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Rice Terraces of Ifugao (Northern-Lucon, Philippines) - Conflicts of Landuse and Environmental Conservation

Josef Settele[1], Harald Plachter[2], Joachim Sauerborn[3], Doris Vetterlein[4](eds.)

[1] UFZ Centre for Environmental Research Leipzig-Halle

[2] Philipps-University Marburg

[3] Justus-Liebig-University Giessen

[4] Brandenburg-Technical-University Cottbus

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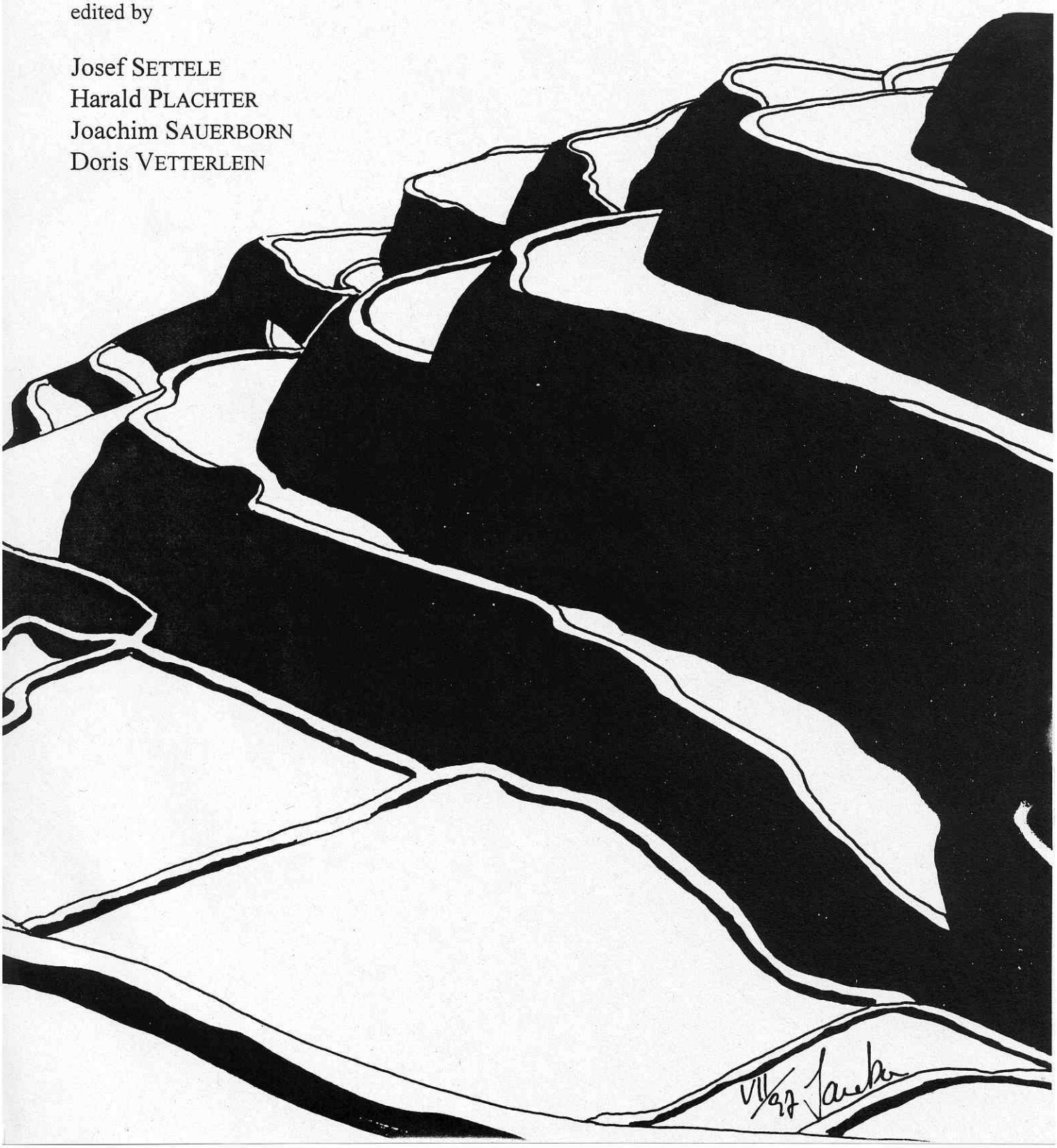
Rice Terraces of Ifugao (Northern-Luzon, Philippines) Conflicts of Landuse and Environmental Conservation

