The United Nations University

PLEC NEWS AND VIEWS

No. 1 – July 1993

A NEWSLETTER OF THE UNITED NATIONS UNIVERSITY PROJECT OF COLLABORATIVE RESEACH ON POPULATION, LAND MANAGEMENT AND ENVIRONMENTAL CHANGE (PLEC)

Produced in the Division of Society and Environment, Research School of Pacific Studies, The Australian National University for the United Nations University

Edited by Harold Brookfield
Scientific Coordinator

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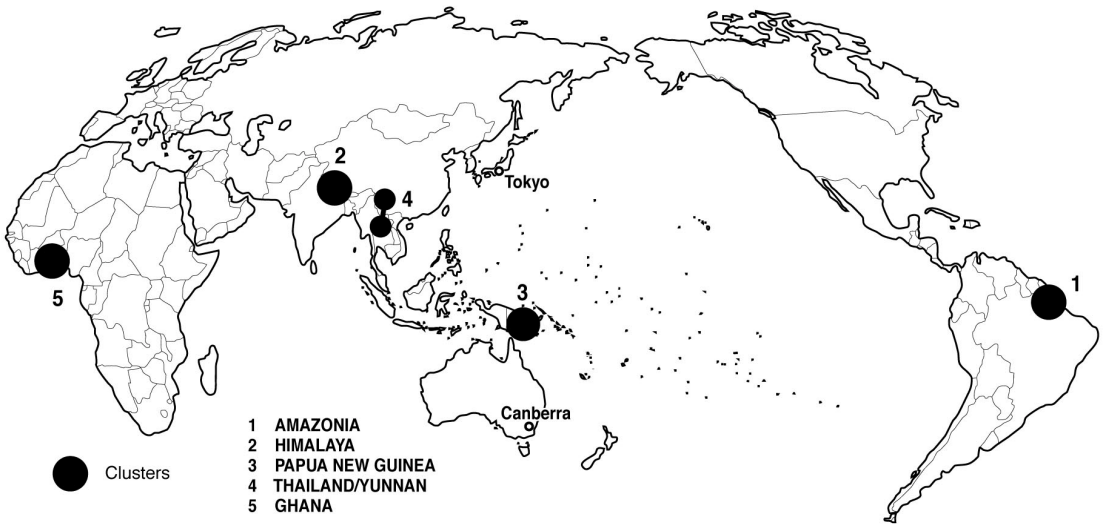

The cluster of PLEC

PLEC NEWS AND VIEWS

No. 1, JULY 1993

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PART 1

INFORMATION ABOUT THE PROJECT

PLEC AND THE UNITED NATIONS UNIVERSITY ENVIRONMENTAL PROGRAMME

Juha 1. Uitto
Administrative Coordinator

The United Nations University is an academic institution established under the United Nations General Assembly. The charter of the University, adopted in December 1983, states that UNU shall be an international community of scholars engaged in research, post-graduate training and dissemination of knowledge, and it shall devote its work to research into the pressing global problems of human survival, development and welfare that are the concerns of the United Nations and its agencies. An international organization, the University is an independent part of the United Nations family without an inter-governmental structure, and based on voluntary funding.

The project on Population, Land Management and Environmental Change was initiated as part of the programme area on Global Life-Support Systems, administered from UNU Headquarters in Tokyo, Japan. The environmental programme area is one of the main focal domains of UNU's research. The activities of this area have two basic foci. The first emphasizes the importance of local and regional ecological sustainability through appropriate environmental and resource management. The second stresses the research and multilateral action needed to understand and deal with environmental change that can affect the Earth as a whole. The research encompasses both social sciences and humanities, as well as natural sciences.

PLEC demonstrates the research and mode of operation of UNU in an exemplary manner. The project addresses a highly topical issue affecting sustainability of the world's food production: ecological changes caused by and affecting small- and medium-scale farming in the developing countries operating under conditions of rapid population growth, socio-economic change and environmental stress. The key concepts– production pressure and agrodiversity– contain both the problems as well as the potential solutions worth studying in detail, in the field.

PLEC is also a project organized and carried out through an international network of scholars. The collaborating researchers come from every continent, and bring together a body of knowledge accumulated through years of field work in the tropics and sub-tropics. The role of the United Nations University is to give cohesiveness and a common framework to the work carried out in the various regions, and to disseminate the acquired research results throughout the United Nations system and to the decision-makers.

PLEC is a new project, but it builds firmly on earlier work. At UNU, it is organizationally a part of the programme on Sustainable Environmental and Energy Futures. The programme seeks to promote ecologically as well as socially and economically sustainable development in the developing parts of the world. PLEC has close links with other efforts, including the project on Critical Regions in Global Environmental Change. That project, which is now in its final phase, studied geographical areas that were identified as being particularly vulnerable to global environmental change. Several of them, including the Himalaya and Brazilian Amazonia, coincide with PLEC cluster areas, and many of the PLEC collaborators participated in the Critical Regions project.

PLEC has also benefited from regional meetings on sustainable environmental

futures organized by UNU. The Scientific and Administrative Coordinators organized together a 1991 meeting on South-East Asian environmental futures which, *inter* alia, laid the basis for the Thailand sub-cluster.[1] A second meeting on Sub-Saharan Africa was held in Ghana earlier this year, and facilitated establishment of the West African cluster. A conference on South-South cooperation held in Manaus, Brazil, immediately following the United Nations Conference on Environment and Development in 1992, led to formation of the Amazonian cluster.

The United Nations University is a relatively small organization and our financial resources are limited. Nevertheless, we hope to play an important catalytic role in instigating research into the issues that are central for achieving sustainable development in the years to come. In the short period of its existence, PLEC has already raised considerable interest in global change and international development circles. We believe that PLEC can become a major project in that field.

[1] The book arising from this meeting will be published in September 1993: H. Brookfield and Y. Byron, eds, *South-East Asia's Environmental Future: the Search for Sustainability,* Kuala Lumpur, Oxford University Press, and Tokyo, United Nations University Press.

WHAT PLEC IS ABOUT

Harold Brookfield
Scientific Coordinator

Population, Land Management and Environment: the Background

As its title indicates, PLEC emphasizes the consequences for land management, and hence for the environment, of continuing population growth at global, regional and local scales. However, increase in population numbers and density is by no means the only driving force of change. There are, and have long been, other forces which lead to 'production pressure, and 'management stress', which may be unrelated to population density. PLEC seeks realistic explanation by disaggregating the nexus of population and environment, seeking to determine, through analysis at the levels of farm, community, nation and region, the actual forces impinging on farming systems, and their relative importance.

'Production Pressure'

A central element in this disaggregation concerns the partial replacement of direct population pressure on resources by pressures for production emanating from the market economy. They also arise in other ways, as in the demands of landlords and the state, but in modern times these external sources of pressure have escalated. The ability of farmers to adapt to changing conditions has been important for centuries, and is responsible for the great variety of farming systems that exists in the world. However, this ability to adapt is under threat, and we seek to analyse it in the context of a fast-changing world.

Studying 'Agrodiversity'

In examining how farmers adapt, or fail to adapt, to growing resource scarcity, we emphasize the value of studying **agrodiversity.** By this term, we mean the very many ways farmers have of exploiting the natural diversity of the bio-geosphere, with greater or lesser success. While one element, diminishing crop-biodiversity, has attracted growing concern in recent years, the varied and adaptive management of land, its waters and biota, the core of agrodiversity, remains imperfectly understood.

Agrodiversity has an intimate relationship with the maintenance of biodiversity, whereas modern trends toward system uniformity are inimical to species conservation. Except in the most commercial of rural economies, the majority of the world's farmers make some use of wild resources and in many indigenous systems this use is substantial. In some, including a number that are sometimes characterized as 'primitive', wild species of

known value are selectively conserved, or even replanted. Crop-biodiversity is also substantial and, where this includes the interplanting of a large number of crops, it has importance for soil conservation.

Sustainability and Unsustainability

Sustainable development is impossible without sustainable agriculture. The question of criteria to determine sustainability and unsustainability is a strong common thread running through the ongoing research selected for incorporation into PLEC. This issue will be discussed in some depth in the second issue of *PLEC News and Views.* In addition to explaining agrodiversity, we shall therefore also be subjecting it to analysis. Since many farming systems are undergoing change, and the demographic and socio-economic conditions affecting them are in constant flux, it is important to be able to project sustainability as well as to estimate it on the basis of contemporary practice. We propose to take account of both ecological and socio-economic sustainability, and of their interrelation, but from the standpoint that the conditions of socio-economic unsustainability are more readily reversible than those of ecological unsustainability, so that the two must be considered separately.

The Variable Environment

We lay stress on the fact that the resource base is not a constant. Land differs greatly in qualities, in sensitivity to interference, and in resilience or ability to recover. A region seemingly much more degraded after interference than another may not have been more heavily impacted; it may have been far more sensitive or less resilient; some erosion is far older in origin than has been presumed.

In examining the state of land and biota PLEC will, so far as possible, aim equally to consider the geophysical and human elements of the problem, without pre-determining that one or the other is dominant. Full attention will also be given to climatic variability, of particular importance in major areas of the tropics and sub-tropics.

In Chapter 5 of *Agenda 21* (United Nations, 1992), on 'Demographic Dynamics and Sustainability', there is a call for research on the interaction between demographic trends and factors, and sustainable development. There are numerous references to these issues in Chapters 10, 12, 13 and 14, and in Chapter 32 small farmers and indigenous people are given credit for their considerable knowledge about how land resources should be managed; the urgency of documenting, synthesizing and disseminating this rapidly changing body of knowledge is stressed. The principal context of PLEC is, however, set out in Chapter 14 (Promoting Sustainable Agriculture and Rural Development), where it is said that:

'By the year 2025, 83 per cent of the expected global population of 8.5 billion will be living in developing countries. Yet the capacity of available resources and technology to satisfy the demands of this growing population for food and other agricultural commodities remains uncertain. Agriculture has to meet this challenge, mainly by increasing production on land already in use and by avoiding further encroachment on land that is only marginally suitable for cultivation' (para. 14.1)

and:

'Land degradation is the most important environmental problem affecting extensive areas of land in both developed and developing countries ... Land degradation is serious because the productivity of large areas of land is declining just when populations are increasing rapidly ... it is urgent to arrest land degradation and launch conservation and rehabilitation programmes in the most critically affected and vulnerable areas' (para. 14.44).

The significance of women as farmers is mentioned in many places in *Agenda 21,* but nowhere fully brought together. Yet, paralleling agrodiversity, there is enormous diversity in types of rural household, and in the dependence of households on artisanal, commercial and other forms of both on-farm and off-farm work, in addition to crop and livestock production. The distribution of work between the sexes exhibits great variation, and it is probable that in many areas women have long had a more important managerial role than is allowed for in most of the literature. More certainly, there is a widespread increase in both the proportion of farm work performed by women, and in the role of women as *de-jure* as well as *de-facto* farm managers.

