impressions gained from the reports and at the meeting in New York regarding the overriding importance of the demonstration sites *vis a vis* the other three project goals. Activities related to the other three goals are done only in connection with the demonstration sites. It is at the demonstration sites that communities are engaged and main human resources are built. In addition, there are other more formal instances of training, such as graduate training, in many areas, and several clusters have made good use of these options. In most cases the students' field-work was conducted in or in some way associated with the demonstration sites.

The agrobiodiversity assessment, which still remains to be much further analyzed, has shown that even in the most intensively cropped land, in small mainly poor villages across wide ranging agroecosystems of the different clusters, some level of biological diversity is routinely cultivated by farmers. Biodiversity has been found in species and genotype mixes in individual fields, over the different seasons and in mosaics of land use stages and field types over the landscape. Most importantly, a new body of knowledge has begun to emerge. The project has contributed much to the growing understanding of farmers' biodiversity management, in the usage and maintenance of many individual species, including wild and semi-domesticated ones as well as those

considered “weeds” by agronomy textbooks, and sometimes even a few on the national endangered list.

PLEC takes place in very poor rural communities where poverty alleviation is the major social concern. At some sites, for example in Africa, there is little of the original biodiversity left. The project’s main objective was helping people improve their livelihoods, mostly through increase yields, and increasing within plots biodiversity at the species, varieties and life forms levels of diversity. Most sites received from the project technical assistance and inputs leading to land use intensification, including germplasm, and opportunities to visit and learn from other farmers. Farmers cultivated species they found useful and a *quid pro quo* was apparent at sites where a conservation area was supported (for example in Guinea).

While visiting the communities where the project took place it became very clear that a conservation-only project would not have been possible or successful. It is only by providing livelihoods that the project could introduce biodiversity enrichment and management approaches. It is because PLEC was able to provide inputs and technical assistance contributing to improve the livelihoods of people that it has had the impact reviewers were able to see in the field. People liked PLEC and in numerous occasions we heard them saying they would like to have more, to be able to expand to other areas or to go deeper in the same communities. In Papua New Guinea, PLEC has been and continue to be approached by farmers and NGOs who asked for the project to expand to their own areas.

PLEC is also a project about agro-biodiversity in productive landscapes and is not centered on protected areas. In some cases, for example in Ghana and in the Amazon, there are sacred groves and other protected areas, and the project is contributing to their conservation, but they are not the main focus of the project. Given the low financial resources per site and its overall goals, the project made no attempts to ensure the protection of those areas by permanently removing all human-induces threats to them. PLEC is focused on providing demos of how sustainable, productive and biodiversity friendly agriculture can be done, but sometimes with very little money. Some of the sites visited received about USD 10,000 per year for all their activities. Under these conditions, PLEC cannot be asked to account for permanently eliminating all threats to the biodiversity of the working areas. The project’s role was to facilitate exchanges, remove barriers, leading to higher productivity and within-plot biodiversity.

Only in China, where PLEC was working with villages on the edge of protected nature reserves, PLEC activities have had direct impact on biodiversity in the reserves, the work of the Nature Reserve Bureau responsible for protecting the reserves, as well as on farm productivity and agrodiversity.

The project faced the challenge of biodiversity management by real farmers in the production landscape, usually in very poor areas and with imperfect or inaccessible markets. Farmers were cultivating species and varieties they found useful at the time of the project. From this perspective many of the achievements are sustainable. People accepted PLEC because it was clearly in their own benefit and it is most likely that they will maintain these achievements in the short- term. However, preferences and markets change and thus the long-term sustainability of projects such as PLEC cannot

refer to the actual biodiversity managed in the field. Specie and varieties cultivated may change as access to the sites improves and new markets and opportunities arise.

To reach for long term sustainability of agrodiversity would require that PLEC, or more appropriately it's individual follow up projects, to critically analyze for social and financial as well as biophysical conditions that promote or limit biodiversity. The systems approach may be brought in to examine interactions among various components of local agrodiversity, specifically at the household, to village, national and regional level. Such analysis would relate agrobiodiversity data, between varieties of individual species as well as between species, to strategic determinations of variations in the physical environment, including those estimated by farmers as well as measured. Long term databases started or continued during the GEF phase provide an excellent opportunity for analysis of dynamics and long-term trends.

Sustainability of biodiversity projects in productive landscapes must refer to the approaches and how the issues will be addressed in the future. The project successfully supported exchanges among farmers and built capacities at various levels. It is these capacities that are likely to give sustainability to the project approaches in the future. Our visits gave us an optimistic view that the basic PLEC approaches and especially farmer-farmer and scientists-farmer contacts will be maintained. We had the strong impression that all sides saw these contacts as directly benefiting them and therefore the need to continue with them.

Another aspect of the strengthening the sustainability of PLEC approaches is that at all sites the scientists were also training students and thus passing information and approaches to the next generations. This formal training was possible because PLEC scientists are all associated with learning centers. In addition farmers received formal training at agricultural schools nearby, as in Guinea and Ghana for example, and informal training through their contact with other PLEC farmers and with the scientists. In several cases, for example in Ghana, Guinea and Brazil, children also received training with the same long-term effect in mind. The training of graduate students and future generations of teachers will also contribute towards the sustainability of the approaches.

Visits confirmed the strength and validity of PLEC's three "pillars" in the field, farmer-farmer exchanges, scientific-farmer exchanges, and the use of local examples of biodiversity friendly activities to build more productive and sustainable agricultural systems. People singled out by the project for having developed these practices, the so-called "expert farmers", effectively demonstrate good practice and, for example in Brazil, experiment with options for further development. At all clusters visited, demonstration sites had been used for dissemination and training.

At most sites PLEC played an important role in helping constitute, strengthen or make official existing farmers associations. This is likely to be one of the more important and sustainable outcomes of the project. These associations give farmers negotiating power with banks, governments and allow for further exchanges of information and genetic material. One of the reviewers had a chance to see a group of women in Ghana negotiate a small loan with a bank, and this would not have been possible without a formal organization. Although PNG PLEC did not encourage formal farmers' association, it assisted the villages of Tumam to apply for public funding of

water storage tanks and Ogotana in negotiating for funds to add two classrooms to its primary school.

The role of scientists in PLEC seems to vary. On one extreme they are close to agricultural extension workers, disseminating techniques to improve yields, providing alternative livelihoods, and in general helping with the sustainability of the operations. On the other extreme, scientists observed and document what farmers do and facilitate exchanges among them. At most sites they played intermediate roles.

It is not strange therefore that contributions of PLEC scientists to the peer-reviewed international literature differed markedly among clusters. Scientists in Brazil, for example, submit and publish their papers on a regular basis in well-known international journals. First publication in respectable peer-reviewed national journal in Chinese helped China PLEC to quickly disseminate their findings and made them accessible to younger scientists and students. This is a measure of the scientific success of the clusters. At other sites, however, contributions are of more restricted scientific interest. This is not to say that these latter contributions are not of the greatest interest to the poor communities benefiting from the project. However, there is always the problem of quality control, without some form of review.

In a meeting with PLEC scientists and the reviewer, farmers in Nduuri in Kenya asked what had happened to the agrobiodiversity information collected and knowledge that they shared with the project. For all clusters, it would seem that a compilation of the information in a simple booklet in local language would serve many purposes. It would begin the store of local knowledge that can be built upon and used by everyone. School children may use it and so closing the gap in traditional knowledge between the old and young generations that is becoming increasingly wider everywhere. It may even encourage other farmers to share their knowledge. A simple and inexpensive publication, e.g. with photocopies, quickly produced, can serve as a working version that can be reviewed by farmers.

Scientists in PLEC tend to be mostly related to agricultural development and anthropology, with an evident lack of economists. Economists would have allowed for more informed judgments on the financial feasibility and replication potential within existing conditions. The fact that not all farmers near demonstration sites wanted to replicate PLEC approaches, may mean that in addition to lack of start up capital there could be other constraints.

Along the same vein, in some cases there were so many plants added to the production plots (for example at some sites in Ghana), that reviewers questioned themselves what would be the optimum density and mixture of plants. Multi-cropping is more effective than single cropping only under limited assumptions about the sign and strength of within and between species interactions. The optimum mixture of species, and their arrays and densities are the subject of involved academic studies, or the result of long trials and errors in the field. In the instances mentioned, the project did not have the time to test the relative value of the new configurations. The four years of the project are not enough and there was no specific design aimed at testing the assumptions.

At most sites is was very obvious that the time given for the project to show its results is too short. In four years the project cannot be expected to generate, test and disseminate land use innovations. For Papua New Guinea, with its many problems ranging from local unrest to death of key personnel, the work in Ogotana demonstration site had been going for only two years. Consequently, most results disseminated are well known ones, such as for example the role of fertilization, contour plowing or planting fruit trees in a field with annual cultivars. Successful exchanges were mostly of species or varieties that worked at one site and farmers are now testing at other sites. Results will be apparent in at least another four or five years. It is evident that agricultural development projects such as PLEC should have been designed over an eight to ten years horizon.

As a result of the last three issues commented in the last two paragraphs, the role of PLEC in policy design is likely to remain limited, although there are a few exceptions were governments are adopting selected PLEC techniques. In all cases these are specialized techniques, such as for confined livestock in Guinea, rather than the PLEC approaches as a whole.

China provides an example of achievements that can be made in a project like PLEC when scientists have had sufficient time to gain an understanding of local conditions and can collaborate effectively with farmers, local governments and other stakeholders. These have led to identification of expert farmers whose skills could effectively help other farmers to make a living while contributing to enhancing biodiversity in local plant genetic resources. The PLEC initiated and facilitated Gaoligongshan Farmers' Association for Biodiversity Conservation runs its own farmer-to-farmer training program. The first of its kind in China, the association is model for some 40 other farmers' associations in the province. China's model for biodiversity management involved a tripartite collaboration between PLEC, the farmers' association and the Nature Reserve Bureau, a local government office responsible for protected areas. A PLEC recommendation that the model should be further tested in other areas have been favorably received by provincial governments in Yunnan and neighboring provinces of Guizhou and Guanxi in Southwestern China. China PLEC probably had the longest experience with local involvement in biodiversity management. PLEC scientists in China began to look for diversity in local agroforestry even before 1995, when they started on participatory work with farmers of the demonstration villages that had evolved into PLEC.

The strength of PLEC in helping shape agro-diversity policies is also affected by the overall weakness in design between and within clusters. Clusters have little in common, besides the goal of improving yields and increasing biodiversity. In fact, people in the field could mention very few, if any, directly useful issues/techniques/approaches learned from or by contrasting with sites in the same or in other clusters. From this perspective, the case made at each cluster *vis a vis* a policy recommendation is weaker than it would have been had the overall design allowed for meaningful comparisons.

There is also an unclear rationale for the number of demonstration localities chosen in any one country. Reviewers had the strong impression that the project was funding replication even within small geographical areas. A redundancy better explained by

the wish to help as large a number of people as possible, rather than by strategic thinking aimed policy recommendations.

Interaction between groups and clusters was associated largely with annual meetings, limited regional meetings and visits and the scientific coordinators directed development and dissemination of methodology and guidelines. Other exchanges and collaboration have begun to emerge, mostly between the more advanced clusters, e.g. Brazil, China and Ghana. Sometimes, some of the newer clusters have also benefited from interaction with more established ones, e.g. Guinea and Papua New Guinea from Ghana and the outreach from Brazil to Peru. Between countries collaboration has become more active as clusters mature technically, and are more confident to make contribution as well as to learn from one another. Should there be the next phase of PLEC, more synergy might be expected from interaction between countries. However, we would like to suggest that exchanges and collaborative activities are clearly specified in the project design and workplan, and the costs (in time as well as money) and expected benefits be carefully evaluated. Suggestions for follow-up have also been made for each one of the areas visited.

From an overall GEF perspective, the PLEC project is a pioneer for activities in the agricultural production landscape. Had it been presented to Council during year 2001 it would probably have been eligible under the new Operational Program 13, on biodiversity of importance to agriculture. In 1998 there was no such an Operational Program and found eligible under the general biodiversity focal area. *De facto*, however, this project is actually pioneering the type of projects that GEF may want to support under its relatively new Operational Program on agro-Biodiversity (OP 13). The GEF Secretariat, and the Implementing and Executing Agencies may find that many of its approaches can become mainstream under OP 13. The most important of these approaches are perhaps, the active involvement of scientists with a *bona fide* interest in biodiversity-friendly agricultural development, the farmer-farmer contacts and exchanges, and the support for rural organizations allowing farmers access to knowledge, credit and leveraging power with governments.

7. EVALUATIONS OF THE SIX CLUSTERS.

In the following sections reviewers will describe the main findings at the various locations visited.

BRAZIL

Summary

In Brazil PLEC is supporting working groups in the Amazon delta (Macapa) and in the lower Amazon (Santarem). Approaches differ. In the delta, PLEC is learning how farmers have adapted to living in a complex environment and is helping disseminate best practices and genetic material. Near Santarem, PLEC is learning what farmers do and also helping increase yields, promoting diverse home gardens, supporting habitat restoration and strengthening critical institutions. PLEC's goal here is support biodiversity friendly fisheries and land use agreements.

Brazil also has a very attractive environmental education program. In this program they assessed the needs of elementary school teachers and then provide them with very attractive materials and trained them in their use. This program may be worth replicating elsewhere in the PLEC and non-PLEC world.

Brazilian scientists are also among the most productive and are effectively contributing to the peer-reviewed international literature on fisheries and land use management.

Process

The reviewer (EF) arrived in Belem on 17th May. Dr. Theresa Ximenes, PLEC leader for Brazil was the host on that day. On arrival a visit was made to the Universidad Federal do Para and to Nucleo Altos Estudios Amazonicos.

On 18th May EF traveled to Macapa in the Amazon delta, where the field visit started. The host for the whole field visit was Dr. Miguel Pinedo-Vasquez.

On May 19th, Mr. Jaime Oliveira and Mr. Fernando Galves accompanied us to the Mazagao community.

On 20th May we visited the Ipixuna community and the expert farmers were Mr. Hilario Santana Vilhena and Mr.Alziro Lobato da Silva.

Early on 21st May we left for Belem and Santarem. In Santarem the host was Dr. David Mc Grath, also with Universidad Federal do Para. The Santarem site has two locations, on Ituqui island and Sao Miguel, and both were visited.

Project Implementation and Impacts

During the New York meetings reviewers received an electronic report of the Santarem sub-component of the project. In addition, Brazil prepared and had already submitted two papers: Biodiversity as a Product of Smallholder Management (M. Pinedo-Vasquez), and Small Agriculture Along the Lower Amazon Flood Plain, Brazil (A. Winkler-Prins and D. McGrath).

On arrival in Belem Dr. Theresa Ximenes provided an integrative final report for the whole Brazilian PLEC component. This report is well written and describes a very successful project.

In the Amazon cluster PLEC is working basically at three sites, in the delta, in Santarem and in Iquitos (Peru). Only the first two sites received GEF support and will be discussed here. In the delta land is flooded twice a day with the lunar tides. Inland sites are only seasonally flooded. Flood lands are locally known as varzeas.

Amazonian sites differ from other PLEC sites in significant ways. First, in the Amazon PLEC is working in environments with relatively low human use, unlike in, for example, Guinea, Ghana or Tanzania. That is, Amazonian sites still maintain a large fraction of what to start with was a very high biological diversity. Second, the Amazon river and the tides constitute an immense challenge for farmers and they have to adapt to them if they want to survive. Farmers in Amazonia seem to have adapted to the unique environment of the flood plains in unique ways.

The combination of high natural biological diversity, low human occupancy, and a culture of adaptation to an environment of periodically fluctuating water levels, have led PLEC scientists into a somewhat different approach from the one taken elsewhere. In Brazil the emphasis of scientists has focused more on understanding human uses of the complex and diversity rich Amazon ecosystems, on facilitating exchanges of information and germ plasm among farmers working in species-rich plots (the so called expert farmers) and other farmers, and to a lesser extent on direct interventions to intensify land uses. Most of the budget, the reviewer was explained, was spent paying for farmers from the three sites (delta, Santarem and Iquitos) to meet and exchange know-how and germ plasm. But the emphasis at the two Brazilian sites is different. The study only approach is more important at the delta site, whereas at Santarem there is more intervention.

Another difference between Brasil/Peru and other PLEC clusters concerns the role of scientists. Amazon scientists studied human use in an attempt to understand what is being done and why, and regularly published papers in the peer-reviewed international literature. In other clusters scientists frequently had more the role of agricultural extension agents and less the role of students of a previously non-described reality.

During the visit to the first site in the delta, Mazagao, the reviewer had a chance to talk to three expert farmers, Mr. Tome di Souza Velho, Ms. Maria Rosario Costa, and Mr. Edmundo Almeida. Expert farmers were very sure of themselves while explaining what they do.

