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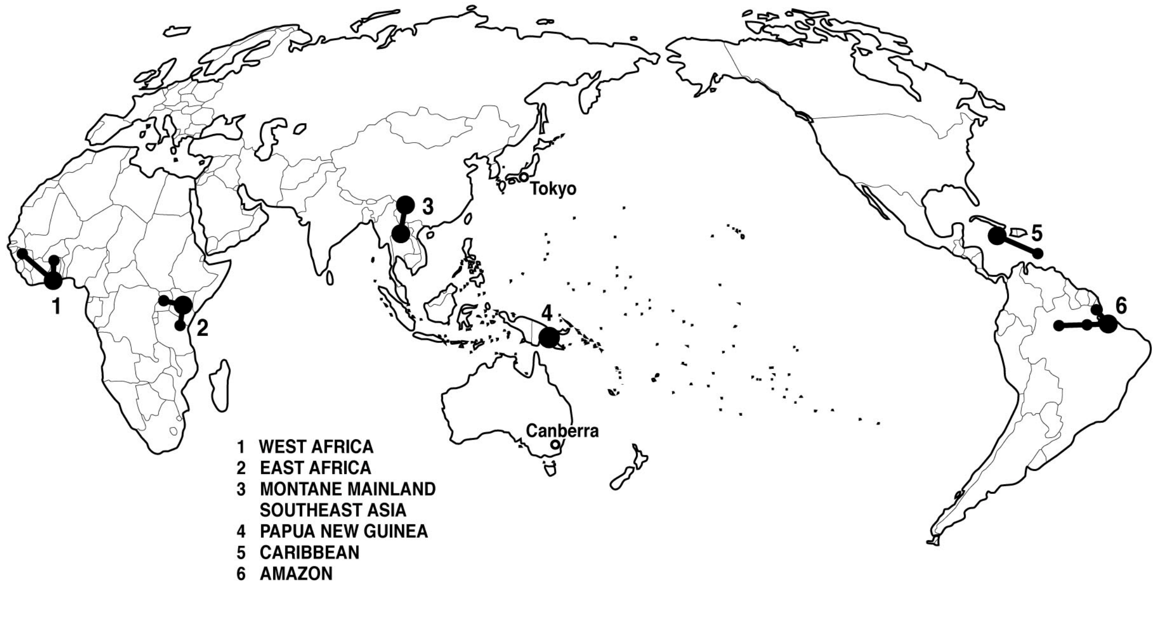

The clusters of PLEC

P L E C N E W S A N D V I E W S **No. 5, September 1995**

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FROM THE EDITOR: NEWS OF THE PROJECT AND THE CLUSTERS

PLEC AND THE GEF

The March issue reported completion of the Draft Project Document and its transmission to UNEP in Nairobi, which happened at the end of February. I followed it there in late March. PLEC had a generally good reception in UNEP, but the timing of our submission was too early from the point of view of presenting the project for funding to the Global Environmental Facility. The Pilot Phase of the GEF came to an end in 1994, but without getting a whole new set of policies into place for the Restructured Programme. The new Scientific and Technical Advisory Panel (STAP), replacing the old one, was not appointed until February. New strategies for the three main areas of GEF operation had reached only a preliminary phase, and the Biodiversity Strategy, in particular, would not be completed until later in 1995. The old policy on research within the GEF was no longer operative and a new policy will not be formulated until later in this year.

Moreover, some major changes in the format of submissions were made in November and February. The format in which we had prepared our document had become obsolete. An Executive Summary on lines laid down in November was fairly quickly prepared in late March and April, but will have to be modified to reflect a new format determined in early May. We have to realize that we are dealing with what is, to all intents and purposes, a new GEF Programme which is still determining its rules. There is, however, progress.

Padoch and Stocking visited a number of key people in UNDP (New York) and the World Bank (Washington) in April and May. They and the Coordinators met at Arima (outside Kobe) in Japan after the re-convened Global Environmental Forum in Osaka at the end of May. It was decided to delay submission until after the October GEF meetings, and to scale down some planned activities. The new schedule demands that we get full draft material to Nairobi by the end of October, then Uitto and I will follow it to Nairobi in November for final revision in UNEP. We are now finally revising the (shorter) project document, preparing new budgets to reflect revised GEF policy known to date, and to satisfy UNEP requirements, and drafting the required summary documentation. Some substantial work has already been done, in Canberra and in some of the Clusters.

The Project

Although central project work has been overwhelmingly concerned with the GEF application during most of the past few months, one major paper on methodology was written, initially for external use. It has been distributed to all Cluster leaders, and an adapted version, extracted from the original, is printed below. In April, final editorial work on the papers for the special PLEC issue of *Global Environmental Change* was completed, and the last papers were despatched to the journal in England in

May. The issue will appear about October.

A major event for the project as a whole is a second change in leadership of the Amazonia Cluster. The leader is now Profa. Dra. Tereza Ximenes-Pontes, Vice-coordenadora, Nucléo de Altos Estudos Amazônicos (NAEA), Campus Profissional Guamá Universidade Federal do Pará, 66.075-900, Belém, Pará, Brazil. Prof. David (Toby) McGrath, also of NAEA, remains deputy leader.

This issue of *PLEC News and* Views is prepared by the Project's own secretary in Canberra (Margaret Forster), rather than by the staff of the Department of Anthropology. It follows the same style, and benefits from the technical advice of the Department's staff. For reasons described above, it is being prepared to a rather tight deadline. Some matter which was promised cannot be provided in time, and will have to be carried over to the next issue. However, the opportunity is used to include four papers.

The Clusters

In their mid-1995 reports, and by other correspondence, several Clusters report substantial progress. Because of limited time and space, only one part of one of these reports is presented in the original form. The following summaries are prepared from Cluster material by the editor.

West Africa

The expansion of the West Africa Cluster, reported in the last issue, has been put into effect with small subgroups formed in central and northern Ghana (Kumasi and Tamale), and a larger group at Conakry, in the Guinea Republic. Although not yet fully formed, the latter reports completion of the first stage of a substantive research task in a watershed draining the central sandstone plateau of the Futa Jalon, carried out by five of its members. The area has about 7,700 people of Fulani (Puelh) ethnicity, practising mixed farming on an infield-outfield pattern. The well-tended and manured infields appear to be sustainably managed with considerable diversity. A lower-intensity shifting cultivation, mainly for fonio millet *(Digitaria exilis),* together with pastoralism, in the outfields is accompanied by severe degradation on the weaker soils. There is serious depletion of remaining woodland, for fuel wood and charcoal. More detailed inventories and inquiries are planned in the second half of 1995. (Report by Abdul Karim Barry, Alpha Abdoulaye Sow, Amirou Diallo, Ibrahima Sory Seck and Sékou Fofana).

The new group in northeastern Ghana has also prepared a preliminary report, setting out the main characteristics and problems of the region in which they propose to work. Although close to the Sahel climatically, with a mean of only 900-1,100 mm of rain, and high variability, the region has a high density of population, ranging from 50 to almost 200/km^2. Settlement is dispersed, with compound farms around homesteads and short-fallow cultivation outside. Cash cropping is limited and there is widespread poverty. Heavy pressures of production and shortage of land would seem to be having serious consequences in terms of land degradation. (Report by A. Sadik Abdulai and Saa Dittoh).

Most Ghanaian members of the Cluster met in Legon, Ghana, in May to review progress and plans. The Chief Director and two other senior members of the Ministry of Environment, Science and Technology were also among the participants, and so was Dr Bede Okigbo, Director of UNU/INRA and Scientific Advisor to PLEC. Papers were presented describing the ongoing research in southeastern Ghana, and also the preliminary work of the new groups in central and northern Ghana. Other papers reviewed aspects of methodology, and a general statement leading toward a Cluster methodology has since been prepared and distributed. One of the methodology papers presented,by Kojo Amanor, is printed (lightly edited) in this issue. A further meeting, to include a representative from Guinea, is planned to be held in November, possibly at Tamale in northern Ghana. The growing size of the West African group has presented some problems of organization, and as a first step toward resolving these Dr Lewis Enu-Kwesi has been nominated as deputy cluster leader. (Report by Edwin Gyasi).

East Africa

There has been substantial progress both in Kenya and Tanzania, but commencement of work in Uganda has been seriously delayed by difficulties in transmission of funds that were not resolved until June. The Cluster leader visited both Tanzania and Uganda during the first half of the year. Work in both Kenya and Tanzania has mainly been concerned with detailed site characterization, including sequential aerial photograph interpretation in Kenya. The Kenya group has spent two short periods working on selected sites in Kiambu District, an area of very high population density on which it was decided mainly to focus 1995 work. Work in Tanzania has covered three villages in Arameru District on the slopes of Mt Meru, an area exhibiting great variation in altitude, rainfall, vegetation, agriculture and population density. Densities range from 60-80/km^2 at 2,100 m to 100-200/km^2 at 3,800 m. Work has included characterization of household types, marriage, migration and mortality patterns. Preliminary findings suggest that agrodiversity diminishes with altitude, the upland villages having more specialized production; however, biodiversity increases with altitude, despite the higher population density.

The Cluster has received two visitors during 1995. Professor Elizabeth Thomas-Hope, leader of the Caribbean Cluster, spent a few days with the Kenya group after a conference in Nairobi, which she attended. In June, Dr Bede Okigbo, Scientific Advisor, visited the Kenya group to discuss the place of biodiversity in Cluster work, and its relation to work on soil quality. Both visitors were taken to field sites.

A major review and planning meeting of the whole Cluster, to be attended also by Michael Stocking (Principal Scientific Advisor), will be held at the start of 1996. (Report by Romano M. Kiome).

Montane Mainland Southeast Asia

The principal activity during the period has been the Workshop described below. Both Subcluster groups have continued field work at chosen sites, and in Thailand an additional site among Lua/H'tin villages in the remote Nan Province, practising traditional rotational shifting agriculture, has been inspected. The Yunnan group has commenced work under its grant from the MacArthur Foundation which, while primarily in western Yunnan (Baoshan), also includes a biodiversity protection initiative in the border areas of China, Myanmar and Vietnam. They were visited at Baoshan by Christine Padoch in January. The Thai group has had to face the problem that, since Thailand has not yet ratified the Convention on Biological Diversity, they cannot be included in the first phase of the GEF application. They have therefore actively been seeking other funding. (Reports by Kanok Rerkasem and Guo Huijun).

Papua New Guinea

The ongoing programmes of both Japan-based and Australia-based groups have continued, using their funds from Japanese and Australian sources respectively. The Australian group, and their PNG collaborators, have now completed all main field research for their three-year study of agricultural systems. A paper describing this methodology is printed in this issue. The Japanese group, mainly through their students, has continued their programme of demographic and nutritional studies.

The main use made of PLEC-supplied funding has been to support the new work of Graham Sem and his students on 'fallow' successions in Papua New Guinea, and its integration as a core element in the total

PLEC programme in the country. Sem visited Canberra for five months to review literature, and has now returned to the University of Papua New Guinea (UPNG). During the balance of 1995, funds will be used to place two UPNG fourth-year students in the field, where they will be visited by Allen and Sem. Sites chosen will be determined in association with Ohtsuka, and will most likely be associated with those studied by two Japanese postgraduate students. Sem will himself work on a third site, where a party of undergraduate students will be trained by Sem and Allen. (Reports by Ryutaro Ohtsuka and Bryant Allen).

The Caribbean

This is a first report from the Caribbean Cluster, formed in 1994. A meeting to plan work was held in Jamaica on 24-27 November 1994, with two intended members from the Dominican Republic. Unfortunately, one of these latter soon afterward left his university, resulting in the decision to defer development in the Dominican Republic. The remainder of the Cluster, which includes Janet Momsen, Scientific Advisor to the Project, decided to focus its main attention during 1995 on basic survey in Jamaica and on an island in the eastern Caribbean. There would also be emphasis on the effect of global economic prescriptions (especially affecting the market for bananas and sugar) on small farmers, their livelihood and their land. During the first part of 1995 the Jamaican subgroup developed this programme by documentary research.