The Hard Part

'Production pressure' and 'agrodiversity' are, as the Administrative Coordinator notes above, the key concepts of this project, together with 'sensitivity' and 'resilience' in the bio-geophysical domain. They require new approaches, separately but also together. It is important to understand the reasons for adoption of particular practices, and why they are changed or not changed in face of stress. Single-factor explanations, including population growth by itself, as well as commercialization, political interference, land-tenure inequities and farmers' ignorance, are rarely sufficient. If policies to attain a more sustainable land use are to be formulated, a much more systematic exploration of 'agrodiversity', its causes and consequences, is required. While everyone agrees that this task is of major importance, no-one believes that it will be easy.

How PLEC Operates

PLEC operates through a network of experienced and motivated researchers at work in selected areas on the problems of agricultural systems, land-resource management, their demographic and societal correlates, and their environmental consequences.[1] With initial resources, five international and multidisciplinary clusters have been formed. Two more are under negotiation. Although a much wider network could be formed, PLEC is seen as a pilot project in which the significance of spontaneous adaptation must first be demonstrated. Although there may be association with other projects, it is therefore intended to hold PLEC at the present, manageable, size. There is a very large body of relevant research, undertaken in several parts of the developing world. This work is scattered through the literature of several disciplines, and much is reported only In places where it has little visibility; it lacks focus. PLEC provides this focus. We aim to understand the causes and consequences of spontaneous and induced change in farming systems and to derive a clearer understanding of what can be expected under rising pressure on resources, and on farm management, in the coming years.

The project has been developed by Professor Harold Brookfield, University Fellow, The Australian National University, Canberra, with the help of some early-recruited principal colleagues. Professor Brookfield is now Scientific Coordinator, assisted in the United Nations University by the Administrative Coordinator, Dr Juha I. Uitto, Academic Officer.

The five present clusters are described in the following section, and their location is shown in the map on the front cover. There are plans, still in a preliminary stage, to form two more by early 1994. Networking is central to the method of PLEC, both between clusters and within them. Regional clusters are constituted around more than one research group or set of individuals and, so far as possible, the approach is to form clusters of individuals rather than of institutions, so that they form real groups of researchers. Each cluster has either one principal researcher or two joint principal researchers, with whom the Coordinators will relate most directly.

All PLEC collaborators are experienced field workers, most having done from several to tens of years of work among farming communities in developing countries. Project members are trained in branches of agricultural science, anthropology (social, ecological and physical), geography (human and physical), human ecology, ethnobotany, rural sociology, agricultural economics, or soil science. Most of the work incorporated into the project is done by small, usually multi-disciplinary groups, or by individuals, working with local collaborators, assistants and interpreters. There are also student members of most research groups.

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[1] Land-resource management is defined as the use and purposive modification of the land and its biota to obtain production, with special emphasis on management and mismanagement of the production site, and of natural physical and ecological processes modified by human activity, together with their consequences.

Field Meetings

PLEC is a field-oriented project bringing together the work of researchers in different situations. Notwithstanding all that can be achieved by means of a newsletter, exchange of literature, and with modern electronic communications, field situations can only be appreciated and argued about, leading to cross-fertilization of ideas, in the field. Moreover, 'in the field' does not mean at an office, or meetings room, in a city somewhere nearby. In research of this order, there is no substitute for seeing with one's own eyes. An important element in our plans is therefore a series of small, week-long field meetings, held in the research areas of selected clusters, spaced over the life of the project. It is intended that attendance at these meetings should rotate between different members of each cluster. These field visits will have a major role in coordination, in internal monitoring, in the development of comparative research, and in the testing of hypotheses and provisional conclusions. Moreover, these meetings implement proposals for South-South Cooperation, which were a principal recommendation of a Conference, of which UNU was a joint organizer, on Environmentally Sound Socio-Economic Development in the Humid Tropics, held at Manaus, Brazil, in June 1992.

The Formal Objectives

In the most recent document, the objectives of the project are set out in the following words: PLEC seeks in the long term:

(a) to obtain data-based, policy-related propositions concerning both induced and spontaneous adaptation of farming systems to population growth, to changing economic and societal conditions, to changes in age- and gender-composition of farm workforces and households, and to environmental deterioration. In this connexion, strong emphasis is given to the hitherto-neglected study of agrodiversity. The purpose is both to clarify theoretical and practical discussion of the population-environment nexus, and to guide policy.

(b) identification of what is sustainable, and what is unsustainable. The means by which sustainability and un-sustainability (both ecological and socio-economic) may be estimated or measured are being discussed through correspondence within PLEC and with other projects. This is a question that has great theoretical and practical importance.

In the short and medium term, objectives are defined as follows:

(a) by mid-1994 to bring together the different approaches of researchers in widely-separated cluster areas around the common themes above, in order to develop comparative understanding of the relationships between population, development, and environmental change, through a common set of questions concerning management of land by developing-country farmers;

(b) by late-1996 to make farmers (and NGOs working with them) aware of the research and its results, and of the manner in which the farmers in other parts of the world resolve the problems of adaptation created by demographic, societal and environmental change;

(c) during the whole life of the project, and where possible in our selected areas, to provide researched options for the better management of land, its waters and biota, under societal, demographic and environmental change in different bio-geophysical settings, and evaluation of capacity to adopt these options.

The time frame of the project is near-contemporary, about 20-25 years around the present. However, a longer historical context must necessarily be taken into account.

The project is scheduled to last until 1997, with a main research period from the 1994 meeting until mid-1997, when there will be a second general meeting. Publications will then be finalized. We are proposing that there should be a mid-term review in 1996.

THE CLUSTERS: MEMBERSHIP AND PRESENT RESEARCH

The five present clusters have been formed between July 1992 and April 1993. Membership and programmes of research (within PLEC) are not yet complete and definitive. The following is therefore based more on research brought into PLEC than on plans developed for the project. Research designs will be revised after a series of meetings to be held in the coming months. Some clusters have student members, but they are not yet listed. Clusters comprising more than one group have principal and associate, or joint, leaders.

1. Amazonia

This cluster is based at the Centro de Pesquisa Agroflorestal da Amazônia Oriental, Empresa Brasileira de Pesquisa Agropecuária (CPATU/EMBRAPA), Caixa Postal 48, 66.000 Belém, PA, Brazil. The principal associated group is based at the Institute of Economic Botany, New York Botanical Garden, Brorix, NY 10458, U.S.A. The cluster is holding a general planning meeting, at Belém, in August 1993. Details of programme and membership will then be modified.

Active Members (mid-1993):

E. Adilson Serrão (Principal Leader), agricultural science (EMBRAPA, Belém)
David G. McGrath, geography (National University of Para)
Erick Fernandes, agricultural science (EMBRAPA, Manaus)

About three other members of CIPATUIEMBRAPA, and other members, will be added.

Nigel Smith, Department of Geography, (University of Florida)

Mario Hiraoka (Associate Leader), geography (Museu Goeldi, Belém, and Millersville University, Pennsylvania)

Christine Padoch, ecological anthropology, agrodiversity and biodiversity (New York Botanical Garden)
Miguel Pinedo-Vasquez, resource management (School of Forestry and Environmental Studies, Yale University)
Daniel Zarin, ecology (Department of Geology, University of Pennsylvania)

The emphasis of research is on the use of the floodplain, the *várzea,* of the Amazon, and the relation of this use to that of the adjacent *tierra firme.* Although a difficult environment, the *várzea is* often seen as the most promising of Amazonian land for development. There is, however, serious risk of overexploitation. A note on his research during the past two years is provided below by Mario Hiraoka.

2. Ghana

This most-recently formed cluster is based in the Department of Geography, University of Ghana, Legon, Ghana. A foundation meeting was held in March 1993, and the cluster met again in April to establish its preliminary programme. Additional members, including both Ghanaian and foreign corresponding members, will be added in the coming months.

Active Members (mid-1993) (all present core members are at the University of Ghana):

Edwin A. Gyasi (Leader), geography, agricultural land use systems, population and technology in rural change
G.T. Agyepong, geography, land use ecology, remote sensing
L. Enu-Kwesi, botany, plant physiology, ecophysiology and seed biology
Elizabeth Ardayfio-Schandorf, cultural and historical geography, gender and environmental change
J.S. Nabila, population and medical geography
S.K. Amanor, social anthropology
E. Owusu-Bennoah, agriculture, soil chemistry and fertility
G. Benneh (Technical Adviser), geography of agricultural systems, population and rural development

In this case, research is being developed specifically in the context of PLEC, and also of the Project on Critical Regions in Global Environmental Change. The focus is on 'environmental endangerment', specifically in the southern forest/savanna zone of Ghana which has been experiencing environmental stress at a growing rate, due to rising population and increasing pressure of production. It is intended to explore stress in terms of natural vegetative cover, soil fertility loss, fallow length reduction, biodiversity and agrodiversity reduction, and changing farming systems. A background statement by Edwin Gyasi appears below.

3. The Himalaya

This two-group cluster has grown directly out of a case study in the Project on Critical Regions in Global Environmental Change. It held one meeting in January 1993, and plans a second in November/December 1993. The base of this project is the Mountain Farming Systems Programme, International Centre for Integrated Mountain Development, G.P.O. Box 3226, Kathmandu, Nepal. The associated group is based at the Graduate School of Geography, Clark University, 950 Main Street, Worcester MA01610-1477, U.S.A.

Active Members (mid-1993):

Narpat Jodha (Joint Leader), resource economics and farming systems (ICIMOD)
S. Shrestha, livestock economics and field surveys (ICIMOD)
T. Partap, ethnobotany, agro-biodiversity (ICIMOD)
R.M. Tamrakar, land use (ICIMOD)
P. Sharma, demography and human geography (ICIMOD)
S. Shakya, environmental engineering (ICIMOD)
P.K. Kotta, GIS and computer applications (ICIMOD)

Roger Kasperson (Joint Leader), geography and environmental risk assessment (Clark University)
Billie Lee Turner 11, geography and land use change (Clark University)
J. Ronald Eastman, remote sensing imagery analysis (Clark University)
T. Millette, remote sensing imagery analysis (Clark University)

Piers Blaikie, geography and development studies (University of East Anglia)
Pei Shengji, ethnobotany (Kunming Institute of Botany and ICIMOD)

Emphasis is on environmental change, sustainability and unsustainability, in mountain and foothill areas of very high and rising population density, classic ground for discussion of population pressure an, resources, and with a very substantial base in written-up research. The ICIMOD group has a long-term programme studying the dynamics of land-use change and its sustainability or unsustainability. Fuller detail, on this and the Clark group project, is presented below in a report by Roger Kasperson and Narpat Jodha.

4. Northern Thailand and Yunnan

This two-group cluster is based in the Agricultural Systems Programme, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50002, Thailand, and in the Programme on Traditional Land Management Systems Research in Yunnan, Kunming Institute of Botany, Academia Sinica, Heilongtan, Kunming 650204, China. Other groups and individuals are associated. One field meeting has been held in Thailand in June 1993, and a principal planning meeting will follow, in Kunming, in November 1993.

