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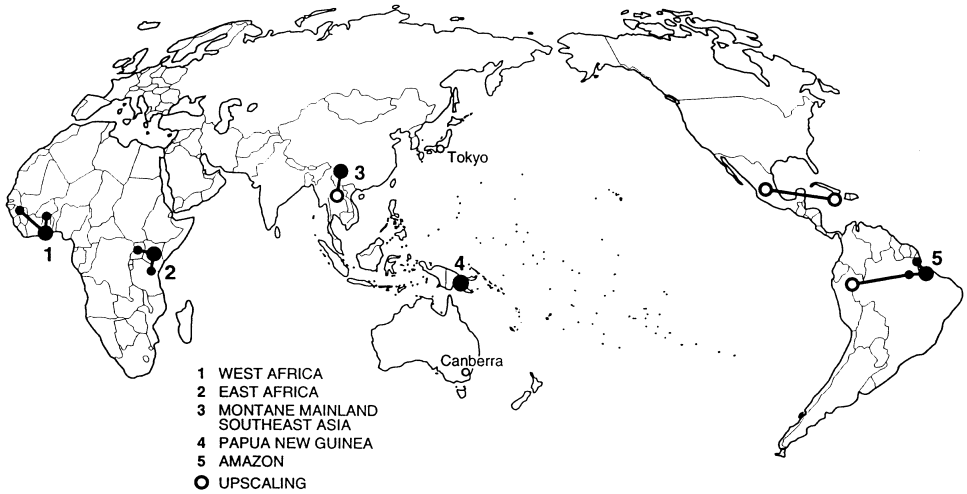

The Clusters of PLEC

P L E C N E W S A N D V I E W S **No. 9, DECEMBER 1997**

SCIENTIFIC COORDINATOR'S REPORT

PAPER FROM THE SCIENTIFIC COORDINATORS

PAPERS BY PROJECT MEMBERS

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THE STATE OF GEF-PLEC

We open with an apology for the late appearance of this issue. *PLEC News and Views* 8 reported the approval of PLEC by the 9th Council meeting of the GEF, on 30 April, and also innocently said that we were then going to have to prepare an 'implementation plan'. In fact, much more than this was involved in what is called, rather oddly, the 'Appraisal Stage'. We had to prepare a whole Project Document, more extensive than the Project Brief prepared for Council, and to append to this a whole group of Annexes, some of which were new material, requiring new inputs from Cluster leaders and their Institutions. We also had to reach agreement with UNEP as implementing agency, before UNEP could forward the product of this agreement to the GEF Secretariat for their appraisal. This stage has now been reached, and we can report on it.

In addition to the (1) Project Matrix and (2) Calculation of 'Incremental Costs', both previously available, the material includes annexes on: (3) Personnel and Institutional Arrangements, detailing responsibilities of staff and Cluster leaders, contract arrangements, and providing data on all participating institutions; (4) an Implementation and Operational Plan; (5) a Monitoring and Evaluation Plan; (6) a Stakeholder Involvement and Information Dissemination Plan; (7) a full statement on the Demonstration Sites and their biodiversity significance; (8) Methodology; (9) Relationships with Existing Projects and Programmes, both national and international; and (10-13) presentation of project costs, a disbursement plan, a 'procurement plan' (the sub-contracts), and budget allocation by years, with appendices.

This took a considerable time. Some material was drafted and re-drafted more than twice in exchanges between Tokyo, Canberra, New York and Norwich. It was only in early September that the whole documentation was complete and sent to UNEP in Nairobi for their review. Juha Uitto, Audrey Yuse and Harold Brookfield then went to Nairobi for a week at the end of September, for detailed and very constructive discussions. These led to some substantial re-writing, which was completed at the end of October. New drafts then went to UNEP, and after only minor changes were, at the end of November, forwarded to the responsible officers in the GEF Secretariat in Washington, for their initially informal review.

Final approval is therefore still awaited. We have delayed making our statement until the UNEP stage was complete, but the GEF Secretariat stage remains. Once the GEF Secretariat is satisfied, the documentation goes out again to Council members for statement of any objections. If none or only a very small number are received, the Chief Executive Officer of the GEF will sign the document. So it will be a

while more yet, and meantime we have only UNU funding, of which a new supply will fortunately become available in January.

The project documentation will be supplied to Cluster leaders by courier when the GEF Secretariat send it out to Council members. Until now, only the uncontroversial Implementation and Operational Plan (Annex 4) has been mailed out; this was done in October after the meetings in Nairobi.

The plans are very much as was forecast in *PLEC News and Views* 8: 1-4, but with one significant difference. PLEC had to answer a number of critics who doubted its ability to manage a project of the present size, and has done its best to do this. In the process, however, we have had to defer all plans for upscaling from the present five Clusters. Nor can we make any other budget revisions until the project is already well under way. What were called **'upscaling' groups** in May become '**associated groups'**. They continue to be a part of UNU-PLEC.

The administration of the Project

The post of **Managing Coordinator** was advertized in August, especially among PLEC's Clusters. A short list has now been drawn up, and a decision will be made in the next month. The Managing Coordinator will have a key role in the project, acting as 'focal point' for all official correspondence, and taking over many of the administrative duties that have been informally shared between Juha Uitto and Harold Brookfield during the preparatory years. Juha Uitto is now Senior Academic Officer in charge of the Environment and Sustainable Development Section of the Academic Division at UNU as a whole. He will retain oversight of the project, and remains ultimately responsible for its success, but he will in future be at a greater distance from the 'coal-face'. Harold Brookfield will continue to be the principal among the three scientific coordinators, with responsibility more exclusively for the scientific work of the project than has been possible in the last two years. He, and his two colleagues, Christine Padoch and Michael Stocking, will now be closer to the 'coal-face'. Audrey Yuse, Programme Administrative Officer, will continue to provide the same excellent service as before, but will now be assisted by the Managing Coordinator. Dealings with UNEP, where Timo Maukonen is the Implementing Agency Task Manager, will in future be more exclusively from Tokyo than in the past. The Organization Diagram, revised to show the agreed structure, is printed on page 3. It is actually simpler than it looks. It supersedes the draft version printed on p.2 of *PLEC News and Views* 8.

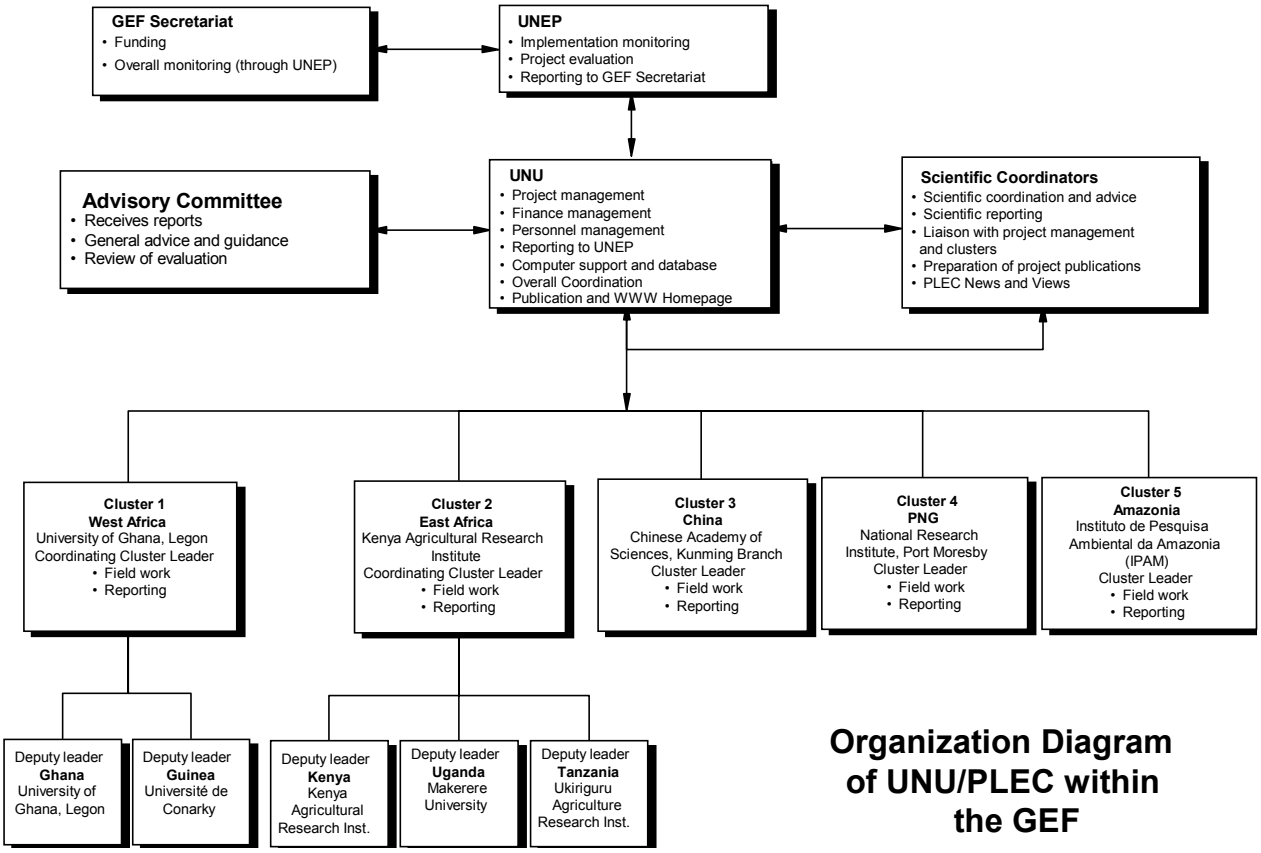
The Management Group

We regard this group as now a reality. It is composed of the leaders of the five Clusters or their deputies, and those deputy Cluster leaders who are in charge of work in whole countries as well. It also includes the three scientific coordinators, the UNEP Task Manager and, as chair, the Senior Academic Officer (Juha Uitto). The Managing Coordinator will be its secretary. It will meet at least once a year, and twice in the early months when there is a great deal of planning to do. We expect to have a short first meeting at the Mbarara workshop, announced below, followed quite soon by a three day working meeting, in which all the relevant UNU personnel will be involved to brief the members, in Tokyo.