In spite of being surrounded by amazing amounts of species, Amazon farmers are proud to conserve. For example, Mr. Di Souza explained that he left 90 hectares of intact forest as a reserve because he wanted to have animals and plants of the forest for his family to know these organisms, and was using a tax exemption given by the government in these cases. He felt he had enough and wanted to keep a piece of nature.

Ms. M Rosario Costa explained in detail how she maintained her species-rich home garden and how she managed fallow lands. Traditionally fallow lands are left untouched but she learned from her father that they are best managed to produce larger incomes. During the natural process of ecological succession, she selects (leaves) seedlings of useful species, eliminates non-useful seedlings, enriches the

plots with scarce and valuable species brought from the nearby forests, and thins and cleans the under story. She changes the composition of the forest. Her fallow lands have a different species composition and physiognomy from wild fallow lands and from “natural” forests. She also obtains more income.

Ms. Costa’s example and know-how has become well- known. She has even been visited by the governor and by many farmers (some of them already using and modifying her approach) from all three Amazonian sites. In addition, she has become an adviser to the federal government on management of fallow lands. The government wants to disseminate her approach to the use of fallow lands. Ms. Costa has also taught her methods to schoolchildren brought to her farm.

Mr. Almeida was very enthusiastic in showing and explaining what he had done to convert his farm from buffalo raising back to a forest. Low buffalo prices and high densities of vampires made buffalo ranching uneconomical. We visited plots of different ages, and saw his management approach, very similar to the one of Ms. Costa. He selectively leaves seedlings of useful trees and brings from nearby forests seedlings of useful trees. His plots looked well cared.

Both, Ms. Costa and Mr. Almeida are responding to the possibilities of the land and to markets. There is little doubt in the mind of the reviewer that if market conditions were to change, these two expert farmers would manipulate the composition of the forest to meet their new needs. This site thus raises an important point about sustainability. Will the current biological diversity at the sites be conserved? Farmers here are in a market economy and must be willing to change if they ant to survive. It cannot be expected that they will conserve the same species and in the same proportions as they do today. At most it can be expected that their organization and knowledge will help them continue evolving and maintaining biological diversity in their farms.

The second site visited in the Amazon delta was Ipixuna. In spite of both sites being in the same delta, distances in the Amazon are large and much time was spent in traveling.
The expert farmer, Mr. Hilario Santana, initially took us and showed us a bird nesting reserve that the community spontaneously decided to protect. It is an impressive site with hundreds of birds of many different species. He was proud to show us and explain the behavior of the large flocks and nesting pairs under their custody. When questioned about the rationale for conserving such a remote area in the delta, he explained they do it out of pride and to show their descendants the wildlife of the area. This is the same criterion earlier explained to us at Mazagao.

Mr. Santana then proceeded to show us some of his experiments. Farmers in the delta seem to be constantly experimenting rather than directly applying prescribed notions. Even Ms. Costa’s know-how was not taken directly, but used to experiment. From our discussions with Mr. Santana it became evident that he is constantly trying new combinations of plants and experimenting with the cultivation of new plant species.

In the delta bananas cannot be planted in monocultures. By experimenting, Mr. Hilario Santana learned that if he clears the land and leaves some *Heliconia spp* as well as some other understory species, he can cultivate bananas without they being

subject of the fungus attacks prevalent in the area. He explained that with PLEC assistance he taught this technique to people from the other community we visited earlier (Mazagao).

Mr. Hilario Santana also showed us two of his most recent experiments, growing mixtures of the useful Acai palm with bananas, and growing bananas with most of the forest trees still in place. The results will only be known in a year or two.

When discussing exchanges between sites, he explained he had visited the PLEC group in Iquitos. When questioned, he clarified the visit was too short, just a couple of days, and he did not learn much. He brought, however, bananas he is now growing in the delta. He explained that longer visits, including in-plot discussions among farmers, would be needed for effective transfer of knowledge.

The exchanges among sites included Brazilians from both sites visiting Iquitos, but not Peruvians visiting the Brazil sites. Peruvians could not get passports at the time, but PLEC scientists are working to remedy this situation in the near future.

Later in the afternoon we visited the home garden of Mr. Alziro Lobato, another PLEC expert farmer. Mr. Lobato experimented mostly with the economically very important Acai palm. He left the existing palms in his plot and also increased their density by casting seeds. Mr.Santana, accompanying us during the visit, explained that in his opinion and according to his experience it is more effective to grow seedlings in a nursery or to get them from the forest and plant them directly, rather than casting seeds.

In the State of Amapa, where the delta site is located, PLEC is also supporting the process leading to regulation of buffalo farming. Where unregulated farming of Asian Buffalo can lead to landscape degradation. The farmer's association strengthened by the project is actively discussing wit the state regulation of this activity and the need to support agricultural and forestry alternatives in the delta.

The interest of delta farmers to experiment with new options seems most valuable to ensure their livelihood in a changing environment. PLEC supported this approach through workshops and transfer visits.

This constant search for innovation should also have repercussions on the type of PLEC project to be designed. The minimum number of demonstrations needed increases dramatically when so many farmers are constantly experimenting. Mr. Pinedo Vasquez explained in their surveys they found many more expert farmers. PLEC has been able to work with only a very small fraction of the potential expert farmers in the region. With more resources they would have been able to facilitate more exchanges among more expert farmer groups.

At some of other PLEC clusters visited the reviewer had the impression PLEC was working with more expert farmers than the minimum required to exemplify the range of innovative techniques available. In the case of the two sites in the Amazon delta, only a small fraction of the available techniques being developed could be captured by PLEC. There seems to be more know-how available for dissemination.

The second site visited is Santarem, upstream of Macapa. In the Santarem area the project has focused on supporting conservation and sustainable uses of farmers at two localities, Ituqui and Sao Miguel. Efforts in the Santarem area have been focused on helping people diminish pressure on natural resources, supporting alternative sources of income, and environmental education.

The environmental education program seems unique within PLEC. During the visit to Brazil the reviewer had access to several PLEC prepared educational documents in Portuguese and aimed at elementary school teachers. Some of the documents reviewed were Mulato (about useful floodplain plants), Environmental Legislation, Agriculture in the Varzea, Piracucu (management of an endangered fish species), the Floodplain (Varzea) World. The documents are very didactic and well designed.

The reviewer discussed the preparation of these materials and how they are used directly with the people responsible for them, Ms. Maria do Carmo Azevedo and Ms. Fernanda Pimentel. Instead of attempting to guess what was needed, they started by assessing the demand for supporting material. They interviewed teachers and households and inquired about their needs. In this assessment of needs they noticed recurrent themes and concepts, and these themes and concepts became the foci of their efforts and publications, including the ones mentioned above.

With the published materials in hand they usually have three-day workshops with the teachers and go over the material in detail. So far they have trained 150 teachers. The material is used in science and Amazon studies classes. After PLEC, training will continue with support from WWF.

So far they have not sampled the actual students to determine effectiveness of the knowledge transfer, but the initial assessment of needs, the training of teachers and the materials prepared and distributed seem to indicate that this initiative may well become best practice in future efforts of this nature.

There are two important biodiversity related issues in the Santarem area that became the focus of PLEC. On the one hand, there is perceived decline in the abundance of some fish species presumably by over-fishing and, on the other, livestock and buffalo ranching are degrading natural grasses protecting the riverbanks. PLEC scientists are helping farmers deal with these issues by several means.

As in other clusters, PLEC is helping to strengthen the institutional basis of farmers by assisting them to get official recognition. Then, PLEC provided technical assistance and the start up materials for a seed and seedlings fund for annual and perennial crops. These crops, including bananas, cassava, tomatoes and maize, are helping reduce the pressure on forests, natural grasses and native fishes, while improving the nutritional status of the population.

We had a chance to visit several farmers benefiting from this fund. They plant these cultivars in their home gardens and on elevated platforms to keep them dry. PLEC supports intensifying land use by increasing species and life form diversity of crops grown in home gardens, and by promoting annual and perennial crops. It has provided technical assistance, seeds, plants, and opportunities for exchange of genetic material.

The goal of this assistance is to help support the pre-existing fisheries accords. These agreements limit how fishing is to be conducted and have already reduced the pressure on several Amazon species. PLEC detected that accords will be enforceable only if reduced fishing is compensated by alternative livelihoods, and this is what the project provides through annual and perennial crops in home gardens. The PLEC's supported exchanges of knowledge and plants within the Amazon cluster, has proved a powerful instrument for the improvement of people's livelihoods.

PLEC supported fast growing manioc (cassava) plantations and the processing of the flower. Buying cassava flower involved about 60% of the household budget. Now with financial and technical support from PLEC the San Miguel community can consume its own cassava and sell the rest. This effort was very well received by farmers and perceived as effective help in improving their livelihoods.

Several farmers interviewed, including Mr. Luis Parenite Miranda president of the Sao Miguel Community, benefited from these exchanges. In some cases the exchange was not successful given the somewhat different flooding regimes at the various sites, but in others, where they sought more similar conditions, the exchange of plants was successful. In one case we saw how Paw Mulato, brought from the delta was successful only when planted in a low flooding area, and not in the deeper waters. PLEC in association with individual farmers is currently testing other practices aimed at increasing yields. The most successful of these will be disseminated.

The visit actually took the form of exchanges between PLEC scientists and farmers. The reviewer had thus access to the rich give and take from both sides.

Supporting fisheries accords also led PLEC scientists to address the problem of excessive livestock grazing along the riverbanks. Overgrazing of native grasses leads to erosion of the banks and to interference with fish spawning habitat. PLEC is supporting re-planting of the original grasses, and feeding of livestock in confined areas during the flood season. At Nuestra Senora de Livramento, the reviewer had a chance to discuss directly with beneficiaries of these programs and hear from them some of the difficulties found in reaching the agreements.

PLEC is also acting as a catalyst to frame buffalo and livestock use in the communities. Ms. Alcilene Cardoso is a lawyer working with the project and helping prepare these accords. Accords are intended to help manage the herds and prevent over-explotation of floodplain habitats. The federal and municipal governments, and Instituto de Pesquisas de Amazonia (NGO) also sign them. So far they have signed eight such agreements. In the meanwhile PLEC has provided wire fencing and electric fences to keep buffalo out of critical areas.

Supporting sustainable fisheries has also led PLEC to help restore part of the tree cover in demonstration areas. There are several species of Amazonian fish renown for eating and dispersing fruits of trees. The reviewer had a chance to see in Anacampina the trees planted and was taken as an observer in a fishing trip. The bait used was fruit from the trees. Within about 30' three fishes were captured under the canopy of the planted trees. There is little doubt that if trees had been planted over larger surfaces, the total fish crop would increase substantially.

So far farmers working with PLEC have identified the five most promising species of trees for these efforts. A financial analysis should indicate if the revenues from increased fishing pay for the re-planting the native trees. This may well be one of the win-win cases in which biodiversity and people's well-being can be improved simultaneously. If this were the case, a barrier removal follow-on project may be advisable. So far the project has disseminated its results to other farmers in six nearby communities.

Farmers of Ituqui decided it was in their own interest to set aside a 500 hectares island, leave it as a conservation and nursery area. PLEC has supported this initiative and provided technical assistance. Farmers enforce prohibitions of hunting, burning, and land conversion. Livestock grazing is also limited. So far they have found increases in wildlife (capibara, several ducks, turtles) and fishes.

Farmers are also interested in management of aquatic turtles. PLEC helped protect the nesting grounds of three species of aquatic turtles. With the support of the federal government (IBAMA) this activity may be expanded in the future to other areas.

The Brazilian team seems to be among the scientifically most productive groups within PLEC. A few of the papers and manuscripts prepared by team members were also reviewed. Avoiding the Tragedy of the Commons: recent Developments in the management of Amazonian Fisheries (DG McGrath), Fisheries and the Evolution of Rewsource Management on the Lower Amazon Floodplain (DG McGrath, F de Castro, C Futemma, B Domingues de Amaral, and J Calabria), Stauts and Prospects for water Buffalo Production on the Lower Amazon Floodplain (P Sheik, F Merry and DG McGrath). The papers were peer-reviewed or will be sent to front line journals. To the reviewer these documents appeared as good contributions to the advancements of applied knowledge that will help manage floodplain resources.

Opportunities for Consolidation and Follow-up

Understanding what Amazonian farmers do and why is a big challenge. Perhaps modeling their efforts and attempting to formalize what is being done would allow better define best practices in the future.

In the future it may be worth attempting to generate integrated management of some of the areas near Santarem. Integrated management should consider fisheries, livestock, agriculture and perhaps some tourism. Some of the efforts under the current project could thus be consolidated ensuring threats to biodiversity are effectively addressed.

Replication of the fishing accords and of tree planting to increase fish productivity may well be a win/win solution. If a financial analysis proves that increased revenues from fishing actually pays for planting more trees and thus expanding fish habitat, a project to remove the barriers preventing this practice from disseminating may be needed.

CHINA

Summary
The focus of China PLEC was on the country's premiere reserves, the Gaoligongshan State Nature Reserve in Baoshan and various tropical reserves in Xishuangbanna. The first is a biodiversity hotspot of global significance. The later is of special national value as China's main tropical region. Agrodiversity assessment of the demonstration sites was quickly and efficiently conducted and effectively analyzed, employing the BAG MS Access biodiversity database system. Local funding from the Chinese Academy of Sciences will continue to fund yearly update of the agrodiversity data, and analysis of long-term trends. The agrodiversity assessment, and the household agrobiodiversity assessment method developed by China-PLEC, led to identification of expert farmers that covered the village's diverse ecological environment. The expert farmers have been instrumental in farmer-to-farmer transfer of practices that encouraged crop diversification that meet a diverse range of household, agronomic and economic needs. A farmers' association has been established at one demonstration site, Baihualing on the edge of the Gaoligongshan Nature Reserve, to implement the process of farmer-to-farmer transfer of agrobiodiversity management. It has become the prototype for more than 40 other farmers' associations. China PLEC has worked closely with the Nature Reserve Bureau in both Xishuangbanna and Baoshan as well as the village and county governments in both places. Collaboration with PLEC has enabled local offices of the Nature Reserve Bureau to build a better and more co-operative relationship with villagers who depend on the reserves for their livelihood. There is strong possibility that this model of tripartite collaboration between the Chinese Academy of Sciences, farmers' associations and the Nature Reserve Bureau will be extended to other provinces in southwestern China as well as other parts of Yunnan, to be funded by respective provincial governments.

Process
BR went to China for the final evaluation of the GEF-funded phase (1998-2001) of PLEC. The visit took place between May 14-22. This review is based on the site visit, various interviews with farmers, researchers and local administrators, the project's various reports including the final report and papers published in various issues of PLEC News & Views.

I talked to PLEC researchers from the Chinese Academy of Sciences (Kunming Institute of Botany and Xishuangbanna Tropical Botanical Garden), led by Prof Guo Hui Jun, and visited the PLEC demonstration sites at Baihualing adjacent to the Gaoligongshan State Nature Reserve, and Baka and Daka in Xishuangbanna.

PLEC Chinese Academy of Sciences team met included Guo Hui Jun, Dao Zhiling, Chen Aiguo, Cui Jinyuan, Fu Yongneng, and graduate students Qi Danhui, Du Xuefei and Gong Zhilian. Prefecture/district/county officers who accompanied us on the site visits: Li Ying Guang, Peng Lei, Meng Shi Liang for Baoshan Nature Reserve Bureau; Huang Jianguo and Zhen Rong of Xishuangbanna Bureau of Nature Reserve. Farmers and officers of the and farmers' association the reviewer met for discussions and field visits included Wang Yausheng (Chairman of the Gaoligongshan Farmers' Association for Biodiversity Conservation), Li Jaihu (former chairman, now vice chairman), Chen Shihou (secretary), Li Dayi, Wu Chaoming, Yang Zhixue, Gao

Denglin, Zhao Yongmei, and other members of the Gaoligongshan Farmers' Association for Biodiversity Conservation, and in Xishuangbanna: A Lao, Boba, A Hua, Zi Mula, Saan, Sang Long. At Xishuangbanna Tropical Botanical Garden I examined the project databases with Fu Yongneng.

Project Implementation and impacts

Agrodiversity assessment of the demonstration sites was quickly and efficiently conducted, with inventories of diversity made at landscape level at all three demonstration sites. One of the most significant results of this baseline information is the range of "agrodiversity" found in relatively small areas dominated by agricultural activities. Baihualing with its 1,810 ha had 7 major land-use stages and 22 field types; Daka's 727 ha had 15 field types in 5 land-use stages and Baka's 173 ha had 11 field types in 4 land use stages.

Species inventories according to the BAG guideline also found huge ranges of species in many of the field types, e.g. 93 species in the community forest of the Hanlong, a sub-unit of Baihauliang (Dao et al 2000). The study went on to find that 63% of the species, which occupied 70% of the area, were managed for various uses. They also found that lack of clear management regulations has led to a serious decline and suggested some remedial measures. Unfortunately I was unable to assess how effective these measures have been. Another analysis found resource degradation in some land use stages in the Xishuangbanna sites (Fu et al 2000).