- Report of a Scientific Students' Excursion -

edited by

Josef SETTELE
Harald PLACHTER
Joachim SAUERBORN
Doris VETTERLEIN



dedicated to

THE PEOPLE OF IFUGAO

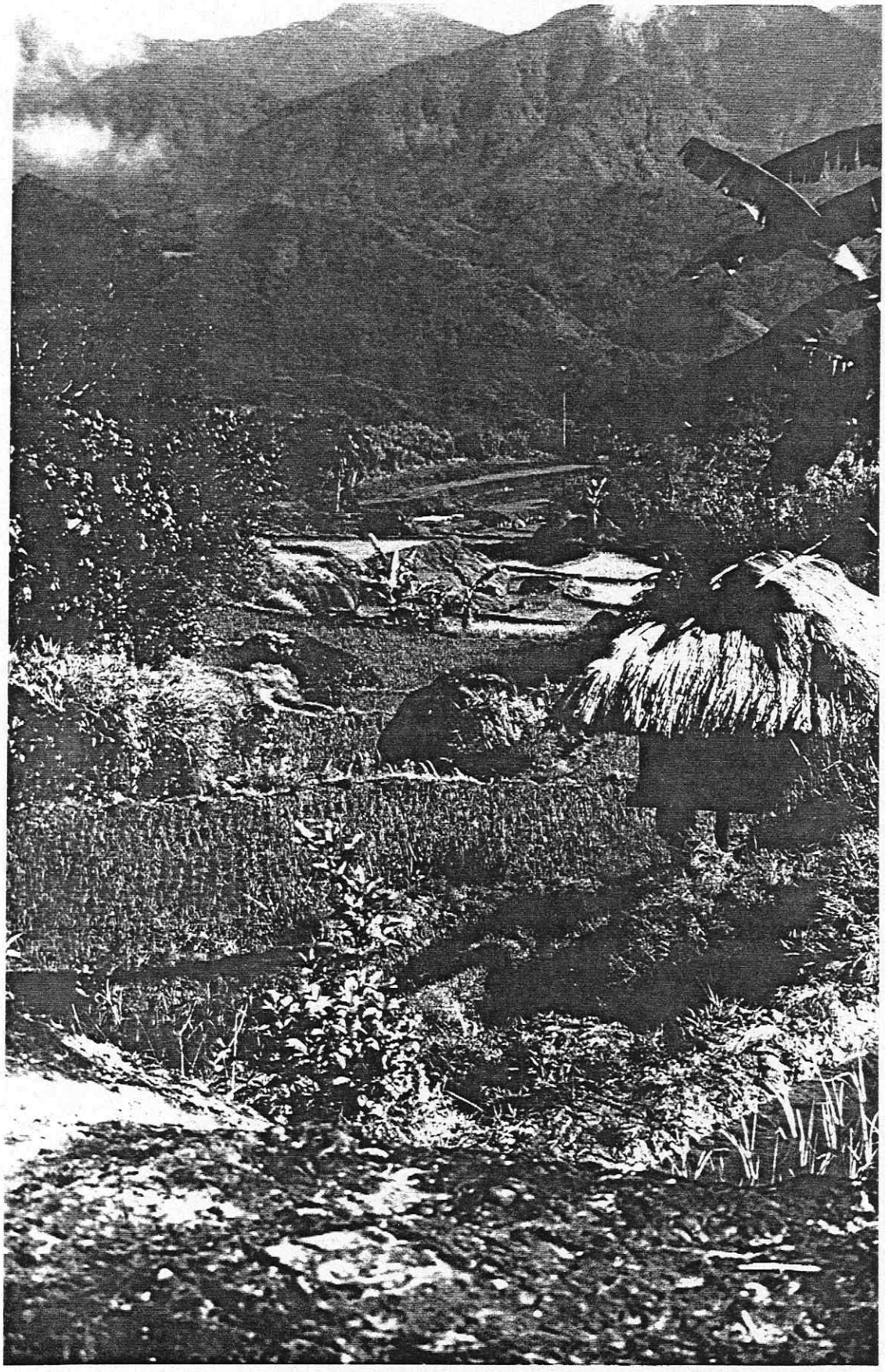
for their longterm support and hospitality

and to

Prof. Dr. Werner KOCH

University of Hohenheim

for his guidance during
two decades of research in the
Ifugao Rice Terraces



Picture 1: Impression of Ifugao landscape structure (near Natonin, February 1988)