Communication among the Management Group

The Management Group will not only work through meetings. There will be a rising need for ongoing communication. Much has changed from the days when all communication within PLEC was by fax. All the Cluster leaders and some deputy

Cluster leaders now have e-mail, and in three cases PLEC has assisted them in getting this. We plan to give priority to upgrading the communications of the two remaining deputy leaders who continue to rely on the fax. Then it will be possible for the Management Group to work effectively and continuously by electronic communication.



Organization Diagram of UNU/PLEC within the GEF

OTHER ACTIVITIES

A visit to the Uganda sub-Cluster

After the meetings with UNEP in Nairobi, Harold Brookfield together with Romano Kiome visited Uganda. Meeting Joy Tumuhairwe, Francis Kahembwe and Edward Nsubuga, they went directly out to Mbarara, and spent most of a day visiting the developing demonstration site area at Mwizi, an upland area close to Mbarara. Later, we visited the proposed second area at Rubare. Returning to Kampala for an important meeting with the Dean of Agriculture and Forestry at Makerere University, Harold Brookfield was fortunate in being invited to attend the celebrations for the 75th anniversary of the first establishment of Makerere, addressed by – among others – the President of Uganda. Both at Mbarara and in Kampala we discussed the organization of the **March-April 1998 Workshop** (announced on p. 9), and set up preliminary plans. These have

since been taken further forward in correspondence.

A regional meeting in China

As in previous years, PLEC has cooperated with UNESCO and the Third World Academy of Sciences in the UNESCO-led 'South-South Cooperation Programme on Environmentally Sound Socio-economic Development in the Humid Tropics'. The 1997 meeting is in Kunming, China, from 8 to 14 December. PLEC decided to use this opportunity to hold a regional meeting among its Asia-Pacific members. This will be at Xishuangbanna Tropical Botanic Garden, Menglun, Yunnan, beginning on 12 December (when the PLEC members will separate from the rest of the conference), and concluding on 14-15 December.

Those attending the meeting are:

For the China Cluster:
Professor Guo Huijun,
Mr Shen Lixin
Mr Dao Zhiling
Prof. Chen Aiguo

for the Papua New Guinea Cluster
Prof. Ryutaro Ohtsuka
Dr Masahiro Umezaki
Mr Thomas Nen
Dr Geoff Humphreys

together with Christine Padoch, Harold Brookfield and Juha Uitto.

Unfortunately, no-one is able to attend from Chiang Mai, Thailand, because the meeting dates clash with those of the 30th anniversary celebration of the Faculty of Agriculture in Chiang Mai University. Bryant Allen also had to withdraw, being asked to lead a second investigation team to work on drought relief in Papua New Guinea. Geoff Humphreys fortunately is able to take his place.

At the time of writing, the meeting has not yet taken place, and by the time it has, this issue will be printed. PLEC has only a minor share in the Kunming proceedings, but Guo Huijun is giving a paper, and informal presentations will be made by Masahiro Umezaki and Harold Brookfield, and by Geoff Humphreys on behalf of Bryant Allen.

In Xishuangbanna, the main purpose of the meeting is to review the plans of the two Clusters in relation to the commencement of GEF-funded work. The China Cluster already has an established demonstration site, at Gaoligongshan. There are plans for either one or two sites in Xishuangbanna, where a lot of preliminary work has been done. The meeting will include field visits to two possible sites. The Papua New Guinea Cluster has not yet established a demonstration site, but have completed a through analysis of farming systems over the whole country.

The unfortunate absence of the Thais makes this less than the full regional meeting we had hoped, and communication problems have led to delays in getting attendance organized. These have prevented the development of a formal programme. Nonetheless, the holding of this meeting does make it possible to shift the balance of support for the Mbarara meeting to Africa.

* * *

Promotions

Juha Uitto is to be congratulated on his promotion, in September, to the level of Senior Academic Officer in the United Nations University.

Among others of earlier date that might have been noticed sooner, have been Christine Padoch's promotion to Senior Curator in the New York Botanical Garden, and Adilson Serràо's to become Chefe da EMBRAPA Amazonia Oriental.

PLEC's members should not be modest about these attainments: we like to congratulate, and share the pleasure with them.

* * *

PLEC and *PLEC News and Views* on the World-Wide Web

Jerry Velasquez, a member of Juha's staff in Tokyo, proposes to set up a Home Page for PLEC itself, and this will be done early in the New Year. He will be asking all Clusters for inputs of a suitable nature, and he will be asking that they be updated from time to time. *[Few things are more irritating to an inquirer than visiting a sought-after site only to find it offering out-of-date information. Associate Editor].*

We want also to keep a full and up to date register of PLEC's members, and their publications, and this too can be put on the Web. Already there is a PLEC section in the UNU Environment Area web-site at :

http://www.unu.edu/env/

All issues of *PLEC News and Views*, right back to the first, are being put on line at the present time. All this should be up and running before the next issue of *PLEC News and Views* appears.

* * *

CHANGE IN CANBERRA OFFICE TELEPHONE/FAX NUMBERS

Please note that there is now an additional digit in our telephone and fax numbers. See back cover for details.

Further information on the Mbarara meeting

The Mbarara meeting in March April is announced on p. 9

Further information can be obtained from:

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(for Mrs Joy Tumuhairwe)

or in case of difficulty through the African Crop Society:

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e-mail: acss@starcom.co.ug
(for Mrs Joy Tumuhairwe)

NEWS FROM THE CLUSTERS

Timely reports

There is a need for the Project's Managing Coordinator to chivvy Clusters to report more promptly. This will become obligatory under the GEF contracts. During the last few months when Juha Uitto and Audrey Yuse in Tokyo, and Harold Brookfield in Canberra, have found most of their PLEC time fully taken up with preparation of the Project Document and its Annexes, correspondence with Cluster leaders has lagged. Overdue reports have been promised, but have not arrived, and pressure has not consistently been put on Cluster leaders to deliver them. Since present contracts are not yet concluded, there are few new reports covering the second half of 1997. Extracts from three that have been received are presented below. The Peru report has already been seen, in full, by all Cluster leaders, who were sent it by mail some months ago.

Peru

In June, the PLEC group in Peru carried out three inter-community meetings in the areas where the PLEC project will be most active. Each meeting was three days in length. The first took place in the community of Panguana and a total of 78 farmers from 25 neighbouring hamlets and communities participated. The second meeting was organized in the community of Muyuycillo, with the participation of 83 *ribereños* from 46 communities. The third was held in the community of Fatima and a total of 65 farmers from 34 communities participated. A central feature of the meetings was presentations by nine *ribereño* experts who have been collaborating with the project. They reported on their activities training other farmers in conservationist and productive agriculture, agroforestry and forestry techniques.

PLEC team members also presented preliminary results of the data they have collected on the land and resource use history, lake reserves, and production and management systems in the *várzea*. Based on these presentations, the team discussed further project activities with the participants at the meetings. The establishment of new demonstration sites on the land of selected households, in different communities, was discussed. Farmer participants agreed to spend two days visiting the demonstration sites at some future date. The team also explained the need for selecting a larger region of *várzea* where long term research can be conducted and several demonstration and experimental sites can be established.

The PLEC team includes Miguel Pinedo-Vasquez (coordinator), and three local senior researchers, José Barletti, Mario Pinedo and Noe Buendia. Collection and analysis of data on the historical process of human settlement, fluviodynamic and other natural events, and patterns of resource use are being coordinated by historian and rural teacher José Barletti. Data on current production and management practices of *várzea* lands and other resources are being collected by agronomist Mario Pinedo, and information on local conservation initiatives, particularly of lakes, are under the direction of biologist Noe Buendia. PLEC-Peru is focusing its work on an integrated programme of research, training and extension activities in *várzea* environments.

Based on the surveys and discussions with villagers, the team selected the *várzea* sector known as the Zona de Muyuy as a principal site. A total of 38 *ribereño* villages are part of Muyuy with a total population of approximately 7,000. The total area is approximately 112 km^2 and includes several islands, of which Panguana and Muyuy are the largest. Several small oxbow lakes are

also found within this sector. All of these land-forms and water bodies are under different intensities of human use and exposure to river floods. Long-term interdisciplinary research, training and extension activities have began to be implemented by the PLEC-Peru team in the communities of Muyuy. The focus is on identifying the historical, biotic and abiotic factors that can help to explain the complex and dynamic relationship of *ribereños* with their *várzea* environment, and resources that they manage and use.

Each team member has begun working with selected university students from the Universidad Nacional de la Amazonía Peruana (UNAP), and the selection of village experts and informants has begun. The selected *ribereños* are playing a critical role in collecting research data and implementing training, and in extension activities. This participatory approach is seen as the most promising in helping to find alternatives for sustainable development of the flood-prone Muyuy communities. Only systems and techniques of resource production, management and conservation that are adapted to the very dynamic *várzea* environments and to the needs of the *ribereños* can guarantee sustainable development for Muyuy families. Great variation has been found in the diversity and intensity of production, and in management systems and techniques used by local ribereño farmers. These will require long term observation and data collection. Team members are being trained in appropriate participant-observation techniques and quantitative agroecological methods.