A meeting in the eastern Caribbean in June was attended by three members of the Cluster. The meeting provisionally selected field sites in both parts of the region and, using RRA methods, will conduct initial field work between August and the end of the year. The object of field work will be to establish field methods for the study of agrodiversity and biodiversity, deforestation and erosion, and the uses and potential value of 'idle' land and its vegetation. Population and migration will also be studied, and there will be emphasis on gender and generational comparisons. (Report by Elizabeth Thomas-Hope).

Amazonia

There has been a good deal of activity in Amazonia, notwithstanding the change in leadership mentioned in the general section above. One group has withdrawn but has been replaced by another, working in the upper Amazon and based at Iquitos, Peru. There has been field research in the Estuary project at Macapá, the Delta project at Abaetetuba, and in the Middle Amazon project near Santarém. An important new aspect has been networking among the sub-projects to exchange experiences. The deputy leader visited Mamirauá, now separated from PLEC, early in the year for an evaluation, and was able to draw important lessons from the experimental agroforestry work done there with assistance from members of the Várzea project. In February-April, work at Ituquí in the Middle Amazon included completion of census work, covering seasonal migration. Miguel Pinedo-Vasquez of the Estuary project visited for several days, and assisted with the development of participatory research involving the fishermen's union, other grass-roots organizations and the farming/fishing people. Also in the Middle Amazon, an experimental programme is now under way examining the relationship between aquatic plants and fisheries, and changes in comparative biomass arising from pressures from commercially grazed cattle and water buffalo. A fuller report describing these new developments will appear in the next issue. (Report by David McGrath).

REPORT ON A WORKSHOP ON AGROECOSYSTEMS AND BIODIVERSITY IN MONTANE MAINLAND SOUTHEAST ASIA

Kanok Rerkasem and Guo Huijun

Introduction

At the MMSEA Cluster meeting held in November 1994 it was proposed that a main 1995 activity should be a workshop, held largely in the field in both regions, to exchange and familiarize team members with the methodologies normally used in each area, and to harmonize and improve these methodologies within the PLEC framework. An additional purpose would be to train new members of the Cluster. This workshop was held between 30 May and 13 June 1995, in northern Thailand and Yunnan (Xishuangbanna). In Chiang Mai, a Hmong village (Pah Poo Chom), where the Thailand group has already begun work, was selected for the field site. In Xishuangbanna, the villages were a Jinuo village (Baka) and a Dai village (Man Zhang). These are sites where student members (Guan Yuqin and Cai Kui) are already working. This report presents brief results of the workshop and, at the same time, also describes activities at the chosen villages.

The session at Chiang Mai and Pah Poo Chom ran from 30 May to 3 June, with one night spent in the field. Fifteen Thai, one Vietnamese and five Chinese participants attended this part of the workshop, together with Geoff Humphreys (Australia), invited specifically to advise on sustainability and soil-surface management questions. The Yunnan session began on 7 June and quickly moved to the Xishuangbanna Tropical Botanical Garden, which remained the base until 12 June. There was a final session in Kunming on 13 June. There were 19 Chinese participants, with four from Thailand and one from Vietnam. Three Chinese (Guo Huijun, Dao Zhiling and Cai Kui), four Thais (Kanok Rerkasem, Jamaree Chiengthong, Laxmi Worachai, Kwanchewan Buadaeng) and one Vietnamese (Bui Thai Tam) attended both parts of the workshop. In each region the group divided itself into three teams, concerned respectively with sustainability, biodiversity, and coping strategies.

Workshop results: Chiang Mai session

Research Methods

Papers formed part of the programme principally in Chiang Mai. The first session was devoted to discussions on methodologies which have been used in the Cluster. These are agroecosystem analysis (AEA), rapid and participatory rural appraisal (R/PRA) and biodiversity assessment. The AEA has been focussed on the village system with emphasis on livelihood diversity and system sustainability (Rerkasem and Rerkasem 1995). This links closely to the proposed new methodologies on (a) land use sustainability and (b) farmers' coping strategy, presented respectively by Geoff Humphreys and Chayan Vaddhanaphuti. Geoff discussed the strength and weakness of the Framework for Evaluating Sustainable Land Management (FESLM) and suggested that the workshop participants might consider an hierarchical analysis of land-use systems from the field at the bottom up to the farm, the watershed or landscape and the national or regional levels (e.g., Lowrance et al. 1986, Izac and Swift 1994; Brookfield and Humphreys 1994). Discussions led to suggested indicators for sustainability assessment.

Chayan Vaddhanaphuti and Kwanchewan Buadaeng presented concepts on farmers' coping strategies. They define 'coping strategies' as farmers' ability to deal with or manage the changes. It is the ability that is created or re-created by a group of farmers in responding to the changing environment and socio-economic conditions in order to sustain their living and social relations. (Vaddanaphuti and Buadaeng 1995). A number of coping strategies have been proposed such as diversification, regeneration technology, labour exchange or common land management. A model of farmers' coping strategy has been suggested for field testing. On assessment of biodiversity, Guo Huijun and Chusie Trisonthi proposed a format for rapid field assessment which suggested ways to combine rapid appraisal with transect survey and on-site community plot investigation. Dao Zhiling also proposed an ethnotaxonomic approach for biodiversity assessment.[1] After the paper sessions and a briefing, the workshop moved into the field.

Pah Poo Chom (Hmong village)

The major changes in Pah Poo Chom may be listed as follows:

- 1959: Hmong people resettled in a forest area near the Department of Public Welfare (DPW) headquarters. Wage income from tea picking in a nearby plantation.
- 1960: Moved close to the present Pah Poo Chom site but settled on the peak of the mountain. Adopted extensive shifting cultivation and opium growing.
- 1962: Relocated at lower Pa Sang site.
- 1972: Paddy and irrigation development with assistance from the DPW.
- 1980: Commencement of large Development project (World Bank support). Opium reduction and introduction of alternative cash crops, e.g. Lychee.
- 1983-4: Moved to the present site in a small valley. Stopped opium cultivation.
- 1985-present: Introduction of cabbage and successful expansion of production on a commercial scale.

The land-use group concluded that soil erosion does not appear to be a problem at the local scale, though it has been observed in some patches, especially on steep slopes. Lower fields seem to benefit from deposition. Chemicals are increasing, P and K fertilizers and herbicide in particular. Mechanisation is also increasing and use of 4-wheel tractors for ploughing is not uncommon. Crop intensification is rapidly taking the form of simple structure of mixed cropping of lychee as a canopy crop, with vegetables or traditional crops grown underneath, but the sustainability of this is uncertain. There seems to have been some economic advantage of lychee growing, i.e., early harvests (April- mid May) and hence good price even if the quality is relatively low, juicy and sour. However, there are also agronomic problems with lychee, not yet fully understood. On a larger scale, increasing demand for irrigation water may lead to negative impacts on the watershed as a whole.[2]

On biodiversity, a transect survey shows that in the forest, the tree coverage is rather poor, estimated at <20 percent. Understorey growth is also very poor. Only 26 species can be counted. There is a need to know about forest management in the past. Who used the land and how? What

[1] A paper derived from these presentations will appear in *PLEC News and Views* No. 6 in March 1996. So far, little study has been attempted and research has been carried out on a fairly limited area (e.g., Guodong 1992 and Xu Zaifu and Hongmao 1994).

[2] There is a need for mapping of land use and monitoring land use changes. Existing maps e.g., road construction mapping, forest mapping etc. have yet to be found. If aerial photographs taken during the World Bank project in 1980 can be discovered, it may be worthwhile to find out the possibility of taking aerial photos of the present land use, in cooperation/coordination with the RFD and the Air Force.

were the purposes? In the orchard, 24 species (crops, weeds and wild plants) were counted. *Mimosa invasa is* abundant. In the swidden fields, sample plots of 10 m x 10 m were marked in a 20-year fallow. These plots contain 11-13 species of trees and about 24 species of understorey plants. There is a need to establish the changes in biodiversity. Comparative approaches might be used, e.g., sampling biodiversity from natural forests (with scattered rock) or less disturbed habitats.

The Coping Strategy group has been able to identify potentials and limitations of the local people in terms of value systems, indigenous knowledge, resources, local community networking and/or organisation and external support. The Hmong have been conventionally labelled as 'pioneer' shifting cultivators but now can manage sedentary systems with prospects of sustainability. The Pah Poo Chom case may offer the opportunity to find out the social learning and interactive processes which enable them to practise permanent cropping or forest protection and watershed conservation. A number of specific research questions on indigenous knowledge of biodiversity, the design and management of the permanent agroecosystems and local land tenure have been raised.

Workshop results: Yunnan session

Discussions in Kunming

As a number of Chinese participants had not attended the Chiang Mai part, brief presentations and discussions on field methods were repeated on the first day. In this session, the Chinese participants came from a wide range of institutes in Yunnan and Xishuangbanna, suggesting possibilities for widening the interdisciplinary team. Official participants provided invaluable background information on the land use and forest policies. From the immediate point of view of the workshop, the most significant information was on the relatively new forest land-use policy or Liangshan Yidi. This is based on stabilisation of forest rights, delineation of private mountain land, and delineation of contract mountain land. Each family may own 2-5 mu of private mountain land, which cannot be leased or sold. Liangshan Yidi is intended to increase access to natural forests, through contract or private tenure.

Baka (Jinuo village)

In Baka, some of the major events and changes were as follows:

- Before Liberation in 1950: traditional shifting cultivation with communal arrangements.
- 1953-64: Individual land ownership and exchange labour systems.
- 1964: Commune system; production plan enforced, communal land ownership.
- 1965: Production teams formed, with own work plans.
- 1972: Moved from natural reserve to the present village site; paddy development and irrigation supported by government.
- 1983: Land allocation for individual households (use-right).

The people of Baka were from a remote area on the mountain, and resettled in two different sites (including the study village). However, not all the people from the original site moved. Some 30-40 households stayed and have grown up to 45 households. About 50 households moved out to the new sites. The study village has now grown up to 53 households and is located near a main road. Government support for paddy development appears to be one of the major incentives for relocation of the Jinuo in Baka. Traditional shifting cultivation provided inadequate rice for household consumption. Moreover, wet rice production was intensified by the adoption of high yielding hybrid rice, but when government price support for the hybrid seeds was removed, poor households could not afford to buy them. The villagers are currently buying rice from other villages. Land use has changed rapidly towards short fallow periods, and to permanent agriculture. Recent commercialisation has led to rubber monoculture on the hillslopes, where it is rapidly replacing traditional crops in shifting cultivation fields. Woodlots have been established for household use, i.e., fuelwood and timber. Non-timber forest products are now sold to outside markets. Baka people have been able to negotiate with the foresters to use natural reserve land for the production of Chinese Cardamom *(Amomum villosum)* for cash income.[3]

New cash crops have been introduced, e.g., passion fruit, which is expanding rapidly, but depends on a single fruit factory in the nearby town. Success in crop diversification depends on the ability of the local people to identify an appropriate ecological 'niche' for specific crops, i.e., rubber on the uplands, passion fruit at lower elevation in the shade close to water supply and near the village, and Chinese Cardamom grown under forest. The dynamics of land-use change in Baka will be a major investigation task. Baka farmers do not apply any chemical fertilizers on the upland fields. Preliminary assessment of soil fertility ranges from very poor (laterite soils) to moderate. Soil depth varies greatly. The distribution of soil types is highly diverse in patches and local people understand the variation very well.[4]

Local technical knowledge has contributed to the design of the new systems but the processes of system reconstruction have yet to be investigated. There are a number of unsustainability risks associated with the land-use changes (e.g. economic risks in passion fruit production or government price support in rubber, losses of biological diversity in monoculture of rubber plantation, and genetic erosion in traditional food crops). The trade off between intensification of land for higher productivity and land use sustainability will have to be investigated. The traditional land management of the local people is largely unknown and should be explored further. This study may have to be extended to cover the original sites where the older generations could provide the information from their past experiences.