Typically, richer diversity was found in home gardens, community forests and other conservation forests such as holy hills and head-water forests. Field types such as monoculture rubber, sugarcane and wetland rice contained just the economic species and a few weeds. The project, however, found many ways in which farmers were actually cultivating biodiversity in all sorts of land-use stages and field types, including under the rubber and fuel wood plantations. More than 200 species of wild plants were found collected by the Jinuo ethnic group for food, medicine and other uses. Collection of wild vegetables for the market and home use has been identified as a serious threat to some species, e.g. *Citongcao* (*Trevesia palmata*). A few species have begun to be cultivated.

The project found that, through proper management by the community and farmers, biodiversity of the natural forests had been enhanced. In one instance, an MS student's research (Du et al 2001) in the village of Daka in Xishuangbanna showed how two important functions of biodiversity have been cleverly combined in the management of the head-water forest. Documented in an agrodiversity assessment early in the GEF funded phase of PLEC, the head water forest was one of the many land used types managed by the village, that also included irrigated paddy fields, shifting cultivation fields and plantations of cash crops and fuel-wood. About half of the plants species found in the forest were identified by villagers to be useful. The use of the head-water forest was, however, strictly controlled due to its importance to the village's domestic water supply.

On the other hand, the village committee of Daka has allowed their only medical practitioner to "cultivate" a small portion of the head-water forest, for a fee, with medicinal plants she had collected from the wild. Twice as many species of plants were found in the medicine woman's garden as in the surrounding head-water forest,

70 species have been listed as having medicinal value. Nine of the species are on China's endangered list. The medicine woman expressed concern about the disappearance of the habitats of numerous valuable and rare species with the expansion of rubber and other commercial plantations.

In Baihualing, contrary to the recommendation of Baoshan horticultural experts, tree crops from lychee in the lower part of the valley to walnut and chestnut closer to 2,000 m elevation were generally widely spaced and intercropped with various food crops and useful species. Paddy fields, growing only rice in summer, became a mosaic of potato, wheat, maize, tobacco and various other temperate crops in winter. After every 3-4 years the paddy fields at lower elevations may be converted to sugar cane. Over in Xishuangbanna, trees were intercropped with tea, passion fruit and *Ammomum villosum*.

In addition to biodiversity through intercropping, multiple cropping and agroforestry systems, another aspect of biodiversity that PLEC China has found was in the intraspecific diversity within each crop species. Although China's national statistics have shown that 100% of the country's rice land has been planted to hybrids and other improved varieties for several years now, some 70 varieties of rice were found growing in villages of the Jinuo Township, 20 in the small demonstration village of Baka. In Baihualing, improved varieties of chestnut, walnut, persimmon, *jing tao* (a chinese berry) and other temperate tree crops are commonly grafted on to wild rootstocks obtained from the nearby Gaoligongshan Nature Reserve. The village's expert farmers were able to identify wild walnuts from the appearance of their shell. However, no one knows how much diversity exists within the wild populations, or what are the potential impacts of cross-fertilization between the introduced "improved" and wild populations.

With all this biodiversity, questions about sustainability inevitably arose. Is this agrodiversity just a temporary stage? With major social and economic changes now sweeping China, which of these biologically diverse cropping systems will disappear, which will remain? It is obvious that some of the diversity is determined bio-physically, and will be less likely to be wiped out with changes in the market. For example, tropical species are grown at lower altitudes or in summer and temperate ones higher up or in winter.

To provide further insights into potential sustainability of some of the agrobiodiversity in each village, however, a new direction of further study may be fruitful. The systems approach may be brought in to examine interactions among various components of the local agrodiversity, specifically at the household or farming system, the village and valley, up to the provincial and regional level. There could also be more efforts to relate biodiversity data, especially between varieties of individual species, to strategic determinations of the physical environment, including those estimated by farmers as well as measured. Into the future, such analyses will be greatly augmented by the historical database that has been established. This could be a direction of future PLEC.

By 1999 the project had developed a methodology for assessing household level agrobiodiversity which became their focal point of analysis. For example, a great range of species richness and also financial benefits were found in the home garden

belonging to different households in Daka in Xishuangbanna (Cui et al 2000). Farm income and on-farm diversity were not always directly related, but those farmers who conserve biological diversity on their farms also tended to have higher income. Expert farmers were invariably those who have both good income combined with high biodiversity in their fields. Many other interactions, which are important of the maintenance of biodiversity, are likely to be found within the household or farming system.

The China cluster was the only one among the five PLEC countries visited by this reviewer that has made effective use of the BAG/STAT Microsoft Access database package for biodiversity inventory. The whole team contributed to building the database. Fu Yongneng, one of the young researchers at Xishuangbanna Tropical Botanical Garden, has been put in charge of database management. After necessary translation, the database now operates in Chinese. A Chinese database system for household level agrodiversity was developed, incorporating various agronomic and management information.

All of the data for the two Xishuangbanna demonstration sites, which have been collected yearly since 1998, have now been entered into the MS Access database. Analyses of these have already resulted in six publications so far (mainly in Acta Botanica Yunnanica Supplements Vol XIII), and significant contributions to two MS theses. Agrodiversity data from Baihualing, which has been collected yearly since 1995, now begin to be entered into the databases. Analysis of all of these data from the three demonstration sites continues, including anticipated long term trends over, possibly, 10 years. Local funding from the Chinese Academy of Sciences, through the Kunming Institute of Botany and Xishuangbanna Tropical Botanical Garden, will continue to support yearly agrodiversity assessment.

PLEC China had very early arrived at the idea that farmer's efforts to earn a living does not necessarily always have to be at the expense of local biodiversity. Furthermore, the Chinese scientists, who had been working under central planning with the premise of uniform management among farmers, became convinced of diversity of farmers' management through the idea of expert farmers. With the household agrobiodiversity analysis, they have also developed a simple method of relating farm income with species richness on the farm. And so potential expert farmers were identified as those who maintain a high species richness while also making above average income from farming (Guo et al 2000).

Many skills that contribute to agrodiversity management have already existed in the demonstration villages or in the neighborhood of project sites for a very long time, e.g. homegardens and woodlot management for fuel in Xishuangbanna and agroforestry in Baihualing. Often the village's diverse range of agroecosystems made it essential to identify different expert farmers with different specialized skills. In Baihualing, where 1,810 ha of land ranged in elevation from 850 m to 2,000 m, the expert farmers PLEC identified and worked with included those who were skilled in tropical agroforestry to experts in systems dominated by temperate tree crops such as chestnut, walnut, Chinese fur and other temperate timber species. In Xishuangbanna, the expert farmers are often those with extensive knowledge and skills in the use and care of wild and semi-domesticated species.

With PLEC support, the Gaoligongshan Farmers' Association for Biodiversity Conservation has been established at one demonstration site, Baihualing on the edge of the Gaoligongshan Nature Reserve. The farmers' association took on the responsibility for organizing farmer-to-farmer training, in which the expert farmers are paid a nominal fee (basic local wage of 20 – 30 yuan per day). The expert farmers are always seeking out and experimenting upon new crops and new varieties. I met several farmers who are domesticating wild species of the area, e.g. *Phoebe puwenensis* (a rare timber, by Li Dayi), various medicinal and food plants (Wu Chaoming). Wild chestnut, walnut, persimmons and *Prunus* spp are commonly used as rootstock for grafting. Improved varieties are sometimes provided by PLEC, from the research station in Baoshan, where materials from all over China are introduced and evaluated. Mrs. Zhao Yong Mei showed me some of the several hundred seedlings of *Ying Tao* she has recently planted among coffee. This is a Chinese berry (a small tree, *Prunus* sp.), that she has successfully grafted with a PLEC provided improved variety on to a rootstock of its wild relative, after attending a training course given by some of the expert farmers.

Sharing of farming skills and planting materials appeared to be part of the village culture. Older and experienced farmers like Wu Chaoming and Gao Denglin were eager to share their knowledge (and stories, like the battle with a Japanese army during WWII) and were quite well known. PLEC's intervention has, however, reinforced this in three significant ways. Firstly, some less well known experts have been discovered. Secondly, it has encouraged other farmers especially the younger ones to share their skills and knowledge. Thirdly, the organized training has helped some of the less enterprising farmers who were less inclined to seek out technology and information on their own.

China PLEC as a group has developed an impressive capacity for agrodiversity research and management. These included understanding and skills in the handling of agrodiversity databases and their analysis, participatory methods for working with individual farmers and their associations and effective communication with decision-makers at various levels of local and provincial government. The project's capacity building was in four major areas: (a) on the job training of PLEC scientists from the Kunming Institute of Botany and Xishuangbanna Botanical Garden through their involvement in participatory research at the project sites, (b) training of graduate students, (c) farmers' organization and (d) the reach by the senior scientists to inform policy up to the provincial level, and interaction with neighboring provinces of Southwestern China.

Six graduate students (M Sc) have been trained through the project. Using PLEC ideas and methodology they conducted their thesis research on PLEC related topics at the demonstration sites. Two of these (Du Xuefei and Gong Zhilian) who began their research after the project has acquired its capacity for electronic database management were able to make use of the database for their studies. Together the students published a total of eight articles, in subjects including indigenous knowledge and community forest management, community agroforestry, socio-economic development and biodiversity, domestication and conservation of medicinal plants and biodiversity of upland rice.

The Gaoligongshan Farmers' Association for Biodiversity Conservation exemplified China PLEC's achievement in facilitating capacity building in agrodiversity management by a local organization. It is a significant achievement to have a farmers' organization that is fully functional, autonomous and democratically governed. However, two important questions demand answers, if this success is to be sustainable and replicated in other villages. The first of these is why the idea of the farmers' association has not taken root in Xishuangbanna, and according to PLEC staff, not for lack of trying. The other is related to the fact that the Gaoligongshan Farmers' Association for Biodiversity Conservation has operated largely on financial support from PLEC. A token subscription of 12 yuan per year is paid by the membership. The end of PLEC has therefore raised the sustainability question for the association's ability to carry on its main activities of farmer-to-farmer training.

I found two related "recommendations" for good management of agrodiversity from the project. The first is the deployment of expert farmers in the evaluation and transfer of good practices. The second is the organization of farmers' association and their active role in the promotion of biodiversity conservation and specific skills in crop management.

Cultivation and domestication of wild plant species appear to be one of the "good agrodiversity practices" that has emerged from China PLEC and is transferred from farmer to farmer. Expert farmers were often those with extensive knowledge of wild plants and their use, who possess special skills in propagation, e.g. germination of rare species and grafting improved varieties of tree crops onto local wild types. The home garden of Saan, a Hani farmer at Daka, contained numerous species of wild and semi-domesticated plants as well as cultivated ones. Grafting of walnut is considered by most college trained horticultural scientists as very difficult, because the union between scion and rootstock is often inhibited by the presence of some naturally occurring biochemical compound. Wu Chaoming, an expert farmer at Hanlong, did not think it was much of a problem, but he added, "it has to be done at the right time of the year".

As in other clusters the scientists in China PLEC all agreed that the first behavior change was in themselves. "Scientists and technicians have gradually reduced their roles in experimental and demonstration activities from being organizers to being facilitators…." But the project went on to report behavior change also in farmers "……while farmers, especially the Gaoligongshan Farmers' Association for Biodiversity Conservation has taken an increasing roles in promoting conservation farming and forest management."

China PLEC has published their findings largely in Chinese. Most of these were in two volumes of Acta Botanica Yunnanica (Supplement XII, 2000 and Supplement XIII, 2001), plus some papers in Chinese scientific periodicals, e.g. J. Chinese Ecology. In terms of scientific quality, the Acta Botanica Yunnanica (ABY) is a well regarded journal in China. It is published by the nationally prestigious Science Press, and according to an independent evaluation in 1997 the ABY ranked 7th in Citation Index and 8th in the annual citation record among China's top biological periodicals.

The decision of China PLEC to publish in Chinese first, though a major drawback for a reviewer without knowledge of the language, has two things to commend it. Firstly,

it enabled a timely publication and therefore an independent review of their research results. Secondly, it has made the project's findings highly accessible to all stakeholders including graduate students. Especially important on this second point are those method papers (e.g. Guo et al 2000; Zarin et al 2000 translated into Chinese) that students have found most useful for their fieldwork. Adding English titles of columns and rows in tables and English legends in figures in the Chinese language papers would have allowed the project's research results to be scrutinized as well as making them more accessible to the international scientific community.

A total of 45 papers have been published by China PLEC from the GEF supported 1998–2001 work. For comparison, the group published some 10 papers in the preceding four-year period between 1994-1997. More than half of the papers from the GEF phase were by younger researchers (Chen Aiguo, Fu Youngneng) and graduate students (Zeng Yiqun, Du Xuefei, Gong Zhilian). I have been very impressed by the grasp of PLEC ideas and understanding by these young researchers that I had an opportunity to meet and talk to (four out of five, except Zeng Yiqun). The founding members of PLEC (Guo Huijun, Dao Zhiling and Cui Jinyun) have also been more productive during the GEF phase compared with the four years previously, in spite of many more new responsibilities.

Some of the papers have been published in English. Most of these were in PLEC's in-house newsletter, the PLEC News and Views, and five peer-reviewed chapters (Guo et al, Fu and Chen, Guan et al, Fu et al and Dao et al) in the "PLEC Book", Cultivating Agrobiodiversity, edited by Brookfield, Padoch and Stocking, published by ITDG Publications, London.

In addition to the PLEC researchers, personnel from the Nature Reserve Bureau have worked closely with the project. Although the reviewer had no opportunity to see publication or documentation of their work, the bureau staff showed good understanding and appreciation of the PLEC's idea of farmers' role in biodiversity conservation during our discussion with farmers. Li Ying Guang from Baoshan Nature Reserve Bureau, for example, has really been much encouraged by the fact the so many new farmers' associations for biodiversity conservation have been started around the Gaoligongshan Nature Reserve. On the other hand, he also admitted that some of the new associations have not been very effective.

The other capacity built during the GEF phase was that of the Gaoligongshan Farmers' Association for Biodiversity Conservation, especially in organization and management of farmer-to-farmer training. Considering that this was the very first farmers' association for biodiversity conservation in the whole of China, it is no mean achievement. Apart from training in crop production practices such as grafting of fruit trees, biodiversity conservation was discussed a lot. An old farmer remarked "if Li Dayi, who is a Lisu and former shifting cultivator can practice conservation, why can't we?"

PLEC initiatives in the Jinuo village of Baka in Xishuangbanna has led the local government to provide resources for the development of some 115 mu (7.7 ha) of paddy fields (valued at 400,000 yuan) and concrete paving of the village main road. Pressure on the land, especially on steeper slopes, will be significantly lightened by the production of rice from the new irrigated paddy fields.

Wang Yausheng (Chairman of the Gaoligongshan Farmers' Association for Biodiversity Conservation) admitted that while he was at first skeptical about the association, now he takes great pride in being chairman. According to the farmers themselves and officers from the Nature Reserve Bureau, the success of the Gaoligongshan Farmers' Association for Biodiversity Conservation has been attributed to the fact that farmers felt that it was "their" association from the very beginning. Mr. Wang who attended some meetings of the other associations, told me that the other associations were not working so well because they were not started by farmers themselves but were initiated by some "project".

PLEC's light, participatory touch in facilitating the organization of the association is highly commendable. But there could have been a little more serious discussion between PLEC and the farmers about long term sustainability of their association. Two issues need to be raised. Firstly, there are inherent problems associated with the farmers' association's dependence on external temporary funding sources, like PLEC and other projects, lasting at most for a few years. Secondly, possibilities for the roles of farmers' associations in agrodiversity conservation to be institutionalized as part of the provincial conservation policy that would include allocation for funds to support the associations' conservation activities could be explored.

Nature Reserve Bureau staff and farmers agreed that their relationship has also seen much improvement and become more cooperative in the past 4 years. The Nature Reserve Bureau staff uniform, which had previously often attracted hostility from the population in villages on the edge of the nature reserve, has become much more welcomed than before. The tripartite collaboration, between PLEC, farmers' association and the Nature Reserve Bureau, that has worked well for the GEF funded project could be instrumental in the formalization of the roles of farmers' associations in the implementation of provincial conservation policy.

China-PLEC's approach to sustainable agrobiodiversity management through the formation of farmers' association for conservation has already been adopted by an externally funded project operating in the southwest of Yunnan. I was informed by Mr. Li Ying Guang of the Baoshan Nature Reserve Bureau that some 30 farmers' associations have been established in villages in the vicinity of the Gaoligongshan Nature Reserve. In the project's national workshop conducted in Kunming on 20-21 January 2002, it was agreed that a Network of Agrobiodiversity Conservation and Research for South-western China will be established, in order to test PLEC ideas and methodology and perhaps disseminate them to Guizhou and Guangxi Provinces as well as other parts of Yunnan. Researchers from the three provinces have agreed to prepare a joint proposal to apply for national and international funding.