The team will create a database on agriculture, agroforestry and forest management practices at Muyuy from relevant information documented in technical reports and publications of agricultural and forestry agencies, university, research and related institutions based in Iquitos. Students from UNAP will participate in the elaboration of this database, and will use the information for planning their research theses. Mario Pinedo has established close contacts with professors of the forestry, agronomy and biology faculties of the UNAP, and has begun the selection of students.

West Africa (Ghana)

Work at the Gyamfiase demonstration site has pressed forward throughout 1997. A plant nursery, a diverse food-crop/tree-farm garden, and an income-generating pepper farm have been set up by the core association of farmers, with technical support from the Ministries of Agriculture and of Lands and Forestry. Some of the planting materials for the food-crop/tree-farm garden were collected from the conserved forest grove behind the village. A protective belt has been created around this grove. In Gyamfiase and nearby Bewase, associations of women farmers have been formed, and the finances of the farmers' organization have been placed on a sound footing.

Elsewhere in Ghana the Kumasi group has been analysing conservation practices in the area around a sacred grove at Bofie, in Brong Ahafo District. In northern Ghana, exploratory work has continued at Bawku, near the Burkina Faso border, and at Tolon, near Tamale. The northern Ghana group has been enlarged to five persons, with the addition of Dr Joshua Yidana (Horticulture) and Mr I.K. Nkrumah (Geogaphy), both of the University of Development Studies. Constraints of time and finance have restricted plans to develop a second demonstration site in southern Ghana, although meetings have been held with farmers in Sekesua-Osonson, and in Amanase-Whanabenya.

Mexico

There is an interim report from Cristina Chávez Mejía and Carlos Arriaga Jordán on

their work on agrodiversity management and sustainable agriculture on the hill slopes of the highlands of central Mexico. The objective is to set up demonstration sites in two Mazahua villages. A database will be established. Work has been initiated in two Mazahua communities in the highlands of Central Mexico, Mayorazgo and San Pablo Tlachichilpa in the municipality of San Felipe del Progreso, State of Mexico. Sixteen campesinos are taking part in the project. The emphasis here is on agrobiodiversity, especially in maize.

Initially, work has focused on collection of data regarding socio-economic aspects of households (family structure, activities, area of land cultivated) and phenotypic characteristics of the different maize varieties cultivated, both local and improved. It is found that the seed that a farmer sows in a year can be from different sources: (i) his/her own seeds (ii) from relatives, and (iii) from the market. A farmer can change the seed to be sown every year or he may not change it for several years. Varieties are matched to soil types, but the timing and amount of the rain are also important constraints. When rains are late people sow only early maize (90 days) which are the red, pink and blue landraces. When the rainy season is good, both late and early maize are sown. The former are white and yellow landraces (180 days). Farmers like to sow different kinds of maize, observing which develop better. That is why several varieties are sown in one field, with seed obtained from relatives and from other States of the Mexican Republic (Puebla, Distrito Federal). Harvesting is generally done among families, so cash payment can be avoided. Sometimes people can obtain maize instead of cash, so they get their maize from their neighbours or relatives. There are gender issues in selection of the seed to be cultivated. Men say they prefer to sow maize of high density (heavy grain) to sell, so a better price can be obtained. Women say that maize has to be tasty, soft and easy to cook, so they can make beautiful *tortillas*. At harvest time maize cobs are put in the yard; cobs of all kinds and from different sources are placed in the same pile. Farmers select the cobs to obtain seed from the mixed pile. The criterion for selecting a cob for seed is that it has big grains. Grains from the middle part of the cob are the seed.

The group has also undertaken a study of the homegarden system (inventory of species, management and the role of the homegarden in livelihood). Fifty plant species have been collected and their local name and use recorded. They are used as medicine, for fire wood and construction, and as food, beverages and ornamentals. Some of them are sold locally. At the present time they are being identified scientifically.

Forward plans include work on the soils, and also the organization (with other funds) of a Meso-American Seminar on Agrodiversity to be held in April 1998.

A coming publication from the African Clusters

In defence of the Cluster leaders it should be added that very comprehensive interim material from Ghana, Guinea and Tanzania were received early in 1997. None was in final form for publication, and all were too large for *PLEC News and Views*, but the data assembled and interpreted were impressive. It has now been agreed that, when finally revised and updated as comprehensive findings from the Preliminary Stage of PLEC, extended papers from Guinea, Ghana, Uganda and Tanzania will be published by UNU Press in soft-cover format as a product of the work of PLEC in Africa.

ANNOUNCEMENT OF PLEC WORKSHOP MEETING

MBARARA, WESTERN UGANDA

29 MARCH - 4 APRIL 1998

There will be a workshop meeting of between 30 and 40 members of PLEC at the Lake View Hotel, Mbarara, Mbarara District, Uganda, beginning Monday 30 March and ending Friday 3 April. Our hosts are the Uganda sub-Cluster, based in the Faculty of Agriculture and Forestry, Makerere University, Kampala, and led by Mrs Joy Tumuhairwe. Most participants will arrive on 29 March and leave on 4 or 5 April. Attendance will be by invitation, of as many members as we can afford to invite, drawn from all parts of PLEC though with an emphasis on the African groups. A list has been drawn up, and letters of invitation have been issued before this announcement appears.

The focus of the meeting will be on planning and carrying out work in the demonstration sites that are now the central element in PLEC with GEF funding. A programme on this, convened by Christine Padoch, will occupy one whole day. Another day will be devoted to reports from Clusters and groups, especially those that have not yet established demonstration sites. There will be two field days, the first visiting the evolving demonstration site area of the Uganda sub-Cluster at Mwizi, and the second viewing a future second site at Rubare, then continuing to Kabale in the densely populated western highlands. Mbarara is about 280 km from Kampala, and Entebbe International Airport, and half-a-day will be spent travelling in each direction. Mbarara is in southwestern Uganda, part of the former Ankole District. It is an agricultural and pastoral area west of Lake Victoria, at altitudes between 1,200 m and 1,900 m. Temperatures are therefore comfortable, but March/April is a moderately rainy season.

Travel is being arranged for most of the invitees (except those living within East Africa), and tickets will be provided. Economical fares have been obtained so as to maximize the number who can be invited. Because Entebbe is not the easiest of destinations to reach from a wide range of countries, arrival times will be staggered between 28 and 30 March. However, everyone will be able to leave on either 4 or 5 April. Those leaving on 5 April will stay the night of 4 April in Kampala. All ground transport will be arranged by the Uganda sub-Cluster.

Accommodation at Mbarara will be at the Lake View Hotel, located 2 km from the centre of town on the Mbarara - Fort Portal road. Room and meal costs for all invitees will be paid through a block booking. A small balance of per diem will be paid to invitees in cash, to cover incidental expenses. Overnight bookings will also be made, as necessary, in Kampala, but here invitees will be responsible for their own costs, and will receive a full per diem. Advances can be paid, from UNU, on request.

The provisional programme (subject to change) is as follows:

Sat.	28 March	Some participants arrive in Entebbe
Sun.	29 March	Most participants arrive Entebbe, travel by road to Mbarara
Mon.	30 March	Registration, Opening ceremony, General presentations, Welcome cocktail party
Tues.	31 March	A symposium on demonstration site work (A meeting of the PLEC Management Group will follow)
Wed.	1 April	Visit to the Mwizi demonstration site area near Mbarara
Thurs.	2 April	Cluster/group presentations. Closing ceremony. Workshop dinner
Fri.	3 April	Excursion to Rubare and Kabale
Sat.	4 April	Travel by road to Entebbe or Kampala; some depart
Sun.	5 April	Remaining departures from Entebbe

PAPER FROM THE SCIENTIFIC COORDINATORS

THE METHODOLOGY OF PLEC: A NEW STATEMENT

Harold Brookfield[1], Christine Padoch[2] and Michael Stocking[2]

The final documentation of PLEC for GEF Appraisal includes an Annex on the methodology of the project. The annex was prepared by interchange between Harold Brookfield, Christine Padoch and Michael Stocking. What follows is an extract from this Annex, omitting the first three general paragraphs, and introducing additional sub-headings for clarity. The statement printed here differs in many respects from that presented in *PLEC News and Views* 5 (September 1995), and supersedes that statement. Zarin's diversity measurement methodology (*PLEC News and Views* 4 1995) is still included.

Demonstration sites

PLEC focuses its work on and around its demonstration sites. During the preparatory phase, several sites have already been established and cooperating farmers within them identified: plots have been set up for measurement and experiment. There is, and will continue to be, considerable variation in the precise form and scheduling of demonstration site activities in response to local needs and opportunities.

Preparatory work

All the Clusters have initiated or will initiate their work at landscape level, with surveys of important socio-economic and physical characteristics. This work includes traverses, conducting village censuses, local market assessments, soil surveys and biodiversity inventories. At site level, this work will be followed by participatory inventories of the diversity of local biological resources and farming systems. The identification of local village experts and evaluation of particularly conservationist and productive resource-management practices, will be key activities at each site. The selection of farmers' fields that will serve as demonstration plots or sub-sites then follows. Information on land-use history will be assembled as work proceeds. All experimentation and introduction of improvements into locally-developed systems will be done in close participation with village farmers. Demonstration of sustainable systems will be done in farmers' fields. Extension activities will take various forms including meetings of farmers, on-site training of local extension agents, and on-site demonstration to decision-makers. Written or illustrated materials appropriate for various groups including local agricultural scientists and decision-makers will be elaborated. Media presentation for a wider public will also be important.