Man Zhang (Dai village)

Man Zhang in Dai literally means elephant village (or Ban Chang in Thai). The village has been settled recently, in 1963 when a few households from a nearby Dai village (Man'e) decided to move to the uplands to open up new land for living. The village population has now grown to 22 households. Livelihood activities have now expanded to cover rice production from paddy, water melon and vegetables as major cash crops after wet season rice, and traditional food crops from shifting cultivation fields, e.g., upland rice, maize, cotton, peanuts and beans. Rubber plantation is also expanding. The local people keep large numbers of livestock, i.e., buffaloes, cattle, pigs and chickens, but they are currently using walking tractors to plough the paddy fields. Young members of the family also go to work for the service sector in town.

The village is located near the buffer zone of a natural reserve, and government has taken their cardamom in the forests. Therefore, cardamom production is on a very limited scale with no opportunity for future expansion. The Dai in Man Zhang

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3 The evaluation of Chinese Cardamom under agroforestry systems in this village has been described by Guan et.al. 1995.

4 *Chromolaena odorata* is abundant everwhere when management pressures are released. The role of *Chromolaena odorata* in swidden succession may help to build up soil fertility during the fallow periods. However, if land use intensification increases, its ecological function may be disrupted.

appear to have better external contact and networks than some other villages. For example, the labour exchange system for rice production is organized between villages. As production has moved towards commercialisation, wage labour systems are adopted for production of cash crops in the dry season or in rubber plantations. Farmers in Man Zhang make heavy use of chemical fertilizers, without which water melon would not give fruit of reasonable size for the external markets. Paddy land was officially claimed to cover a total area of about 32 mu (1 ha = 15 mu) but the area observed during the field walk is much larger. A village land-use survey is planned in the near future.

Intensification in the use of paddy land is prominent. It relates to the high rate of hybrid rice adoption and multiple cropping, with rice as the main season crop and watermelon or vegetables for the dry season. The proportion of hybrid rice is currently over 80% of the total planted area. Farmers are facing water constraints in the dry season. Moreover, fertilizer subsidies have been reduced. Some farmers have already introduced chilli to replace water melon, because less water and fertilizer are required. Further development of surface irrigation water is possible but the potential impact on downstream villages has to be recognized. As at Baka, the area of rubber expands rapidly and competes with shifting cultivation fields. Another significant factor in intensification is good access to information. Unlike the Jinuo group (Baka), not officially recognized before the 1970s, the Dai of Man Zhang enjoy access to government support and extension services.

More details are needed to elaborate the historical changes in Man Zhang. As forests have been declared natural reserve, the extent to which villagers still depend on forest products has yet to be known. On the whole, villagers say that their livelihoods have improved greatly for the past 15 years. Attempts to evaluate land use sustainability in Man Zhang have to await understanding of historical changes and 'big events' which have happened. More intensive interview and survey or mapping of the village are required. Land tenure, allocation and arrangement have to be better understood. For example, inability to use the buffer zone seems in contrast to the Liangshan Yidi and unexpected.

Future plans

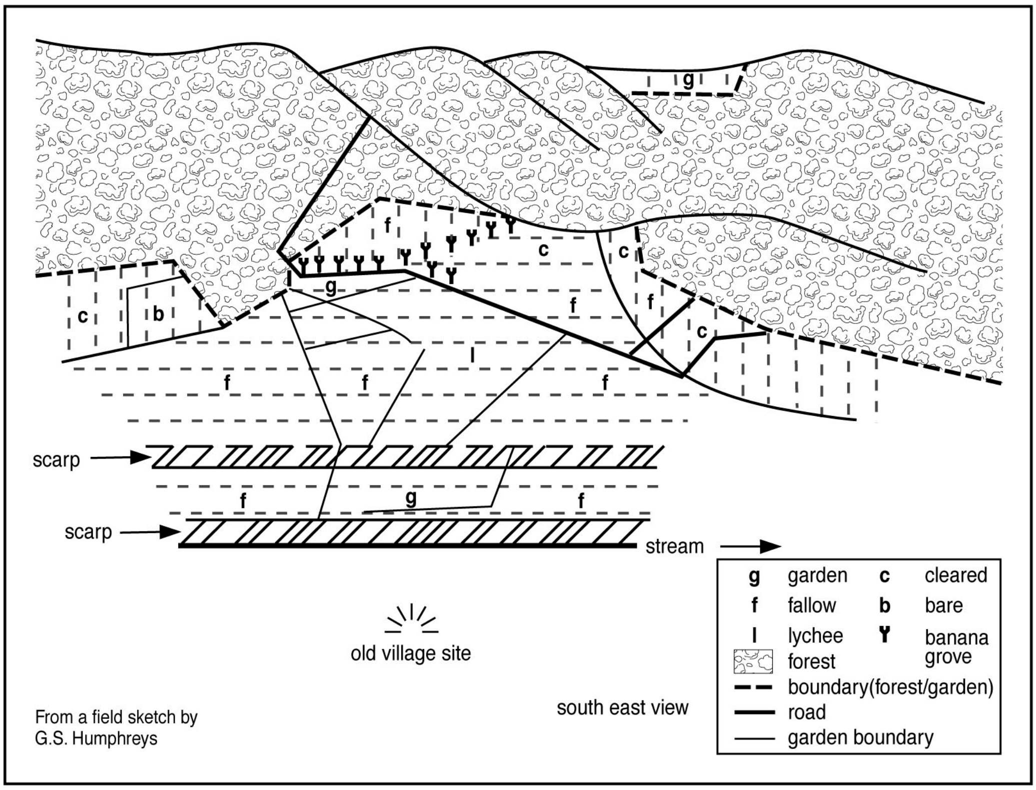
All papers and most diagrams presented at the meeting will be published, in Chiang Mai, together with a more complete version of this report. It was agreed that the common methodological focus should be on three main areas. The first of these is land use sustainability. It will involve study of historical land-use systems and changes, paying attention to the major events in the modern histories of both regions. This will lead on to studies of productivity, and of particular stresses identified in the preliminary phase. The second focus will be on biological diversity assessment in different land-use types, including the use of biodiversity, and social aspects of management in the wild. There will also be emphasis on indigenous knowledge of biodiversity, and its role. The third focus will be on farmers' coping strategies with emphasis on changes in land management, especially the transition from swiddening to permanent farming. The future of the cash economy is embraced within this focus, as also is social inquiry in the villages, and on indigenous practices and knowledge. In all three focus areas lessons will be drawn from cases both of apparent success, and apparent failure.

References

Brookfield, H. and Humphreys, G.
1994 Evaluating sustainable land management: are we on the right track? *Proceedings of the 15th International Congress of Soil Science*. Acapulco, Mexico.

Dao Guodong.
1992 *Some historical culture of Dai*. Beijing: Ethnic Press.

Guan Yuqin, Dao Zhiling and Cui Jingyun
1995 Evaluation of the cultivation of Amomum villosum under tropical forests in Southern Yunnan, China. *PLEC News and Views* 4: 22-28.
Izac, A-M N. and Swift, M.J.
1994 On agricultural sustainability and its measurement in small-scale farming in sub-Saharan Africa. *Ecological Economics* 11: 105-125.
Lowrance, R. Hendrix, P.F. and Odum, E.P.
1986 A hierarchical approach to sustainable agriculture. *American Journal of Alternative Agriculture* 1: 169-173.
Rerkasem, K. and Rerkasem, B.
1995 Montane mainland Southeast Asia: agroecosystems in transition. *Global Environmental Change* (in press).
Vaddhanaphuti, C. and Buadaeng, K.
1995 Farmers' coping strategies. Paper prepared for the MMSEA/PLEC Field Workshop on Agroecosystems and Biodiversity in Montane Mainland Southeast Asia. 31 May 1995. Chiang Mai.
Xu Zaifu and Liu Hongmao.
1994 Approach on the relationship between indigenous botanical knowledge of Dai and rural sustainable development in Xishuangbanna, Yunnan, China. Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences.



PAPER FROM THE SCIENTIFIC COORDINATOR

THE METHODOLOGY OF PLEC

(Adapted from a note written in June 1995)

Harold Brookfield

PLEC is an 'integrated core project', bringing together the guided work of six 'Clusters' of scientists for common aims in targeted, action-oriented research on the management of biodiversity and the land. By thus combining sub-projects distributed across the tropics and sub-tropics, the work of each is given greater global significance, and the whole networked product will be greater than the sum of the parts. The basic capacity building task is to equip developing country professionals and practitioners with the tools they need to deal with an increasingly complex mandate. This mandate now involves national economic development, livelihoods of the poor and disadvantaged, and environmental protection, as well as longer-term conservation and biodiversity issues. The latter issues, in the context of sustainable welfare for small-farming populations, are the principal area in which PLEC methodology is applied.

Use of the knowledge and experience of participants

The six PLEC Clusters include three which brought substantial ongoing work into the Project (Southeast Asia, Papua New Guinea, Amazonia), and three in which all PLEC work has been designed since their formation, though there is substantial background in related work (West Africa, East Africa, the Caribbean). All contain experienced as well as more junior scientists, and students. All Clusters are multidisciplinary, with both natural and social scientists working together. Disciplines represented include anthropology, botany and ethnobotany, soil science, agricultural science, geography, resource economics, sociology, and others. Among the 75 scientists involved in PLEC are several who have a wide international reputation for expertise in particular fields of relevance. One important objective of PLEC is to share this expertise and transfer the knowledge to the younger workers and students. At the same time, through *PLEC News and Views,* through meetings, and with the aid of the Scientific Advisors, it is planned to introduce all participants to methods and approaches to research, monitoring and measuring that are at the cutting edge of international research on small farmers, their agricultural systems, and their management of land and biodiversity.

The question of scale

Management of biodiversity and the land in agricultural areas calls for ability to research the problems, monitor the situation, and analyse problems and potential solutions at a range of scales. The regional or landscape scale is appropriate both for initial reconnaissance and final generalization, but this must be supplemented by more detailed analysis at chosen sites. Establishment of the wider framework calls on a number of methods, including rapid rural appraisal, interpretation of satellite imagery and aerial photographs, as well as the systematic determination of agricultural system characteristics. More detailed work also calls on participatory rural appraisal and the use of transects. It leads to the determination of particular sites for closer study, whether representative, or presenting critical problems. Work at still finer scale, that of the small catchment, field or patch, is required for measurement of biodiversity, soil fertility status and trends, erosion, and management.

At the present formative stage of PLEC certain Clusters are already concentrating efforts on particular communities, while others are advocating prolonged use of survey methods over 100 km^2 areas. While these contrasts to some degree reflect differences in landscape complexity and population density, a priority task must be to develop a common method of proceeding from landscape to community level, and in turn to specific measurement at patch, field or landscape unit level, and then of assembling results so as to generalize at landscape level. This applies equally to those areas of relevance that are amenable to natural science approaches, and to those requiring social science approaches.

The problem of wider scale versus depth is common to all forms of work on land resource management. Academics commonly use a recursive approach that takes time. PLEC does not have this luxury, and must establish a set of replicable methods quickly. One guiding principle has to be the use of short-cut methods that will achieve reliable results without serious loss of scientific rigour. Two such have been proposed or discussed in previous issues of *PLEC News and Views* (Stocking, 1994, Elwell and Stocking, 1983; Zarin, 1995). Another is elaboration of the transect method used in agroecosystem research. A fourth is use of 'participatory environmental monitoring' in which particular indicators, selected both by observation and enquiry, are used to build up a reliable general view of trends that can be used as it stands, or form the basis for more detailed inquiry into ‘rural people's knowledge' (Leach and Fairhead, 1994, pp. 89-93). In all these areas, PLEC has to develop both the successful combination of observation with inquiry that must form the core of a replicable methodology, and also test this by longer-term on-the-spot inquiry in depth. In the present design, most of the latter work will be done by students under supervision, but more senior team members, in particular anthropologists and geographers, human ecologists and ethnobotanists, also have an important role to play.