The farmers' association's management capacity, however, has one structural weakness. The farmer-to-farmer training programme, organized by the association, is driven purely by supply of funds from PLEC, which paid the expert farmers a nominal fee. Sustainability of the programme is therefore a major problem after PLEC ends. There were some discussions about a possibility for a portion of the village's community forest to be allocated to and managed for an income by the farmers' association. Those training programmes with direct potential for income generation could perhaps pay for themselves from farmers who can see financial

benefits and would be willing to shell out 2-3 yuans. It would be more difficult to ask farmers to pay for those other activities relating more to biodiversity conservation and less on income generation. Financial support from the provincial or even national government to "successful" farmers' associations for biodiversity conservation may be an option.

Opportunities for consolidation and follow-up.

There is no question that China PLEC has had an impressive list of achievements during the GEF phase between 1998 to 2002. However, these achievements could be significantly enhanced with some consolidation and follow-up, in three specific areas, (a) the database and publication, (b) the farmers' association for biodiversity conservation. In addition I would like to suggest a "follow through" with (c) a new direction to examine sustainability of local agrodiversity.

The database update, analysis and publication

I strongly recommend that GEF, UNEP and UNU provide all the necessary support to China PLEC for (a) the annual update and (b) further analyses of the databases. It may also be beneficial to begin examining trends over time even before 10 years. Data from Gaoligongshan that began to be collected in 1995 would be a good start. It is most encouraging that local resources will be made available to continue with agrodiversity data collection and analysis in the different land-use stages, field types and sample households in the three demonstration villages.

This historical baseline and long term trends will be one of PLEC's most valuable and long lasting legacies. Analyses of the data over time and major economic and social changes (e.g. China's joining WTO, opening of new highways connecting Baoshan with Kunming, Xishuangbanna with Thailand and Southeast Asia) could help to answer those questions related to sustainability of local biodiversity.

China PLEC appears to be fully capable to publish in Chinese and their decision to first publish in Chinese is supportable. But publications in English should be encouraged for two reasons. It would enable research results to be evaluated by the wider international scientific community. More publications of key results in English from PLEC China would also add to the global body of knowledge on agrobiodiversity and make these valuable results accessible to others who are dealing with similar problems outside China.

Farmers' associations for biodiversity conservation

In the Gaoligongshan Farmers' Association for Biodiversity Conservation, PLEC has shown how local capacity in agrodiversity management may be nurtured and encouraged. In order that this success may be repeated in other villages it will be important to (a) document the procedures used by PLEC that has worked as well as those that should be avoided, (b) examine why PLEC's considerable efforts to establish farmers' association in Xishuangbanna have not succeeded, and (c) in collaboration with selected leaders in the Gaoligongshan association, examine a range of the newer associations, those that are successful as well as less successful.

The question of sustainability of these associations after external project funding ends also needs to be addressed. Now that farmers are beginning to appreciate the benefit from these training, training programmes that are directly related to income

generation could perhaps respond to demand from farmers who might be willing to shell out 1-2 yuan. National and provincial conservation programmes may be another sustainable source of funds, especially on those training topics not directly related to income generation. China PLEC is in a unique position, and in close collaboration with the farmers' association and Nature Reserve Bureau, to draw up a guideline and criteria for functional and effective farmers' associations for biodiversity conservation that could be eligible for national or provincial funding.

A booklet (in Chinese) on the methodology for facilitating the organization of farmers' associations for agrobiodiversity management (with a list of do's and don'ts) could be developed, preferably in association with the farmers' association and the Nature Reserve Bureau. This would incorporate solutions to (a) organizational constraints that need to be overcome, as in Baka and Daka in Xishuangbanna, and other struggling farmers' associations in Gaoligongshan, and (b) the problem of funding after external support ends.

Sustainability of local agrodiversity

That some farmers are really "growing biodiversity" has been clearly documented by PLEC. It is inevitable that some of this biodiversity will decline over time, as can be seen in many rapidly urbanized Dai villages and towns of Xishuangbanna where their once famously diverse home gardens have largely disappeared under the twin pressures of population growth and urbanization.

China-PLEC is in a unique position to find out which of these biologically diverse land use systems, and especially genetic diversity of which agricultural species, are merely transitional stages and which are likely to withstand the test of time and major social and economic changes. A special focus on genetic diversity of selected agricultural species would be desirable for two reasons. Yunnan is the centre of diversity for many important agricultural species, including the all-important rice. The technical capacity that has been built up under PLEC, especially in understanding the role of farmers' management in the utilization and conservation of biodiversity, could be brought to bear on the definition of conditions favoring in situ conservation.

Of special interest, in addition to rice, is the on-going process of domestication of wild species that are endemic to Yunnan. Wild walnut, chestnut, and other temperate tree species are commonly used as rootstock. Very little is known about genetic diversity of these wild populations and how they are likely to be affected by introduction of "improved" varieties. Disappearance of many wild plants that are gathered for various uses is reasonably well documented. Much less is known about many of those wild plants used for food, medicine, spices and so on that are being domesticated. One of the local Nature Reserve Bureau laboratories is currently propagating by tissue culture many local orchids (including one that is said to be very good for sore throats that is also of exceptional beauty) that have become popular. Will biological diversity in these species be threatened or enhanced in the process, or by intervention from modern science?

In order to gain some insight into long term sustainability of local agrodiversity, and how it may withstand the social, economic and technological changes, a more critical analysis is needed. I suggest the systems approach. Interactions among various components of local agrodiversity, specifically at the household or farming system,

the village, valley and provincial, and up to regional and global, level could be explored. More efforts could be made to relate biodiversity data, between varieties of individual species as well as between species, to strategic determinations of the variability in the physical environment, including those estimated by farmers as well as measured.

GHANA

Summary

Ghana is one of the world's hotspots for biodiversity because of its high and endangered biodiversity. Until not very long ago, forests covered the southern part of the country. Current satellite pictures of southern Ghana show little forest left and what remains is interspersed in between cultivated fields. This is the general scenario where PLEC activities take place. The project worked at three sites in a climatic and vegetation gradient representative of Ghana. The transect covers the savannas in the relatively dry north, and the forests and forest/savanna transition in the more humid south. The northern Ghana segment is hosted in Tamale (approximately 700 Km north of Accra), the central part in Kumasi (approximately 260 Km north of Accra), and the southern part in Koforidua (about 50 Km north of Accra). Each site has one or more localities, a team leader, scientists and farmers. In Ghana PLEC is demonstrating land use intensification with increases in within-plot diversity. The project is, successfully in the opinion of the reviewer, showing and disseminating how to use and increase within-species diversity (yams, for example), species diversity (10 or more crop species in some cases) and life form diversity (by adding useful trees to the plots). PLEC is also helping with alternative livelihoods and soil conservation and improvement. The PLEC approach seems to have been accepted by farmers and scientists. The acceptance by government and policy makers is still pending, but there are reasons to be optimistic.

Process

Arrival in Accra was on the evening of 3 May. Professor Edwin Gyasi was the host throughout the visit. May 4th was used to read over the numerous reports produced by PLEC-Ghana.

On Sunday 5th May we departed towards the more northern PLEC sites, near Tamale about 700 Km north of Accra. May 6th was used to visit the site at Bognayili-Dugu-Song, Mrs. Gordana Krnajac-Berisavljevic, team leader for northern Ghana and faculty member at the University for Development Studies, was our host. We also had extensive discussions in the field with the following members of her team: Mr. William Asante (Natural resources Specialist), Mr. Briools Eandaa (Assistant Researcher), Mr. Issaka Balma Yakube (Assistant

Researcher). Mr. Mamma Afa Asuma was the expert farmer and Mr. Seini the translator.

On Tuesday 7 May we arrived in at the University of Science and Technology in Kumasi. The leader of the central Ghana component, Dr. William Oduro, was expecting us. Prof. Gyasi and EF had a first meeting with 13 scientists working in the project on that same afternoon. Scientists included Mr. MO Ellis, Mr. E Mensah, Dr. P Sarfo-Mensah, Mr. SN Buabeng, Dr. K Nkyi, Mrs. O Agbnyega, Mr. G Amelsitsi, Dr. W Oduro, Mr. C Quansah, Mr. PY Adjes, Mr. E Asave, and Mr. M Adjalw.

On 8th May we departed to the field to see the demonstration site. The whole morning was spent at the site seeing and discussing project activities and achievements. In the afternoon we left for the southern localities.

We arrived at Koforiuda, center for the southern Ghana activities, at about 5PM. During our stay at Koforiuda we had an opportunity to discuss with several scientists, including Dr. L Enu-Kwesi, Dr. Mariana Awumbila. Dr. K Kufogbe, and Dr. BD Ofori. During the next couple of days, we visited the three PLEC localities in southern Ghana.

On 11 May the reviewer left for Guinea.

Project Implementation and Impacts

PLEC Ghana prepared and submitted more than 50 reports, including all the required ones on biodiversity databases, biodiversity and agrodiversity inventories, social analysis of demo site populations, comparative management regimes, training, integration of scientific and community information, results from the experimental work, technical and policy recommendations, potential sites for replication, and the final cluster report.

The following reports were made available throughout the permanence of the reviewer in the country: Integrated Final Report, Final Reports for Northern, Central and Southern Ghana, a collection of PLEC News and Views containing articles about the project, Demonstrating the Value of Agrodiversity (2000), Report of the Workshop on Methodologies held in March 1997, Report of the 3rd and 5th WARPLEC Regional Workshops. In addition, the following papers were made

available: Impacts of PLEC in Ghana, Adding Value to Biodiversity Conservation Through Management of Homegardens and Homegarden Agroforests: Case Studies of PLEC Farmers in Ghana. (by L. Enu-Kwesi and VV Vordzogbe). A list of all reports submitted to PLEC was also provided.

In addition while in Tamale in northern Ghana, the following reports were made available: Processing of Information for Northern Ghana: Methodology, Procedures and Output; Biodiversity and Agrodiversity Inventory (with review of causes of land degradation) in Northern Ghana; Agrodiversity Conservation: In-situ Conservation and Management of Indigenous Rice Varieties in the Interior Savanna Zone of Ghana; Climatic Trends and their Effect on Farming Systems and Biodiversity in Northern Ghana: Case study Bongnayili-Dugu-Song; PLEC Demonstration Site, Analysis of Resource Tenure in PLEC Demonstration Sites in Northern Ghana; Social Analysis of Demonstration Site Populations: The case of Bongnayili-Dugu-Song, and Nyorugu-Binguri-Gonre, Northern Ghana; Organizational and Management Aspects of Agricultural and Biological Diversity in Demonstration sites in Northern Ghana; Resource Access and Distribution and how it Relates to Biodiversity Conservation in Northern Ghana; Detailed Statement on Output of Training Programmes (capacity building) in Northern Ghana; Integration of Scientific and Community Information on Resources: The Northern Ghana Case; Experimental and Monitoring Programmes of Sites in Northern Ghana; In- situ conservation of Indigenous Rice Varieties at Bawku_Manga in the Sudan Savanna of Ghana; Sustaining the Diversity of Yams in Northern Ghana; Effects of Indigenous Trees Canopy Covers on Soil Fertility in a Ghanian Savanna;

Technical and Policy Recommendations; Potential Sites for Replication of Demonstrated Agrotechnology.

In Kumasi we also received several reports: a power point presentation on achievements of the project in central Ghana, a document summarizing project findings, and a paper on training programs in the region.

In the short time available the reviewer could not read them all in depth. Based on a sub-sample of those available, in the opinion of this reviewer, the reports are generally informative and of good quality, reflecting the work done.

In northern Ghana the project takes place in a transformed park/savanna where only useful trees were left. Cleared areas are used for agriculture and grazing, mostly goats. The project is working with farmers to improve productivity, increase income and increase/maintain within-plots biodiversity. Inhabitants of the region are generally poor and the supply of clean water is still a basic, unmet need.

Biodiversity was increased by helping farmers maintain within-species diversity of local yams and African rice, and by facilitating tree plantations. Useful native and particularly exotic/improved trees, such as mangos, were preferred. The project provided technical assistance and fences.

PLEC is also helping maintain the comparatively rich biodiversity in nearby sacred groves, most notably Jaagbo. A major problem at these groves has been encroachment and grazing. The project's strategy has been to support the creation of a wider buffer zone around the groves. At Jaagbo we visited the buffer zone and saw some of the tree plantations around the grove. PLEC provided the seedlings, technical assistance and supported raising awareness of the importance of the groves.

PLEC also supported cultivation of medicinal plants, as a means help conserve biodiversity. We visited a garden that received project support.

Northern Ghana is reach in native yams. Researchers in the project are helping identify varieties of indigenous yams, helping farmers finding ways to improve their propagation, and disseminating the know-how for their cultivation. PLEC researchers believe that by promoting sustainable uses of yams farmers will become their custodians. Up to now, 23 varieties of local yams have been described. With African rice the work is still at the identification of varieties stage. So far ten varieties have been found. Evidence indicates they flourish under different environmental constraints.

PLEC is playing an important role in increasing the awareness of farmers of the ecological niches of yam and rice varieties and hence the need to maintain them, their different culinary attributes and, eventually, will help find market niches for them.

The project also provided technical assistance in fertilization with manure, composting and later fertilization with compost. The area has also been severely

deforested and eroded and the project is supporting stone bunding to fill the gully and prevent sedimentation of the community dugout. During the short period of the project, stones have effectively helped fill the gully.

The two pillars of the PLEC approach, farmer-farmer and farmer-scientist exchanges seem well rooted at the site. Farmers were learning from scientists how to increase productivity, protect soils, conserve and increase in-farm biodiversity.

Scientists used their exchanges with farmers to initially decide and then actually work on the most urgent problems, including those linked to biodiversity conservation and uses. This direct communication, not mediated by extension agents, is new to the area and is proving useful. Because of this direct exchange modality, PLEC is supporting local interests and initiatives rather than imposing new needs from the outside. Moreover, PLEC is largely removing knowledge barriers rather than providing for capital expenses and its activities are thus likely to be sustainable. Farmers seemed to trust the scientists.

The technique of directly accessing farmer's needs was adopted by the University for Development Studies and is now using it extensively in its own work.

During our visit we saw and had farmer women explain to us how they have benefited from the project. The project built a small training center serving several villages. So far 41 women have been trained in weaving cotton, using an improved loom, sawing garments and selling them at nearby markets. A network of villages now exists and they benefit from these alternative livelihoods training.

In general, the packaging of alternative livelihoods, methods to increase land productivity and ways to increase/maintain useful biodiversity, seems most appropriate and is probably the only way for sustainability of the interventions in a region of dramatic rural poverty.

In central Ghana the initial meeting with the 13 scientists working in the project was very useful to get insights into their views of PLEC. The conversation focused on their exchanges with farmers, on sustainability of PLEC methodology and achievements. The meeting was lively and almost scientists participated actively giving us their opinions.

Almost all participants emphasized that exchanges with farmers went both ways. Scientists taught them techniques to improve their incomes, such as bee-keeping, tree planting, growing snails and mushrooms, improvement of soil fertility *via* mulching, and how to add value to some of their products. Farmers were especially grateful for the technology to make cassava flour. Farmers taught the scientists about their indigenous knowledge, including on indicator plants for soil fertility, and on multiple cropping.

During the meeting scientists acknowledged how much they had learned about indigenous practices and expressed their respect for the farmers. They attributed this increased knowledge to their interactions with them during the PLEC project. Scientists felt farmers had something real to contribute to their endeavors.

Similarly to what was done near Tamale in the north, in central Ghana scientists also initially attempted to understand the farmer's problems, and then worked to improve their traditional methodologies to increase production and/or biodiversity. Scientists expressed their interest in building on what farmers already have rather than trying to build something new. For example, when working to help them protect sacred groves, rich in native biodiversity, they built on their beliefs and management structures to make protection more effective. In this particular case, scientists helped demarking the groves, increasing awareness of the various meanings of the groves, labeling trees, and supporting the education of the younger generations.

The project also worked to boost the almost abandoned technique of prokaw. This old practice instead of burning the fallow cuts the plant material and allows it to decompose in the field, with concomitant increases in soil fertility. Scientists explained they analyzed why was prokaw being abandoned and looked for solutions maintaining prokaw and dealing with the other emerging problems, such as pests. The reviewer had an opportunity to see prokaw in PLEC fields and compare the soil humidity under it with that of burned fields in neighboring non-PLEC farms.

When helping protect wetlands, scientists explained they discussed with farmers and made them aware of the connection between their land use activities along the borders, deforestation, and lack of water during the dry season. As a consequence a reafforestation program was implemented around them and now farmers seem to understand why they should conserve that vegetation. The reviewer saw the nurseries and seedlings planted around a wetland.

In spite of 8 May being "taboo day", prohibiting visitation of agricultural fields and scared groves, we were allowed to go to the demonstration areas. We were not allowed, however, to visit the sacred grove where the former chiefs are buried. From a distance the grove looks like an island of relatively mature forest (approximately 15 Ha) surrounded by agricultural fields.