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CONTRIBUTORS

and participants of the scientific excursion to
Ifugao/N-Luzon/Philippines in February/March 1997

Ralf BARTHELMES[5], Rubensstr. 8A, 70597 Stuttgart, Germany

Carola BUSEMANN[3], Dresdener Str. 3, 35440 Linden-Leihgestern, Germany

Christoph DIEFENBACH[3], Am Lemberg 12, 35466 Rabenau-Odenhausen, Germany

Henrik GRÖLZ[3], Wieseckerweg 18, 35396 Gießen, Germany

Sabine HERZMANN[2], Ernst-Moritz-Arndt-Str. 1, 35039 Marburg, Germany

Eva HEUSINGER[3], Dresdener Str. 3, 35440 Linden-Leihgestern, Germany

Stephanie HOLZHAUER[2], Konrad-Laucht-Weg 4, 35037 Marburg, Germany

Ulrike JAHN[4], Lausitzer Str. 9, 03046 Cottbus, Germany

Andrea JOST[3], University of Giessen, Tropical Crop Science, Schottstr. 2, 35390 Giessen, Germany

Thomas KORBUN[2], Philipps University Marburg, Faculty of Biology, Department of Nature Conservation, Karl-v.-Frisch-Str., 35032 Marburg, Germany

Dr. Konrad MARTIN[5], Institute of Plant Production in the Tropics and Subtropics, Agroecology Section, University of Hohenheim, 70593 Stuttgart, Germany

Christian OCHS[3], Am Festplatz 13 c, 35440 Linden-Leihgestern, Germany

Prof. Dr. Harald PLACHTER[2], Philipps University Marburg, Faculty of Biology, Department of Nature Conservation, Karl-v.-Frisch-Str., 35032 Marburg, Germany

Silke ROTHER[2], Konrad-Laucht-Weg 4, 35037 Marburg, Germany

Prof. Dr. Joachim SAUERBORN[3], University of Giessen, Tropical Crop Science, Schottstr. 2, 35390 Giessen, Germany

PD Dr. Josef SETTELE[1], UFZ (Centre for Environm. Research) Leipzig-Halle, Dept. of Conservation Biology and Natural Resources, Permoserstr. 15, 04318 Leipzig, Germany

Michaela STRÜMPELER[2], Rudolf-Bultmann-Str. 5, 35039 Marburg, Germany

Torsten TIPPMANN[4], c/o Dr. Doris VETTERLEIN (see below)

Björn TROSOWSKI[2], Rudolf-Bultmann-Str. 5, 35039 Marburg, Germany

Dr. Doris VETTERLEIN[4],Brandenburg Technical University Cottbus, Chair of Soil Conservation and Reclamation, P.O.Box 10 13 44, 03013 Cottbus, Germany

Nicolas WALTHER[3], Unterstruth 129, 35418 Buseck, Germany

Katrin WEBER[3], Asterweg 14, 35390 Giessen, Germany

Ulrich WENDEROTH[3], In den Gärten 16, 35398 Giessen, Germany

Christian WILLERDING[2], Bergwiesenweg 2, 35037 Marburg, Germany

Kerstin WELLERSHAUS[2], Zu den Höfen 2, 35085 Ebsdorfergrund, Germany

[1] UFZ, Department of Conservation Biology and Natural Resources, Permoserstr. 15, 04318 Leipzig, Germany
[2] Philipps-University Marburg, Faculty of Biology, Department of Nature Conservation, Karl-von Frisch-Str., 35032 Marburg, Germany
[3] Justus-Liebig-University Giessen, Tropical Crop Science, Schottstr. 2, 35390 Giessen, Germany
[4] Brandenburg-Technical-University Cottbus, Chair of Soil Conservation and Reclamation, P.O.Box 10 13 44, 03013 Cottbus, Germany
[5] University of Hohenheim, Institute of Plant Production in the Tropics and Subtropics, Agroecology Section, 70593 Stuttgart, Germany