Active Members (mid-1993):

Kanok Rerkasem (Joint Leader), agricultural ecology (Chiang Mai)
Benjavan Rerkasem, soil fertility (Chiang Mai)
Chusri Trisonti, botany/taxonomy (Chiang Mai)
Benchapun Shinawatra, resource economics (Chiang Mai)
Ramphaiphun Apichatpongchai, community development (Chiang Mai)

Guo Huijun (Joint Leader), botany and traditional agricultural systems (Kunming Institute of Botany)
Dao Zhiling, botany (Kunming Institute of Botany)
Pi Wenling, botany (Kunming Institute of Botany
Sheng Lixin, engineer (Yunnan Academy of Forest Science)
Cui Jingyun, engineer (Xishuangbanna Tropical Botanic Garden)
Cai Chuantao, ecology (Kunming Institute of Ecology, Academia Sinica)
Hu Gang, geography (Yunnan Institute of Geography)
Gao Lishi, ethnology (Yunnan Institute of Ethnology and Yunnan College of Nationality)
Pei Shengji, botany (Kunming Institute of Botany and ICIMOD)

Jack D. Ives, geomorphology and mountain systems (University of California, Davis)
Janet Momsen, geography, rural development and gender analysis (University of California, Davis)
Geoff S. Humphreys, soil science and geomorphology (ANU)
Christine Padoch, ecological anthropology (New York Botanical Garden)
Douglas Porter, geography and social aspects of rural development (ANU)

Both centres have existing programmes assisted by the Ford Foundation, which also supports a project by Ives and Momsen in association with the Yunnan Academy of Social Science. The programme on traditional land management systems in Yunnan seeks to show how these systems can offer different models for rural development. The Chiang Mai agricultural systems programme covers northern Thailand and adjacent areas of Laos, with emphasis on agroecosystems, soil fertility, and rural development. Two 1993 meetings will harmonize these programmes in the context of PLEC, especially around the theme of sustainability or unsustainability. Statements on the the background in Thailand by Kanok and Benjavan Rerkasem, and on the Yunnan programme by Guo Huijun, appear below.

5. Papua New Guinea

This cluster is based on the Land Management Project, Division of Society and Environment, Research School of Pacific Studies, The Australian National University (ANU), Canberra, A.C.T. 0200, Australia, and on a group of Japanese scholars formed around the Department of Human Ecology, School of International Health, Faculty of Medicine, University of Tokyo, 7-3-1 Hongo, Tokyo 113, Japan. There are local participants in Papua New Guinea. A meeting involving members of the Australian and Japanese groups was held in July 1992, and some met in the field in early 1993. A further meeting will be held during 1993.

Active Members (mid-1993):

Bryant J. Alien (Principal Leader), geography and land use change (ANU)
R. Michael Bourke, agronomy and land use (ANU)
Robin L. Hide, anthropology and human ecology (ANU)
Geoff S. Humphreys, soil science and geomorphology (ANU)
Robin Grau, GIS and computer applications (ANU)

Ryutaro Ohtsuka (Associate Leader), human ecology (Faculty of Medicine, Tokyo University)
Yukio Kuchikura, anthropology (Gifu University)
Tsukasa Inaoka, human ecology (Kumamoto University)

Jacob L. Simet, anthropology (National Research Institute, PNG)
Ted Sittipai, agricultural science (Director, Research Division, Department of Agriculture and Livestock, PNG)
Graham Sem, geography (University of Papua New Guinea)
Malcolm Levitt, geography (University of Papua New Guinea)

Full statements on background are presented below in separate notes by Bryant Alien and Ryutaro Ohtsuka.

PART 2

NEWS ABOUT PLEC

By the Editor

A SHORT HISTORY OF THE PROJECT

PLEC was initiated in early 1992, and clusters were formed in the Himalaya, Amazonia and in Papua New Guinea by July. Some participants, and a number of others, met in Washington, D.C. in August, immediately after the International Geographical Congress which several had attended. This meeting refined the objectives of the project, and in the subsequent months these were further developed. In November, a fourth cluster was formed in Thailand and Yunnan, then in March 1993 a fifth cluster was formed in Ghana.

During this early period, working relations were also established with the IGBP/HDP Project on Global Land Use and Land Cover, with the Global Change and Terrestrial Ecosystems Core Project of the IGBP, the UNU Project on Critical Environmental Regions in Global Change, and with the International Board for Soil Research and Management. Then, in April 1993, I visited North America for discussions with UN Agencies and foundations about the prospects for major funding, and cooperation. Two substantial applications have been drafted during May and June, and will be submitted from Tokyo very shortly. Meanwhile, an initially small budget from UNU has been enlarged somewhat, assisted by a sum generously offered to UNU by the Obayashi Corporation of Japan.

Cluster Meetings

With the exception of the cluster in Ghana, each of the research groups brought into PLEC already had its own ongoing programme of research, funded from a variety of sources with greater or lesser adequacy. Initial UNU contracts with clusters provided seed funding in small amounts, principally to assist the research groups to hold their own planning meetings and meet some seed research costs for work within the framework of PLEC

The first of these meetings brought together Australian and Japanese collaborators to discuss work in Papua New Guinea, in July 1992. The Nepal and American participants in the Himalayan cluster met in Nepal in January 1993, and visited field sites together. The Chinese collaborators in the Thailand/Yunnan cluster visited Chiang Mai at the end of June 1993, and a planning meeting will be held in Kunming in November. A large meeting of the Amazonian cluster, together with other interested parties, is to be held in Belém, Brazil, in August 1993. The Himalayan group will meet again in late 1993 or early 1994. Further meetings are planned in Ghana, where the initial meeting also had some Nigerian participants.

Forward Plans

The speed with which the project can advance from these initial stages depends very much on how soon we are able to secure more substantial funding for cluster research within PLEC, for networking and inter-cluster visiting, and for whole-project activities. We plan to hold a general meeting of the whole project, involving several participants from each cluster, provisionally in the last week of May 1994. Most probably this will be held in Chiang Mai in Thailand, where the Thai cluster leaders have generously offered to act as hosts. We hope to hold certainly one, and possibly two, of the planned series of small inter-cluster field meetings during 1994. Even

by early 1994, we hope also to be able to round out the design of the project by forming a sixth and a seventh cluster, representing environments and situations that are not well exhibited among the present five. Preliminary steps are being taken toward all these activities.

The 1994 general meeting will be of major importance. Although there is no wish to overlay the diversity of interests and expertise among our collaborators, nor ignore the fact that they deal with radically different field situations, it is at this meeting that PLEC must become a single project in the sense that a set of core questions is being asked by all groups as a central part of their research. These core questions must lie in areas delineated by the title of the project: the reality of the population/land relationship in the context of development and change; the sustainability or unsustainability of the farming practices investigated; the significance of adaptive agrodiversity for future development. By its section on 'Views' below, this issue of *PLEC News and Views* opens a discussion that will, hopefully, lead toward these ends.

A Scientific Advisory Group

During my talks in the United States I encountered the strong suggestion that a project of this size and complexity needs an advisory committee. I have for some time felt the need of back-up support, and put the question to cluster leaders in sending them a report on my mission. The very general feeling came back that that is a good idea, but that it should not become a steering committee, and should be composed of people with a participant interest in the project, now or in the early future. Its members should represent specialisms of importance, but should see these in context and therefore be persons of broad view with wide field experience in developing countries.

After discussion with Juha Uitto in Tokyo, it has been decided to form such a Scientific Advisory Group (dare we call it SAG?). Its members will have a role in assisting project coordination. They will, at some time, visit all cluster areas, and attend some field meetings. They will advise on research design, gaps in membership, and on research techniques. Initially, they will have the particularly important role of advising on the matters requiring discussion at the 1994 general meeting. Funds have been budgeted for the group to come together by early 1994.

On this basis, 1 have written to three persons representing the areas of (1) land degradation and soil management, (2) gender and household questions in land management, and (3) the social management of biodiversity and agrodiversity. All have agreed to help. They are: (1) Michael Stocking (School of Development Studies, University of East Anglia, Norwich), a land degradation specialist with mainly African field experience; (2) Janet Momsen (University of California), a gender and rural development specialist with Caribbean and Brazilian experience; (3) Christine Padoch (New York Botanical Garden), an anthropologist and human ecologist with both South-East Asia and Amazonian experience. More about this group will appear in the second issue.

Postscript and Request

Several of our members receive invitations of value to PLEC, in getting the project better known and interrelating it with other work. I have spoken on PLEC at meetings in Tokyo, Accra and Mexico City during recent months, and will shortly do so again at a regional meeting of START (Global Change System for Analysis, Research and Training) in Manila. Separately, I have become a member of the Scientific Advisory Committee of the Sustainable Biosphere Project of SCOPE (Scientific Committee on Problems of the Environment). I know of three or four others who have many useful invitations, but lack full details.

Would members who have had, or get, such useful invitations please let me know? They should at very least be recorded in this Newsletter. And would everyone please note that we plan to hold the General Meeting in about the last week of May, 1994, with a selection of members from each cluster?

PART 3

NOTES, REPORTS AND SHORT PAPERS BY CLUSTER LEADERS AND MEMBERS

SUSTAINABLE RESOURCE MANAGEMENT IN THE AMAZON FLOODPLAIN: REPORT ON THE FIRST STAGE OF THE 'VARZEA PROJECT'

Mario Hiraoka Museu Goeldi, Belém and Millersville University, Pennsylvania

INTRODUCTION

The estuarine tidal floodplains *(várzea da maré)* are described as the region with most potential for rural development within eastern Amazonia because of their relatively large human population, easy accessibility, and fertile soils. However, their large population and accessibility could lead to an uncontrolled predation of easily extractable flora and fauna. The tidal movements also hamper modern mechanized farming and restrict the range of crops to be cultivated.

Modern resource management practices are unable to offer adequate solutions to utilization of the tidal floodplains. Therefore, our attention has turned to traditional, site-specific techniques. Researchers increasingly point out that indigenous inhabitants, familiar with local ecosystems and their floral, faunal, and edaphic components, have devised technologies that successfully utilize them, without apparent ecological disruptions. We hypothesize that significant portions of this farmers' knowledge and agrotechnology could be adapted to meet both present market and subsistence needs.

OBJECTIVES OF THE VARZEA PROJECT

The objectives of the VArzea Project of the writer and Christine Padoch are to combine research, experimentation, extension, and training to produce data on the tidal floodplain inhabitants, their resource management practices, and their environment, and to improve the use of *várzea* resources and the lives of floodplain residents. My stage of the work began in August 1991, in the *várzea* near Abaetetuba, on the south side of the Amazon estuary. The area is within the economic zone of Belém, the largest city of Amazonia. A second site is to be established by Dr Padoch near Macapá, another major urban centre on the northern edge of the estuary. Research at the Macapá site will begin in August, 1993.[1]

Specifically, the Project aims to:

1. Identify the major resources and their distribution, and examine current and past resource management practices in terms of their socioeconomic viability and ecological sustainability;
2. Devise resource management options, especially in agroforestry, through experimental treatments using local knowledge, and monitor these experimental plots over an extended period for socioeconomic and ecological sustainabilities;
3. Examine the viability of several smallscale industries and promote the development of those that can increase the value of *várzea* products;
4. Disseminate the results of research and experimentation to local inhabitants through informal and formal demonstration and extension methods,

[1] Hiraoka's research was initially supported from a number of sources, and is conceived as a longterm project extending over a number of years. From 1992, the project has been centrally funded by the Heinz Foundation, around the theme of 'sustainable resource management in the Amazon floodplain'. The grant is administered through the New York Botanical Garden.

and to train local students in research and experimental techniques.