Mrs. Cecilia Osei was the expert farmer guiding us. She also directs the local women farmers association. This association was created under the auspices of PLEC to help women developing more profitable agriculture. Most men have migrated out and women find themselves having to cultivate the land.

Similar to other PLEC sites, the visits confirmed the project's focus on intensifying land use by the use of natural fertilizers (manure, mulching), multiple cropping, introducing the cultivation of trees in agroforestry, and sustainable uses of biodiversity.

The reviewer visited the multi-cropping systems where they grow cassava, corn, yams, pepper, or subsets of these. Animals, such as pigs, goats and sheep were also seen. They are grown in confinement and fed with kitchen and farm residues. PLEC provided seeds, seedlings (native and exotic), pigs, poultry, goats, and technical assistance. Technical assistance included identification and know-how for planting crops in special niches, such as sugar cane in more mesic habitats.

The reviewer was also taken to see a nursery (native and exotic trees) and a woodlot (native and exotic trees). In all cases, the interest was on useful trees and in all cases the project provided initial very small scale, demonstration investments.

During that same morning EF was also taken to see how they grow home gardens with multiple crops and some animals (goats, chicken, pigs) in an integrated system. As elsewhere, PLEC provided technical assistance and start up capital.

Later, the reviewer was also taken to see a home where PLEC provided technical assistance to grow three species of local snails. Growing snails seems to be a profitable business with little additional expenditures, as they can feed on kitchen rests. The snails are taken from the wild. It is expected that now that the knowledge barrier was removed by PLEC, this activity will be propagated to other areas without further assistance.

Female farmers as well as scientists were enthusiastic about the project and explained how they used their demos to educate children and other farmers. They were enthusiastic in explaining how the project provided income generation activities and how they would like to have more of these types of projects. Farmers expressed an interest in having more start up capital to expand the operations and to improve the existing ones.

Towards the end we visited the District Chief, Mr. Addaje Munumkum. He already knew about PLEC and was interested in its role in poverty alleviation. An agreement was made during the interview to present a follow-up project for funding under the government's poverty alleviation program.

Scientists were very optimistic about replication and sustainability of PLEC. They commented how farmers would transmit their experiences to their equals in other villages, even in northern and southern Ghana, and how in formal exhibits they would show their achievements. They also believe PLEC will be sustainable given the interest it is raising with various authorities, including in the ministry. PLEC has trained agricultural extension agents that will also continue disseminating PLEC approaches. Most important they believe the sustainability and dissemination will be given by the win/win nature of the PLEC interventions. This is an opinion shared by the evaluator.

There are evidences that the PLEC approach in Ghana is gaining support. Recently the Council for Scientific and Industrial Research of Ghana approached PLEC people asking for a proposal to expand the project into other areas. Along similar lines, the WB-GEF project for resources management in Ghana has also approached PLEC researchers with the intention of using the PLEC methodology in the implementation of their project.

Our discussions with scientists in southern Ghana confirmed many of the issues previously learned in central ad northern Ghana regarding the PLEC approach. In southern Ghana scientists also expressed that PLEC gave them the opportunity to learn from farmers and what they do, and actually saw this experience as a challenge to their understanding. They were also happy to be able to transmit know-how and research results that improved farm productivity and within-plot diversity of species and life forms. Scientists also expressed they used PLEC material for their lectures and had students work on farmer issues.

During the field visits to the tree localities in southern Ghana, the reviewer had a chance to discuss with many farmers, including Mr. S. Freeman, Mr. A Zigah, Mr. E Kouse, Ms. J Abougyevoa. The demonstration visited included: a sheep project (PLEC supplied the animals), plant nurseries (useful native and introduced species), several mixed cropping plots with several species (including cassava, plantain, citrus, cocoa and other yams, bananas, beans, maize, papaya, and wild pepper relatives), two snail farming operations, fish farming (tilapia and Africa mudfish), bee-keeping (mostly a women source of income), and application of the traditional no-burning technique (prokaw). Examples of second growth forests with medicinal plants and spices, and home gardens with similar species were also seen. The pattern of what PLEC provided and encouraged is similar to what we had seen in the two more northern segments and will not be repeated here.

Several farmers expressed that for them the PLEC concept is equivalent to intercropping and greater land use intensity. Not surprisingly, some of the fields at this site, as well as some earlier ones seen in central Ghana, looked somewhat overcrowded with plants. The suggestion was made that researchers should make a careful analysis of the costs and benefits of adding individuals and species to plots. Relationships among species in such plots are likely to be complex and include at least within and between species competition, allelopathy, and mutually beneficial effects. How many individuals of how many species it is worth planting is far from obvious. It was indicated the existence of several models addressing this issue. Fortunately, the botanist in the group, Dr. Enu-Kwesi, is currently studying the interactions between trees and various crops in an attempt unravel their relationships and eventually determined best mixes.

At the southern Ghana localities, farmers were very enthusiastic about PLEC. One of them was very grateful because he (and his non-PLEC neighbours) could see how his situation had improved in the short lapsed since the initiation of the project. Farmers spontaneously praised the opportunity PLEC had given them to go see what other farmers were doing and how this gave them the opportunity to bring innovation to their fields. Some of the farmers met had actually attended courses, funded by PLEC, in a nearby agricultural school. One of them had been sick and so far had had no opportunity to apply his knowledge, but the other was very happy and found it useful.

Regarding dissemination, farmers expressed that only some farmers copied the examples provided by PLEC demonstrations. The reasons for this behaviour are still unclear, particularly given the apparent success of some of the PLEC farmers.

At two of the localities visited, farmers also used their plots to teach school children and also helped them have their own gardens at school. As in other cases, PLEC provided seedlings and technical assistance for the children to have their own agricultural plots within the school's yards. The revenues will be used to improve the facilities.

One of the sites visited had a plot planted with *Mansonia altissima*, a tree with decreasing abundance in the wild. Dr. Enu-Kwesi was surprised at the rate of growth and expressed his interest in having students come and measure growth and relevant parameters for the planning of future plantations.

During the visit the reviewer was taken to a 5-acre plot that had been left fallow for 20 years. Now, with a general forest physiognomy, it is being used for bee-keeping and as a source of limited amounts of fire wood. The owner, a PLEC farmer, expressed that in a few years he may sell some of the most valuable trees in this plot.

Nurseries here differ from the ones seen further north in that they sold the seedlings to non-PLEC farmers, thus incorporating sustainability component o their venture. In the north the sustainability of nurseries was less clear.

Ironically, throughout the morning while we were discussing PLEC's achievements in increasing plot biodiversity, we were hearing chainsaws cutting the forest in nearby non-PLEC farms. The reviewer was explained the forest law does not provide enough incentives for farmers to keep the trees and, rather than wait for someone else come and log their farms, they prefer to cut them illegally and by themselves.

PLEC is providing many examples and suggestions for farm improvements in southern Ghana. Based on what had been seen here and at previous sites, the reviewer suggested the project needs an economist that would help sort out the absolute and relative economic merits of the various initiatives. Only by showing with clear number the long-term advantages of the various options will results be replicated and eventually become part of government policies.

For example, at the location of Akotomor, farmers are planting native yams under the forest canopy. Yams can grow at relatively high densities (about 3000 plants per ha) in some cases. Farmers claim that growing these native yams is better business than converting the forest to maize and cassava plantations, but they have to convert a fraction of their land in order to have access to these crops. An economic study could well prove that maintaining the forest, growing and selling yams is better business than converting. Yams are also a good way for farmers to store resources. The problem, however, is that people would need access to markets where to sell yams and buy what they need. Removing the transport barrier to nearby (10 km) away markets could well do much to conserve remaining forests in southern Ghana and it may even prove to be good business to restore some of the lost forests, truly win/win solutions. But a solid economic study would be needed.

More generally, it seems that in many cases PLEC is working with win/win situations for environment and/or biodiversity. For example, mulching, rearing snails, bee-keeping, intensifying land use, all seem to be profitable. PLEC has removed some knowledge barriers, but further financial assistance will be needed in the form of start up capital. In discussions with local counterparts, the reviewer was explained that in Ghana rural development banks require a collateral and the interest rates border 45% per annum. Both of these requirements make it almost impossible for farmers to get access to the start up capital. Serious economic analysis of the various PLEC initiatives may, however, help in convincing banks to support some of these initiatives.

It was encouraging to see in our last day in the field that the women of the farmer's association were negotiating a 16 weeks loan with a bank at these rates. They will use the resources for inputs for beads making, cassava processing, and palm oil extraction. They felt confident to be able to pay the loan.

From the general perspective of sustainable rural development, PLEC-Ghana has obtained very important achievements. Firstly, they helped farmers get organized, and secondly, they taught farmers how to open bank accounts. Both of these achievements will allow farmers in the future to apply for loans or micro-credits in an organized way, and will also allow them to better manage their resources. Bank accounts are currently yielding interest rates of about 10% above inflation, thus providing an incentive not to spend all income immediately. Bank accounts, just as planting yams or raising livestock, allow farmers to capitalize, buffer seasonal variations and allow them work with markets.

Opportunities for consolidation and follow-up

PLEC was not intended to show final solutions to rural poverty and biodiversity depletion in the tropics, but rather to show promising ways to work with farmers and scientists. A basis for it has been established. Other instances, such as WB-GEF, the Partnership for critical ecosystems (CI-GEF-WB-MacArthur Foundation) and others seem interested in discussing follow up projects. There are many options for follow-up and it will largely depend on Ghanaian people and resource availability to determine which way will go forward first.

The reviewer was impressed by the amount of charcoal and firewood being sold, especially near the northern Ghana site. Firewood piles around villages and is later transported in trucks to the south, especially Accra. Around the villages there is already a deforestation halo. Firewood must be seen as part of an integral energy policy, including alternative energy sources. Deforestation is a problem in the country and it may be high time to propose realistic options.

Goats are under an open access regime, at least in the northern areas. In the central and southern portions, confined feeding may be closer to the norm. Open access is known to cause problems with afforestation efforts and is likely to cause further land degradation in the future. A follow-up option would be to help farmers create a system of grazing quotas or similar, that limits the amount of grazing in any one area.

An obvious follow-up activity is expansion of win/win options explored by PLEC. In some cases, this may be partially funded by local resources, and in others a revolving fund or a cheap loans system may have to be implemented. Activities funded by the project were very small scale and clearly insufficient to solve the environmental problems. They only showed a way forward. More assistance to up scale would be needed to consolidate the results.

Intercropping at the PLEC sites needs more research and experimentation to determine optimal mixes and densities of species.

Protection of the sacred groves may require more efforts in terms of alternative livelihoods compensating farmers for (illegal) benefits lost by not accessing them. Attempting to enforce the laws without compensation may have limited success.

Hearing the chainsaws illegally cutting the forest provoked a disturbing feelings. It would be most important to help Ghana prepare a realistic forest law ensuring sustainable and equable sharing of benefits.

GUINEA

Summary
In Guinea the project used innovative approaches to help farmers reduce human pressure in degraded areas, in exchange for higher yields in areas with deeper soils and less prone to erosion. PLEC also provided alternative livelihoods contributing to reduce pressure on the land. The project has trained farmers and helped them later disseminate techniques to improve yields, including soil fertilization. Forested areas are conserved, less wood is cut for fencing, trees are planted and fallow periods are longer. The project is well appreciated in Guinea and the government is interested in replicating the cowsheds introduced by the project. Guinea is also providing an interesting example of how PLEC results can be replicated. An NGO is recruiting financial assistance from migrants out of the rural poor areas and convincing them to support the replication of PLEC techniques, and thus help their relatives back home. So far this scheme seems to be succeeding.

Process
The reviewer (EF) arrived in Conakry on 11 May. The host was Professor Ibrahima Boiro, leader of PLEC in Guinea and Director of Centre d'Etude et de Recherche en Environment at University of Guinea. Prof. Boiro, Dr. Karim Barry and Dr. Amirou Diallo accompanied the reviewer to the field.

On 12 May the party left for Pita (about 400 Km from Conakry), the only project site visited in Guinea. During 13 May various demonstrations were seen and discussed.

Three villages were visited, Misside Heire, Goloy and Dar es Salaam. The reviewer had a chance to talk to two expert farmers, and to larger groups of men and women farmers. The Prefect and Sub-prefect of Bantignel Prefecture were also seen. Mr. Balde Ahlassane of ther Centre for Agronomique de Bareng accompanied the visits.

On the 14th May the party traveled back to Conakry. On 15th May the reviewer had several meetings with university and ministry authorities, and other members of the Guinea PLEC team, before departing for the airport.

Project Implementation and Impacts
PLEC Guinea prepared reports including material on biodiversity assessment, biophysical diversity, management diversity and a final report. The final report and the report containing policy recommendations were made available. Both documents seem rigorous. Policy recommendation would still need more work before becoming operative.

There are two PLEC sites in Guinea. Only Pita, the nearest to Conakry, could be visited. The Pita site is in the geologically old and weathered Foutah Djallon (FD) mountain ranges. The FD landscape used to carry forests, but they now overwhelm by the amount of environmental destruction seen and the poverty of its people. Swidden cultivation is the predominant form of land use. Mountain rice and fonio millet are the preferred crops. Fallow periods are getting shorter (less than 5 years). Recently

burned fields and active fires were frequently seen along the road. Trees are generally few and scattered in the landscape. Patches of continuous forest are rare. Grazing resistant plants cover old fields, when not burned. Soils are poor and have very low cation exchange capacity (ferralitic).

In Pita PLEC has been helping farmers work their way out of the poverty and low productivity cycle in an innovative way, not seen at other PLEC clusters. The project has been working on a real *quid pro quo*, intensification in some areas and conservation in others. The project has been supporting land use intensification at locations where soils are richer and erosion less likely (such as valley bottoms and flatter areas) in exchange for reducing pressure on some forested areas and fallow lands. The project has also provided alternative livelihoods to make people less dependant on short fallow periods and increased awareness among farmers of the importance of lengthening fallow periods.

The project has discouraged burning among PLEC farmers and recommends to extend fallow periods for at least 15 years. The impact of these measures are already apparent in increased soil cover, taller shrubs, and more litter covering the soil.

One of the sources of degradation has been the free-roaming livestock (mostly cattle and goats). Farmers avoid intrusions by building fences with wood from remaining trees and patches of forests. Many fences are built around individual houses and much wood is used in these efforts. PLEC has helped reduced excess wood cutting for fences in three ways. First, it worked with farmers to reduce the number of fences by suggesting a single fence around the whole settlements. Secondly, by replacing wooden fences by live or wire ones, and third by helping farmers manage their livestock in enclosures. Evidences for all these were seen in the field.

Confining livestock also provides an opportunity to use manure for fertilization of home gardens and thus improve productivity. Farmers were very proud to show their cowsheds and how they collect manure to fertilize the fields. They were even able to expand the number of cowsheds, without PLEC support, and had others from nearby villages come and learn without PLEC support how to build and manage cowsheds for improved soil fertility. This is a win/win solution in which farmers improve their income and help conserve the remaining vegetation.

Composting is another recycling technique introduced by PLEC to help farmers improve their yields in home gardens and in fallow fields. Farmers were also told to fertilize their fallow fields with soil litter from forest patches.

The reviewer had a chance to see the tree nurseries (native and exotic trees). Useful trees, such as coffee, orange, lemons, avocado, and an Australian *Acacia spp*. were abundant in the nursery. In general, PLEC provided materials (gloves, boots, improved seeds, seedlings, raingear, fencing wire) and two storehouses. The project supported planting of indigenous trees used for dyeing (Indigo) and making soap, and then helped farmers to actually work on the processes ending up with marketable products. These are now important sources of income for women in the villages.

PLEC is helping women with the whole process, all the way from planting cotton to weaving and dyeing clothes. The project provided know-how and start up capital.

Everybody, men, women and all authorities contacted, expressed themselves in very positive terms about these income-generating activities. Women expressed their interest in scaling up and in disseminating it to more villages. Unfortunately, the rural banking system in this area does not allow villagers to get loans to finance this type of operations.

Watershed protection has played an important role in PLEC. Women and men expressed how the re-afforestation and protection of the remaining patches of forest was needed to protect their water supply. Some watercourses have become more sporadic and farmers attribute it to deforestation. When questioned about why conserving forests, men and women independently mentioned the need to maintain their water supply. Provision of medicinal plants, opportunities for bee keeping, wind breaks and fire wood were also mentioned as important reasons to maintain remaining forests. PLEC was recognized as the agent helping them realize the multiple benefits of forests.

PLEC is helping farmers cultivate coffee under the canopy of trees to make the forest more valuable. It is also helping plant bananas and to expand forest patches by planting more trees and advising farmers to leave more trees in the fields. The project provided technical assistance and seedlings.