Multiple working hypotheses

One of PLEC's principal objectives is to provide a rational assessment of the causes of trends in resource management and environmental change within the areas chosen to exemplify its method. Without an understanding of causes, no intervention is likely to be successful. In several areas, recent work has shown that prevailing conclusions about environmental degradation and its causes rest on incorrect assumptions, even about the speed and direction of environmental change itself. Conclusions about the effect of human interference which disregard the sensitivity and resilience of the natural system are very likely to miss the mark. 'Conclusions' that growth of population density is the central determinant of past, ongoing or threatened future degradation, are often based principally on assumption. Such assumptions are thrown into question by several modern studies which have demonstrated environmental enhancement, through improved management, under marked increases of population density (e.g. Tiffen, Mortimore and Gichuki, 1994; Leach and Fairhead, 1994). If PLEC is to contribute to improved policy formulation, knee-jerk generalizations of the former kind must be avoided.

The approach being advocated to our Clusters is that of 'multiple working hypotheses'. Given observation of a state and its apparent trend, the first task is to test the reality of that trend, first by use of the historical record of aerial photographs and, where available, written accounts by officials and travellers, and then by participatory enquiry among the people. Once a trend is established, whether or not it is the trend that was initially supposed, the major task then becomes that of enumerating all possible causes as hypotheses, and testing these. Hypothesized causes may include external interference of several kinds, catastrophic climatic events, and wider changes in land cover, as well as internal trends in population, land tenure, income inequality, and management practice. In modern times, commercialization is everywhere a major force. Although mainly in a natural science context, an excellent and well-illustrated statement on 'multiple working hypotheses' is provided by Cooke and Reeves (1976).

Rational paths by which each postulated cause can impinge on the quality and success of land management then need to be set out. Each path must then be explored, and elaborated as required. In many small-scale cases, the effect of one explanatory path may be overwhelmingly obvious, but on a regional level this may be far less clear. Commonly, in fact, contributions from multiple causes will all be recognized, though not in equal proportion. Where this happens, there is an important conclusion for policy, in that intervention in one part only of the system is likely to be ineffective. However, close inquiry may also demonstrate that farmers adapt to large and complex changes, and the most proper intervention is to assist them in this process rather than impose external coercion.

Farmers' adaptations and use of knowledge

Pilot work within and around PLEC, and work in other areas, is demonstrating that farmers' knowledge and skills are not a static inheritance from the past, but are in constant change as new pressures emerge, and new sources of information are evaluated. Adaptive innovation in farming is as old as agriculture itself, and indeed is responsible for the great variety of farming systems, and micro-level variation within them, that exists in the world. In regard to biodiversity, most farmers not only possess an extensive knowledge of its range, but they also manage it. Their indigenous efforts to do so are often at least as effective as are external science-based interventions e.g. Haverkort and Millar, 1994).

Faced with degradation and its consequences, farmers who are free to do so often experiment with ways in which to manage its consequences, and reverse the trend. Some fail, but others enjoy a measure of success (e.g. Amanor, 1994). One of PLEC's most basic working hypotheses is that farmers' adaptations and the knowledge on which they are based could be successful, if societal conditions permit and assist. The study of, and search for, farmers' adaptations and innovations is thus central to PLEC methodology, and inquiry into the knowledge on which these are based, and its sources, is thus a major task. Equally, as a policy-oriented objective, it is important to identify those societal conditions that permit and assist successful adaptations. PLEC hopes to give farmers' knowledge and practices an equal place with the findings of external science in the search for sustainability with conservation. However, recognition of a problem by farmers may well be a necessary condition for innovation. If outsiders see a problem, but farmers do not, it does not necessarily mean that the farmers are wrong. Moreover, they may see quite different resource problems from those identified by outsiders. In a few fortunate cases, the solution to both farmers' and outsiders' problems may coincide, but this is not all that common. Successful intervention demands that the farmers' problems be thoroughly understood. (See also Amanor, this issue.)

Working with farmers

Certain of our Clusters are working very closely with farmers' groups, to the extent that farmers are already full participants in an agenda that is designed with their collaboration. Others do not yet have this close relationship, and for still others the necessary farmers' groups and community groups do not exist as bodies with which they can work. Their main target areas, therefore, have to be the extension services and local leadership, rather than the farmers themselves. To all, the linkage between farmers, the local leadership, and the extension services are of major importance in policy guidance. Closely exploring these connexions, PLEC can provide concrete inputs to project design for rural development.

For some Clusters, an important part of the plan of work includes experiment, on farmers' land, with crops and methods identified as most promising from among the farmers' own stock. In only four years, we shall not be able to equalize this inequality between the Clusters, but it is none the less possible to reduce it. Strong support is therefore given to experimental initiatives.

While these activities have obvious national benefits, there is also a major global benefit in demonstrating that close participation with farmers whose own problems, methods and adaptations are the topic of interest, is a feasible strategy. Experimentation in collaboration with farmers is also a feasible international strategy both for conservation and sustainable development. Indeed, since most of the global conservation problem lies in agricultural and pastoral areas, a strategy of collaboration with farmers is by far the most promising for world-wide use. Development and demonstration of this strategy is therefore central to our method.

Science and policy formation

Scientists are well aware of the importance of 'multiple working hypotheses' but a lot of applied science makes scant use of them. A culture hostile to spending on basic research often prefers to assume that the answers are all known, and that all that is needed is to find ways of getting them adopted. Modern work on small farming should already have shown the importance of farmers' own methods and adaptations, but findings are slow to seep through to places where they most matter. Unfortunately, many scientific institutions in developing countries tend to be behind the cutting edge of thinking in many areas. They lack contacts, good libraries, and a constant flow of information. One of PLEC's major tasks is to remedy this situation in Cluster areas, and thereby encourage testing of alternative hypotheses which challenge prevailing wisdom. PLEC needs, through networking, to support and encourage the excellent intellects that are available among and around our membership. Major benefits to the donor agencies in terms of project design will flow from such empowerment of our Clusters, in making a strong future contribution to conservation with development.

References cited

Amanor, K.S.
1994 *The New Frontier: Farmers' Response to Land Degradation, A West African Study*. Zed Books, London.

Cooke, R.U. and Reeves, R.W.
1976 *Arroyos and Environmental Change in the American South-West*. Clarendon Press, Oxford.

Elwell, H.A. and Stocking, M.A.
1983 Developing a simple yet practical method of soil loss estimation. *Tropical Agriculture 59: 43-48.*

Haverkort, B. and Millar, D.
1994 Constructing diversity: the active role of rural people in maintaining and enhancing biodiversity. *Etnoecológica* 11 (3): 51-64.

Leach, M. and Fairhead, J.
1994 *The Forest Islands of Kissidougou: Social Dynamics of Environmental Change in West Africa's Forest-Savanna Mosaic*. IDS, Brighton, U.K. Report to ESCOR of the ODA.

Stocking, M.A.
1994 Assessing erosion quickly and (hopefully) cleanly. *PLEC News and Views* 3: 17-21.

Tiffen, M., Mortimore, M. and Gichuki, F.
1994 *More People, Less Erosion: Environmental Recovery in Kenya*. John Wiley, Chichester, U.K.

Zarin, D. J.
1995 Diversity measurement for the PLEC Clusters. *PLEC* News *and Views* 4: 11-21.

ANNOUNCEMENT

MONTANE MAINLAND SOUTHEAST ASIA IN TRANSITION
A Regional Symposium in Chiang Mai, Thailand November 12-16,1995

This international symposium has grown out of a suggestion that a group of researchers at Chiang Mai University might get together with colleagues from Vietnam and the Yunnan Province of China to share experiences about a common concern on sustainable upland resource use. Interest was shown by government, NG0s, and academic researchers and practitioners who share a common focus on environment and development issues in the upland areas of Thailand, Yunnan Province of China, Laos, Myanmar, Vietnam and Cambodia. In consequence, this intended informal gathering has now become a collaboratively organized symposium with an expected international attendance of about 120.

UNU and PLEC are two of the many groups which have provided support, intellectually, in the form of programming and papers, and financially for travel cost of participants, as well as assisting the publication of proceedings and the MMSEA-Agenda, a brief booklet to provide an outline of the region, its development trends, opportunities, and emerging problems and research and support needs. The agenda is expected to provide a guidance for a wide range of future activities within the region. The programme so far contains 35 papers. Contributions to the programme from PLEC include papers by Christine Padoch, Xu Zaifu, Guo Huijun and Michael Stocking, as well as by Chiang Mai members.

The symposium is being organized by the CMLI-consortium, a collection of research groups within Chiang Mai University, in collaboration with a number of national institutions, namely, the Chinese Academy of Science/Kunming, Institute of Rural Economy of Yunnan Academy of Social Sciences and the Vietnam Upland Management Working Group, Thailand Development Research Institute and CARE International - Thailand. International institutions include Ford Foundation, East West Center, World Resources Institute, United Nations University, International Institute on Environment and Development, Southeast Asian Universities Agroecosystems Network, Centre for International Forestry Research, International Centre for Research in Agroforestry, SAMUTE.

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PAPERS BY PROJECT MEMBERS

AGRICULTURAL SYSTEMS IN PAPUA NEW GUINEA PROJECT: APPROACHES AND METHODS

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Introduction

This paper presents the approach and method of the Papua New Guinea Agricultural Systems Project, run from within our department with national collaborators. The project is producing information on small holder (subsistence) agriculture at provincial and national levels. Information is collected by field observation, interviews with villagers and reference to published and unpublished documents. The information is entered into a computer database (dBase IV), from where it can be transferred to a mapping program (ARC/INFO). From ARC/INFO, maps and data are transferred to the PC based mapping software MapInfo, in the form of a GIS for PNG users. The scale of field mapping is 1:500,000.

Project objectives are both applied and theoretical. Information generated will be applied to practical problems such as the estimation of the contribution of staple food crops to the national gross domestic product and the description of agro-ecological zones in order to better allocate scarce national research resources. Agricultural systems will also be assessed vis-à-vis their physical environments in order to estimate their stability and sustainability, in the face of rapidly increasing demographic and socio-economic demands. Sustainability implies a successful and on-going adaptation to changed environmental and socio-economic onditions. Sustainability also implies a system has the capacity to withstand short term environmental, demographic or social shocks such as droughts, periods of unusually high rainfall, labour migration or epidemics. The information being assembled will be especially important in any assessment of the impact of a potential epidemic of HIV/AIDS in PNG.

At a theoretical level, the Project is investigating the evolution of agricultural systems from low intensity systems to high intensity systems. It is hypothesized that intensification occurs in response to a demand for increased production which originates primarily from increasing social and economic differentiation, and secondarily from population increase. As production increases and land is used more intensively, environmental changes occur that necessitate changes in agricultural technology. These may demand more labour per hectare than previous less intensive techniques, or may bring about changes in the relations of production and in gendered labour patterns. Increased involvement in urban fresh food markets and increased demand for consumer goods is the modern counterpart of pre-colonial involvement in competitive exchanges of food and in trade networks.

Essential elements in the assessment of the sustainability of contemporary agricultural systems are an understanding of how intensification takes place, how present systems are adapted to their environments, the numbers of people they are supporting, and an estimate of how long they have been functioning. Ideally, research into agricultural systems should be longitudinal and take place over periods long enough to monitor changes as they occur. In reality, funding for long term research is extremely difficult to find and few institutions are prepared to commit themselves to programs of a sufficient length. An alternative is a cross-sectional study, supplemented by historical air photography, archaeological and palynological investigations, documents, and oral accounts of change.