Controlling variables for measurement

On-farm measurement and experimentation lacks the formal methodology of on-station measurement and experimentation where conditions can be controlled. On-farm work is affected by a large number of uncontrollable variables, and the method-ology used will minimize these problems. For example, parallel measurement of productivity under indigenous and non-indigenous practices can be partially

controlled by using sites on land of similar soil, slope or hydrology. Variation can also be reduced by characterizing both soil conditions and farmers into a small number of groups, for example high-, medium- and low-quality land; high-, medium- and low-resource farmers. These classes will be derived in association with the farmers themselves as partners in demonstration site work.

'Participatory Learning and Action'

The method can be described as bringing together the best elements of 'Participatory Learning and Action' (PLA), going beyond Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA), and defined by IIED (February 1995) as 'a collective term to describe the growing body of participatory approaches and methodologies' which, properly used, can enable local people to 'undertake their own appraisal, action, monitoring and evaluation'. In PLEC, PLA is extended to include participatory action carried out by local people, designed between them and the scientists. Scientific observation, monitoring and measurement of outcomes are continuous; and technical help is provided on demand.

Philosophy of demonstration site work

The demonstration sites belong to the rural people, and the work done in them is the farmers' own. The scientists' role is to measure and evaluate local work methods, and help select what is best and most likely to be sustainable. Farmers have to cope with many problems, in economic, political and environmental fields, and also respond to new opportunities.

Experimentation is constant, leading to adoption or rejection of new crops and practices, and to restructuring of the use of 'farming space' in response to changing needs and opportunities. Where they are faced with declining rewards for their efforts, farmers often experiment with ways to manage the consequences and reverse the trend. PLEC's most basic hypothesis is that farmers' adaptations to environmental and socio-economic change can often be successful if the conditions of wider society provide encouragement.

Local knowledge

PLEC puts its primary emphasis on what farmers do. The local knowledge that underlies these practices is unequally distributed among farmers of both sexes and is not always shared. Moreover, it cannot be understood outside the social and cultural context in which knowledge is handed on, and in which new information and experience are interpreted. Scientists' interpretations of information they gather on local knowledge have to be drawn up in relation to farmers' own perceptions, best first approached through close observation of the practices that are followed. PLEC views 'local knowledge' not as a fixed or traditional pool, but as constantly changing and being renewed by information and experience. This in turn is the basis of dynamism in peoples' farming systems which PLEC observes and on which it also relies for success in extracting best elements from peoples' own resource management practices.

Questions of scale and time

Scaling up and down

The project's demonstration sites are small areas, selected within wider regions of about 100-200 km^2, rarely more. Survey of biodiversity, crop-biodiversity and management diversity (or agrodiversity) is concentrated within such areas, but by methods which make it possible to scale up and down between the regional landscape and the inventoried quadrats. PLEC commissioned a methodology paper on this aspect in 1994 and it was published for general project information in *PLEC News and Views 4* (March 1995: 11-21). With some differences related to the conditions of

each area, this has become general PLEC method.

The same problem of scaling up and down is encountered in other aspects of project work, including selection of sites and later the selection of areas over which particular agrotechnologies might be serviceable. The strategy has been to begin with general survey, a stage now completed, followed by the move into detailed participatory work at local level. This then leads into partnerships among farmers, NGOs, local governments and scientists in the execution of projects that belong to the people. At a later stage, the scale will again be widened to seek possibilities for extrapolation into other areas. At this stage, both GIS and field methods will be employed.

Rapid methods and their limitations

A guiding principle in choice of methodology is the use of short-cut methods that will achieve reliable results without serious loss of scientific rigour. The simple method of rapid diversity measurement for small areas, within a landscape framework, mentioned above, is one such. Another 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. This can be used as it stands, or form the basis for more detailed inquiry into local knowledge about environment and its processes.

Not all PLEC work can be done by rapid methods. Monitoring in the demonstration sites has to be illuminated by the sort of understanding that can only be gained through time. Long-resident work in village communities is mainly carried out by students who are simultaneously being trained, or by assistants employed locally. It is an essential complement to the reconnaissance methods, and briefer visits by the scientists. Experimental work measuring the utility of farmers' methods requires a long period. This work can be initiated within the life of PLEC, and indicative results can be obtained, but it is so structured in collaboration with the farmers and the agricultural authorities that it can be sustained beyond project life.

Multiple working hypotheses

One of PLEC's objectives is to provide a rational assessment of the causes of environmental change within the chosen areas. Arising from classic work on *arroyos* (gullies) in the American southwest, a 'multiple working hypothesis' approach is being adopted. Environmental change (for example loss in biodiversity), is an outcome that may be explicable by a large permutation of variables, both proximate and distant. Multiple working hypotheses assist in modelling these causes and their combinations, and in constructing diagrammatic representations of the chain of events leading to environmental change. The diagrams are useful to policy-makers, educators and planners.

Checking the facts

A primary challenge for PLEC is to test the reality of presumed causes of environmental change. Trends in change in environmental attributes need particular attention, and simplistic notions of causation require careful inquiry. Within the overall framework of multiple hypotheses, testing of the importance of particular combinations of variables will be undertaken through participatory inquiry among local people, historical and oral record, aerial and ground-based photographs, remote-sensing imagery, experiments and evidence of travellers and officials. Demonstration sites will be a useful focus for assembling local people and gaining their knowledge and understanding of changes in the environment, and attributable causes. Farmers' adaptations to constraining conditions are instructive in contributing to improved policy responses. Without a proper understanding of causes, no intervention is likely to be successful.

PAPERS BY PROJECT MEMBERS

TOWARDS ENHANCEMENT OF AGROECOLOGY DISTURBED BY THE DAMMING OF THE RIVER VOLTA IN GHANA: PRELIMINARY PLEC FINDINGS AND MITIGATIVE SUGGESTIONS IN THE LOWER BASIN[1]

Edwin A. Gyasi and Lewis Enu-Kwesi, with assistance of
B.D. Ofori, J.S. Ayivor and Von V. Vordzogbe, all of the University of Ghana[2]

Introduction

The post-1960 era witnessed the construction of hydroelectric dams at Akosombo and Akuse/Kpong on the Volta, Ghana's largest river which drains 70 per cent of the country (Figure 1). These massive *landesque* capitals have created both opportunities and problems, including environmental disturbances. All these have far reaching implications for human living conditions, especially through their impacts on farming, the land, biodiversity and other biophysical aspects.

In 1996 the Volta River Authority (VRA), which holds responsibility for operating the dams, commissioned the Volta Basin Research Project (VBRP) of the University of Ghana to carry out a major action-oriented multidisciplinary study into the environmental impact of the damming in the lower Volta basin, where the adverse effects appear to be severest (Figure I). A key component of this multidimensional assignment is agroecology, which studies interactions among the diverse ecological and cultural variables in the process of farming, with the goal of using the knowledge obtained to determine optimal ways of harmonizing the farming systems with the natural environment (Tivy 1990; Reijntjes et al. 1992; Altieri 1995).

In a collaborative arrangement with the VBRP, the PLEC group based at the University of Ghana was assigned to seek a holistic understanding of the agroecological disturbances, and to promote cost-effective methods of enhancing harmony between agriculture and the biophysical environment for sustainable food production and rural livelihood improvements.

This report embodies findings of the preliminary agroecological investigations, which were carried out over six months (October 1996 to March 1997), mainly through field work involving, *inter alia,* the following methodologies:

- visual observations;
- on-site farm inspection;
- transect survey;
- discussions with officials and probing records of GOs and NGOs;
- discussions with over 200 local people, both on individual and group basis;
- trend analysis;
- quantitative measures of biodiversity.

In the field studies, special emphasis was placed upon agroecological problems and opportunities as perceived, understood and reacted to by the local people. This was done with a view to generating more realistic information, and to enhancing popular

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[1] Abbreviated version of paper presented at a Volta Basin Research Project (VBRP) Seminar on *Phase 1: Lower Volta Environmental Impact Studies,* held at the University of Ghana, Legon on 14 May 1997.

[2] Gyasi and Enu-Kwesi respectively are Leader and deputy Leader, WAPLEC (West Africa component of PLEC). The rest are post-graduate scholars who serve as Research Assistants for WAPLEC and the VBRP.

commitment to envisaged supportive intervention measures. The method follows the widely advocated bottom-up, essentially self-reliant participatory strategy of development founded on local aspirations and indigenous knowledge of the environment (Chambers et al. 1989; Scandinavian Seminar College 1996).