There has been a two ways exchange between scientists and farmers. Scientists taught farmers techniques to improve yields and conserve, farmers taught scientists what they do and why. Scientists are also learning with the PLEC process in the villages. Scientists are also studying the secondary successions being generated by the new, more conservation oriented activities around the villages. A student is attempting to identify the active compounds in some medicinal plants.

The Miguel Pinedo Vasquez field provided a demonstration of land use intensification in a flat area with relatively deep soils. PLEC provided a water pump, know-how and seeds for onions, tomatoes, and other cultivars. The home gardens visited exhibited high crop diversity, including maize, cassava, beans, peppers, and potatoes. Farmers were proud in explaining the benefits of multiple cropping and improving soil fertility thanks to PLEC.

During the visit to Goloy village the reviewer interviewed a lady expert farmer with a home garden with multiple crops. She had received technical and financial support from PLEC to intensify land use, and trained another ten farmers in the techniques.

In its efforts to provide alternative sources of income, the project also supports French alphabetization for women. This will help them improve their skills in the market place and in organizing themselves. A group of 44 young women showed their recently acquired reading skills.

PLEC has also helped farmers have a formal association. Here, as well as other PLEC sites, this organizational contribution of PLEC has been widely praised for its potential in helping farmers in the future. Farmers here also mentioned that now they also learned to appreciate scientists!

Expert farmers were initially sent to an agronomy school in Pita to improve their agronomic skills. Later the project provided them with bicycles to allow these expert farmers to move between villages and provide training and technical assistance. People appreciated these very concrete inputs received.

Everybody interviewed was very enthusiastic about the project. The project seems to have increased employment opportunities and raised the standard of living of people. Farmers, scientists and politicians coincided on the value added by the project to poverty alleviation in rural communities. All of them expressed their interest in replicating the project results and deepening its achievements. When asked, people mentioned they wanted to have schools for their children, plows, breed fish and chicken, have more livestock, and plant more coffee. They also wanted to have PLEC replicated in the whole district. The President of the District was particularly emphatic in having such poverty reducing projects be extended.

On the last day the reviewer had a chance to talk to Mr. Mamadou Bhoye, Director General for Breeding and Agriculture at Conakry. He mentioned the government was very impressed by some of the results achieved by PLEC and is interested in replicating them. Specifically he mentioned that moneys from the European Union would be used to replicate the cowsheds for about 450 families in middle and lower Guinea. Management of livestock in confinements is probably the single most important technique introduced by PLEC at Pita.

On the last day EF also had a chance to discuss with Mr. Mamadou Kane Diallo, Secretary General of an NGO called "Miside Heide". Mr. Kane is the enthusiastic creator of this NGO, designed specifically to replicate PLEC results in the overall area in middle Guinea and later in the country as a whole. The NGO started in 1998 with about 50 members and now has more than 200 of them. Mr. Kane expressed they will start by replicating wire fencing to protect the forest and disseminating the practice of confining livestock. They also want to help people breed cows, goats and chicken. They also want to start fish aquaculture. They currently operate in 21 villages and have local scientists and farmers cooperating.

Financing of these efforts is very innovative and may be worth replicating elsewhere. Mr. Kane Diallo managed to contact people that had migrated out of the areas, and now live elsewhere in Guinea or even abroad. These people are offered the opportunity to help their communities back home by donating a monthly stipend. The 200 members mentioned above are subscribers to the system and have contributed about USD 10.000 so far. Mr. Kane explained migrants feel they are helping their relatives back home and the environment. This is a very innovative approach to replication, that seems to be generating enthusiasm among people at one time forced to leave the villages due to the poor conditions in them.

In explicitly discussing exchanges within country, within cluster and between clusters, people confirmed what was already apparent before. They learned mostly from other people at the same site, in the same country, in the same cluster and only peripherally from people in other clusters. Cost effectiveness in the transfer of knowledge within countries and between countries is still a challenge.

PLEC is strongly supported by people in Guinea. The reasons are linked to it being directly connected with their urgent needs. Biodiversity is protected because they realize forests are important for their water supply, trees are protected because of their use, fallow periods lengthened because they see their role in soil fertilization, confined raising of livestock is practiced because of its impact on their livelihoods. Sustainability is built into these results because people are interested in them.

Opportunities for consolidation and follow-up

There is an obvious interest in expanding PLEC assistance in the FD area. From a biodiversity conservation perspective, one option would be to select areas near remaining forest patches and help people manage their resources, very much like was done by PLEC during the 1998-2002 phase. This would be a win/win approach supporting conservation and people's livelihoods.

Another option is to have a follow-up project that helps the same farmers consolidate and improve their situation. In exchanges during lunch time, they expressed an interest in more resources to help them improve their situation. An integrated resources management project helping them manage the whole set of resources (forests, soils, livestock, fallow lands, water and energy) coupled with some processing and marketing of products, could be most helpful.

KENYA

Summary

The village of Nduuri in Embu, focus of Kenya PLEC, was dominated by small holder coffee, but farmers also commonly kept dairy cattle and goats and sheep. Although there was no systematic agrobiodiversity assessment or identification of land use stages or field types, the project found an impressive diversity of plant species associated with coffee, in spite of a strict regulation from the national coffee board that generally prohibited intercropping coffee except with *Grevillea robusta*. Transect walks and detailed village studies found coffee was commonly associated with numerous cultivated, semi-cultivated and wild species of large and smaller trees, shrub, annual and perennial herbs, and grasses. Some of the plant species were introduced, but many more were indigenous. Many of the annual species were just weeds, but many more were kept and cultivated for some specific purposes. Of special interest is the rather big fig tree, *Ficus sycamorus*, commonly left among the coffee. Farmers' belief that the trees are good for coffee, especially in dry years, was verified with careful measurements. Home garden, the one land use type singled out for detailed analysis, was found to be especially rich in species used for food, fodder, medicine and various other uses. Notable richness in agrodiversity documented included local knowledge, utilization and management of a diverse range of species for goat fodder, medicine, and agronomic purposes. Even more important is the beginning of an understanding how these numerous different species are put together and the appreciation of local knowledge and skills involved in the species usage and maintenance. Farmers expressed interest to see a booklet containing agrodiversity information, local usage and other local knowledge that the village has shared with PLEC

An extension of the project into other zones, with more complicated management problems, e.g. villages near a wetland, as proposed by Kenya PLEC seems an appropriate next step. However, I would recommend that such a proposal should be funded on two conditions. Firstly, there must a commitment to acquire capacity for more efficient database management. Secondly, for potential implication and long term impact, the project should be integrated with the national programme such as Agricultural Technology and Information Response Initiative (ATIRI).

Process

BR went to Kenya for the final evaluation. The visit took place between May 9-11. This review is based on the site visit to the village of Nduuri in Embu, interviews with individual and group of farmers, inspection of their fields, researchers, administrators, and review of the project's various reports and documents.

During the field visits I was accompanied by PLEC researchers Mr J.N. Kang'ara, Mr C.M. Rimui and Mr. E.H. Ngoroi. I met with Dr Macharia Gethi, Director of the Embu Regional Research Centre of Kenya. Farmers I met and had discussion with and visited some of their fields and home garden were Shadrack Najagi, Alice Ciathuni, Alice Gitiiri, Francis Muriuki, Bernard Muthungu, Gad Nyaga. I also met and had discussion with chairman and treasurer of the Kimiugu Self Help Irrigation Scheme. On the final day I had a meeting with about 25 farmers at the Nduuri primary school to discuss PLEC's impact on their farming.

Project implementation and impacts

Kenya PLEC started with two sites, but dropped the Kiambu site in 2000, and focused on the site at Embu. The project started off with a reconnaissance survey covering a very large area of 450 km^2 in Embu. A preliminary report of this survey was filed (Okoba et al 1999) provided a general description of agricultural systems of the area. The project then chose to focus on the demonstration site at Nduuri village.

The implementation of Kenya PLEC coincided with the low cycle for coffee price. The primary concern of farmers of Nduuri, the project's demonstration village, during the project was how to cope with the currently very low price of coffee. Although the local coffee-based cropping system had already been diverse before the crash, PLEC scientists reported that biodiversity in the area has been enhanced by the coffee decline.

There was no systematic agrobiodiversity assessment or identification of land use stages or field types. The research area at Embu was dominated by small holder coffee, but farmers also commonly kept dairy cattle and goats and sheep. In spite of a strict regulation from the national coffee board that coffee can be intercropped only with *Grevillea robusta*, Kenya PLEC has found an impressive diversity of plant species associated with coffee in their study site at Embu. The work on transects and detailed study of the village demonstration site at Nduuri showed that coffee was commonly associated with numerous cultivated, semi-cultivated and wild species of large and smaller trees, shrub, annual and perennial herbs, and grasses. Some of the plant species were introduced, but many more were indigenous.

The project found 33 cropping systems in the whole village, 40% of which was based on coffee. Understanding of farmers' management of agrodiversity was gained through 10 specific areas of study. Although they did not produce and inventory of land use stages and field types, Kenya PLEC singled out "home garden" as one land use stage that was studied in detail.

Most of the information reported was very interesting but generally still incomplete. In some that reported biodiversity information, the method section failed to mention if the information was aggregated or means over all the households surveyed. No information for individual farmers or their management diversity was presented. Kenya PLEC was another of the cluster that was unable to make use of the BAG Access database program and preferred to use the spreadsheet program, Excel, instead. So unfortunately they were unable to take advantage of Access program in order to summarize and analyze the different layers of information. This is a great pity because it would have been really interesting as well as informative to be able to make comparisons between farmers on the different species and varieties found in their different fields.

In spite of the above problem of analysis, which should not be so difficult to rectify, these reports have provided valuable information of the range of agrodiversity found the village. For example, considerable intraspecific diversity existed in the village's major food crops such as banana (20 varieties), sweet potato (4), cassava (6), yam – *Dioscoria rotundata* (9) and sugar cane (6).

Nduuri's home garden, the land use stage singled out for detailed study, ranged in size from 40 to 300 m^2, with a mean of 114 m^2. It was apparently rich in biodiversity and functions. Thirty nine percent of the species were used for food, 19% for fodder, 13% for fuel, 10% of medicine and 8% for construction. The hedge around the homestead constituted a living fence, for which one of the 7 specific species were used, but up to 30 other species of food, fodder, medicine, etc may be found in the hedge. All the home gardens together contain 46 species of food crops, 23 fodder species, 22 medicinal species, 29 species used for fuelwood and 13 various species grown for sale.

The investigation into local botanical knowledge in Nduuri found a wealth of information on usage of species normally considered "weeds" in agronomy textbooks. The uses found ranged from the ordinary (food, fodder, timber, medicine, fuel) to novel and very interesting (e.g. beehives, fungicide, ripen banana, trapping moles, making candle, perfume and witchcraft).

Up to 56 species identified as fodder were of great interest to project scientists who were trained in livestock science. This led to a comprehensive evaluation (complete with feeding trials) of different indigenous fodder trees and shrubs in the performance of dual purpose and dairy goats. Local forage species that were offered to goats in the dry season numbered 62 and in the wet season 66. The nutrition study and feeding trial found some species, e.g. Mutundu (*Neoboutonia macrocalyx*) and Mukwego (*Bridelia micrantha*) to out perform some other local fodder species. To bring these definitive findings to bear on the project's primary objectives, the next step would be to describe and analyze the agroecological condition defining the niches of these species.

The village herbalists with specialized knowledge of medicinal plants were among expert farmers identified. Although some of them were reluctant to share their knowledge, several were identified who were willing to share at least some of their knowledge about properties of certain medicinal plants, e.g. for treatment of malaria, fever, tooth ache to cures for various livestock ailments. As the result of this sharing, one or more of the several species with reputation for malaria treatment was found almost everywhere in the village.

Notable among the project's reports were documentation of the knowledge on local plants and their use and functions of farmers by age groups and verification and documentation of the effect of *Ficus sycamorus* in coffee and stall feeding of goats with local plants. Older farmers knew more local plants in general, but they also knew more plant by their usage, e.g. medicinal, fuel, fodder, and more specialized used, e.g. for ripening banana, trapping moles, and for keeping bees (Ngoroi et al PU1). The project found some farmers leaving a few very large trees known locally as "*Mukuyu*" (*Ficus sycomorous*) among their coffee. Further investigation, by actual measurement of coffee yield and soil as well as by farmers' observation and judgement, found that coffee tended to perform better under the tree than away from it. Soil analysis found slightly higher available phosphorus under the tree. Farmers observed that when drought is a problem coffee under the tree always yielded better than away from it. (Ngoroi et al, PU2). The data presented in the final report supporting the claim that there was greater biodiversity under the *Mukuyu* than outside it were, however, far from conclusive.

Nduuri farmers appeared to be genuinely appreciative of what PLEC has done. However, in the meeting with a group of farmers at the village school on May 11, 2002, one of the farmers asked, "Those records of our plants that you have made and the knowledge we have shared with you, where are they now?" This was followed by murmurs of agreement by many others. In one of PLEC's report (Ngoroi et al, PU1) concern regarding the knowledge gap between older and young farmers on local biodiversity was expressed. That is, they found that the younger generation knew a lot less about local plant species than the older generation. It seems that a booklet in local language recording all the local agrodiversity and knowledge collected would fill this gap very nicely. It should also encourage other farmers in sharing their knowledge as well as be a source book for the local school so that local knowledge may be passed on to the children.

Kenya PLEC's development of participatory sustainable management was sometimes directed at crop production alone, e.g. introduction of soybean, new disease resistant potato and maize hybrids, and various good practices for coffee. In my opinion, these are relatively harmless. However, such introduction should always be accompanied by at least some preliminary evaluation regarding threats to local biodiversity, i.e. with minimum potential for trade-offs between productivity and diversity, for this particularly physically diverse agroecosystem. Indeed, some local innovations have emerged as a result of certain expert farmers adapting introduced technology to their particular need.

Coffee in Embu, as in other coffee areas of Kenya, has two major fungal diseases, coffee berry disease and leaf rust. Control with fungicides is costly. A hybrid cultivar of coffee called Ruiru 11, proved to be 90% resistant to fungal diseases, was released in 1985. Bernard Njeru, one of the farmers, has so far grafted 500 of his 964 coffee stems belonging the old variety SL34, and 300 have taken. The first plants grafted have now come into production. The farmer said he will phase out the old SL34 only after he has made careful comparison of the new grafted plants. Four other farmers have begun to adopt the practice from Mr. Njeru. Others prefer to wait and see the results first.

The productivity focus often coincided with the enhancement of biodiversity, i.e. resulting in many potential win-win situations. Some of these have originated from PLEC sponsored farmers' visit to Meru (September 2000 and December 2001), some from local knowledge that already exists in the village but gained recognition and better understanding after PLEC has encouraged their exposition and some times verification. The use of *Mukuyu* tree in coffee reported above is but one of the examples of benefits from biodiversity that has been promoted. Three other examples are the case of goat improvement, the promotion of multipurpose trees and medicinal plants.

Agrodiversity in Nduuri, far from being just a random mix of species, was the result of carefully considered management by the farmers out of their knowledge and understanding of their genetic and other resource and the local environment. The project reported on a spectacular success by one farmer, Alice Ciathuni, with "*Marenge*" (a kind of pumpkin or winter squash with very long shelf life) and beans intercropped with coffee. The early slow growing habit of the *Marenge* allowed the

bean to grow and mature first, after the bean harvest the *Marenge* took over and finally covered the ground. Mrs Ciathuni, who is generally regarded as one of the village's expert farmers, harvested more than one thousand fruit of the *Marenge* which fetched very good prices from buyers from Nairobi. The system has now been adopted by many farmers in the village.

From their visits to Meru, Nduuri farmers became convinced of the potential of their own resource and capacity for improved goat keeping. The values of improved breeds, cross breeding and keeping and feeding goats in stall for the purpose of manure collection are straightforward animal husbandry. Kenya PLEC and the Nduuri farmers have, however, combined these with indigenous knowledge of local fodder species. The farmers have identified 56 of these as fodder for goats. Similarly, knowledge shared by village herbalists (not all local herbalists are so forthcoming in the sharing of their knowledge about medicinal plants) has generated interest in the planting of medicinal plants for human and animal use. The role of medicinal plants has become crucial in the village especially since the collapse of public health services for both human and livestock.

Kenya PLEC has noted the increasing economic importance of "Miraa" (*Katha edulis*), a drug plant (also known as Qat or Khat) grown for export to the Middle East where it is consumed for the psychomotor stimulant effects. The plant has previously been cultivated in monoculture, but it is now spreading into coffee in Embu. The project scientists noted on the potential for local abuse and harm that might come from its growing use especially by youths. Perhaps this was one of the times when diversity was not always good.