The Papua New Guinea Resource Information System (PNGRIS)

Data from the Agricultural Systems project are designed to be integrated with data held within the Papua New Guinea Resource Information System (PNGRIS). PNGRIS is a PC-based database and GIS (FoxPro and MapInfo) which contains information on the natural resources of PNG (Bellamy 1986). However PNGRIS contains no information on agricultural practices, other than an assessment of land-use intensity based on air photograph interpretation by Saunders (1993), and a program concerned with predicted crop performance. For this reason the Agricultural Systems database contains almost no information on the environmental settings of the systems, except for altitude and slope. The layout of text descriptions, the database code files and the village lists are modelled on PNGRIS, because users in PNG are already familiar with information presented in this format.

The mapping of agricultural systems has been carried out on the same map base and scale as PNGRIS (the World Tactical Pilotage Chart, 1:500,000), and mapping within the areas of agricultural land use established by Saunders (1993) from aerial photography. Except where specifically noted, agricultural systems boundaries have been mapped without reference to PNGRIS Resource Mapping Unit (RMU) boundaries. Agricultural systems are defined at the level of the Province (following PNGRIS) but their wider distribution is recognized in the database by cross-referencing systems which cross provincial borders.

The PNGRIS database, the Agricultural Systems database, and GISs have been linked to enable movement from one to the other. From selected RMUs, it is possible to access information on the agricultural system which occur within those RMUs, and from selected agricultural systems it is possible to access information on physical environmental measures, such as soils or rainfall, in the RMUs which occur in those agricultural systems.

Identification of agricultural systems and subsystems

An agricultural system is identified when a set of similar agricultural crops and agronomic practices occur within a defined area. Six criteria are used to distinguish one system from another:

1. Fallow type (the vegetation which is cleared from a garden site before cultivation).
2. Fallow period (the length of time a garden site is left agriculturally unused between cultivations).
3. Cultivation intensity (the number of consecutive crops planted before fallow).
4. The staple, or most important, crops.
5. Soil fertility maintenance techniques (other than natural regrowth fallows).
6. Garden and crop segregation (the extent to which crops are planted in separate gardens; in separate areas within a garden; or are planted sequentially).

Where one or more of these factors differs significantly and the differences can be mapped, then a separate system is distinguished. The measures of significance differ between factors, but are carefully defined and documented. Nevertheless, the defining of systems is not an entirely objective or mechanistic process. It is undertaken by discussion and debate between three very experienced principal researchers, and is based on field observations; interviews with farmers; and the spatial distributions of all the factors. It is certainly not undertaken by a computerized classification program. The reasons behind the definition of each system are documented and included as a text field in the database.

A subsystem is identified where variation occurs, but is not able to be mapped at 1:500,000 scale because the areas in which the variation occurs are too small or are widely dispersed within the larger system. Subsystems within an agricultural system are allocated a separate record in the database.

Methods

Prior to fieldwork, existing published and unpublished literature is reviewed and base maps of agriculturally used land are prepared (see below). Field traverses are planned with topographic and population distribution maps, so that all major concentrations of rural populations are visited. Along these traverses current gardens and fallows are inspected and farmers are interviewed in their gardens, to obtain information on features that cannot be directly observed. The most difficult information to collect is that relating to fallow and cropping periods. Farmers are helped to estimate the length of the fallow period of their present gardens based on the present age of the previous user, if still alive, or the ages of children now living when the site was previously cultivated. Important historical events are also used to estimate fallow lengths.

Information is collected systematically on 44 variables, the most significant of which are described below. Both notebooks and a pre-prepared field-form are used to capture information. Probable or possible boundaries of agricultural systems are located on the base map and on topographic maps at a scale of 1:100,000. Photographs are taken to document the outstanding characteristics of each system. Approximately six person-weeks are scheduled for fieldwork in each Province.

Following fieldwork, the large number of field-forms are examined against the tentative system boundaries created in the field. At this stage considerable discussion takes place over whether or not agriculture in some areas is similar enough to that in other areas for both areas to be included in a larger system, or dissimilar enough for a separate system to be created. The field photographs and the literature are used extensively during this process. Finalized system boundaries are added to the digitized base map, and data entry completed for all systems. Text descriptions of the systems and notes of outstanding features are included in the data entry.

At the completion of a provincial survey, the database is published as a *Working Paper*. The *Working Paper* presents the data in basic English text and as numeric codes. Also presented are listings of villages by census codes, alphabetically and by Agricultural Systems identification numbers. Some additional information is included from the National Nutrition Survey of 1982/83. The families included in the survey were asked about foods they had eaten during the previous day.

The Agricultural Systems Database

Information on agricultural systems is stored in the database, one record per agricultural system (or subsystem where identified) and 109 fields per record. A number of fields identify the agricultural system and its location, using National Population Census codes and a Papua New Guinea-wide four digit number. ***Districts*** and ***Census Divisions*** are also included. The lowest and highest ***altitudinal extent*** of the system is recorded, as is the ***slope*** of gardens in the system (in four classes from flat to very steep).

A description of the quality of the information is given, including details on areas visited, the length of time spent in different areas, traverses undertaken, the mode of transport used, the month and year of the survey.

The database also includes the ***area*** occupied by each System, in square kilometres (the figure is calculated by the mapping program ARC/INFO).

Crop components

The most important staple food crops grown in the system are recorded. A ***dominant staple*** *is* defined as a crop estimated to cover one-third or more of the staple garden area, and therefore no more than 3 dominant staples may be identified for a system. An important exception occurs when sago is the staple. Sago is extracted from palms which are not cultivated in gardens. A ***subdominant staple*** *is* defined as a crop estimated to cover more than 10 percent of a staple garden area; up to six crops may be listed.

Staple crops are mostly root crops including various species of taro (*Colocasia esculenta* and others), sweet potato (*Ipomoea batatas*), yam (*Dioscorea* spp.,), 'Chinese' taro (*Xanthosoma sagittifolium*), cassava (*Manihot esculenta*), and potato (*Solanum tuberosum*). Other staple crops include banana (*Musa* cvs), sago (*Metroxylon sagu*), breadfruit (*Artocarpus altilis*) and coconut (*Cocos nucifera*).

Up to 10 important **vegetable crops** are recorded. These are mainly greens, in particular *Abelmoschus manihot*, *Amaranthus* spp., *Rungia klossii*, *Gnetum gnemon*, *Oenanthe javanica* and choko leaves (*Sechium edule*). Also grown are winged bean (*Psophocarpus tetragonolobus*) and the common bean (*Phaseolus vulgaris*); grasses (*Setaria palmifolia* and *Saccharum edule*); corn (Zea *mays*); pumpkin (*Cucurbita moschata*); and peanuts (*Arachis hypogaea*).

Up to eight important ***fruits*** are recorded. These include sugarcane *(Saccharum officinarum); the* oil-bearing pandanus *(Pandanus conoideus);* and *a* number of tree species. Important ***nuts*** and ***narcotics*** are listed, including two nut pandanus species (*P. julianettii* and *P. brosimos),* betel *(Areca* spp.) and tobacco *(Nicotiana tabacum).*

Many of the important food crops have been introduced from the Americas, most within the last 100 years. Although sweet potato was introduced at least 250 years ago and perhaps earlier, the important varieties now are more recent introductions.

Arrangement and sequencing of crops in *time* and space

Observations are made on the arrangement of crops within and between gardens, on when they are planted during the year, and on particular repetitive sequences of planting of crops. The ***seasonality of main crops and other crops*** are measures *of* whether the dominant staple crops, the subdominant staples, and other crops and vegetables are planted at about the same time each year. ***Garden segregation*** and ***crop segregation*** refer to whether individual staple food crops are planted in different gardens, or in different parts of the same garden. A garden is defined as a contiguous area of land planted with crops under the management of a social unit such as a family or *a* household. ***Crop sequences*** occur when the harvesting of one crop species is regularly followed by the planting of another, eg. yams followed by sweet potato, or sweet potato followed by peanuts followed by sweet potato. If crop sequences occur repetitively, and one of the crops is leguminous, they are also classed as ***legume rotations.*** Another garden type is the ***household garden*** which is typically small relative to the main gardens and is located near houses, and contains a variety of crops. Household gardens are also known as door-yard or kitchen gardens.

Fallow clearing practices

The most common method of clearing fallow vegetation is ***burning****.* This measure includes the burning of material which has been heaped, and the frequency of burning relative to the cropping intensity. Burning is considered to be 'very significant' if the majority of the fallow material cleared from the site is burnt at the initial clearing of a garden, and only one or two plantings are made before fallowing. If a large number of plantings are made before the next long fallow, with little or no burning between plantings, burning is considered to be of ‘minor' importance.

There are a number of areas in Papua New Guinea where felled fallow vegetation is not burnt. In some areas, crops are planted beneath standing vegetation, and the ***fallow vegetation is later cut down onto the growing crops****.* Variations on this practice are: to fell all the vegetation and to plant through the uncleared debris into the soil beneath; to place the felled vegetation into heaps on specially constructed hurdles that are later used for the planting of particular nutrient demanding crops; or to plant crops beneath the canopy, and to gradually expose the crops to increasing sunlight as they mature by progressive clearing of trees. These practices are associated with high rainfall areas.

Soil fertility maintenance techniques

The presence and significance of a number of agronomic techniques to assist in the maintenance of soil fertility, other than the use of a long fallow, are recorded. They include: ***legume rotations****,* usually peanuts or winged bean, between plantings of main food crops; the use of ***short fallows*** of less than 12 months between plantings; ***planted tree fallows*** in which tree species (eg. Casuarina spp.) are planted into gardens or fallows for the stated purpose of improving soil quality during subsequent cultivations - this measure excludes the relatively common practice of planting fruit tree species into gardens and fallows, but does not exclude the planted trees being used for timber or firewood; the ***use of compost****,* which is the placing of organic matter, usually dried weeds, sweet potato vines and grasses, beneath the surface of the soil into which crops are planted; and the ***use of mulch****,* which is the application of organic material to the soil surface.

Mounds and beds

In addition to these techniques, the soil is formed into circular mounds or raised beds of varying dimensions and crops are planted on them, in many parts of Papua New Guinea. Mounding is not to be confused with composting. Mounds may or may not contain compost and composting may take place in the absence of mounds. Mounds are usually re-formed at each new planting. The following types of mounds are recorded: ***very small mounds*** up to 10 cm high; ***small mounds*** 10 to 40 cm high, ***mounds*** 40-70 cm high and between 1m and 2.5m in diameter, and ***large mounds****,* more than 70 cm high and 2.5m in diameter.

Two shapes of beds are distinguishable: ***square beds*** are constructed by digging shallow ditches typically 2m to 4m apart on a grid layout, and throwing the soil removed onto the surface to form a bed. The outcome is a characteristic 'chequerboard' or 'grid-iron' pattern in gardens. ***Long beds*** are constructed by digging shallow ditches down slope, typically 2m to 4m metres apart, and over 10m in length, and throwing the soil removed to the centre to form a bed.

Other agronomic techniques

A number of other particular techniques are considered important and are recorded. ***Soil tillage*** is the breaking up, or turning over, of the whole or the major part of the soil on the garden surface. The measure includes tillage in either the first planting and/or subsequent plantings. The ***placing of pigs in gardens*** between plantings is practised for a number of reasons: to eat earthworms, to eat unharvested crops, or to till the soil. This measure excludes the deliberate breaking of fences to allow pigs to forage after the cropping phase, immediately before a long fallow. An associated, but generally unimportant technique is the placing of ***animal manure*** on or in the soil. This excludes deposition of manure by the animals themselves, such as tethered pigs, a technique mainly confined to house or kitchen gardens. The use of machines, hand tractors and motorized tractors as a form of ***mechanical soil tillage*** occurs in a very limited number of places.

Other activities

A number of other activities do not fall easily into any broad category. They relate to overcoming environmental constraints at a site; improving crop production; producing crops of a culturally desired shape and dimension; and to the presence of wild pigs or management of large numbers of domestic pigs.

Drains are commonly used in and around gardens to remove surface water or to lower the ground water table.

Island beds are beds of soil on which crops are planted and which are raised above the level of a surrounding area of standing or slowly moving water.

Irrigation is used less commonly, mostly in highly seasonal environments during a long dry season.