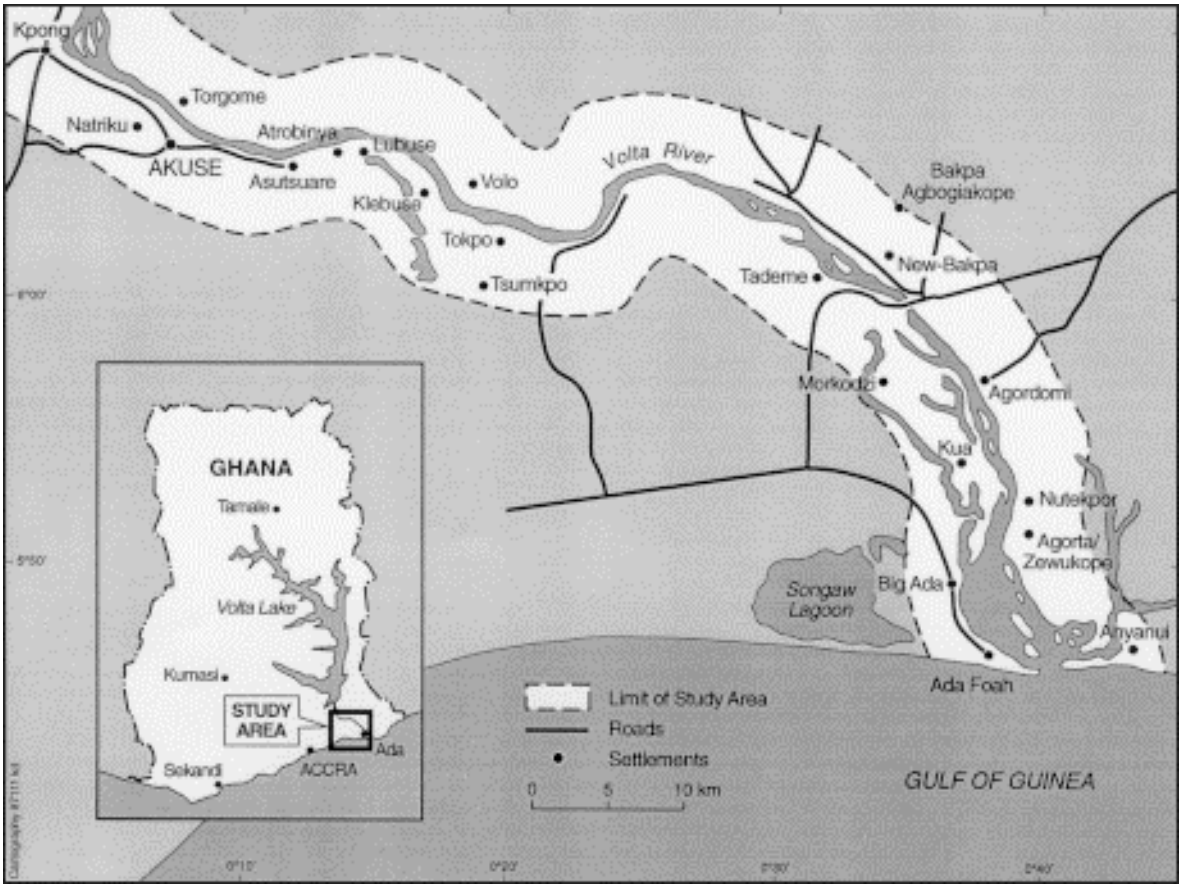

Figure 1 Lower Volta Basin

The five study sites centred on Akuse-Torgome, Tokpo-Volo, Tademe-Bakpa, Agordomi-Mokordzi, and Nutekpor-Kua, represent ethnic groups throughout the study area, the lower Volta basin, which is located in the coastal savanna zone (Figure 1).

The presentation highlights findings on:

a) hydrology and soils;
b) flora;
c) land tenure and land availability;
d) farming practices;
e) promising local environmental adaptations and initiatives bearing upon agroecological enhancement, that might be developed into models for adjoining communities following the 'growth centre' concept and Mosher's ideas of a 'progressive rural structure' (Mosher 1969; Hansen 1972; Economic and Social Commission for Asia and the Pacific 1979).

Findings

Hydrology and soils

The impoundment resulted in various hydrological changes including the following, which bear significantly on the agroecological situation:

- cessation of seasonal inundation of the flood-recessional productive farming areas adjoining the Volta river channel;
- drying out of the hitherto fish-rich creeks, lagoons and other subsidiary water bodies of the Volta, or their shrinkage into small stagnant pools of water, and the consequential loss of fish;
- modified rates of flow of the river Volta, which in the pre-damming period ranged from 30 m^3/s to a peak of 3,750 m^3/s - 11,700 m^3/s, compared to the post-damming relatively constant rate of 800 m^3/s (Halcrow and Partners 1956; Hilton 1961; Moxon 1969; Petr 1986; Volta Basin Research Project 1996);
- creation in the modified aquatic environment of habitats that are favourable to vectors of diseases such as malaria and bilharzia (Bannerman 1985), and to the proliferation of weeds, with all their negative implications for economic activities including farming, fishing and water transportation.

As elaborated upon below, the loss of the moist river-borne alluvium that seasonally regenerated soil fertility, has proved to be particularly disastrous for the traditionally crucially important highly productive sustainable crop-farming that the rich alluvial soils supported.

Local informants reported that since the formation of the lake, there had occurred a decrease in the volume and reliability of the rainfall, and an alteration of the double rainfall maxima to a single one. Decline in recorded average annual rainfall from 1183 mm during 1961-64 in the pre-damming period to 1116 mm during 1965-90 in the post-damming period at Akuse, and from 1031 mm to 838 mm at Ada during the same period, is rather suggestive of a trend towards a more arid climate since the time of the dam.

General observation on flora

Work aimed at determining the total number of plant species in the lower Volta basin continues. In one detailed 4 km linear transect survey carried out at Mokordzi, about 75 species belonging to 43 plant families were identified.

The family *Papilionaceae* appears to be the most predominant with 7 species; the other 27 families are represented by at least one species each. From preliminary observations, the life form distribution of flora in the area is predominantly grass with thickets, as anticipated in the coastal savanna ecosystem.

Uses of flora

The flora provide multiple uses such as:

- fodder for livestock;
- wood and charcoal for domestic fuel;
- trees, shrubs and sedges for construction;
- herbs, for medicine;
- provision of shade and shelter, climate amelioration and soil stabilization.

Fodder and browse

Literature survey indicates that *Andropogon gayanus* is a highly preferred fodder that was originally found more abundantly in a niche along the banks of the Volta. Preliminary observations indicate that this species may have reduced in abundance. More detailed empirical studies, using specific ecological methods such as transects and quadrats, are needed in order to determine the actual status of this species. *Echinochloa pyramidalis, Imperata cylindrica, Panicum maximum, Vetivera fulvibarbis* were also important fodder; but similar studies are needed to determine their current extent.

Reported pre-damming browse plants included *Baphia nitida*, young *Antiaris africa*, *Grewia carpinifolia*, *Griffornia simplicifolia* and *Milletia thonningii*. At present, *M. thonningii* and *Grewia carpinifolia* occur along the transect that was laid at Mokordzi. The species has also been found deliberately left on farms at Nutekpor where it is, on the basis of traditional agroecological knowledge, popularly regarded as rejuvenating soil fertility. This may indeed be the case as this leguminous species is a high litter producer. It would be useful to investigate further the efficacy of this traditional agroecological knowledge, with a view to possible incorporation of the species into farm and agroforestry packages.

Pertinent questions requiring further research include the following:

a) does the litter of this species decompose rapidly to replenish the organic matter content of the soil?;
b) what micro-organisms, particularly fungi and bacteria, are involved in the decomposition of this litter?;
c) is this leguminous species a nitrogen fixer? If so, what is its role in the observed rejuvenation of soil fertility by traditional farmers?

Additionally, as with the fodder species, more detailed studies using ecological tools such as transects and quadrats, are needed to establish the status of these browse species.

Mat-weaving and thatch-roofing materials

Cyperus articulatus and *Typha domingensis* are the species used for matweaving and as thatch for roofing. These species are still available, but detailed studies may be needed to establish their status in the lower Volta basin.

Fuelwood and charcoal production

Prior to the damming, *Azadirachta indica*, *Conocarpus erectus*, *Borassus flabellifer*, *Elaeis guineensis* and *Xanthoxyllum xanthoxyloides* were used for fuelwood in most parts of the lower Volta basin.

Around Natriku, a resettlement that existed before the construction of the second dam at Kpong, our observations indicate that there are now fewer stocks of neem. A general scarcity of fuelwood has led to the settlers harvesting young stems of different species of *Combretum* e.g. *Combretum nigrum* and *Combretum moue, Securinega virosa,* and *Piliostigma* sp. for use as fuelwood. At Bakpa, several localities have been virtually stripped bare of neem. Very thin neem stems and even neem stumps are used for making charcoal. This dismal situation obviously warrants counter measures.

A possible way of overcoming the wood shortage is to encourage multi-purpose woodlots. Individual efforts, already undertaken, at establishing multipurpose woodlots and trees on farmland, notably the one initiated by Mr. Goka, Headmaster of Sogakope Secondary School (see Table 1), may be worth support by the VRA. The promotion of tree planting in other areas of the basin should also be considered.

There are other problems. They include drought, which led to crop failure in the last farming season, and to *Striga* infestation, which has also resulted in crop loss. Estimated drought- and *Striga*- related loss due to crop failure range between US$29 and US$81 per peasant farmer for the last cropping season.

Plants for construction

Conocarpus erectus, *Borassus flabellifer*, *Phoenix reclinata* and *Typha domingensis* were species used for local household construction prior to the construction of the dams. These species are still used locally for construction, but preliminary indications are that they are probably less abundant than before around Mokordzi. Again, detailed studies are needed to establish the exact status of these species.

Medicinal plants

We have yet to delve into medicinal plants; but some local people mentioned the use of *Nauclea latifolia, Securinega virosa* and *Sessuvium sp.* for medicinal purposes. More detailed studies of the ethnobotany will be required to find out plants of medicinal value to the local people, as well as their availability since the construction of the dams (Hilton 1961 Lawson 1966; Lawson 1972; Lawson et al. 1971; Mabey and Rose-Innes 1966; Rose-Innes 1977; Volta River Authority 1981; Petr 1986).