PLEC organized farmers visit to Meru have encouraged farmers to form groups for goat breeding and irrigation development. Having seen how well the farmers in Meru were doing with their irrigated high value horticultural crops, four irrigation groups have been formed: Lower Muthege, Kamiugu, Nduuri and Karue. I met with some representatives of the Kimiugu Self Help Irrigation Group, including its chairman and secretary. This group, along with the other irrigation groups, is having difficulties raising enough funds for the full implementation of their scheme. Some were also having problem with the government body that controlled the use of stream water, with too many schemes claiming the use of the limited water source, especially in the dry season. Those farmers who were able to grow vegetables last season had the misfortune to have their export to E.U. cancelled because of the strike in Air France. In spite of all these setbacks, farmers and Kenya PLEC were in agreement that these organizations would enable farmers to interact more effectively with governmental agencies, especially to negotiate for support from the Agricultural Technology and Information Response Initiative. To negotiate and prioritize among farmers and different groups would be valuable learning experience. It seems that in these activities, while the success of individual enterprises may be important to farmers now, the learning experiences should be more valuable in the long run, provided they do not cost participating farmers too dearly.

As in other PLEC countries, the first impact of the project was on the PLEC scientists themselves. In their final report the Kenya cluster wrote, "*The main problems experienced is that of scientists themselves due to KARI (Kenya Agricultural Research Institute) orientation on Farming Systems Approach to Research, Extension and*

Training (FSA-RET) where the problems are identified, prioritised and intervention made either through research or just extension to solve the problem. Here, the scientist and the extension worker are the experts and the source of technology. This differed with PLEC approach as the roles were reverse to appreciate the farmer as the expert and while the researcher and the extension worker were to learn from him and use him to teach other farmers. It took very long for the researchers and the extension officers from Ministry of Agriculture and Rural Development to adjust to PLEC approach. "

In my opinion, such "conversion" is likely to have a lasting effect on the KARI research team. From his association with PLEC, John Kang'ara, sub-cluster leader (who was trained as a livestock scientist), has been appointed a member of the Embu District Environment Committee. It is as yet too early to tell, what influence this appointment will have on how much money the district spends on biodiversity conservation. Dr Macharia Gethi, Director of the Embu Regional Research Centre (Embu RRC) of Kenya Agricultural Research Institute, informed me that the PLEC approach and methodology are very appropriate for the national programme on the World Bank funded Agricultural Technology and Information Response Initiative (ATIRI). The next step suggested was to test PLEC methods and ideas in different agroecological zones under the responsibility of the Embu RRC.

Opportunities for consolidation and follow-up

Before anything else the data collected should be analyzed more fully and substantive studies published, perhaps some in the PLEC News and Views, and some in refereed journals. But at the same time, or even before this, a simple booklet containing agrodiversity information, local usage and other local knowledge that the village has shared with PLEC should be produced and made available in the village including the school. Preferably this should be in the language and writing style that can be easily understood by most people in the village. Involvement of some of the expert farmers in the process would be most desirable.

An extension of the project into other zones, with more complicated management problems, e.g. villages near a wetland, as proposed by Kenya PLEC seems an appropriate next step. However, I would strongly recommend that acquisition of the Access database management skills be made a pre-requisite of such move. This should not be too difficult, since such capacity should be available at ICRAF, who had a collaborative project in an office next door to the PLEC sub-cluster office. Furthermore, it may be desirable to explore the possibility of cooperation with the national ATIRI project.

PAPUA NEW GUINEA

Summary

In spite of their many implementation risks, substantial agrodiversity data has been collected. Only preliminary analysis have been done in which species richness and diversity have been estimated for each land use stages and field types in aggregate for the whole village. PNG PLEC maintained that social and cultural circumstances on farmers in Papua New Guinea are very different from other places. They stated that PLEC methodology such as farmer-to-farmer transfer of knowledge and skills were not appropriate. Nevertheless, problems and potentials for biodiversity conservation begun to be understood in the short time that they have worked closely with farmers and the community in Ogotana. During the site visit it was evident that the project was aware that some farmers did know more than others in a lot things in which farmer-to-farmer transfer would be quite feasible and useful, especially those associated with new crops such as coffee, cacao and vanilla. PNG PLEC in fact expected to bring farmers from Tumam to teach those in Ogotana how to pollinate vanilla. Species richness in some of the home gardens in Ogotana could match the best in any other clusters. While there was no organization of formal farmers' association, PNG PLEC has helped to facilitate communities negotiate for public funding, for water tanks in Tumam and two classrooms in Ogotana. Farmers who were interviewed said that they very much appreciated the grassland rehabilitation demonstration. PLEC activities have generated a lot of interest among farmers, including one farmer who had walked quite a distance to ask if PLEC could extend its work to his village. A network has been built between NRI, where PNG PLEC was housed and other governmental non-governmental agencies. Most notable among these is the collaboration with the Dept. Environment and Conservation and the National Agricultural Research Institute (NARI). Collaboration with NARI holds much promise for continuation of PLEC approaches and ideas to be useful for biodiversity conservation in PNG. There are also very strong possibilities that the PLEC participatory work will continue with the support of UNDP's GEF/Small Grants Program in Papua New Guinea.

Process

The visit to PNG by BR took place between May 26 –31. I met with John Sowei the cluster leader and researchers Hazel Mamae and Inara Bore. Accompanied by John Sowei and Hazel Mamae I visited the demonstration site at Ogotana. At Ogotana we visited the demonstration of grassland rehabilitation, a home garden belonging to one farmer (Roy Oori). Farmers I met and dicussed PLEC with were Iani Waeako, Roy Iori, Maeana Waeako, Margaret Iori (chair of the women's group), Francis, Daiva Boboro (a PLEC undergraduate trainee from the village, who has graduated with a BSc in agriculture from PNG University of Technology in 2001) and Yarei Wahona (leader of the clan that owns all of the village land in Ogotana).

On May 31, the cluster leader presented overview of PLEC work at Tumam and Ogotana, introduced by Dr Beno Boeha, Director of NRI. The seminar was attended by about 15 people from NRI, National Agricultural Research Institute and various government departments in Port Moresby. I also had discussion with Vagi R Genorupa (Dept. Environment and Conservation) and Rosa Kambuou (National

Agricultural Research Institute) on their involvement with PLEC and possible future collaboration.

Project Implementation and impacts

PNG PLEC was a difficult cluster with partners from the Australian National University (ANU) in charge of the Tumam/Ngahmbole site, Tokyo University was in charge of the Tari site and National Research Institute (NRI) of Papua New Guinea in charge of the Ogotana site.

No record of agrodiversity assessment from the Tari site, conducted before the site was abandoned due to local unrest, was available in Port Moresby for this final review.

On the recommendation of village's "experts", PNG PLEC defined "land-use stages" as the cultivated and fallow fields of different ages for the agrobiodiversity assessment. They reported of sampling a total of 376 10 x 10 m plots in Tumam at 7 (the fields locally known as wa), 20 (yakene) and 33 (nerakas) months after clearing. Fallow fields were classified into four stages by their approximate age after cultivation, 0 to 5 years, 5 to 15 years, 15 to 25, 25-50 years and the rainforest. Land use stages in Ogotana consisted of fallow fields on flat land and hillside, at 5, 10, 15 and 20 years and virgin forest.

Data analyses that have so far been documented are still largely preliminary. For each land-use stage and field type, from both Tumam and Ogotana, species inventories from individual households have been aggregated, i.e. information from fields and farmers combined. This appeared to have been influenced by the PNG team's assumption that "management diversity" was absent in PNG rural villages. This particular hypothesis could easily have been tested with the data already collected.

Recurrent bush fires were identified as the primary factor that constrained forest regeneration and biodiversity at Ogotana. A list of general external and internal threats to biodiversity was presented, from population density to governance and politics, but supporting data were lacking (Sowei et al 2001).

Recognition, usage and value of the different species represented the major element of farmers' management assessed. PNG PLEC seemed to have some problem with the PLEC idea of "expert farmers". A number of "expert farmers" were identified in Tumam, one even went to Canberra in August 2000 and "assisted Bryant (Allen), who had entered the material (genealogical information) into a genealogical computer program, to clean the information and to make sense of the way in which his fellow villagers organize themselves and their land." Two expert farmers assisted PLEC in species inventory at Tumam, but documentation of their skills in biodiversity management was limited.

The following quotations came from the Tumam/Nghambole part of the section on demonstration activities final reports.

- "*PLEC activities mainly involved collecting information about the agro-diversity and bio-diversity aspect of their agricultural system, a system that is well known to them and from their point of view is tried and true*"

- "*Innovative biodiversity conservation techniques may be common within a similar agro-ecological zone. Therefore, to promote a management technique that is common does not signify the issue of identifying and promoting the best practices with the farmers in rural PNG*" (Sowei 2002).
- "*The PNG PLEC was always a little uncertain about how farmer-to-farmer training would be accepted in Tumam… Throughout Melanesia there is a marked reluctance to give up knowledge to potential rivals who may use against one. Farmer-to-farmer training is a foreign concept in such as environment*."
- "*No attempts were made to form farmers associations at Tumam and Ngahmbole. This area has a colonial history of the formation of various forms of cooperatives, all of which collapsed in various states of bankruptcy. …people are left feeling depressed and let down. …People are generally suspicious of new organization*."

It was abundantly clear from these and other similar statements that there was a serious disagreement with the PLEC ideas and methodology for participatory sustainable management. Alternatives judged as better suited to local circumstances offered, included "raising awareness" in discussions with some farmers, field days and publications. Alone among the clusters, PNG PLEC has a regular column in the local newspaper, Post-Courier. The newspaper's Focus page on Wednesday has been allocated to "Searchlight with NRI". John Sowei, the cluster leader has featured articles in the Post-Courier such as "Sustainable resource management promotes diversity, support life" (August 1, 1999); "Population and the Environment" (September 26, 2001); "Regulating introduction of germ plasm material" (August 1, 2001); "Skills in managing the environment" (October 3, 2001). There was also a featured article in the Independent: "People, land management and environmental change" (January 8, 1999).

However, the above statements not withstanding, PNG PLEC has begun to understand problems and potentials for biodiversity conservation in the short time that they have worked closely with farmers and the community in Ogotana. A visit to the Ghana cluster by John Sowei, the PNG cluster leader, has also played an important role in this.

During the site visit it was evident that the project was aware that some farmers did know more than others in a lot things in which farmer-to-farmer transfer would be quite feasible and useful, especially those associated with new crops such as coffee, cacao and vanilla. PNG PLEC in fact expected to bring farmers from Tumam to teach those in Ogotana how to pollinate vanilla. Species richness in some of the home gardens in Ogotana could match the best in any other clusters.

While there was no organization of formal farmers' association, PNG PLEC has helped to facilitate communities in both Tumam and Ogotana to apply for public funding of their development. Tumam has succeeded in securing funding for domestic water supply facility. Ogotana's application for support to build classrooms for its primary school is being processed.

The project reported that demonstration activities related to grassland rehabilitation in Ogotana had been developed from farmers' experience. Propagation of introduced as well as local species of tree seedlings, first initiated to supply the grassland

rehabilitation project, became a demonstration activity in itself. Farmers who were interviewed said that they very much appreciated the grassland rehabilitation demonstration.

The Ogotana site, which began to be developed only in 2000, has become a focal point for networking between NRI, where PNG PLEC was housed and other governmental non-governmental agencies. Most notable among these is the collaboration with the Dept. Environment and Conservation and the National Agricultural Research Institute (NARI).

Collaboration with NARI holds much promise for continuation of PLEC approaches and ideas to be useful for biodiversity conservation in PNG. Ms Rosa Kambuou, who works on conservation of genetic resource of locally important species, taro, yam, banana, and so on, is preparing a proposal for an in situ conservation project with IPGRI. She informed me that Tumam and Ogotana will be two of the new project's pilot villages, because of PLEC's experience there. This NARI and NRI collaboration should contribute significantly to sustainability of PLEC's impacts on the conservation of PNG's valuable plant genetic resources. Ms Kambuou's exceptional insights and culturally sensitive participatory skills have enabled her to gain trust and co-operation from farmers into sharing even their most treasured germplasm.

PNG has its own special set of cultural, social and economic conditions. This was brought home to the reviewer while we were visiting Ogotana in the form of, Mr Yarei Wahona, the head of the clan that "owns" all of the village land. The exact implication of this "ownership" is, however, far from clear. For example, none of the villagers pay the landowners any rent. Mr Wahona was at first very hostile indeed, saying that all this PLEC activities were conducted without his knowledge. However, he became much more accommodating after accompanying us to the demonstration site and had PLEC work explained to him, translated by Daiva Boboro, one of PLEC's former undergraduate trainees who was from the village. [At the beginning he insisted on speaking in a local language. But after joining us for lunch, organized by the village at Iani Waeako's, he became very friendly and told me in English that he had been to Bangkok.] Mr. Wahona later told PLEC that he had no problem with PLEC working in Ogotana, but there are some disputes about the land among his kins. It should not be too difficult to include him in PLEC activities in the future. The episode nevertheless served to highlight one of the many such problems that PNG PLEC had to deal with.

PNG PLEC at NRI have shown many signs of beginning to understand these complications which can only be slowly understood by someone who lived there and working closely with farmers and the local community. Henry, a young researcher at NRI spent some time during our Ogotana visit with some of the young men of the village. Later he remarked that perhaps PLEC could also include younger people too.

Opportunities for consolidation and follow-up

The agrodiversity data they have collected need to be managed properly in PNG. As discussed above since the capacity already existed at NARI, it should be simple to transfer the capacity to NRI for the management of PLEC data. PNG PLEC

expressed an interest in further analysis, but said that they will need some guidance and support.

I fully sympathize with PNG PLEC and the villagers that the work at Ogotana has only been going on for two years. Some valuable lessons about participatory management of biodiversity are only beginning to be learned.

There are, however, very strong possibilities that this participatory work will continue with the support of UNDP's GEF/Small Grants Program in Papua New Guinea. John Sowei, the PNG cluster leader was informed in a letter from the resident representative (dated 19th April 2002) that the National Steering Committee has agreed to fund the community participation component of NRI's proposal on the Biodiversity Conservation Research. Other components of the proposal may also be considered for funding if co-funding arrangements can be organized by NRI.

TANZANIA

Summary
PLEC has achieved important goals in Tanzania. The project has shown the importance and possible successes of farmer-farmer contacts in the provision of know-how and germplasm. In an area with high poverty levels, the project was able to show the merits providing traditional land use intensification methods, including biodiversity enrichment with species, varieties and trees. It is too early to see how the PLEC approach and its activities will be sustained in the future and if Tanzania will make them part of their own mainstream activities.

Process
The two reviewers BR and EF visited Tanzania together for the final evaluation. One of the goals of this joint mission was to agree on general format and style for the rest of the reports. In Tanzania as elsewhere, the goal of the evaluation was to tease out achievements and particularly impacts, of the biodiversity-oriented and GEF-funded phase (1998-2001).

The visit took place between Monday 29 April and Thursday 2 May. Unfortunately, the PLEC leader in Tanzania, Mr. Fidelis Kaihura, had problems with his flight connections from New York city and was unable to reach Arusha by the time we left for Nairobi at 8 am on May 3rd. There was nobody else available with an in-depth knowledge of the project to lead us in the field evaluation.

Mr. D.M. Rugangila, Head of the Arumeru District Agricultural and Livestock Office (DALDO) kindly served as our host during the whole visit. The assistance of Mr. Charles Ngilooit, Extension Officer in translating was most helpful.

On April 30 the two reviewers met with Mr. DM Rugangila and Ms. E Kahembe, extension officer from DALDO and later with Mr. Dr. A.S.S. Mbwana, Zonal Director of the Selian Agricultural Research Institute.

On 1 May reviewers visited the two field sites in the altitudinal and rainfall gradient on the windward side of Mount Meru. During the morning reviewers talked to three farmers at the dry site (Kiserian), and in the afternoon with two groups in the more humid site in the foothills of Mount Meru (Olgilai and Ngiresi). On 2 May the reviewers made a short visit to Arusha National Park and later reviewed available documents and reports.

Project Implementation and Impacts
Tanzania submitted to UNU its reports on biodiversity and agrobiodiversity, social analyses, management regimes, experimental work, policy recommendations and its final integrated report.

Reviewers were provided with copies of the final Tanzania report. On arrival back in Santiago, EF received from Mr. Fidelis Kaihura a large envelope containing copies of many of the Tanzania reports, including information on the agro-biodiversity assessment, management regimes, land degradation, social analysis, experimental and

monitoring, linkages of community and scientific information, capacity building, and policy recommendations.

The reports were examined and found informative, and containing useful information for further work.

The visit showed that the emphasis of PLEC in Tanzania was on land use intensification, and on increasing in-farm species and life form diversity. A major effort was aimed at expanding mixed cultivation of food crops and planting trees in farms. Both of these existed before but were less known due to scarcity of farmer-to-farmer exchanges. The project provided seeds (sometimes enhanced strains), seedlings and fences. Species used in enrichment were both native and introduced. New practices and farming methods from scientists included contour plowing, water management, assistance in fertilization (manure and urea) demos, seedling production, improved method for raising chicken. The project, however, differed from conventional extension in that it encouraged farmers to experiment on these instead of just accepting them.