Stakes are used, including trellises or standing dead trees, to lift crops off the soil surface. This practice is usually applied to yams *(Dioscorea* spp.*),* beans and sugarcane, and sometimes gourds, cucumber and choko. Banana trees are sometimes tied to stout poles to prevent them failing under the weight of the fruit.

Deep holes are sometimes used in yam cultivation in order to grow exceptionally long tubers for competitive exchanges. Deep (> 50 cm) holes are dug, the soil is broken into a fine tilth and the hole re-filled before planting. This technique is usually restricted to the cultivation of *Dioscorea alata.*

Fences (linear barriers made of wood, bamboo, cane grass or stones, which may incorporate a ditch or a bank) are used to exclude or control the movements of pigs and people. The measure excludes low ridges which form between fields when stones are thrown to the perimeter during cultivation. In the assessment of the significance of fences, the occurrence of fences around every individual garden is given greater significance than one fence around a large number of gardens.

Inorganic fertiliser records use in food gardens and excludes the use on cash crops, such as coffee or vegetables.

Fresh ***silt from flooding*** contributes to soil fertility. It is assumed the flooding is of natural causes, but the measure does not exclude deliberate manipulation of stream channels in order to enhance the delivery of silt, or for the partial control of flood waters.

Soil retention barriers (pegged logs, fences or hurdles, stone walls) are sometimes constructed along the contour or below individual plants on steep slopes, in order to prevent or reduce the down slope movement of soil, a measure which can be viewed as fertility maintenance.

Population data

The ***total population resident*** within the area covered by the System at the time of the 1980 National Population Census is recorded (the 1990 National Population Census figures are not used because of questions over their reliability, but the 1990 National Population Census maps are used to locate most Census Units). An estimate is made of the proportion of the ***population absent*** from villages in the system in 1978-79, expressed as a percentage of the total population.

The ***population density*** (persons per square kilometre in 1980) is calculated from the area and total population figures.

There are two situations where adjusted figures are given: in some systems sago is the staple food and there is little or no agriculture; or subsistence is based completely on non-agricultural activities (eg. fishing or trading) and no agricultural land use can be identified. For these systems the area has been adjusted to include a 5 kilometre buffer strip around the system boundary, or centred on settlements where no land use is identified. The 5 kilometre buffer zone is assumed to be the area of non-agricultural land, usually forest, in which wild plants and animals are exploited. In the latter case, settlements are identified with point symbols.

The second kind of adjustment occurs where the populations of two adjoining systems, both of which use both systems, are unequally distributed between the two system areas due to the locations of the census units.

Land use intensity

Measures of the intensity of land use are based on two measures. The ***long fallow period*** is an estimate of the length of time (greater than 12 months) land is left to revert to regrowth, before it is cultivated again (in four classes: not significant, 1 to 4 years, 5 to 15 years, and greater than 15 years). ***Cropping intensity*** is the number of times staple crops are planted in the main gardens before those gardens are returned to a long fallow (in six classes: 1 planting only, 2 plantings, 3 to 5 plantings, 6 to 14 plantings, 14 to 40 plantings, and more than 40 plantings).

From these data an index of ***intensity of land*** *use is* calculated, based on Ruthenburg's R-value, the ratio of the cropping period in years to the length of the cultivation cycle in years. Cropping period is estimated from the number of plantings of the staple crops before a long fallow and the cultivation cycle is the sum of the cropping period and the long fallow period.

The **predominant *type of fallow vegetation cleared*** from garden sites at the beginning of a new period of cultivation is recorded (in eight classes: short grass (eg. *Imperata cylindfica <1.5 m tall*); tall grass (eg. *Miscanthus* or *Saccharum >1. 5 m tall*); grass and woody regrowth (*dense short or tall grass and short woody regrowth*); short woody regrowth *(shrubs and trees <10 m tall*); tall woody regrowth (*trees >10 m tall*); forest (*forest with no indication of previous use*); no long fallow; and savanna (*scattered woody growth with grass ground cover))*. Where short fallows less than 12 months long are used between plantings of important crops, fallow type refers to the vegetation cleared after a long fallow.

Cash earning activities

The importance of a number of rural cash income earning activities carried out by people living within the system is noted. Those included are sources related to agricultural or land based production from the farmers' own resources. They include the sale of ***animal products*** such as skins, furs and bird plumes; ***betel nut, cardamom; cattle,*** as live beasts or as fresh meat; dried ***chillies; cocoa*** bean; ***copra*** and nuts from coconut palms; ***Arabica coffee*** and ***Robusta coffee;*** freshwater or salt water ***crocodile products*** such as skins or meat from managed and wild animals; ***firewood;*** fresh or smoked, freshwater or salt water ***fish,*** shellfish or crustacea; ***fresh food*** such as vegetables, fruits, nuts and fresh or smoked meat from domesticated or wild animals; ***oil palm;*** Irish ***potato;*** dried ***pyrethrum*** flowers; ***rice;*** latex from ***rubber*** trees; ***sheep*** as live animals, meat or wool; unprocessed ***tea****;* and dried ***tobacco*** leaf. ***Other*** products are occasionally sold and these include copal gum *(Agathis sp);* massoi bark *(Massoia aromatica);* tigasso oil *(Campnosperma* sp); salt extracted from plants or natural springs and deposits; mineral oil; bêche-de-mer; insects and butterflies; live birds, marsupials, pigs and horses; house building materials including thatching and sheets of woven cane; canoe hulls; clothing; weapons; string bags; carvings; and artefacts. This category excludes other sources of cash income such as wages and salaries, logging or mining royalties, gold mining, banditry, gambling and remittances.

Applications outside of Papua New Guinea*

The methods described here are applicable in any area in which forest, bush and grass fallow agriculture is practised. They are immediately applicable in Vanuatu, where a similar database to PNGRIS (known as VANRIS) already exists, and to other Melanesian areas such as Irian Jaya, the other half of the island of New Guinea in Indonesia, and the Solomon Islands. They would be extendable with little adaptation into much of upland Southeast Asia, in particular Eastern Indonesia, Kalimantan, Sumatra and much of upland Java. Extension into many parts of Africa would also be possible with minor changes.

Figures 1 and 2 (pages 24-25). These two figures represent selected data extracted from the surveyed material, in both cases diagnostic of more intensive practices. The two Provinces shown lie across the central mountains from north to south, including sparsely-peopled lowlands, uninhabited high mountains and the densely-peopled intermontane valleys.

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Working papers

A list of the 11 working papers that have so far appeared is available but cannot be reproduced here for want of space.

References

Bellamy, J. (ed)
1986 *Papua New Guinea Inventory of Natural Resources, Population Distribution and Land Use Handbook.* CSIRO Division of Water and Land Resources, Natural Resources Series No. 6, Canberra.

Brookfield, H.C. with D. Hart
1971 Melanesia: a Geographical Interpretation of an Island World. Methuen, London.

Ruthenberg, H.
1980 Farming Systems in the Tropics. Oxford University Press, London.

Saunders, J.C.
1993 *Agricultural Land Use of Papua New Guinea* [map with explanatory notes]. Scale 1:1 000 000. PNGRIS Publication No. 1. CSIRO, Brisbane.

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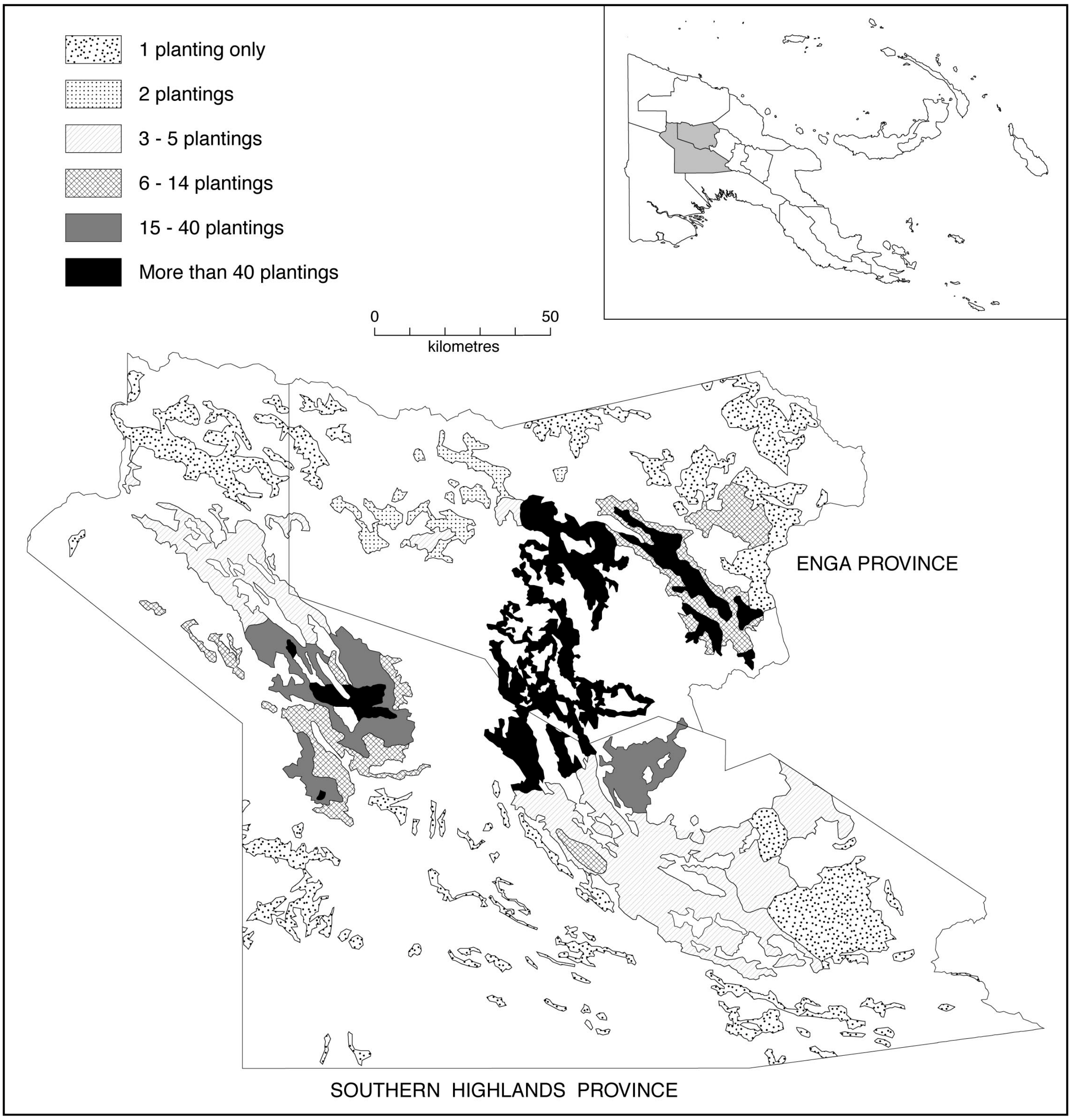
Figure 1:

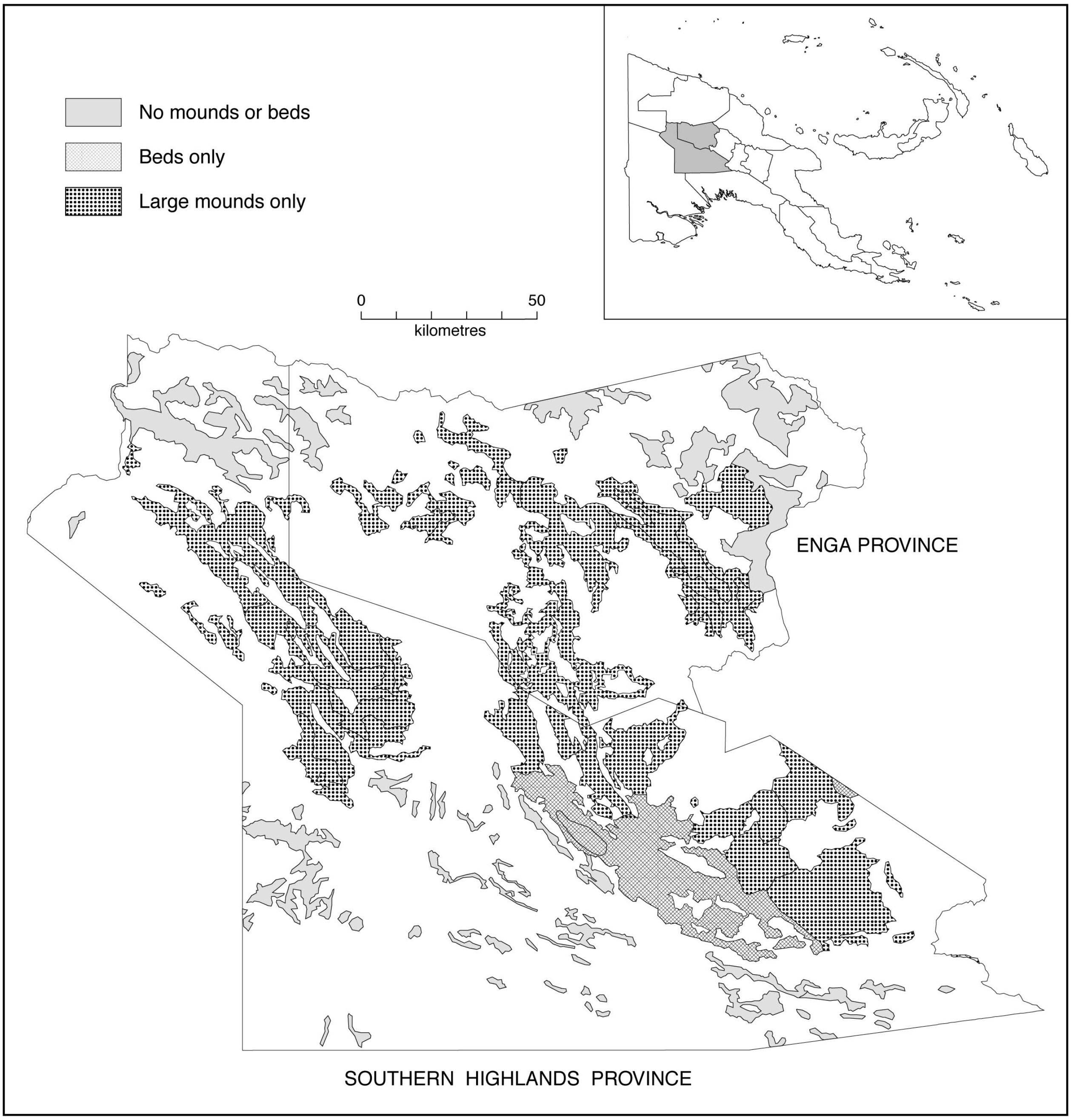
Number of plantings before a long fallow, Enga and Southern Highlands Provinces.



The continuous cultivation of sweet potato occurs on colluvial terraces and valley floors, in drained swamps and on a high altitude plateau, in these most western highlands Provinces. Short fallows are used between crops. They vary from 3-6 months between 1600 and 1800 m to over 12 months over 2200 m. These intensive highlands sweet potato systems are associated with pig to person ratios greater than 1. Until recently local group political relationships were based upon large scale pig exchanges.

Figure 2:

The use of mounds and beds, Enga and Southern Highlands Provinces.



Intensive sweet potato production in the western highlands is closely associated with use of large mounds. These are filled with green compost, dry grasses, old vines and weeds, before being closed. Mounding appears to have been invented in Enga Province and to have spread west and south into the Southern Highlands over the last 150 years. The adoption of mounding involves a major step away from bush and forest fallowing into continuous cultivation in grasslands.

INDIGENOUS KNOWLEDGE IN SPACE AND TIME

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Introduction

The knowledge and perceptions which rural communities hold about the environment will determine their relationship to the environment, and their capacities and willingness to engage in activities which will ameliorate environmental degradation, or enable people to adapt to changing conditions. Failure to understand popular perceptions of the environment, and experiences of degradation, may lead to failure in the design of 'green technologies', if these do not take local farming styles, and the objectives and strategies of farmers, into consideration. Farmers have considerable knowledge of local conditions and microenvironments, which often elude scientists who tend to aggregate data or abstract models from them. Farmers' knowledge often constitutes a science of the concrete or an art of the locality, a dynamic system of interaction between people and the environment in which responses are continually made to changing conditions, and knowledge is continuously updated as adaptations are made and remade.

Indigenous knowledge is often supposed to be traditional - old knowledge rooted in antiquated customs and ways of doing things which ignorance and apathy prevent rural people from overcoming. However, there is nothing traditional about the farming systems of West Africa, which have shown dynamic ability to adapt crops from the New World and create new varieties which have become an integral part of popular culture. This includes food crops such as cassava and maize, as well as more recent export crops such as cocoa. Farmers have themselves found ways of adapting these crops to fit into the local agroecosystems, and of integrating them into indigenous cropping patterns.

One example comes from the late Sam Asare Mate Kole, a senior agricultural officer who served at Cadbury Hall, and was instrumental in inspiring my own interest in agriculture. During the early colonial period farmers planted cocoa 8 ft (2.44 m) apart. The Colonial Agricultural Department decried this as too close, following recommendations for a 12 ft (3.66 m) spacing worked out in Trinidad. It was, however, found that 12 ft was too wide for Ghana, and that 8 ft was the ideal distance at which cocoa would form a canopy shading the soil. The much maligned farmer, castigated as practising forms of agriculture which constituted robbery of the soil, turned out to be right. This knowledge arose from no long familiarity with cocoa, but from ability intuitively to apply ecological principles grasped through long observation, interaction and experiments with nature.

Policy makers and government services often dismiss the ecological knowledge of farmers, and advise them to give up their 'backward ways' and follow modern methods of farming. However, modern agriculture has hardly established a good record in Ghana. Large state farms such as the Ghana Oil Palm Development Company at Kwae, and the Branam, Ejura and Wenchi state farms, stand out from the surrounding mosaic of small farms by the extent of land degradation on their enterprises.

In a recent book on the history of world technology, Pacey argues that African technology has made great contributions to modern science. He writes:

> The greatest technical expertise of many African cultures has been the survival technology they have developed to cope with the especially demanding environments. Recognition of the possibility of a dialogue between this fund of expertise and western agricultural science has come very late, after tremendous ecological damage has been done by inappropriate techniques, unbalanced development and population growth, but still offers more hope for the future than any pretence about the transfer of unmodified western technologies (Pacey 1990, p. 205).

Following Paul Richards (1985), he sees that a growing appreciation of the dynamics of traditional African agriculture is beginning to shift the whole paradigm of tropical agriculture away from monocropping and 'soil and water engineering' approaches toward greater understanding of ecological principles, integration of trees with crops, and farming systems with the ecosystem. How ironic it is that our policy makers and experts in agriculture continue to decry those very principles now found to be of great value on the frontiers of science, and instead promote old and worn theories and technologies!

Indigenous environmental knowledge

Two types of environmental knowledge can be found in rural agricultural communities. The first consists of ritual knowledge, in which custom sanctions and regulates activities in such a way as to preserve the environment. This may include regulations which prohibit fishing during a particular season, which prevent the felling of certain sacred trees and plants, or involve the protection of sacred places from cultivation or other human productive activities.[1] In the early 20th century, the oil palm tree was considered sacred among the Krobo, and before a tree could be felled for making palm wine an elaborate series of rituals had to be performed.

While such rituals may protect the environment, no environmental consciousness is articulated with them. Thus sacred groves are not protected specifically for ecological preservation, but often because they are ancient burial grounds or historical sites. It is for researchers to presume or project an articulated environmental consciousness onto these activities. Moreover, in the modern period many of these customs have become outmoded and no longer influence daily practice. *Akpetishie* distilling is now a major enterprise in Krobo, and no one performs any rituals before felling oil palm trees for tapping palm wine.

Approach through 'custom' will therefore not get us very far. Detailed understanding of indigenous environmental knowledge must proceed from the conscious environmental knowledge that is associated with the processes of production, work, and transforming the environment. In studying this knowledge, researchers need to be careful not to project their own environmental biases and prejudices. Environmental knowledge should not be equated with present global (western) concerns about environmental conservation. It should be formulated in a broad, neutral way to embrace all knowledge about nature and ecology, which people use to achieve production goals.

Indigenous knowledge in time

In an epoch when population density is very low, and people are concerned with moving into the hostile frontier of new forest,

[1] Some sacred trees protected include *odii* (*Okuobaka aubrevillei*) and *ahomakyem* (*Spiropetalum heterophyllum*). Before farmers can collect any part of these trees for medicinal or other use they must first perform an elaborate series of rituals which include pouring of libation and sacrifice of eggs.

ecological knowledge will not be involved with conservation. It will be concerned with ways of manipulating natural processes, to enable people to settle within the forest and transform it into an agroecosystem (Amanor 1994). The types of ecological knowledge which will emerge relate to methods of farming which will minimize on labour, and will enable agriculture to develop while preventing rapid soil erosion, destruction of the root mat, and depletion of organic matter. The development of cocoa farming involved sound ecological principles of intercropping the orchard crop with shade-tolerant food crops (plantains, bananas, cocoyams [taro] and cassava), and with an upper storey of shade forest trees. But this took place within an overall strategy which stressed minimal labour expenditure and extensive farming practices, involving rapid penetration of the forest, and heavy use of accumulated soil fertility. As population density began to build up, frontier land ceased to be available and pressures led to land degradation. Farmers began to evaluate their farming strategies. Faced with mounting problems of weed control, declining soil fertility, and build up of pest populations, some began to hark back to the golden days of the frontier when real forest land existed.

For some, at least, this process of revaluation may result in a conscious effort to preserve elements of the past environment which were considered a blessing, including attempts to preserve certain species of trees to shade out grassy weeds and halt the spread of bush fires, to conserve woodlands, and activities to ameliorate the environment and encourage forms of forest/woodland regeneration. The negative impact of land degradation on livelihoods encourages farmers to develop new strategies based on ecological principles of which they are aware. This revaluation mirrors scientific ecological thinking. In both formal science, and in popular production activities, may be found trends which lead to unsustainability, and also new trends which aim for a more balanced exploitation of the environment.

Historical dimensions

Farming practices which define the ways in which ecological knowledge is applied are likely to change in relation to transformation in the conditions of production. Farming knowledge is not static. Therefore it is important to understand the changes in farmers' perceptions and the directions in which knowledge is moving. This can be achieved in different ways:

1. Through interviewing old people on conditions in the 'old times', how things have changed, and significant events which were associated with change. This could involve changes in vegetation, weed associations, cropping systems, crop yields, weeding work loads, availability of land and hiring arrangements, gender division of labour, labour exchange and hiring of labour, and in general how people felt about agriculture in those times. Care must be taken not to engage in romanticism of the 'old days', in producing a catalogue of how everything has changed for the worse, and encouraging informants to engage in a kind of thinking which neatly fits an environmentally alarmist ideology.
2. Through interviewing young people about their perceptions of the past, and what they consider to be the main significant differences. This may not necessarily be an accurate record, but will provide much insight into how environmental problems are being conceptualized at present, and what types of environmental knowledge are being transmitted between generations.
3. Comparisons between spatially different areas that have been settled at different times, and which lie at different stages in the cycle of land degradation. This can reveal much about changing patterns of environmental use, and

conceptualization of the environment in relation to changing conditions.

Data elicited from these research activities can be woven with data collected from secondary sources, including travellers' accounts, various sector and political experts, colonial archives, aerial photographs, maps and other sources, to build up a picture of environmental change. However, the information gained from informants has the added merit of imparting consciousness and perceptions of local people to more empirical data.