Land tenure and availability of land

The land continues to be owned by clans and extended families, with the major exception of the increased cases of ownership devolution through sale, and through compulsory acquisition by VRA at Akuse, Amedika, Natriku, Asutsuare and Torgome (Figure 1). In some instances, there was reportedly no compensation for the crop losses incurred. A pervasive sense of uncertainty among resettled people, about their rights to land allocated them, did not appear to favour long-term farming ventures, which are needed to secure livelihood.

Decreased farmland was a widespread problem, especially in the resettled areas. In resettled Natriku, parcels allocated for farming ranged from 0.1 ha to 1.0 ha (0.25 - 2.5 ac) per household, compared to the average 1.6 ha (4 ac) reported for house-holds in their original habitat of far greater soil fertility. A telling manifestation of land shortage is increased farming distance which, in Akuse, exceeded 5 km. Others include increased tenancy and land squabbles, shortened fallow, wood depletion and other symptoms of ecological stress, all of which relate to the loss of the seasonal recharge of soil fertility by the river Volta.

In Asutsuare the land scarcity was compounded by the acquisition of a large tract of land for the now abandoned state-owned sugarcane estate. Because of its uncertain ownership status in a situation of diminished agricultural land and of socio-economic deprivation, this tract of land has become the focus of indiscriminate environmentally destructive squatter farming. Finally, the sense of insecurity of land holding is fuelled by the progressive loss of land for fish ponds by the VRA subsidiary, Kpong Farms, at Amedika.

Farming practices

Before the damming, agriculture comprised mainly rain-fed upland bush fallow farming, and flood-dependent lowland flood-recessional farming which dominated with 60 per cent of the cropped area. The flood-recessional farming benefited in a fundamental way from 90 mg/l of suspended solids carried bi-annually by the river Volta. Farming generated 75 per cent of the aggregate income of the riparian communities, and was characterized by:

- more or less permanent cultivation of food crops and vegetables in the floodplain, especially during the flood recession in November-June;
- natural replenishment of soil fertility by river-borne moisture and alluvium;
- multiple cropping;
- minimal or complete absence of weeding owing to the suppression of weed growth by the floods;
- minimal labour input because the alluvial soil did not necessitate tillage;
- consistently high crop yields (Moxon 1969; Lawson 1972; T-Vieta 1989).

With the cessation of flooding, soil fertility is no longer recharged cyclically and freely by nature, resulting in:

- collapse of the ecologically sustainable flood-recessional farming;
- drastic fall in the momentum of crop farming;
- extension of farming to agriculturally marginal or ecologically fragile areas, and to areas of intractable soils that can be worked most effectively only by tractor-ploughing at a cost of US$30 to

US$36 per hectare (US$12 to US$14 per acre), which most of the small farmers cannot afford;

- increased labour requirements for weeding and tilling;
- poor plant growth and diminished crop yield, as manifested at Natriku where maize did not yield at all in the minor farming season of 1996;
- scarcity of plantain, banana, wateryam, cocoyam and oil palm which thrived in the moist flood-recessional soils;
- increased emphasis on the environmentally resilient cassava;
- food imports from other rural areas;
- youth out-migration, driven by worsened incomes and unemployment (Wills 1962).

However, the diversification of farming, apparently in response to the changed agricultural environment in the post-damming era, offers hope, for in such diversity lie agroecological resiliency, adaptability, stability and risk minimization. The identified practices include monocultural bush fallow, small-to-medium cooperative irrigated rice farming, large-scale corporate type irrigated rice farming, ranching and free range cattle grazing. There are also other types of farming practice, which we consider to be potentially highly sustainable ecologically if nurtured, because of their low external input, great internal diversity, or close adaptation to local ecological conditions deriving from the people's intimate environmental knowledge. These are:

- intercropped bush fallow, the most popular farming practice;
- mixed farming integrating crops and cattle;
- traditional and modern agroforestry;
- small-scale irrigated farming;
- home gardening;
- vale or depression farming along the river Volta banks (Volta River Authority Report 1981).

Promising local adaptations and initiatives bearing on agroecological enhancement

We found impressive local utilization of ecological niches, and other environmental adaptations and initiatives having a bearing on agroecological stabilization and enhancement. Examples are listed in Table 1. They include Mr. Goka's agroforestry project at Bakpa, mentioned earlier, and farming of fertile former water-filled vales or indentations along the river Volta. Given minimal support by VRA and other external agencies operating in collaboration with the VBRP, the University of Ghana Kpong Agricultural Research Station and other research organizations, these initiatives and adaptations hold promise of cost-effective development into models for their neighbourhood.

Forward plans

It is clear that amidst the agroecological disturbances, there are opportunities. The next phase will be an intensification and geographical extension of our studies, including further exploration of useful plant species and agroecological opportunities. Traditional agroecological knowledge will be used to strengthen the information base, leading to an action plan for sustainable improvement of livelihood.

Table 1
Promising local adaptations and initiatives bearing on agroecological stabilization and enhancement in the lower Volta basin

Person or organization	Activity	Location	Profile of activity	Comments
Mr. V. Goka (Headmaster, Sogakope Secondary School)	Agroforestry/ Woodlot	Bakpa Agboglakope	Row planting of mahogany, eucalyptus, cashew, acacia, leucaena and other species, with alleys freely farmed by neighbouring villagers in lieu of their free labour input.	A blend of traditional and modern practices whose demonstrative effect could be enhanced by minimal external support.
Primary School	Woodlot	New Bakpa	Cassia woodlot established by school	Other schools might be encouraged to establish similar woodlots
Mokordzi Community	Woodlot	Mokordzi	Neem trees conserved around settlement	Other communities may be engaged to do similarly
Tsumkpo Community	Mixed farming	Tsumkpo	Use of abandoned kraals for crop production, with the farm fenced off by thorny bushes (cactus and sisal hemp)	High yields
E. Osabutey	Home garden	Natriku	Oil palms integrating ducks and using household waste water	Modified low forest niche in a coastal savanna area; sustainable; worth encouraging
?	Cocoa & oil palm farm	Togorme	Narrow strip farm in indentation along the channel of the Volta river	A classic example of utilization of local ecological niches
M. Andrews	Market gardening	Agorta-Zewukope	Intensive cultivation of spring onions by small-scale sprinkler irrigation on the bank of the Volta, without fertilizer	A returned migrant introduced this system from the Afram plains
Param Farms	Market gardening	Tademe	Vegetables growing by small-scale sprinkler irrigation on the bank of the Volta, with little fertilizer. Crops include sponge gourd, okra (lady finger) and black eye beans. Runs an out-grower scheme	Appears sustainable; worth encouraging more than large-scale irrigation which has not proved successful, as exemplified by the aborted Ghana-Libyan irrigation project at Mokordzi
Nakthan Farms	Market gardening	Agordomi	Export oriented growing of pawpaw, pepper, choral bean and ravaya, by spot irrigation, with pumped water from the Volta	Appears sustainable; worth encouraging
R.K. Ahumbley	Poultry (ducks) farming	Natriku	Duck raising based on pond adjacent to settlement	- do -
Irrigation Development Authority (IDA)	Irrigated rice cultivation	Asutsuare Lubuse Atrobinya Klebuse	Canal irrigation; individually operated plots allocated by a central committee, with the water paid for by the farmers	Project being rehabilitated with World Bank support
Kudzragbe Farms	Irrigated rice cultivation	Tademe	Irrigated rice farming with pumped water from the Volta	
L.K. Animbley	Fish farming	Tokpo	Fish pond in a dammed stream channel, with pond occasionally filled with water pumped from nearby creek	Output able to support family

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AN ASSESSMENT OF THE IMPACT OF DROUGHT AND FROST IN PAPUA NEW GUINEA IN 1997

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Editor's Note

Bryant Allen's 'Land Management Group', working with staff of the Papua New Guinea Department of Agriculture and Livestock, and the University of Papua New Guinea, has recently completed a large project on mapping and characterizing the agricultural systems of all Papua New Guinea's small farmers. Though the project has been associated with PLEC since 1992, by far its largest source of support has been the Australian Agency for International Development (AusAID). When, in September 1997, the drought in Papua New Guinea began to assume serious proportions, AusAID needed information that it could not find in Papua New Guinea, in order to determine how it could assist. AusAID therefore asked Bryant Allen to head a fact-finding mission, organized in collaboration with the PNG authorities. He now offers this short and personal paper, for information and as an example of the unexpected utility that can arise from PLEC's work.

Papua New Guinea is experiencing a severe drought which is related to a major El Niño Southern Oscillation (ENSO) event in the Pacific Ocean. Rainfall was below average at most stations in the country around April 1997 and, apart from minor falls, has remained well below average until the time of writing in November 1997. In September and October 1997, with Michael Bourke, I was involved in organizing and carrying out a national assessment of food, water and health conditions in the country. This paper briefly examines the methods that we used and describes the impacts of the event on food production systems and the environment. It concludes that it is not possible to separate the climatological event from the economic and political conditions of the society upon which it impacts, and examines similar historical events and compares them to this event to support this argument.

The argument is well recognized by thinking people in PNG. Less than three weeks ago I was digging in sweet potato gardens looking for tubers, surrounded by generally cheerful and certainly stoical and fatalistic highlanders. In many places, as far as I could tell, large numbers of men women and children were facing a considerable period into the future with nothing to eat except cabbage leaves, *Ficus dammaropsis* leaves, chopped up banana stems and pig meat. Having established that there was nothing left in the already completely dug over gardens, I asked people what they were going to do. The most memorable answer came from an older man who said:

> When I was a child we lived here and this [famine] happened to us then. There was no government then. We stayed until all the food was finished. People who had friends or relatives in other places where there was food went there. People who had no friends or relatives wandered around here. After about three months they started to die. My father kept me alive and I am still here. When I was grown and married, it happened again. The Australian kiaps were here by then and they gave us food and we survived. Now I am old it has happened again. Now we have our own government. Are they going to give us food? I don't know. If they don't, we will just have to die again.