THE STUDY AREA

As is true of much of the Amazon floodplain, the tidal section is an area of considerable socioeconomic and ecological variation. In order to develop site-specific resource management strategies, two sites were selected, differing in key ecological characteristics such as sediment load and deposition, and in patterns of past and present resource uses, quality of forest and aquatic resources available, social organization, and market sizes.

Work near Abaetetuba was begun in August 1991. The site is situated south of Marajó Island, near the confluence of the Tocantins and Pará rivers and about 80 km south-west of Belém. This site, near the town of Abaetetuba with a population of 150,000 is, like all of the *várzea* zone, a low lying area with very limited relief. Small differences in topography, however, produce significant differences in flooding regimes. Some areas are flooded twice a day, while others are flooded only a few times a year in periods of exceptionally high tides and river levels.

The daily, cyclic, and seasonal changes in tidal levels are responsible for the continual replenishment of soil nutrients. Around Abaetetuba, however, nutrient renewal rates are considerably less than in other parts of the *várzea* as the waters feeding this area are mostly nutrient- and sediment-poor black and clearwater streams. The vegetation cover, most of it in secondary growth, is in different stages of regrowth after repeated cycles of deforestation. Past demands for timber, fuelwood, and agriculture focused on sugar cane, have left little primary cover in the region.

Local inhabitants, known as *caboclos* or *ribeirinhos,* base their livelihood on a combination of small-scale farming, management of agroforests, extraction of forest products, fishing, and production of crafts. The majority live in isolated settlements along the many rivers of the area. Major economic changes of the last three decades have led to the demise of commercial agriculture in the region, while improvements in access to health care, transportation, and communication have led to rapid population growth, transformation of rural people's needs and expectations, and urbanward migrations. The market participation of present-day *ribeirinhos is* narrowly focused on management and sale of *açai* palm fruit *(Euterpe oleracea).* Production systems for managing the palms are quite stable and demand little labour, but the concentration on this seasonal crop with a limited regional market is economically perilous.

PROJECT ACTIVITIES

The long-range goals of the project require a multidisciplinary team to carry out a wide set of activities. The early phases of the work have stressed inventories of natural resources and land use systems, the identification of collaborators and collaborating institutions, and development of appropriate ties. Later phases, while continuing to include a strong research and monitoring component, will also emphasize experimentation, extension and training.

Activities to date

Work done at the Abaetetuba site from August 1991 to mid-1993 includes the following:

1. Socioeconomic censuses were carried out in 150 households at the Abaetetuba site, and in 30 households at the Canaticu basin on the Marajó Island. Data collection included household composition, labor force, migration, production, extraction, and marketing. A longer term study has begun of fifteen households who have agreed to keep detailed economic information on production and expenditures;
2. Frequent surveys of market offerings and price fluctuations are being carried out and informal interviews conducted with marketers, processors of products such as açai palm hearts and fruits, and small scale industrial producers;
3. Following a complete floristic inventory of a one-hectare plot of secondary forest,

the first of several experimental agroforestry treatments was begun in 1991. Plants identified by local informants as not useful were removed, and those identified as sources of fruit, timber, fuel, and medicines, were mapped. After a second thinning to open up the canopy, several species of fruit trees were introduced. Monitoring of growth, production, labor input and other expenses in the plot has been initiated;

4. Four new experimental agroforestry treatments were set up in 1992. Following a floristic inventory of a one-hectare control plot, the neighbouring fields were clear cut. The diversity and mix of planted crops, and levels of management vary in each plot. A number of variables will be monitored in the coming years, e.g., labor and other expenses, production, harvesting schedule, and sale revenues;
5. Soil fertility and biomass are intensively sampled in a subplot within one of the above experimental plots, and in an adjacent control plot. Sampling is done at each stage in the life of the experimental plot and the control plot to evaluate the effects of management on ecosystem dynamics, especially nutrient budgets;
6. Small stock rearing was incorporated into the agroforestry treatments. To date, locally-bred hogs, ducks, and chickens have been introduced on a small scale to examine their roles in supplementing income and household diets. Monitoring of important variables, including growth rates, reproduction, litter size and survival rates has been done. A study of nutritional ecology is currently under way;
7. Contacts have been made with local research and extension agencies. A local agent of EMATER, the national extension agency, has been a particular enthusiast of the project and will be an important channel for diffusing information to local people. Researchers and students from the Museu Paraense Emílio Goeldi, the Federal University of Pará, UNESPA (Universidade Estadual do Pará), ESALQ (Escola Superior de Agricultura Luiz de Queiróz), among others, have visited the site and several have conducted joint activities there.

Future activities

Provisionally, the following activities are planned to be implemented in the next few months:

1. A joint project with the Yale University's School of Forestry and Environmental Studies' Department of Public Health is planned to determine the effects of diverse secondary forests and agro-forestry ecosystems on the risk of human exposure to important infectious agents;
2. Experiments with low cost, technologically simple, and small scale aquaculture will be carried out. Declining catches of fish and shrimp, the main sources of animal protein in the past, now make aquaculture an attractive alternative;
3. Development of small-scale local industries, especially ceramics, basketry, and woodworking. All three industries have a long history in the region, but are not well positioned in contemporary markets. These non-farm activities could provide valuable complementary income to the households in addition to the agroforest products.

Changes In direction

Hiraoka's long period in the field is now ended, though he will continue periodically to visit the region. In August 1993, Christine Padoch (New York Botanical Garden) and Miguel Pinedo-Vasquez (Yale University School of Forestry) will arrive to spend the year 1993-94 at Macapá. Closer links will be developed with EMBRAPA, especially at Macapá and also in Belém. With these changes, and the incorporation of the project into PLEC, it is likely that new directions of research will emerge.

ENVIRONMENTAL ENDANGERMENT IN THE FOREST-SAVANNA ZONE OF SOUTHERN GHANA

Edwin A. Gyasi
University of Ghana
Legon, Ghana

THE PROBLEM

Ghana is a West African country of 238,539 kM2, with a population of 15 million people most of whom are engaged in agriculture (Ministry of Agriculture, 1991). Environmental deterioration, amounting in some cases to endangerment of future capacity to offer life-support, is a growing problem. It has attracted the attention of both government and scholars (Benneh *et al*, 1991; Dorm-Adzobu *et al*, 1991; Environmental Protection Council, 1991). The problem, which we associate principally with the stresses generated by a three per cent annual growth of population, and with increasingly inappropriate and unsustainable farming practices, is more acute in some parts of the country than in others. It is particularly acute in a forest transition zone in the south of the country, between the coastal savanna that occupies the eastern section of the Ghanaian coastal region between Cape Coast and the Togoland border, and the humid forest belt inland.

THE SOUTHERN FOREST-SAVANNA TRANSITION ZONE

This transition zone is a sort of ecological buffer between the dry coastal savanna and the interior forest. It is characterized by a bi-modal annual rainfall regime, generally adequate to support two crops, and by a fairly wide variety of soils, most of which are suitable both for perennial tree crops and annual food crops. Within it, however, population is rapidly increasing and a mosaic of forest-savanna vegetation is expanding at the expense of the forest.

There is considerable diversity in farming systems, land holding arrangements, and crops. This relatively high agrodiversity reflects the transitional character of the ecosystems, permitting use of crops adapted both to humid and drier conditions, and to the ethnic and associated cultural diversity, strongly affected by migration (Hill, 1963). The zone is a major producer of food crops, notably cassava (manioc), maize (corn) and vegetables, for the nearby coastal urban areas of which the principal are Accra, Tema, Winneba and Cape Coast (Dickson and Benneh, 1988).

We propose to examine both the nature and the causes of growing environmental endangerment in this dynamic region. The study of causes will draw on the national and theoretical literature, but we will also focus on adjustment strategies, and the range of options available to a mixture of owner and tenant farmers, the latter mainly migrants. We propose to concentrate on in-depth study at three sites between 50 and 80 km inland of Accra. These are Sekesua, in the migrant Krobo district, Yensiso in Akuapem, the cradle of Ghana's cocoa industry, and Amanase in the historic southern Akyem cocoa district, further west. These are areas that have already attracted a certain amount of research which can form the basis of new work to inform land-use and environmental policy (Allotey, forthcoming; Gyasi, 1976, 1990, 1991, forthcoming; Gyasi *et al.*, 1990; Hill, 1963; White, 1956).

Field study will be carried out on a team basis among an interdisciplinary group, all of whose present members are Ghanaian. Work will include:

(a) participant observation and questionnaire interviewing of a sample of local farmers, as well as government official and NGO members, with emphasis on how changes impact human welfare;
(b) determination of household sizes, their holdings, and conditions of tenure;
(c) determination of changes in species diversity, including pre- and post-farming regeneration rates of different species in the fallow areas;
(d) determination of the natural characteristics of the soils (fertility, erodibility,

etc.), and changes in vegetative cover, the hydrosphere, and other aspects of the natural environment over time;

(e) determination of nutrition and health status, range of land use systems, farm-system modification including intensification, and other adjustments to deteriorating environmental conditions.

In addition to field work, we will also make use of remote sensing and cartographic data. We will draw on PLEC ideas concerning the evaluation of sustainability and unsustainability. We will also draw on comparative material from other West African regions, widening our network for this purpose. A four-year programme, beginning in 1993, is being designed.

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A FIRST MEETING OF THE HIMALAYAN CLUSTER

Roger Kasperson
Clark University
Massachusetts, U.S.A.
and
Narpat Jodha
ICIMOD, Kathmandu

The Himalayan group follows up work done under the UNU Project on Critical Regions in Global Environmental Change more directly than does any other cluster. Kasperson was leader of that project, and Jodha was a team leader. The project broke new ground in exploring issues surrounding notions of environmental criticality. The cluster group had its first project meeting, as part of the PLEC effort, at the International Centre for Integrated Mountain Development (ICIMOD), from 2 to 18 January 1993. Attending the meeting were Narpat Jodha (Joint Leader) and Suganda Shrestha, from ICIMOD, and Roger E. Kasperson, B.L. Turner II, and Smulya Tuladhar from Clark University. The meetings included discussions aimed at project design, data collection and field methods, and also included field visits to proposed study sites.