Spatial dimensions

Detailed collection of ecological knowledge, classificatory schemes of nature and about particular localities carry little merit unless they are woven into an analytical framework. The 'my grandmother says' line of research, or 'the traditional way of doing things as recounted by such-and-such an elder' are full of interesting insights, but are inevitably parochial. Any analytical framework must proceed by documenting a wide range of experiences, and classifying and categorizing differences in production and farming strategies and concepts, in relation to material conditions. The aim must be to produce a large amount of quantifiable empirical data, and also information on qualitative processes at play within localities, which can then be combined in one analytical framework which synthesizes into explanatory scientific theory.

One method of doing this is to carry out research along a transect, documenting the when, how and why of changing farming practice. This is often carried out most successfully across an ecotone where conditions change rapidly among populations with similar material cultures, and extensive networks of communication. Where comparison is carried out among a more extensive sample over a wider area, it is necessary to understand the history of production in the various areas, and the factors which have influenced the development of different societies. It is also important to understand the role and position of each group in the regional economy, including access and linkages to markets, social relations of production, and the history of political and economic relations with neighbouring areas and urban centres.

Field research requires formal research methods providing data on different quantifiable experiences in relation to socio-economic data and environmental conditions. This would include data on availability of land, size of holdings, type of access to land, types of soil available, division of labour, availability of household and extra-household labour, person-hours spent in farming, crop combinations, yields and farming strategies. The last of these would include tillage techniques, types of vegetation preserved on the land, weeding regimes, crop calendars, mixtures and sequences. In addition to all this, more informal data are required revealing the problems with which farmers are coping, and the solutions they are formulating. This emerges through spontaneous conversation and visits to farms.

Breadth of knowledge (whose knowledge counts?)

There are no short-cut methods or magical solutions to accessing the impact of indigenous environmental knowledge, although many researchers have claimed to have developed such methods. It is a time-consuming activity. While group interviews may be a quick way of gathering and assessing information, and encouraging brainstorming, it is easy for the researcher to prompt answers in a particular direction, and gloss over serious problems which can only be articulated by individuals in relation to their own personal conditions. Ranking orders in rural societies, and concerns with prestige, seniority and authority, may also lead to silence, or deference, among the poor, the young, and the women. The more prominent members of the community may not be those who possess the most significant environmental knowledge, and their responses cannot be taken as defining its parameters. The responses of poor farmers, young farmers and women farmers, if separately obtained, may open up new doors in the search for information. Work must proceed by talking to a wide sample of the community, including those who may not seem to be knowledgeable, and to do this on an individual basis so that respondents can exhaust all that they have to say.

Indigenous environmental knowledge emerges as the common store informing the different paths of improvisation, and flights of fancy, of community members. Rather than by sitting under the fig tree at the chief's palace, with dignitaries, it is best explored by taking off along the winding paths and discovering the extremities of the village, the chop bars with their bush-meat soup, the drinking spots, the jokers, the old women with their pithy comments, the young women carrying water. Each of these paths reveals a different story, the diversity of which will point to common themes and precepts in indigenous perceptions, as well as to different voices and nuances.

Conclusion

Indigenous environmental knowledge refers to the modern folk knowledge of farming people, of the relationship of their agricultural systems to the natural environment, of the various uses of natural resources, of the problems which emerge from farming, and of methods of conserving the environment and adapting to change. Environmental knowledge is conscious knowledge. It is constantly being updated in relation to changing factors of production, and changes in technology and society. It is a knowledge concerned with observation, reflection, experimentation and interaction with the environment. Since it is being constantly updated in response to change and new information, it needs to be investigated through time and across different spaces, charting the factors which result in changing perceptual frameworks and processes of adaptation.

Indigenous environmental knowledge needs to be related to different socio-economic conditions, different farming strategies and responses to changing environments. An analytical framework needs to be developed which goes beyond detailed descriptions of local technique and perceptions. The challenge is to develop a framework which merges quantitative and qualitative data, producing a wealth of empirical information about specific localities which can be placed within the theoretical context of the relationship between ecological, technical, socio-economic and political dimensions of agrarian transformation.

References

Amanor, K. S.
1994 *The New Frontier: Farmers' Responses to Land Degradation, a West African Study*. Zed Books, London.

Richards, P.
1985 *Indigenous Agricultural Revolution: Ecology and Food Production in West Africa*. Hutchinson, London.

Pacey, A.
1990 *Technology in World Civilization*. Blackwell, Oxford.

A NOTE ON MIXED CROPPING BY HILL-TRIBE PEOPLE IN NORTHERN THAILAND

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In the course of evaluating a 'Watershed Development and Demonstration Programme' (WDP) in northern Thailand, in 1992-93, several very interesting examples of mixed cropping were seen. At one village, Lo Pa Krai, are examples of some highly developed mixed gardens in fields at a small distance from the village. The few fields above the village (about 10 minutes walk) have been developed into a highly diverse production system, incorporating grass strips, new tree crops, traditional and local useful perennial species, and some annual, new as well as traditional, crops. Most notable among these was a field belonging to Japu Paloh, one of the village leaders.

The 33 species of useful plants cultivated in this 3 rai (0.48 ha) field are listed in Table 1. Many of these species are grown largely for cash, but others provide a year round supply of food, herbs, spices and animal feed. The harvest of these for subsistence appeared to be readily shared within the village. Farmers discussed the possibility of using some of these species in conservation efforts, e.g. the legumes *Acacia pennata* subsp. *insuavis* (Cha-om) and pigeon pea and lemon grass in contour strips.

In all villages in WDP the idea of mixed cropping is still very much in practice in association with upland rice. At Pa Rai, farmers always leave trees standing in their swidden fields. There is a bank of indigenous knowledge on the effect each tree species has on the rice yield. For example, *Pterocarpus macrocarpus,* a valuable timber tree, was pointed out for its 'good' effect on rice yield (though no obvious difference was seen between rice in the open and rice under its shade). *Irvingia malayana* (Ma muen in Northern Thai), on the other hand, was shown to have an extremely detrimental effect on the upland rice: under this tree the upland rice was extremely sparse, with only a few tillers per hill and yielded almost no seed.

Some 'kitchen' species are almost invariably grown with upland rice: a few hills of pumpkin, wax gourds, cucumber, lufa, chili peppers etc. Most notable is the presence of cowpea *(Vigna unguiculata),* in various forms. Some are climbers, which are only grown in isolated hills with stakes. One particular type, called Tua Lod or Tua Sod was found everywhere, when closely asked. It is particularly suitable for intercrop with upland rice because of its ground hugging habit (denoted by the names: Sod = interwoven, Lod = going underneath) it interferes very little with the upland rice. The black seeded type is interchangeable with the recommended black bean (Tua Dam). The regular Tua Dam has a very vigorous climbing habit; upland rice can be quickly smothered by it. Farmers in Pang Gorm prefer their own Tua Lod to the Tua Dam for this reason. They also claim that the seed of Tua Lod is more resistant to insect attack than the Tua Dam.

Ricebean is also commonly grown in association with rice, although farmers have been reluctant to grow ricebean as a cover crop as recommended by WDP. The seed of traditional type is largely buff or of pale green colour, with a few black and brown. The Karen call it Sue Bay.

Another common practice by farmers, to replace tree seedlings from last season planting with their own species, also contributes towards the development of a system of mixed species. For example at Yang Klang kapok and jackfruit seedlings replaced some mangoes from last year that had died. *Calamus spp.* (rattan and cane) have been found cultivated in association with tree crops in Nan and Chiang Rai.

Table 1.
A list of useful plants in Japu Paloh's mixed garden at Lo Pa Krai.

		Common Name	Species
1. Newly introduced tree crops	1	Bamboo	*Dendrocalamus asper*
	2	Lychee	*Litchi sinensis*
	3	Santol	*Sandoricum koetjape*
	4	Jackfruit	*Atrocarpus heterophyllus*
	5	Mango	*Mangifera indica*
	6	Tamarind	*Tamarindus indica*
2. New field crops and vegetables grown largely as cash crops.	7	Soybean	*Glycine max*
	8	Adzuki bean	*Vigna angularis*
	9	Payee (lablab)	*Lablab purpureus*
	10	Ginger	*Zingiber officinale*
	11	Green gram	*Vigna radiata*
3. Traditional trees/shrubs	12	Cha-om (Thai name)	*Acacia pennata subsp. insuavis*
	13	Banana	*Musa sapientum*
	14	Papaya	*Carica papaya*
	15	Jujube	*Zikiyphus jujuba*
4. Traditional field crops, vegetables, and etc. for home use, animal feed, some for sale.	16	Upland rice	*Oryza sativa*
	17	Maize	*Zea mays*
	18	Sugarcane	*Saccharum officinarum*
	19	Sweet sorghum	*Sorghum vulgare*
	20	Makua (Thai name)	*Solanum spp.*
	21	Chili pepper	*Capsicum spp.*
	22	Pineapple	*Ananus comosus*
	23	Pumpkin	*Cucurbita moschata*
	24	Wax or white gourd	*Benincasa cerifera*
	25	Cowpea, several types	*Vigna unguiculata*
	26	Pigeon pea	*cajanus cajun*
	27	Mustard green	*Brassica spp.*
	28	Taro	*Colocasia spp.*
	29	Pak Ped (Thai name)	*Vemonia silhetensis*
	30	Lemon grass	*Cymbopogon citratus*
	31	Sweet potato	*lpomoea batatus*
	32	Tobacco	*Nicotiana tabacum*
	33	Sesame	*Sesamum indicum*

There are advantages of mixed cropping over single species in spreading the risk of production failure (current problem with beetle damage of bamboo; potential fruit set problem with lychee without dry season water) as well as market/price (current low coffee price) failure. A continuous supply of a variety of food can be harvested from the 'homegardens' (on the homestead or on fields not too far from the village. A better ecological balance in the mixed cropping system could also mean fewer problems with pests. Grass strips may help to stabilize the steeper slopes. Mixed cropping should be encouraged, at least on a portion of the land farmed by each family, as part of the WDP in association with upland rice as well as with tree crops.

Adapted, by permission, from Appendix 11 of 'Watershed Development and Demonstration Programme', Monitoring and Evaluation Report by Chiang Mai University, Thai-Australia Highland Agricultural and Social Development Project. 1993.

THE NAME OF PLEC

PEOPLE, LAND MANAGEMENT AND ENVIRONMENTAL CHANGE

The name of PLEC has been changed more than once since the programme was initiated in 1992, and it has now been changed again. Readers may recall that we were originally 'Population Growth, Land Transformation and Environmental Change'. 'Land Transformation' quickly became 'Land Management' the better to describe the real nature of our work. In 1993 we dropped the word 'Growth' after 'Population', thus removing any lingering suggestion that we began with an assumption that growth in population numbers or density is the only major force bearing on change in land management and its consequences for the environment.

More recently, the shift in emphasis toward agrodiversity and its relation to biodiversity has led some observers to question if 'Population' is really our main context. 'Population' is the central field of the discipline of demography. It implies that we study people in the aggregate rather than as individuals, communities and societies. During the second quarter of this year, after the draft Project Document and its Annexes were completed, there was an exchange between a few of us concerning the possibility of a total change in the name of PLEC, which would also have involved a new acronym. It was agreed, however, that 'PLEC' as an acronym is not only widely accepted among the membership, and generally liked, but it is also the short name by which the programme is becoming more and more widely known. Therefore a more limited change only has been made, though an important one.

'People' replaces 'Population'. PLEC is fundamentally about people, the way they manage the land, and adapt to and seek to manage environmental change. Our concerns with 'population dynamics' are embraced within 'people'. We feel that the new name describes the programme much more accurately than does the old one. The new name will not become official in UNU until January 1996, but we are using it informally for all purposes from now on.

A short sub-title is sometimes also useful, especially in describing our work to outsiders. From among the April-May suggestions, we have chosen **'AGRODIVERSITY, BIODIVERSITY AND CONSERVATION'** for this purpose. It appears on a number of documents, including all GEF documents, but is not a formal part of the title of PLEC.

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