Through a better understanding of the various dimensions and aspects of agrodiversity, project scientists have been able to develop participatory models of management that are likely to be sustainable. These included identification of (a) expert farmers, and (b) a model of farmer-scientist collaborative research in which farmers play crucial analytical and interpretative roles. From the later the project has been able to identify problems related to biodiversity such as degradation of the water-sources and common grazing areas and to the production systems. PLEC then went on to identify and evaluate (a) on-farm technical solutions such as better soil and water conservation measures, new options in crop varieties and livestock breeds, and various other crop, soil and water management techniques, and (b) organizational solutions such as the communal attempts, in the form of farmers' associations, to reforest the water-sources in Olgilai/Ngiresi and the common grazing land in Kiserian.

At Olgilai, farmers mentioned they were encouraged by the PLEC scientists to try new cropping systems that might help to mitigate the impact of the 2001 drought. Mr. Lais Kitai of Kiserian showed us the new sweet potato that PLEC brought which he thought was looking better than his old variety and he expected to expand planting of the PLEC sweet potato next year. But he also indicated preference for his old variety of tomato because it was much hardier against disease compared to a much larger fruited PLEC introduced one.

At Kiserian reviewers were shown two methods for water management and erosion control, a diversion ditch and an earthen bank, being tested by Mr Kisioki Sambweti. The farmer clearly saw that these methods worked on some parts of his field and not on others. The effectiveness of this scientist-farmer collaboration in on-farm experimentation could, however, be much enhanced by more inputs and insights on scientific understanding from the scientists.

Mr Kisioki Sambweti also showed his small garden of introduced new crop species and varieties, used for demonstrations as well as a source of material for planting shared with other farmers. He set up a demonstration plot on his land in which PLEC

introduced plant materials (four kinds of sweet potato and one kind of cassava) as well as some of new materials found on his own initiative (a local maize variety) were planted. The impact of this on other farmers was clearly evident. When asked which of the four PLEC sweet potatoes was preferred the farmer pointed to gaps in the row of one variety, which have been taken out as planting material for other farmers. Many hands shot up among the assembled (largely female) farmers when asked who were responsible for these gaps. There was also interest in the cassava, which is new to the area, but Mr Sambweti said they have to wait until the plants have a chance to grow some more. Expert farmers like Mr Sambweti, and also Mr. Lomayani Sarao who is leader of the KUMO group in Olgilai, are instrumental in organizing other farmers in communal efforts of planting tree seedlings in the watershed or communal grazing land. It was not possible for us to judge how sustainable such efforts will be after PLEC. However, since communal resource management appeared to be relatively new in this area further reinforcement of the process may be essential.

At the Mount Meru site we saw a small biogas structure introduced by PLEC for home consumption. This could be an alternative source to firewood. Firewood seems to be a major challenge to the sustainability of the re-afforestation efforts in the area. Household consumption seems to be in the order of one cubic meter per week per family, posing a major threat on the remaining trees. Unfortunately, installation costs, about USD 80, prevent most farmers having cattle from implementing the biogas system. Thus although there is a re-afforestion decree dating from 1997 and leaders in the farmer community expressed their confidence in the sustainability of the efforts, it remains to be seen if without alternative sources of fire wood, people will not continue cutting trees.

Reviewers met two young extension officers who benefited from capacity building and helped develop capacities during the four years of the GEF phase. One of them, Ms. Kahembe, was involved in the extension of an improved method for raising local chickens. The other, Mr. Ngoloriti, who also assisted us with translation, appeared to be well informed of PLEC ideas. The project worked with the Arumeru District Office, especially the District Agricultural and Livestock Development Office, and Mr. Rugangila, its director.

From the site visits and discussions with farmers and the director of research for the Northern Zone, Dr A.S.S. Bwana, it was clear that the key "recommendation" from Tanzania PLEC was the "PLEC methodology" through which expert farmers are employed in sustainable management of agrobiodiversity. This included the identification of expert farmers, collaborative on-farm research between expert farmers and researchers and the farmer-to-farmer transfer of good practices. Farmers' associations have been started in both demonstration sites with restoration of degraded land by tree planting as a central activity, for common grazing land in Kiserian and the watershed area in Olgilai/Ngiresi.

The two pillars of PLEC, farmer-farmer exchanges and farmer-scientists collaboration, were extensively probed. The evidence collected indicates that PLEC made two important contributions. Firstly, it helped remove barriers to farmer-farmer communication and thus helped the transfer of biodiversity and productivity-related best practices among farmers. Secondly, it has encouraged and assisted farmers to experiment on new practices and kinds of crops that are made available to them, and

analysed and interpret results in the context of their own environment. The farmer-farmer model encouraged farmers to learn from the "expert farmers". It also enabled those exceptional farmers to experiment with transfer of knowledge as well as new sustainable management practices.

Apart from the two extension workers we met, there was no opportunity to evaluate the impact of various trainings on the project researchers. We met and attempted to interview a Mr. J. Mollel, a village administrative officer listed as having been associated with the project throughout the GEF years, for his PLEC experience. However, he had very little idea of PLEC, saying that he had only been recently appointed to this position.

One other shortcoming of the project's biodiversity inventory was that although there was some farmer participation in the assessment, farmers at both Kiserian and Olgilai/Ngiresi had only a vague perception of what PLEC was doing in this particular exercise. Neither was there evidence of the result of these activities every being shown to farmers.

The most outstanding evidence of the impact of Tanzania PLEC on stakeholder involvement was clearly indicated at the Arumeru District level. Mr D.M. Rugangila, Head of the Arumeru District Agricultural and Livestock Office, who happened to just have been appointed Acting District Executive Director for Arumeru at the time of our visit, showed a good understanding and appreciation of PLEC ideas and methodology. The final report, however, noted that district councilors are still somewhat reluctant to allocate their scarce resource to fund PLEC-like activities.

At the national level, Dr. A.S.S. Bwana, the director of research for the Northern Zone, indicated that PLEC methodology for involving farmers in agrodiversity management (expert farmers for collaborative experimentation and transfer of technology) has a potential to serve the national agricultural intensification programme.

The evidence collected indicates there have been several training opportunities, including fruitful exchanges among farmers and between farmers and scientists, but the impact could not be assessed, except in the case of farmer-farmer interactions. The evidence for farmer-farmer interactions indicates they were strong and mutually beneficial, and likely to be lasting after GEF funding.

Dr A.S.S. Mbwana, Director of Tanzanian Agricultural Northern Zone (to which Arumeru belong) informed us of a project on Client Oriented Research Management, supported by the Government of the Netherlands, which has been initiated in the zone. Such capacity in farmer-farmer and farmer-researcher collaboration that have been built up the Arumeru District's agricultural research and extension institution and in the villages should be highly complementary to this and other farmer-centered efforts.

Opportunities for consolidation and follow-up

The two demonstration sites are representative of much larger areas in Tanzania and East Africa. About 60% of Tanzania is semi-arid and the rest is somewhat similar to the Mount Meru site. There is not only a need to increase land productivity in the

country, but also ample room for replication of farmer-farmer dissemination of the land use intensification techniques of PLEC. Start-up capital and resources to facilitate exchanges would be critical.

It would also be interesting to follow-up with an integrated watershed management project on the slopes of Mount Meru. The contrast between Mount Meru and Arusha National Park confirmed that the former still has an important fraction of its original biodiversity resources. Unfortunately, on Mount Meru human uses are threatening native biodiversity. The role of Mount Meru in providing water to lowland agriculture could also be jeopardized in the future is present trends continue. Collection of firewood and deforestation seem to be among the most important threats. Human occupation of the slopes seems to be increasing. Solving this problem is beyond the PLEC objectives, but is a much needed effort at this point. Integrated watershed management would have to deal with the delicate issue of zoning of Mount Meru for various uses, including conservation. Among the most important issues to be addressed in such a follow-up are the location of future settlements, types of activities to be carried out in the various zones, design and establishment of corridors, provision of alternative sources of energy and livelihoods for people occupying the land.

UGANDA

Summary

The work of PLEC in Uganda focused on the demonstration site at Bushwere village in the district of Mbarara. The area is dominated by banana, which is largely intercropped with various cultivated and semi-domesticated species. PLEC activities involved participatory experimentation on crop management practices and formation of farmers' groups. The groups acted more like cooperatives, with specific productive purposes and activities that were generally related to introducing local and introduced species into the landscape, including home gardening, producing tree seedlings for sale and raising cattle with zero-grazing, i.e. introduction of fodder species into banana gardens and other field types. There is a real danger that the project's encouragement of certain products for sale (milk, honey) may run into marketing problems that conventional extension services all over the world have faced. The milk glut that is already being felt in Mbarara suggests that the dairy enterprise could be the first to run into this problem. The farmers' groups became instrumental for farmer-to-farmer transfer of information and for negotiating with the government. PLEC ideas have been incorporated into teaching at Makerere University (where a new bachelor degree program has just started) and Mbarara University (which is using Bushwere for students' field work). Six graduate students conducted their thesis research under PLEC. Topics ranged from decision making in banana management, crop diversity and land management, diversity of banana, agroforestry potential in Bushwere and preferences for potato in Kampala. The PLEC work in Uganda will not end with GEF funding, as a proposal from Makerere University to continue and expand to test the ideas and methodology in other areas has been short listed for national funding. Although Uganda is a sub-cluster of the East African PLEC, there was limited evidence of functional linkages among the three sub-clusters, except for the one regional meeting in Arusha in 2001.

Process

The visit to Uganda by BR took place between May 4-8. This review is based on the site visit in Bushwere, Mbarara (May 5 –7), Makerere University and various government offices in Kampala. Project officers accompanying me during the review were Mrs Joy Tumuhairwe, Mr Charles Nkwiine, and Mr. Francis Tumuhairwe. Other project researchers were Mr John Kawongolo, Miss Pamela Busingye, and Mr John Ereng. At Mbarara I met Mrs Beatrice Byarugaba, District Agricultural Officer, Mbarara, Mr Yekonia Musigiwire, District Environment Officer, Mbarara, Mr Emmanuel Mpiirwe, Sub-county Agricultural Officer, Mwizi, Mr Christopher Gumisiriza, Country Agricultural Officer, Bushenyi. Farmers at Bushwere I met and whose fields were visited were Retired Lt. Fred Tuhimbisbwe and wife Rhoda, Mr James Kaare and wife Alice, Mr Wilson Ndyareeba, Mr Frank Muhwezi, Mr Serapio Kashaugirwe, Mr Felix Katungye, Mrs Katungye, Mrs Flora Tindiwaabo. At Makerere University I met a group of about 10 students from the new BSc programme in land use management.

Project implementation and impacts

PLEC work in Uganda was somewhat delayed by the need to co-ordinate within EAPLEC (East Africa PLEC), in which the three sub-clusters decided to work together on the common theme of "Developing sustainable agricultural systems in diverse and dynamic bio-physical and socio-economic environments".

The project started with three sites: Mwizi and Kabingo in Mbarara district and Rubare in Ntungamo district. These were to have represented the southern and western tall grassland/banana/coffee/annual zone (AEZ IV, Mwizi); pastoral semi-arid rangeland zone (AEZ II, Kabingo) and transitional zone between AEZ II and IV (Rubare). By the beginning of GEF phase Rubare had been dropped. Initial characterization involved a reconnaissance survey of covering an area of 5 x 50 km in Mbarara. A more detailed agrodiversity characterization of the transect was conducted in the form of 8 walk transects of 2 km each. The surveyed areas were then given scores for criteria that included agroecological zone (AEZ), accessibility, diversity of land use types and number of crop combinations. The village of Bushwere had the highest score in AEZ VI, with 16 crop combinations, twice as many as the rest. In AEZ II, Kamuri had the highest score, but with only 4 crop combinations. Bushwere was therefore selected as the demonstration site and Kamuri as the secondary site. However, all of the work reported, and so reviewed, was at Bushwere.

The Ugandan PLEC team conducted an extensive transect walk through the district of Mbarara, with detailed inventory of agrodiversity along the transect. Agrodiversity studies were conducted at the demonstration site at the village of Bushwere. These included a highly detailed soil and soil fertility measurement (understandable since Ugandan PLEC is staffed mainly by soil scientists), soil erosion, farmers' management practices (including management of biodiversity) and wealth ranking of the farmers. Analyses that would relate these physical data to the biodiversity data, however, are still to be done.

Six land use stages and 194 field types were identified. Agrobiodiversity inventories were made for 24 field types. An analysis of the biodiversity and agrodiversity data from the 24 field types was reported (Eilu et al, 2001), but there was no agroecological interpretation. PLEC scientists admitted that they have not been able to make any use of the "analysis". The Uganda sub-cluster produced many other reports of good quality, and assisted in documenting the work of two expert farmers (Retired Lt. Fred Tuhimbisbwe and Mr Frank Muhwezi) that was presented by the farmers themselves at the East African PLEC meeting in Arusha.

Occasional discrepancies in results presented in reports sometimes misled and distracted the reader from the papers' main messages. For example, Eilu et al (2001) reported that the field type with the highest species richness was "Banana pure", recording 118 species. The final report, on the other hand, stated, "*Banana-based field types had relatively less species diversity compared to other field types, due to clean culture management that is done in banana gardens. Weeds are normally removed as soon as they appear, and most farmers practice mulching. These practices limit the number and abundance of species*". Crop yields decline, a very important issue reported in Technical Report No. 6, started from the base period 1960-1969 with maize and millet were unrealistically high of 7-8 t/ha.

Expert farmers have been identified and have featured prominently in the project's participatory management. Farmers' experimentation and farmer-to-farmer transfer of knowledge appeared to be taking root in the village. In Bushwere I was shown several participatory experiments, one on erosion control in banana (to improve on the trench method introduced by an earlier soil erosion project). One young farmer has independently, with the aid of materials left from a PLEC collaborative experiment, completed elaborate experiments on storage and germination of several potato varieties. Another young farmer has constructed a storage facility for crops based on the PLEC design entirely on his own.

Although the project has acknowledged the importance of farmers' participation, many of its experimentation is still very much scientists directed, perhaps driven by the desire to help. To be seen pushing specific production activities such as home garden to improve food security may be quite harmless. However, there is a real danger that the project's promotion of certain products (milk, honey) for sale may run into marketing problems conventional extension services all over the world have faced. The milk glut that is already being felt in Mbarara suggests that dairy cattle and goats may be the first among PLEC supported commercial enterprises to face this problem.

Central to PLEC demonstration activities in Bushwere was the formation of farmers' groups. The groups acted more like cooperatives, with specific productive purposes and activities that were generally related to introducing local and introduced species into the landscape. They included home gardening, producing tree seedlings for sale and raising cattle with zero-grazing, i.e. introduction of fodder species into banana gardens and other field types. The zero-grazing and home garden groups are more concerned with increasing productivity of the land through mixed cropping.

The tree seedlings group, which is composed of six young couples, directly contributed to conservation of valuable local timber species that are becoming increasingly rare, such as *Omurama* (*Combretum sp.*) and *Omusha* (*Makhemia sp.*). The group was led by an enterprising young farmer. They also own a flock of goats, which were looked after by one member-couple, was paid wages for this service. The only thing that worried the reviewer about this particular group was the extra burden for the young wives who have walk for two hours, more or less everyday in dry weather, to fetch water for the seedlings.

Collaboration among farmers was probably the primary lesson from these farmers group. The farmers' groups became instrumental for farmer-to-farmer transfer of information and for negotiating with the government.

During implementation the project worked closely with the Mbarara District Agricultural Office. The field work was supported by district, county and sub-county officers. There were also contacts with staff from Mbarara University.

In its national decision makers workshop in Kampala in December 2001, a list of environmental and biodiversity policy recommendations were presented by the project. Dr. Festus Bagoora of the National Environment Management Authority

suggested that follow through activities would be essential for these to make real impacts at national level.

For education the PLEC lesson are already being institutionalized in a new degree program on agricultural land use and management. The first class of students have already enrolled, one came from Kenya. I was able to meet with a group of about 10 students and was most impressed by their interest in current land management issues of biodiversity, sustainability of land use and farmers' livelihood and so on.

Opportunities for consolidation and follow-up

The PLEC team in Uganda has already moved to consolidate and expand their work with a proposal entitled "Effects of market oriented and specialized agriculture on agro-biodiversity, household income and food security: a case study of Mbarara and Bushenyi Districts". On the day that I left to return to Kenya (May 9), there was an announcement in the local newspaper that the proposal made the short list of projects considered for funding by the Network of Ugandan Researchers and Research Users.

They have also planned to get together with the teams from Kenya and Tanzania in Dar es Salaam in July 2002 in order to prepare a joint proposal for East Africa to be submitted for funding. Not having been able to detect any interaction among the sub-clusters beyond the one single regional workshop in 2001, I would strongly suggest that the sub-clusters carefully consider all of the benefits and costs (in time as well as money) for the collaborative project.