The objectives of the project in its present stages derive from three-year funding by NASA. There are four major objectives. These are

1. to explore the types and extent of environmental changes and related changes in human systems, discernible on satellite imagery in selected Himalayan area since 1970;
2. to determine the extent to which the picture of environmental change emerging from this analysis confirms, alters and extends the interpretation formulated during the ICIMOD Critical Regions study, over the past three years;
3. to validate the satellite imagery analysis through comparison with other data bases, and through selected field investigations;
4. to reconstruct in some detail the nature of the social responses to emerging environmental degradation and the human impacts, as these responses have evolved over time, at different scales and by different socio-political groups.

One of the objects of our meeting was to relate these objectives to those of PLEC. As we saw it, they do so in the following ways:

1. we aim to understand the adaptation of farming systems to population growth and changing economy;
2. we seek to determine what is sustainable and what is unsustainable in current regional trajectories;
3. we will identify information needed for well-founded public policy;
4. we shall develop information needed to explain land-use trends;
5. we shall define options for improved land management.

The meeting focused on the data needs for dealing with the various objectives. Existing information and data bases, as well as accumulated small-scale studies, were reviewed and discussed. A time-frame from 1954 to the present was accepted as the study period. Data will be collected in three broad areas: the agricultural system, forestry, and socio-economic variables (including perception and measures of well-being).

The cluster team agreed that the current project should build on previous ICIMOD research on farming systems in the Himalaya, in Nepal, India, China and Pakistan. The dynamics of land use are studied in this. ICIMOD programme, specifically in regard to sustainability or unsustainability. Measurable indicators are sought, and options to reverse trends toward unsustainability are investigated. Work also involves comparative studies of areas characterized by unsustainability symptoms, and those showing positive (sustainability) indicators. While the former indicate decline in the range and quality of production and welfare options, the latter exhibit the opposite.

The underlying patterns of resource use are dramatically different in the two cases. In the unsustainability areas the focus continues to be on primary production activities, with an accelerated rate of extraction. The sustainability area situation shows rapid emergence of secondary and tertiary activities, alongside those of the primary sector. These wider options have visible impact in terms of land management, and the protection - or reduced degradation - of bio-physical resources.

It was agreed by the cluster team that three sub-catchment areas in the central region of Nepal will be selected so as to provide a range of environmental degradation (from relatively benign to relatively severe), and a range of human well-being (from relatively well-off to relatively desperate). For each of the areas preliminary analysis will be conducted, using existing information. Satellite imagery will also be analyzed for discerning trends in nature-society interaction over time.

Study teams will then conduct field research in each of these areas. The studies will each be 2-3 weeks in length and will include:

1. preparation of village sketch maps, using participatory strategies, for the current time and for 1954;
2. collection of village-level data by detailed interviews with village leaders and key informants;
3. record-keeping by school children, under the supervision of cooperating teachers, on a variety of household data and activities;
4. household histories, reconstructing social and economic change, and household

trajectories over the time-study frame, and

5. interviews with informed outsiders.

These local studies will then be placed in the context of accumulated ICIMOD work and on the literature on environmental change in the Himalaya more generally. In particular, the planned studies will be tested for their congruence, or conflict, with existing interpretations. It is expected that the proposed research will extend, as well as test, previous work in several important ways. These include examination of farmer perceptions, the development of family histories, and interaction with state goals and activities.

If sufficient further funds are obtained a systematic comparative analysis will be made of the large number of village and local studies that exist in the grey and published literatures. A substantial collection of such studies already exists in Jodha's research group at ICIMOD, and this collection will be expanded and systematically analyzed. The results will then be compared with the field studies, but also examined as to the light they may shed on generalizations and propositions relevant to PLEC in this critical region.

LAND USE CHANGES IN THE HIGHLANDS OF NORTHERN THAILAND

Kanok and Benjavan Rerkasem
Chiang Mai University
Thailand

The highlands of northern Thailand are home to a population now fast approaching one million, made up largely of several ethnic minorities. Virtually all of these people make a living mainly from growing rice for subsistence and other crops, including opium, for cash income. Traditionally' these crop-production activities have been based on traditional land use systems, either rotational shifting cultivation or the pioneer system, constantly invading new forest. Since the 1960s these systems have undergone marked changes. We describe these changes in general, with a focus on one village that seems to have benefited from the new system.

ESTABLISHMENT OF PERMANENT VILLAGES

Traditionally, highland villages were highly mobile. Pioneer shifting cultivators moved in search of new forest after only 5-10 years of continuous cropping on one site. The villages of rotational cultivators also split up to establish new settlements. All this movement of villages has virtually stopped within the past 20 years, and for some the sedentarization process began as much as 30 years ago. Several Hmong, Lisu and Lahu villages, formerly opium-growing pioneer cultivators, became permanently settled some time in the 1960s; often, this happened after purchase of developed wet-rice paddies from Thai or Karen. National policy, instituted in the 1960s, reinforced this trend toward permanent settlement. Few hill-tribe people had Thai citizenship, and their official recognition demanded permanent settlement as a first step. Provision of health and education services, roads and electricity at some key villages, offered further incentive to settlement. There was also pressure, through development and implementation of national conservation and reforestation policies, together with the designation of large highland areas as wildlife reserves.

NEW CROP PRODUCTION PRACTICES

New cropping practices have accompanied permanent settlement. Thanks to strict enforcement of drug control laws, opium cultivation has almost disappeared. All tribes now practise cultivation of wet-land rice. Where good irrigation is available, land may be double-cropped with soybean in the dry season. Highland paddies are keenly sought after, but the amount of relatively flat land with sufficient water supply for rice is limited in the highlands. Dryland cultivation, much of it on steep slopes, is therefore still widespread, some with short fallows of 2-3 years, some permanently cropped. Upland rice, maize for

livestock, and a large number of other food and cash crops are grown. Lack of fallow rotation ensures that yields are low, and that weeding requirements are heavy. Farmers are reluctant to apply costly fertilizers and pesticides to subsistence crops, but do use them on high-value cash crops, for example cabbages, coffee, tomatoes, lettuce and flowers. This raises another set of problems.

SUSTAINABILITY PROBLEMS IN INTENSIVE CASH-CROPPING

Improved national transportation, and rising incomes in Bangkok and other cities, have created market opportunities for the production of temperate crops in the cooler climate of the highlands. Research to evaluate new species and types began in the 1970s, and has continued. Most of the new crops require heavy fertilizer and pesticide applications. Intensive cultivation, with bare soil surface during the wet season, contributes to soil erosion. There are downstream hydrological consequences, leading to water shortages in the dry season and also sedimentation in the paddies; conflicts have erupted between highland and lowland communities on these issues. All the new cash crops are subject to wild price fluctuations, and simultaneous seasonal collapse of tomato and cabbage prices, combined with the low present price of coffee, threatens food security of poor village families who have converted completely to cash cropping.

MAE RID PAGAE: A WORKING MODEL?

Mae Rid Pagae is a Karen village at 1,200 m, some four hours by road from Chiang Mai. In the past, limited irrigated wetland and a 'sustainable' rotational shifting cultivation provided enough rice for all to eat in only some years. In bad years many had to walk outside to seek work. As population grew, and the national conservation policy made expansion into the forests risky, the luxury of a 7-8 year -fallow period within the dryland cultivation cycle ceased to be feasible. Cabbages were introduced in the early 1980s, sold through traders to Bangkok.

However, Mae Rid Pagae farmers did not turn wholly to cabbage production as did those of other villages. Instead, they incorporated cabbages as an irrigated dry-season crop in the rice paddies, and in the upland fields rice and cabbage are grown in alternate years. The problem of a variable market price is in no way eased, but there is an important bonus in the yield of rice, probably due to the residual effects of organic and inorganic fertilizers, and the effect of clean-weeding of cabbages in reducing weed infestation of rice. Farmers report rice yields two or three times their former harvests in both upland and lowland systems.

The village also has the advantage of a well-structured soil, less susceptible to erosion than many others. Moreover, contour vegetative strips have been introduced, employing a range of species including the weed *Chromolaena* (var. *Eupatorium),* to check water flow across the slopes. However, farmers do acknowledge that they are beginning to receive complaints from villagers downstream about the pesticide content of the water.

CONCLUSION

Land use in the highlands is rapidly changing in response to external pressure of national conservation policy, growth of population, and rising expectations and aspirations of the villagers themselves. The two major issues identified in this short note - food security and the environmental impact of changes - are issues on which we expect to focus attention in greater detail, in PLEC.

THE TRADITIONAL LAND MANAGEMENT SYSTEMS RESEARCH PROGRAMME IN YUNNAN, CHINA

Guo Huijun
Kunming Institute of Botany
Academia Sinica

Traditional (indigenous) land management practices have been condemned as the work of backward, primitive peoples, in China as elsewhere in the world. Work on these practices, brought into PLEC, has been funded by the Ford Foundation, and involves study of indigenous agro-technologies among various ethnic groups in Yunnan Province. The programme comprises four projects: (1) the Yunnan Traditional Agroforestry Systems Research Survey: modification and application (TAF); (2) the Homegarden Survey; (3) Farming Systems in the Gorges; (4) Traditional Irrigation Systems and Forest Conservation by the Dai people of Xishuangbanna. The broad objective is to obtain a better understanding of the traditional management systems, to see how they can offer different models for rural development in the upland area. Discussion in this note relates to projects 1 and 2 only.

YUNNAN PROVINCE

Yunnan Province, in the south-west of China bordering Burma, Laos and Vietnam, has a total area of 394,000 kM^2 and a population of 35,340,000. Some 94 per cent of the area is either mountain or plateau, altitudes ranging from 76 to 6,740 m above sea level. There is a great variety of climates, from tropical to highmontane. Only about 24 per cent of the Province lies in the 'warm zone'.

Yunnan is one of the places in China where early traces of the human race have been found. The discovery of the teeth fossil of the Yuan-mou ape man proves that the human race existed here 1,700,000 years ago. The written history of Yunnan commenced in 286 BC. In 109 BC Emperor Wu-di of the Han dynasty set up the Yi-Zhou shire in the Kunming lake area, awarding a golden official seal to the ruler of Yunnan. At that time, the road to foreign countries by way of Yongchang County in Yunnan was named the 'southern silk road'. In 1276 AD, during the Yuan dynasty, Yunnan was officially made a Province.

Twenty-five nationalities are found in Yunnan, the largest number of ethnic groups in any part of China. In addition to the Han people, the 24 minority nationalities include the Yi, the Bai, the Zhuang, the Hani (Akha), the Lisu, the Dai, the Wa, the Naxi, the Jingpo and others, totalling some 12 million in population. Among all these minority groups are found different traditional life-styles, costumes, folk dances, festivals, customs and house styles. Rich in natural resources, Yunnan has a great variety of plants and animals, and the largest non-ferrous mineral resources in the nation. The Province is sometimes referred to as the 'kingdom of plants', the 'kingdom of animals' and the 'kingdom of non-ferrous minerals'. Except in Xishuangbanna, the remaining forest area is quite small. About 23 per cent of the Province was still forested according to official data in 1981, but the actual area could be as low as 17 per cent.