I spent much of my recent time in PNG with the feeling that Eric Waddell and Michael Watts were looking over one shoulder and Mother Teresa was looking over the other. Eric Waddell was insisting, 'the 1972 food relief program was based on the *wrong* assumption that the Enga lack any means of coping' and that the provision of food relief was an interference with traditional coping mechanisms for 'ideological reasons' (Waddell 1989: 221). Michael Watts was whispering that, although drought may be the catalyst which leads to a famine, a famine triggered by drought is 'more a reflection of the ability of the socio-economic systems to cope, than it is of the drought itself' (Watts 1983: 259). And Mother Teresa was saying, and I paraphrase, 'These poor people have nothing to eat!'

A low-frequency naturally occurring climatological event is taking place, closely associated with the El Niño Southern Oscillation phenomenon. We know that both similar events and agricultural systems have existed for thousands of years. This suggests that the societies using the systems survived these similar events. Is the present climatological event in fact the same as those which occurred in the past? Are these the same societies and agricultural systems that survived these events in the past?

The present situation in Papua New Guinea

Survey method

On arrival in PNG it became apparent that the national government, the National Disaster and Emergency Services Centre and the Australian High Commission urgently required information on conditions in all parts of the country. Thirteen assessment teams were formed from professional staff of the Research Division of the Department of Agriculture and Livestock who had previously worked closely with us on the Land Management Group Agricultural Systems Project (Allen, Bourke and Hide 1995) supplemented by agricultural development staff from Ok Tedi Mining Ltd, a large mining company. Team leaders were brought together for a half-day meeting and were then assigned field areas and were dispatched into the field.

A decision was made to use a form to enable objective information to be collected systematically across the whole country. The form asked the team members to answer the following questions: What are people eating now? What is the origin of that food? how much longer will that supply last? Is sago available? Are famine foods being eaten? Are pigs being killed? Are local markets operating and what is being offered for sale; where is any food in the market coming from? Is cash being used to buy food, how long will the cash last and will local stores be able to maintain a supply? Is replanting material available? Have people migrated, do they plan to migrate? Have bush fires caused loss of food or shelter? What is the present source of drinking water? Is it the usual source of water? What do people think about the quality of the water? Will the water supply be maintained? Where are people washing? Have there been noticeable recent changes in community health? What are the most common health complaints? Have there been deaths in the community within the last two weeks and what were the causes of death? Is there an observable decrease in the nutritional status of children?

Teams were also asked to make observations on the condition of schools, health services, roads, airstrips and communications at the scale of a census division. There are 561 census divisions in Papua New Guinea and they contain between 100 and 40,000 people. Information from the 1990 census was available for the whole country. In practice, observations were received which covered a range of scales, from individual villages to whole Districts, made up of many census divisions.

Teams were asked to categorize the places they observed on a scale of 1 to 5 on the following basis:

Category 1

Unusually dry, but no major problems of food supply, of drinking water or health.

Category 2

Some inconvenience. Staple food is short but other food available, and/or must travel further to collect drinking water. Health satisfactory.

Category 3

Conditions difficult, with food reduced and some famine food being eaten, and/or water available only at a distance, and/or some babies and old people unwell. No lives at risk.

Category 4

No food in gardens, famine food only being eaten, and/or water in short supply and possibly polluted, and/or increasing sickness, and/or the lives of small children and old people at risk.

Category 5

Extreme situation. Only famine food available, and/or water very short, and/or many people ill, and/or small children and old people seriously at risk.

Before proceeding into the field, a computer database was established in the Department of Provincial and Local Government Affairs to receive information from the field teams via fax machines. Field forms were assigned a serial number and after being entered into the database were filed by province, district and census division. Summary information was produced from the database and passed immediately to the National Disaster and Emergency Services Centre.

1990 census data were used to assign population estimates to census divisions. Because a digital map of census divisions was not available, a map to illustrate the extent of the impacts of the drought and frosts was manufactured using information from the Land Management Project and the PNG Resource Information System (Allen, Bourke and Hide 1995).

Data quality

It is important to understand the qualifications and limitations which apply to this information. They were collected rapidly by a number of people who had no chance to standardize their approaches by working together. In many cases, they had not previously seen the conditions they were observing. Their information has been assigned to an areal unit, a census division, sometimes on the basis of one report, sometimes on the basis of a number of reports. Many census divisions have not been visited. The population numbers are from a census the accuracy of which has been questioned.

The food and water situation, October 1997

The people worst off for food live in restricted locations (Figure 1). While some further assessment and reassessment is required in the Eastern Highlands and Madang, on present estimates and in terms of numbers of people, Eastern Highlands and Southern Highlands are the worst affected provinces, followed by nine others in both highlands and lowlands. All other provinces are affected in some places.

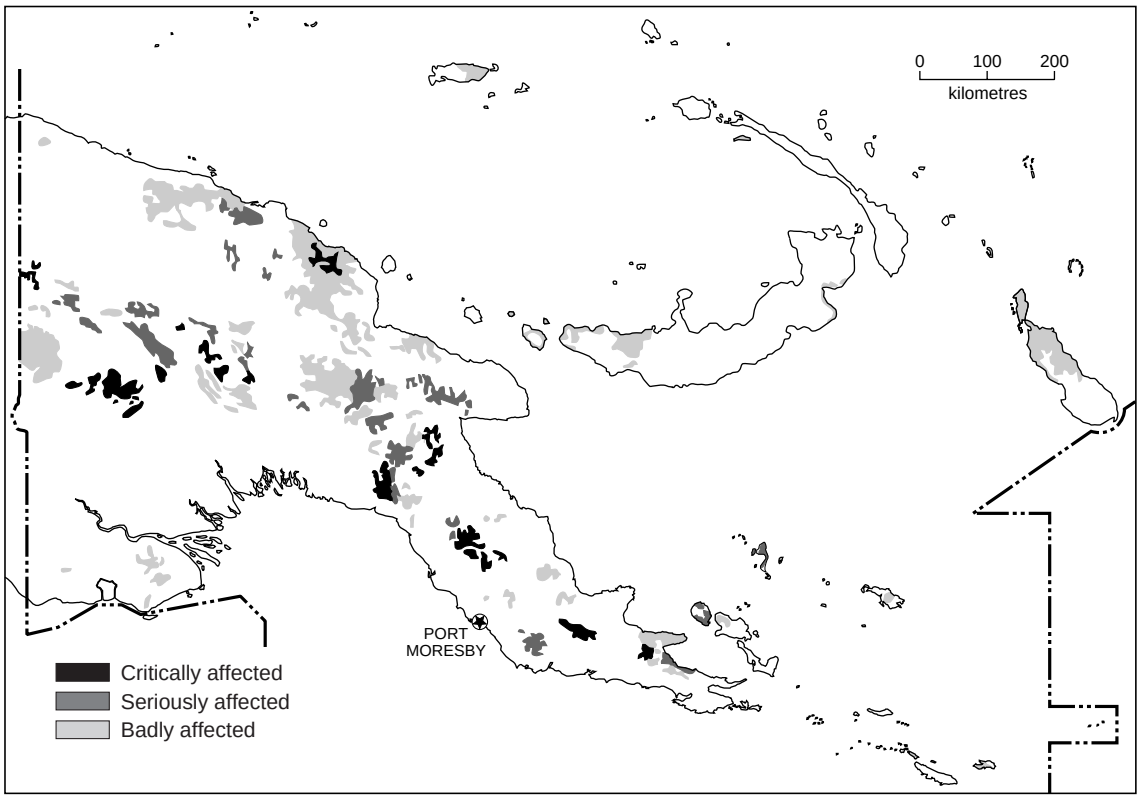

Figure 1 Drought and frost affected areas of Papua New Guinea

While the impacts of the drought are widespread, it is possible to broadly define in geographical terms, where the impacts are the worst.

- **high altitude (above 2200 m asl) areas** of the Western Highlands, Enga and Southern Highlands provinces. Here the staple food of sweet potato has been completely eliminated by a series of unusually cold frosts that began in early June and occurred in July, August, September and October. These areas now have no food remaining in the ground. Many people have adopted the traditional response to such an event and have migrated to the populous lower valleys that remain free from frost. The situation in a high altitude area of Central Province, inland from Port Moresby, is similar and large scale outmigration has occurred. However the receiving areas are also drought affected and are not able to accommodate the migrants as they have been able to in the past. In addition, populations in these areas have doubled over the past 30 years. Some farmers have developed vigorous fresh vegetable growing and marketing cash earning activities and have been able to support themselves with their saving for some weeks. Those cash reserves are almost depleted now. The closure of the pyrethrum factory in Mt Hagen has also severely reduced cash earning ability in the higher altitude areas.

- **mid-altitude (600 m to 1400 m) inland areas**. Here there are few or no roads, very few cash earning opportunities and provincial government services and

administrations are weakest. In this zone, drought has reduced normal garden yields by as much as 80 per cent and has prevented replanting. These areas lie around the fringes of the central highlands, close to the Irian Jaya border in the west, and in the lower valley of the Sepik river. Mostly they have small populations, sometimes isolated from the more populous regions in their vicinity.