TRADITIONAL AND INDIGENOUS LAND MANAGEMENT SYSTEMS

By 'traditional', we mean practices that do not involve the use of fossil fuel. The term 'indigenous' has the wider sense that it includes all customary activities designed to control resource use, including customs, regulations and institutions, as well as agro-technology. Most present-day systems in fact combine the 'traditional' and 'indigenous' with the modern. This applies particularly to the agroforestry systems studied by the TAF sub-project.

Agroforestry

There are both cyclic and integrated systems. A large belt across south-western Yunnan is often termed the 'swidden belt', but within it there is in fact very little real 'slash-and-burn'

cultivation at all. Widely, perennials are planted while annual crops are in the ground. The 'dongya' system practised by the Hani (Akha) people in a Xishuangbanna village may serve as example. Upland rice is cultivated for two or three years, and in June or July in the second year, rattan seedlings are planted in the field. Five to ten years later, farmers return to clear a mature rattan forest which is harvested to yield material of industrial value. Similarly, villagers in Tengcong County, West Yunnan, sow alders in upland rice fields used for only a single year. In eight to ten years a dense alder forest has grown, yielding fuelwood or timber, and leaves which provide green manure. Different groups, in different environments, and under different social conditions, each have their own variation. For example, the Xishuangbanna Dai grow *Casia siamea* in rotation with upland rice, while others, including Han Chinese, employ alder with tea and upland rice, rubber with pineapple, walnut with corn and rape, peach and pear with corn, rape and vegetables. The most popular combination is of tea with annual crops.

Homegardens

Homegardens are the gene pool, food box and laboratory of the rural people. The most diverse are those of the Dai people in Xishuangbanna, in whose homegardens 463 species or varieties are encountered, including food, medicinal and ornamental plants. About 80-100 species can be found in any one plot, and the homegardens yield 30 per cent of the cash income. Over time, the homegardens of Yunnan have changed in species, structure and function. Many wild species are domesticated there, so that in one plot studied 40 per cent of species are semi-domesticates.

The programme and its future

The consequences of these indigenous management practices, and others studied in related projects, for soil fertility, efficient utilization of the land, biodiversity conservation and cash income, have been little studied in the past. On the contrary, officialdom has treated them as impediments to rural development, and many researchers have supported this view. The present programme, which is based in the Kunming Institute of Botany, includes also researchers from the Yunnan Academy of Forest Science, and the Xishuangbanna Tropical Botanical Garden. Some experimental work on agroforestry systems has been conducted by the writer and two of his associates, but is not reported here.

It is clear that a wider set of questions can be asked, both in collaboration with our Thai partners, and in association with PLEC as a whole. In two meetings over the coming months we hope to develop, from this base, a programme that explores the reasons for the remarkable agrodiversity that we observe in Yunnan.[2]

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[2] This note is modified from a draft Chapter 1 in *Indigenous Land Management Systems in Yunnan, China,* Proceedings of the Seminar on Traditional Land Management Systems, Kunming, 8-15 Oct 1992.

AGRICULTURE IN PAPUA NEW GUINEA: BACKGROUND FOR PLEC

Bryant J Alien
Land Management Project
The Australian National University

THE EVOLUTION OF MODERN AGRICULTURAL SYSTEMS IN PAPUA NEW GUINEA

Modern Papua New Guinea (PNG) agriculture is not 'neolithic', as it is still sometimes popularly described. PNG agriculture is as much the outcome of colonialism and incorporation into the world economy as it is the outcome of thousands of years of adaptation to changing physical, demographic and social environments. Agriculture systems have a long history in PNG. It is probable that agriculture evolved in this island, independently of developments in the Middle East or on the Asian mainland, at the end of the last Ice-Age about 10,000 years ago, domesticating vegetable and fruit species indigenous to western Melanesia such as bananas, sugar, winged bean (*Psophocarpus tetragonolobus),* pitpit (*Saccharum edule; Setaria palmifolia*), pandanus, breadfruit, canarium and sago. Probably about 5,000 years ago, these indigenous species were joined by introductions from Asia.

In the highlands, where the pollen record is best researched, detectable forest disturbance begins around 5,000 years ago and was well established by 2,300 years ago. It seems safe to assume this early disturbance of the forest was caused by shifting cultivation with long fallows, by small numbers of humans who were also extensively using managed and wild species. However, there is archaeological evidence from two sites in the highlands that, relatively early in the evolution of agriculture in PNG, intensive systems based on water management, drainage and irrigation, co-existed with extensive systems.

This long period of apparently slow change in dryland agriculture was interrupted relatively suddenly less than 400 years ago. The pollen record in a number of the highlands' valleys shows accelerated reduction of forest species and an increase in grasses and woody regrowth. The rate at which water-borne sediments washed into a number of small lakes in the same valleys also increased suddenly between 300 and 150 years ago, indicating increased erosion and loss of soils from surrounding catchments. The most likely cause for these environmental changes is agricultural expansion associated with the adoption of a new crop with origins in South America, the sweet potato. Transported across the Pacific to the Philippines by the Spanish, the sweet potato plant probably reached PNG through Indonesia during the 17th century.

Sweet potato and Intensification

Sweet potatoes are more tolerant of low soil fertility than either taro or yams – the traditional staple crops of most of the western Pacific. They will grow at higher altitudes. They can be propagated easily by runners, or vines. The adoption of sweet potato allowed cultivation periods to be extended, fallow periods to be shortened, and land which had become degraded to the point where it could not be profitably cultivated with taro and yams to be cultivated anew with sweet potato. It also permitted expansion of the area under cultivation to higher altitudes.

More than this, however, changes in highlands agriculture systems associated with the adoption of sweet potato have been described as a 'revolution' in intensification. The varied agriculture systems which were observed in the 1920s and 1930s by the first foreigners to enter the highlands were, in the main, adapted to the edaphic conditions of sweet potato culture, and therefore probably the outcome of not more than some 300 years of evolution.

The most obvious consequence was the replacement in the central highland valleys of what were probably mixed crop, forest fallow systems with the permanent cultivation of a single crop (sweet potato) in fully enclosed fields, in which soil fertility was maintained by short-grass fallows between crops, complete tillage, ditching, mounding, composting, or legume rotations, and in which mixed crops became segregated from the dominant crop.

these systems support humans at densities of up to 150/kM^2 and higher in some areas, and pig populations of up to 300/kM2.

As far back as the time of the earliest remembered record, central highland societies were involved in large scale exchanges of pigs and shells, and in inter-group skirmishing that sometimes became vicious warfare. They later came to be characterized as 'big-man' societies because they were led by males who achieved status by organizing their followers and the land resources available to them, to participate in the never-ending competition with the groups surrounding them. Uncompetitive groups faced loss of land and dispersal. Within groups, unproductive males were reviled, and antagonism between the sexes was marked. Long cultivation periods released men from their role in the annual labour of clearing new land for cultivation to engage in politics, warfare and trade, but fixed women in the fields, weeding and replanting. During this process pigs took on social and cultural values well beyond their contribution to nutritional wellbeing as food. A major increase in their numbers required further intensification.

Occupation of the high altitude valleys, and change In the highlands fringe

Less obvious were those changes which occurred in the areas surrounding the central highlands, at higher and lower altitudes (the latter area is known as the highlands fringe). The higher altitude valleys and plateaux, not permanently occupied as recently as 200 years ago, were colonized as the cultivated area expanded. The environment here was colder, plants grew more slowly and frosts were a hazard. High altitude settlers kept close links with their originating communities and returned to them for refuge during times of frost. By the 1900s, cultivation had reached the crests of the watersheds of some major river systems.

In contrast, the highlands fringe was occupied before the arrival of sweet potato by groups who had close trading and marriage relationships with the central highlanders. The agriculture systems were probably low intensity bush fallow systems. Faced with the increased 'purchasing power' of the intensifying and inflating central highland economies, the fringe groups had either to keep up or face the prospect of losing their positions in trade and exchange networks to more competitive groups. The outcome was an intensification of agriculture in the fringes, extensive forest clearing and growing populations. The fringe environments however, are commonly rugged hills and mountains, in warmer climates with high to very high rainfall regimes, quite different to the central highland valleys. On the fringes, forest soils cleared of trees and cultivated repeatedly on short cycles, were converted to grasslands and were abandoned in favour of further clearance along the edge of the forest.

Intensification In the lowlands

The lowlands were largely unaffected by the introduction of sweet potato in the pre-colonial period. However, in a few restricted locations intensive systems developed, most often based on yams. The floodplain system developed by the Wosera people in East Sepik Province, which involved the selection of a yam variety which could withstand periodic inundation, is a good example.

COLONIZATION AND INCORPORATION INTO THE WORLD ECONOMY

At colonization, PNG village agriculture systems were characterized by a high degree of agrodiversity. They occurred in a wide range of environments (from sea-level to 2,800 m above sea level, in annual rainfall regimes from 1,000 mm to 10,000 mm), were commonly adapted to local micro-environmental conditions and supported humans and domestic animals at a wide span of population densities. Although hundreds of plant species were exploited, about 50 were regularly cultivated. Most important were the root crops: sweet potato, taro and two species of yams; a large number of banana species; and sugar-cane and green-leafed vegetables. Fruit and nut species were widely cultivated or managed in villages and in fallows. Sago was

the staple food or an important supplement in many areas up to 600 m above sea level.

The existence of areas of grassland with very low population densities marked places where intensification had not been sustainable and land had been degraded to the point where it was no longer worth using for agriculture, and was burned frequently by intent or by accident. Large such areas in both lowlands and highlands provide evidence that environmental limits had been overstepped.

Colonialism and population change

The first colonial settlements were established on the coast in the 1880s. By 1900 the population of PNG was probably about 1 million. We do not know what sort of growth rates had prevailed in the preceding 300 years but between 1900 and 1970, however, the population more than doubled to 2.4 million. Yet there were few spectacular signs of rapid environmental change, intensification or expansion. Nor is there evidence of widespread increases in malnutrition which would suggest food supply had not kept pace with population.

Between 1900 and 1970 unique historical conditions (in the sense that they will not be repeated) came into play. Under their influence the rate at which environmental limits were being approached was slowed in many systems. The conditions included: a probable short-term reduction in the rate of population growth early in the period, followed by a faster increase later; new crop introductions; the use of steel tools; the cessation of fighting; the construction of administration centres and roads; and the introduction of cash cropping.

Although colonialism in PNG did not result, at the national level, in the massive depopulations which occurred elsewhere in the Pacific, there were local instances where severe losses occurred. It is probable population growth was substantially checked from around 1890 to 1930, first by epidemic disease, (smallpox, influenza, pneumonia, whooping cough, measles and dysentery), and then between 1942 and 1946 by the severe disruption of the Pacific War. It is likely that pressure on, land resources was temporarily reduced in some densely peopled areas. From 1946, improved health services and the widespread use of anti-malarial, antibiotic and sulphanamide drugs reduced infant mortality substantially and led to the high population growth rates which allowed a doubling by 1970 and a subsequent increase to 3.9 million today.

New crops and new tools

A number of new crop species (almost all of New World origin), and new higher-yielding varieties of existing crops, were brought into PNG in the late 1800s and early 1900s. They diffused rapidly and were widely adopted. They included 'Chinese' taro *(Xanthosoma* spp.) - the most important, corn, pumpkin, choko, 'Irish' potatoes, peanuts, cassava, triploid bananas and higher yielding varieties of sweet potato. Peanuts replaced winged bean in legume rotations. Many introductions had specific advantages: for example, some provided additional food for little extra labour, others yielded better on poorer soils than existing crops, and 'Irish' potatoes were less susceptible to frost than sweet potatoes. Very little formal extension work was involved in their spread or integration into existing agriculture systems. Corn, for example, which was probably introduced in the 1880s, had reached western highland agriculture systems by the 1930s when the first European explorers arrived. The sweet potato continued to spread. It replaced taro in many parts of the New Guinea islands and was adopted in systems throughout the lowlands, where it became one of the staples. Where it has not become a staple, it is often planted following the harvest of staples, effectively extending cultivation periods for an additional 12 months.

The introduction of steel tools (axes, bush knifes, shovels and spades) increased labour efficiency by between an estimated 1.5 and 3 times. The establishment of a colonial government brought about an enforced cessation of fighting between groups. Not only could men devote more time to agriculture, but also land which could not previously be used because it was too difficult to defend, much of it high quality, could be

brought back into production. The cessation of fighting allowed a revolution in personal movement, especially of males. As a result, existing agronomic technologies of intensification and new crops spread faster and further. In the highlands, for example, composted mounding continued to spread out of the Enga-Huli area at a faster rate into the Southern Highlands and the Western Highlands. Fallow tree planting was another technique that diffused widely across the central highlands after colonization, in this case with some encouragement by the colonial government.

Trade, the nation state and the world economy

Villagers became able to sell or barter agricultural produce on a much larger scale than before. The money earned from selling cash crops allowed people to purchase imported, processed foods, rice and tinned fish, meat and fat in particular. A study in the highlands found the contribution to energy and protein in diets from imported cereals had risen from around five per cent in 1956 to 25 per cent in 1981. The real price of imported foods has fallen steadily (of rice, for example, by 25 per cent between 1971 and 1984) and they are now cheaper, more easily transported, stored and cooked than most local staples. Despite debates in the 1970s, it is now generally accepted that access to purchased food has been associated with lower rates of stunting and wasting in children. Purchased food has also enabled people to even out periodic variations in food supply caused by climatic perturbations or disrupted planting.

In contrast to the situation in 1900, when intensification slowed and in many places reversed, conditions in the 1990s are again forcing intensification in many areas. Populations are now increasing rapidly and no new crops have emerged which can provide significant increases in production. Steel tools are now in use everywhere, but most villagers cannot afford to use hand tractors, or to buy chemical fertilizers. Fighting is again common in the highlands, and robbery, theft and violence, including rape are becoming commonplace in many parts of the country, restricting the ability of people, especially women, to travel freely, and to market domestic and export crops.

In the early 1990s, the prices for the smallholder export crops on international markets are at historical lows and long-term price predictions are poor. Domestic marketing has expanded rapidly in response to increased money in the towns and lower rural incomes from cash cropping. Intensification is again taking place in many areas. In some there are suggestions that this process of intensification will not just be unsustainable but, in the absence of significant changes in technology, will lead to long-term environmental damage which could jeopardize continued agricultural production.

THE ROLE OF THE LAND MANAGEMENT PROJECT

Our purpose is to identify areas of stress and to analyse their problems. However, the comparative data from which to do this across the nation do not exist. Although PNG has an excellent data base on its physical resources, the result of three decades of work by a division of the Australian Commonwealth Scientific and Industrial Research Organization, and other scientists, now brought together in a computer-based system, information on agriculture is scattered, imperfect and very out of date.

Existing maps of staple crops and agriculture systems are based largely on a questionnaire on agriculture, which was sent to government officers (not agricultural specialists) before the 1966 census. These data were used to create highly generalized small scale maps, first published in the 1970 *Atlas of Papua New Guinea,* and since reproduced in a number of other publications. They contained many original errors, also regularly reproduced, and the information is now 27 years old. Although a large number of published and unpublished scientific, academic and popular articles exist, mainly from intensive village studies by anthropologists, geographers and others, they have never been brought together in a systematic way. The only comparative look at PNG systems was undertaken by Brookfield

in 1971; using information on only 44 systems drawn from his own field work and the existing literature. Except for some regionally-specific work in a small part of the country, which involved members of the present project team, nothing has been done since.

There are three reasons for embarking on the unusual exercise in comprehensive agriculture system mapping which is a main activity of the Land Management Project. First, notwithstanding mineral development and urbanization, a very high proportion of the national population continues to depend on the land, under conditions that warrant serious concern for the future. Second, PNG has a remarkable degree of agrodiversity among its systems, the global significance of which - both theoretical and practical - can only be appreciated with comprehensive information. Third, the excellent physical resource database, mentioned above, provides means with which to correlate agrodiversity with the diversity of the natural environment, and to do this at a map scale of 1:500,000 over the whole country. Without such information, moreover, it will not be possible to sensibly direct scarce agronomic and farming systems research to areas most in need of assistance.

How the project is going about providing this information, and in what specific ways it is relevant to the wider concerns of PLEC, will be described in a later article.

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THE HUMAN ECOLOGISTS' CONTRIBUTION TO PLEC

Ryutaro Ohtsuka
Department of Human Ecology
University of Tokyo

This note for colleagues in the PLEC project sets out to explain the past, ongoing and planned field investigations in Papua New Guinea by a group of Japanese human ecologists. In Japan, human ecology has been developed by scholars originally trained in various fields, including anthropology, health science, behavioural science, and geography. Our department, established in the 1960s, has played a leading role in this development. Although we belong to a School of International Medicine (formerly a School of Health Sciences) in the Faculty of Medicine, our members have cooperated with many individuals and/or institutions both within and outside Japan. Papua New Guinea has been our major target area since my own first field study in a Gidra-speaking village in the lowlands of Western Province, conducted in the late 1960s. In cooperation with many colleagues, the Gidra study has been intermittently continued until this year. Several other populations, or linguistic groups, in various parts of the country have been studied since 1985.

POPULATION ECOLOGY AS OUR BASIC STANDPOINT

Japanese human ecologists have paid special attention to grasping, analyzing and assessing human behaviour and/or survival at a population level (e.g. Ohtsuka and Suzuki, 1990). In short, we believe the most appropriate unit for the study of human survival is a human population characterized, in both biological and sociocultural senses, by occupation of a particular geographical region, common identity of its members, formation of the bulk of marriages within the population, and thus maintenance of a gene pool. In this context, our field investigations have attempted to elucidate human survival from both temporal and spatial aspects. In particular, long-term population dynamics through generations stress the temporal aspect, and population migration and diverse adaptation of production systems to different environments stress the spatial aspect. Both are interconnected.

Within this general background, each research project has had its own focus. Many individual investigations have attempted to analyze specific adaptations of some small group, such as a village. Detailed study in such a small location has provided basic information on population ecology. For example, 1 carried out a 10-month survey in 1971-72 in one village of the Gidra-speaking population, focusing on the people to environment relationship through food-provisioning and food-consuming activities (Ohtsuka, 1983). Following this study, the adaptive and survival mechanisms of all Gidra speakers were investigated. In addition to studies on subsistence, nutrition and health in various villages (e.g. Ohtsuka et al., 1985; Hongo et al., 1989), the rates of fertility, mortality and population increase over generations were estimated; inter-regional and intra-regional population movements for all members, including the deceased, were determined with some accuracy, and the rate of inter-generational replacement through females was assessed from the genealogical record (Ohtsuka, 1986).

More recently, our studies have cast more widely, and have been designed to compare adaptative mechanisms and strategies among populations in environments that differ both naturally and socio-culturally, including lowlands, foothills, highlands and islands. In the Western Province, work has been done among the Kiwai in the lowlands, the Samo/Kubor in the foothills, and the mountain Ok, who have only lately accepted sweet potatoes as a staple crop. We have also worked among the sweet-potato dependent Kivruga in the Eastern Highlands Province, and the Lou Island group in Manus Province. Although our inter-population comparisons still have some way to go, some of our findings have been reported, for instance by Kuchikura (1990) on subsistence adaptation among the

mountain Ok, and on migration patterns among different groups by Ohtsuka (1987).

PLANNED RESEARCH IN PAPUA NEW GUINEA AND BEYOND

In order to find sites suitable for comparative study within PLEC, T. Inaoka (Kumamoto University) and I have have recently undertaken reconnaissance in villages of the Huli and Kaluli people in the Southern Highland Province. The suggestion of these groups came from Bryant Allen and his colleagues in Canberra, and Allen and Inaoka walked and travelled together in the Huli region and neighbouring areas before I arrived. The Huli are among people who have, over the last two centuries or more, developed sophisticated agricultural technologies with some unique features. The Kaluli have largely retained what we suppose to be traditional lifestyles. The Huli seem a group particularly appropriate for study within PLEC. Their adaptive mechanisms are markedly different from those encountered among populations previously studied within our programme; they experience high population density and a shortage of agricultural land; moreover, a demographic data have been large amount of accumulated at the former Tari Research Station by the Papua New Guinea Institute of Medical Research.

Our research in the period from April 1993 to March 1996 is supported by the Japanese Ministry of Education, Science and Culture *(Monbusho),* although insufficiently to enable us to complete the whole programme. At present, we plan provisionally to work mainly among the Huli and Kaluli in 1993, among the Lou Island group in 1994, and also to return to some previously-studied groups in the Western Province. The research will include land-use systems, food and nutrition, health and disease, population dynamics and migration. A comparative clarification of human survival mechanisms in different Papua New Guinea environments is our longterm goal as human ecologists. We expect, however, that our findings will become more widely useful when they are combined, and fruitfully integrated, with those of the Land Management Project led by Allen. Moreover, we hope to extend our findings comparatively beyond Papua New Guinea into other tropical regions, particularly in Asia. Already, some Japanese human ecologists have, during the last two years, worked in East Kalimantan (Indonesia) and in northern Thailand. We are in contact with the leaders of the Thailand PLEC group, and look forward to wider communication with scholars in different regions as PLEC advances.

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PART 4

VIEWS

This is intended to be a permanent feature of this Newsletter, raising issues for discussion, and giving space for opinions, replies, and interchange. The first view 'was intended to have been a note opening discussion on one major question for PLEC, that of evaluating sustainability. However, it drew on an exchange with authors who are currently revising their own presentation, and will therefore have to be deferred to the second issue of this Newsletter. Instead, a revision of a statement on 'Theory' in the population/land management area, first written for the Washington planning meeting in August 1992, is offered in its place. While this statement, and the next, come from the Scientific Coordinator, hopefully some others can be persuaded to contribute in 1994, and beyond. I hope recipients (both within and around PLEC) will feel free to comment. Edited comments of wide interest will be published in later issues of PLEC News and Views

Editor

NOTES ON THE THEORY OF LAND MANAGEMENT

by
Harold Brookfield

This is not intended in any way as a definitive statement, but as a set of propositions that require thought in PLEC. The discussion below concerns only the societal aspects of population-production-management-environment issues. Most of the often contradictory propositions set out below are derived from the literature. Selected references only are given at the end.