- **small offshore islands and atolls**, where populations are small but population densities are amongst the highest in the country and where drought has stopped food production, including coconut yields, and has severely reduced drinking water. Many of these small islands have no airstrip and are located some days sailing from the nearest land.
- **lowland and coastal areas that normally have strong dry seasons**. This includes many of the small islands, some of the large islands and the inland lowland areas of the east and northeast. While people and agriculture in these areas are adapted to surviving dry conditions, the length and severity of the 1997 dry season has brought food production to a halt and has forced people to eat their yam planting material. Small amounts of planting material are being kept alive in the hope of rain towards the end of the year. Cash resources in most of these areas are limited.

A number of other areas in the highlands and lowlands have been severely affected by drought. Where these areas are located along the main arterial roads, or are adjacent to main urban centres or are close to a major mining or oil and gas activity, the assessment has taken into account the very much increased capacity of people to use cash to get themselves through the worst of this event, or at least to make their situation known to authorities. Conversely, small isolated places, which are frequently forgotten about or overlooked in the day to day administration of the country have had their plight emphasized.

Comparisons with past events

Is this the ENSO event 'of the century', or even of all time?

In 1989 Harold Brookfield examined the historical evidence for the occurrence of past ENSO events and found that in Indonesia major and catastrophic droughts are recorded as long ago as the 1600s and that at least the more recent events are associated with major ENSO events (Brookfield 1989). On the basis of this analysis and other evidence it seems safe to assume that ENSO is a phenomenon with a reasonably long history.

The historical record of the impact of ENSO events in the maritime continent comprising Melanesia and Indonesia is 120 years long and at its most distant is fragmentary. The PNG record can be pushed back to 1888. There have been drought/frost and forest fire events in PNG in 1902, 1914, 1941, 1972, 1982 and 1987, and now 1997. The statistical association between measures of ENSO severity and the physical impact of these events in terms of drought and frost is reasonable, but by no means perfect.

But these events have not impacted on PNG in same way. The long term rainfall records provide an objective measure of the impact and some PNG stations go back to 1880 (many fewer make it in 1997). By looking at standardized deviations from long term means for as many stations as are available it is possible to identify years in which negative rainfall anomalies occurred countrywide - in other words when the drought started and when it finished. The severity of the impact of these events on PNG may be associated with the month of onset of reduced rainfall, which may in turn

be associated with the nature of the ENSO event. The 1997 ENSO is unusual for events since 1965 in that its onset was rapid and occurred early in the calendar year in March (Walter and Timlin, NOAA-CIRES Climate Diagnostic Centre, Http://www.cdc.noaa.gov/ENSO.enso.different.html).

The historical impacts record changes in quantity and quality from the 1900s, when there was greater concern about colonial enterprise and town water supply than about 'natives' dying in the remote bush. In the 1990s District Managers can phone the national newspaper and provide first hand accounts of local catastrophe.

To keep the 1997 event in some sort of perspective it is worthwhile briefly revisiting reports from these major event years. The primary sources of this material can be found in Allen, Brookfield and Byron (1989).

Drought was reported from either New Guinea or Papua in the 1880s. Pratt reported in 1896 'drought extending far up the Fly River' and fires on the mainland opposite Yule Island that burned large areas of forest. 1901 and 1902 are the first years in which both colonies reported serious drought. This drought was reported as causing 'famine' at Rigo, SE of Port Moresby and on Goodenough Island, and 'a complete crop failure along the Papuan Coast and in Milne Bay', and fire in sago swamps at Cape Nelson. On New Ireland the taro crop 'withered' and people survived on sago and coconuts.

By 1914 more of the country had come under colonial control. In the Gogol Valley, near Madang, the river dried to a trickle and extensive areas of forest burned (Johns 1989). On New Ireland the then Government Anthropologist described 'destructive bush fires along the whole line of coast, bush and mountain ranges'. He believed 'a great loss of life followed this famine'. On mainland New Guinea German reports describe a drought lasting from June until December, with villagers 'suffering from food shortages'. In Papua, rice was distributed on the northeast coast to villagers who 'had been compelled to eat their seed yams' and whose new gardens had failed.

Again in 1941, extensive fires were reported from many parts of PNG, in the Gogol, the Sepik valley (where sago swamps were burned out), on Mt Ialibu, at Wau and in Milne Bay. On New Britain ' the smoke hung everywhere like a thick fog'. In Western Province and Goilala food supplies were described as 'critical'. Port Moresby and Rabaul towns ran out of water.

There appear to be no eye witness accounts of the 1941 event in the highlands, but there are a number of excellent oral accounts of this drought, and another of a major famine that occurred in parts of the Southern Highlands in the 1930s, that appears not be have been associated with drought but with excessive rain. In the 1940s, the Urufu Swamp peat is said to have caught fire and burned for months (descriptions collected by Chris Ballard and myself) and fire swept from the lower basin over the Paijaka Plateau and into the forest, as it has done again this year. The social dislocation caused by these events at Tari was still being expressed in disputes over land in the 1990s.

In 1972 the highlands frosts captured most attention and resulted in a large food relief program. It is worth remembering however, that in 1972 Geoff Hope (personal communication) described a crown fire in *Nothofagus* trees on Mt Capella near the Irian Jaya border. Extensive fires and smoke were also reported at Bulolo, and on Mt Giluwe, at Kandep in Enga and at Tomba in the Western Highlands. Lake Murray dried up into swampy patches, as it has again in 1997.

Are these the same societies and the same agricultural systems that survived events in the past?

No they are not.

Firstly, many of the agricultural systems of 1941 were missing crops which are now critical to the food supply - sweet potato, *Xanthosoma* taro, cassava, triploid bananas. Many system had no cash crop component. In 1997 the majority of systems have intensified, commonly by extending the cropping period, often by making an extra planting, usually of sweet potato. We do not as yet understand the long term ecological and agronomic implications of these changes.

Secondly, there are many more people in 1997 than there were in 1901 or in 1941. The first census of the PNG population in 1966 counted around 2.5 million people: it is now estimated that there are more than four million. Since 1941 the population has probably doubled. Population densities in rural areas are higher and there is greater pressure on land.

Thirdly, in 1941 the towns were tiny colonial outposts. In 1997 they are rapidly growing, sprawling untidy centres of wealth and political power, places to which many young people aspire and to which many people are turning for refuge from the present food shortages.

Fourthly, in 1972 PNG was administered by Australia. In some places local government councils had been created but in many places village officials appointed by the colonial administration were the lowest level of administrative reach. In 1997 PNG is a sovereign nation that has struggled since it gained independence in 1975, striking a balance between central government and decentralized provincial and local forms of government. Yet another series of administrative and political reforms has just been completed. These have had the effect of removing almost all central financial control over the provinces, and has established more than one hundred small local government administrations which are financially and legally responsible for local areas, but which are critically short of the skills and capacity to discharge those responsibilities. The same thing has been said of administrations at the provincial level, and at the national level. This state of affairs has resulted in a serious decline in the capacity of the PNG state to deliver education and health services in rural areas. This decline in capacity has been blamed for increases in infant and child mortality and the declining standards of education. The drought assessment teams found at least half of all primary schools were closed but many had been closed before the drought began. Health facilities were similarly affected by lack of staff, lack of funds and lack of medicines and equipment.

Fifthly, although for most of the time, the rural people most severely impacted by this drought are more or less 'invisible', helicopter loads of journalists with shoulder high TV cameras have suddenly made the world aware of their presence. Furthermore we live in an age when individuals are valued highly and it is not acceptable that the very old and the very young should die during times of hardship, as they did in the past.

Conclusion

It does not matter whether the 1997 ENSO is the biggest since 1982 or 1877 or the PNG drought is the driest since 1941. What matters, as the old man at Kandep said to me in a slightly different way, is whether the PNG state can overcome the relationships of dependency and power that have accompanied development and modernization, in order to provide assistance to rural people in great difficulty with food and water. If the PNG state cannot overcome its problems, it is unlikely the international community will stand by and watch Papua New Guineans die of starvation or thirst.

But as Waddell and Watts remind us, a major conundrum is created by the provision of relief aid. Among the rural people of Papua New Guinea, an effective program of

food relief is likely to create greater reliance on the state, which shows few signs of being able to meet their needs in the future.

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BOOKS FROM UNESCO

La forêt en jeu: L'extractivisme en Amazonie centrale

Éditeur scientifique: Laure Emperaire
Collection latitudes 23, ORSTOM & UNESCO, Paris, 1996

Often presented as an archaic activity, extractivism, that is to say the exploitation of forest products for commercial purposes, might be merely a feature of one of the various economic cycles that Brazil has experienced. However, movements of rubber tree latex collectors, with claims relayed by various institutions, and public opinion aware of ecological problems, have made it a central element of discussions concerning the management of forest ecosystems. The question of its position in regional development is raised. But what is known about its ecological viability? How can it adapt to the ecological and social changes that currently affect Amazonia? Why is so much interest shown in this activity in a global context in which numerous species are cultivated and massive quantities of synthetic products are manufactured? How can extractivism form part of new types of forest management combining conservation and development? [In French; 231 pages]

Reservas da biosfera e reservas extrativistas: Conservação da biodiversidade e ecodesenvolvimento

Luis E. Aragón e Miguel Clüsener-Godt (Organizadores)
Série cooperação Amazônica 18, UNAMAZ, Belém, 1997

The book emanates from the International Workshop on Biosphere Reserves and Extractive Reserves: Conservation of Biodiversity and Ecodevelopment that was held in Belém, Pará, Brazil, in May 1996. It covers case studies from Brazil, Mexico, Madagascar and India. [Portuguese and English; 177 pages]

Those interested in these books should contact:
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