1. Some Suggested Definitions

Ia. Intensification

Measured in relation to constant land, intensification is the substitution of labour, capital and technology for land, in any combination, in order to obtain higher long-term production from the same area. A narrower definition would be the **larger** application of labour, capital or technology to achieve the same result, but without varying the proportions of the non-land factors of production.

Ib. Innovation

Innovation, as distinct from or in combination with intensification, involves some qualitatively new departures in the system of production, whether these be a change in combination of existing factors, or the introduction of new forms of technology or capital. Thus, for example, the introduction of, say, irrigation, is an innovation leading to a quantum jump in either productivity or its security, whereas the further extension and elaboration of the new system then becomes its intensification.

Therefore, **Intensification without Innovation** involves no qualitative change in resource management practices; **Intensification with Innovation** incorporates such changes.

Ic. Degradation

Degradation is a relative rather than absolute concept, and can only be defined in relation to human use. It entails reduction of the quality or capability of a resource to a lower rank in relation to a constant set of uses, whether this is readily reversible or not. Thus a degraded

forest has a lower timber density than that which it replaced; a degraded soil has lower nutrient or physical state than an un-degraded soil. A change in use is not necessarily degradation by itself, so long as a capability to produce is retained in the new form. Thus replacement of forest by grassland is degradation from the points of view of forest production and of biodiversity, but if the grassland is sustainably useful it is not degradation from the point of view of human use as a whole.

Id. Population pressure

A condition, or state of affairs, in which it is perceived that there are more people living and working on an area of land than the resource can adequately and safely support within the normal range of conditions. It is a perceptual concept and, though it can be measured on a conditional basis, any change in the conditions immediately vitiates the measurement. It is, however, a condition that is, empirically, widely perceived to exist, and forms the basis of a considerable range of hypotheses about population-land-use-environment relationships.

Ie. Landesque capital

Physical works created for the purpose of improving or sustaining production that have a useful life well beyond that of a single season, crop or crop cycle, and which include irrigation, drainage and water-control works, contour banks, terraces, dams, plantations, complex agro-forests, and improvements in the soil itself that are of an enduring nature.

II. Hypotheses Based on Population

IIa. The Classic and Boserup forms:

1. (The Classic form) The growth of population pressure on resources leads to land resource degradation, by one or more of:

   a. clearance from forest of unsuitable and sensitive land, extension of cultivation onto steep slopes;

   b. necessary shortening or elimination of fallow periods;

   c. reduction of holding size, increase of tenancy and near-landlessness, leading to peasant immiseration, so that smallholders have no option but to 'mine' their land resources for subsistence;

   d. reduction, due to impoverishment, of available means for repair of damage, or appropriate works.

2a. (The Boserup form and variants). The growth of population pressure on resources leads to intensification of production, including measures designed to conserve resources, because of one or more of the following reasons:

   a. Intensified systems are known (or can be invented), but farmers will only adopt them when they have to, because returns do not adequately compensate for the increased inputs required;

   b. Population pressure requires the occupation of land (e.g. steepland, wetland) that cannot be used at all without intensive preparation and management;

   c. Population pressure, whether leading to 'shared poverty' or to great inequality, requires that labour-intensive management and production systems be used in order to provide employment.

2b It follows that reduction/relaxation of population pressure will lead to improved management, because:

   a. It becomes possible to re-incorporate longer fallows into the production system;

   b. Rising cost of labour leads to the substitution of capital and technology for labour;

   c. Farmers become better able to afford the means with which to manage their land more effectively.

   d. Farmers can obtain sufficient sustenance without having to use unsuitable or marginal land, or 'mine' land resources in order to obtain subsistence.

IIb. Alternative hypotheses to the above

1. Population pressure can create conditions which inhibit adoption of improved management systems, because:

   a. Since labour can be had at little more than the cost of its subsistence, there is no incentive to substitute capital and technology for labour;

   b. Even high mortality and famine can be accepted provided that the land-holding class is able to retain control of the means of production, and retain its own quality of life.

2. Reduction or relaxation of population pressure may lead to a deterioration in the quality of management, because:

   a. The labour necessary to maintain labour-intensive systems of management ceases to be available, or becomes too costly;

   b. Farmers are able to substitute land for labour, capital and technology and, being able to obtain more adequate returns, are less concerned to preserve the quality of the resource.

III. Behavioural and Societal Hypotheses

IIIa. Hypotheses focusing on the individual

1. The purpose of resource management is to ensure immediate and future production, not environmental conservation, future production being valued over a time span which varies greatly according to the circumstances of the farmer;
2. Farmers will not exploit their own labour power beyond levels necessary to ensure their own subsistence, and their own non-subsistence needs;
3. Farmers, and all others, see their natural and societal environment in part, and not as a whole. Decision-makers operating in an environment take their decisions on the basis of the environment as they perceive it, not as it is;
4. a. Farmers with access to only limited resources will go to great lengths to conserve these resources when they perceive them to be threatened, even if their means to do so are extremely limited;

   b. While farmers may be ready to take steps to preserve the quality of their resource, including large investment in landesque capital, so as to sustain future production, this will be so only where resources are perceived as basic to livelihood. Where resources are not so perceived, most farmers will be quite opportunistic about their use;

5. a. However, farmers usually fail to perceive the degradation of the resources on which they depend, and therefore are slow and reluctant to act in the prevention of damage;

   b. Alternatively, whether they manage resources well or badly, most farmers with more than a few years experience on a site have a good understanding of the qualities of the resources available to them, and readily perceive short-term change in resource quality. However, most have poor understanding of long-term environmental degradation;

6. a. Resource management is normally adapted to a range of climatic, market and other external conditions around the perceived mean, but rarely to major disturbances;

   b. Alternatively, many systems are designed to cope with a considerable range of external conditions, and some have mechanisms for adaptation to 'disaster which, often in the societal as well as in the managerial field, provide means of insurance against overwhelming loss of livelihood;

7. a. Most farmers, living and working in an environment of uncertainty, will act to reduce risk, and will not undertake innovations that are perceived to increase risk. The minority of true innovators is therefore likely to be drawn from among those with larger resources, who are more secure;

b. Innovation is far more likely to be undertaken from hope of gain, in either quantity or security of production, than in response to a perception of stress. Contrary to much of population-based theory, which lacks mechanism for the postulated responses, it is hypothesized that the first question regarding innovation should concern who stands to gain by innovating.

IIIb. Hypotheses based more exclusively on society

1. Pressure for production, and stresses on management, may arise in many ways unrelated to subsistence needs. These pressures may be totally independent of population numbers and density, yet may have all the conditional consequences reviewed above. They arise in many ways, including:

   a. Surplus production may be required for use under reciprocity, cementing social relations between persons, or under redistribution, in which payments are made into a centre then re-allocated;

   b. Surplus production may be required to support landlords, ruling classes, state services, religious services, armies, under a range of systems of rent, tribute, tithe, forced deliveries, forced labour and taxation;

   c. Cash production, in place of or in addition to required surplus, has to meet all needs not met by subsistence production, reciprocity and redistribution. Through changing needs, credit, marketing and other arrangements, cash production readily ceases to be optional, and becomes a required use of resources;

2. Production pressure on resources, therefore, is a major force, and in part of the argument used above, the words 'production pressure' could replace population pressure' with little need to change the balance of the conditional hypotheses advanced;

3. However, there are important differences. Production pressure on resources may, hypothetically, be more serious in its consequences for land-resource management than direct population pressure. Any combination of the following reasons might bring this about:

   a. The scale of the pressure to produce, and its nature, vary through time without any necessary close relation to the capacity of the land to produce, in the conditions of any given place and year;

   b. Decision-making is removed from the individual farmer to a more remote level and, in the case of cash production, becomes subject to the economic system as a whole;

   c. Social responsibility for the care of resources is thus transferred to levels at which it often has very low priority. A great deal therefore depends on the degree to which extra-local authorities are interested in, and willing to enforce, resource management, as opposed to taking an interest only in production;

   d. Downstream consequences, impinging on the resources of others and on common resources, come to be treated as 'externalities' rather than as the subject for compromise and arrangement;

   e. Moreover, new institutions which are created to regulate use of resources operate over large areas so that the circumstances of small areas, even if critically impacted, can seldom receive adequate attention;

4. Under many systems, restriction of access to resources, together with external pressures to produce, are of such major importance that many poorer farmers are forced by these causes, above all others, to put heavy pressure on their land leading, wherever that land is sensitive to erosion and degradation, to severe damage. (Essentially, this is a socially-determined variant of hypotheses under 11a.1, in the population-based section above).

IV. Discussion

While all the above hypotheses and quasi-hypotheses need to be taken into account, all need to be viewed as conditional. That is, all or almost all may have validity in certain circumstances, but not in others. Some are much more powerful than others, and it is suggested that 'pressure of population' and 'pressure of production' are two very real forces, although each can operate in different ways according to the circumstances.[3] The behavioural considerations then become important within the context of these larger demographic and societal forces, which is to say that the 'farm system' operates within the 'household system', and in turn these operate within local, regional, national and global 'societal systems'.

An approach focusing on the farmer must therefore be placed in a systemic context. Present responses are conditioned by recent history, and by changes in the political economy. This note therefore concludes with a few propositions focused at the farm and local levels, placed in such a context.

1. Farm systems are dynamic, and some respond quite rapidly to change in external conditions, including those affecting the population/environment relationship, those affecting the conditions of production, and also changes in the natural environment. Others do not, and the reasons why this is so are an important topic for research and theorization;
2. In terms of consequences for resource management, the success or failure of the adaptations made cannot readily be predicted on the basis of any general propositions regarding either population change or change in the conditions of production. Also involved are local circumstances, the nature of social control, the strength of local and national institutions, the status of the farmers in relation to this wider political economy, their own recent history, and their inheritance in terms of landesque capital from the recent and longer past;
3. All change in external conditions has destabilizing effects on resource-management strategies, and the more comprehensive the change the greater the destabilization;
4. However, in adapting management strategies to changed conditions, most farmers seem to hold on to what are perceived as the core elements for livelihood more tenaciously, and for longer, than to what are perceived as peripheral elements. The identification of such core and peripheral elements, associated with core and peripheral elements of culture in the context of a changing world, is of potentially central importance in the prediction of future trends.

[3] It could be suggested that 'production pressure' has dominated in most parts of the world during the past 40 years of rapid economic development, notwithstanding large growth of population. However, in the longer term, 'population pressure' has certainly been and may again become the greater force. If correct, this has implications for method in this project.

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Editor

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- Published about twice yearly
- Editor: Professor Harold Brookfield
- Phone: +61 (06) 2494348
- Fax: +61 (06) 2494896
- e-mail: hbrook@coombs.anu.edu.au