Picture 2: Impression of Ifugao landscape structure (Batad, 1991)

INTRODUCTION

The Scientific Excursion: Participants, Objectives and Working Groups

by
Josef SETTELE, Ralf BARTHELMES, Konrad MARTIN, Harald PLACHTER,
Joachim SAUERBORN & Doris VETTERLEIN

1 Ifugao - cultural landscape and its change

> "The terraced landscape of the Cordillera Mountain Range in northern Philippines is regarded by the nation as the primary symbol of its cultural heritage. It is even more noteworthy that a cultural monument of the extent and grandeur of the Cordillera Rice Terraces was totally constructed without the use of slave or enforced labor.
> The irregular shapes of the terraces result directly from the need of a rice culture to cultivate its mountainous terrain, by necessity evolving its own traditional environmental and resource management system over the centuries, and orally transferring the traditions and knowledge associated with this system to its succeeding generations. The impressiveness of the site reflects the delicately balanced processes of environmental, social and cultural factors which have intertwined constantly from the time of the original construction to the present to assure the continued maintenance of this remarkable land form. The preservation and maintenance of the site is symbiotic with the continuation of the culture which it nourishes. Terracing was said to have evolved for approximately 2,000 years, as postulated by the region's foremost scholars."
> VILLALON (1995: 108)

Because of many of the reasons and aspects mentioned in this idealistic description, large parts of the terraced landscape of the Central Cordillera (Philippines/N-Luzon/Ifugao and neighbouring provinces; compare Figure 1) have been designated as a World Heritage Site by the UNESCO in December 1995. However it has become increasingly obvious, that the area and its people face serious problems especially concerning future development (MARGRAF & VOGGESBERGER, 1986, 1988; SETTELE et al., 1995; see also ITC, 1994: Masterplan of Rice Terrace Commission).

Due to population increase and many influences from the so called more developed parts of the Philippines (like in Metro Manila) as well as from other parts of the world, Ifugao culture has also been changing throughout the last decade(s). Because of increasing demand for rice, new varieties are grown and agrochemicals applied in some areas, enabling two crops per year. In some areas swidden cultivation has been neglected, seemingly around touristic spots (see HERZMANN et al., this volume, pp. 77-89). Tourism itself is one of the options of future development. Partly - for example around Kiangan - the former terrace pond field culture has changed into vegetable gardening.

The new possibilities of education also promise a better future in non-agricultural professions. Thus young people tend to leave the region, which leads to an increase in the average farmer's age. This endangers the future of agriculture in the area in general, and is a typical example of tendencies which can be globally observed in culturally highly developed communities of 'Third World Countries' and in general in many mountainous areas (BEINLICH & PLACHTER, 1995; VON DROSTE et al., 1995). Thus, Ifugao Province seemed to be an ideal place for a case study to experience the problems of social, cultural and ecological changes on the one hand and to contribute to the improvement of knowledge on certain aspects of the system on the other hand. Based on the experience of some of the members of our teaching staff (see compilation of German research activities on page 28) we therefore had the idea to conduct an interdisciplinary excursion with 20 students and 6 scientists of 4 German universities, which took place from 28th of February to 22nd of March 1997.

2 Participants

The excursion was organised by university teachers of

- UFZ - Centre for Environmental Research Leipzig-Halle (J. SETTELE),
- Philipps-University Marburg (H. PLACHTER),
- Justus-Liebig-University Giessen (J. SAUERBORN),
- Brandenburg-Technical-University Cottbus (D. VETTERLEIN), and
- University of Hohenheim (K. MARTIN, R. BARTHELMES).

The students (compare list of contributors and participants on page 5) represented the following university courses:

- agriculture (with specialists in plant production, agro-ecology, environmental safety, human nutrition and sociology),
- biology (emphasis: nature conservation, botany, zoology), and
- environmental engineering (esp. soil conservation).

3 Objectives of the investigations

The experience of interdisciplinary and scientifically as well as socially relevant research was the major objective of the two-week field study. This had to be achieved by confronting students and supervisors with the problems of people living in a system with rapid and fundamental changes. Based on long-term experience in the region of some of the participants, it was possible to investigate a broad variety of aspects of Ifugao landuse and culture. The task also has been to put results of such detailed work back into the landscape ecological frame later on, and to prepare a public presentation of the results.

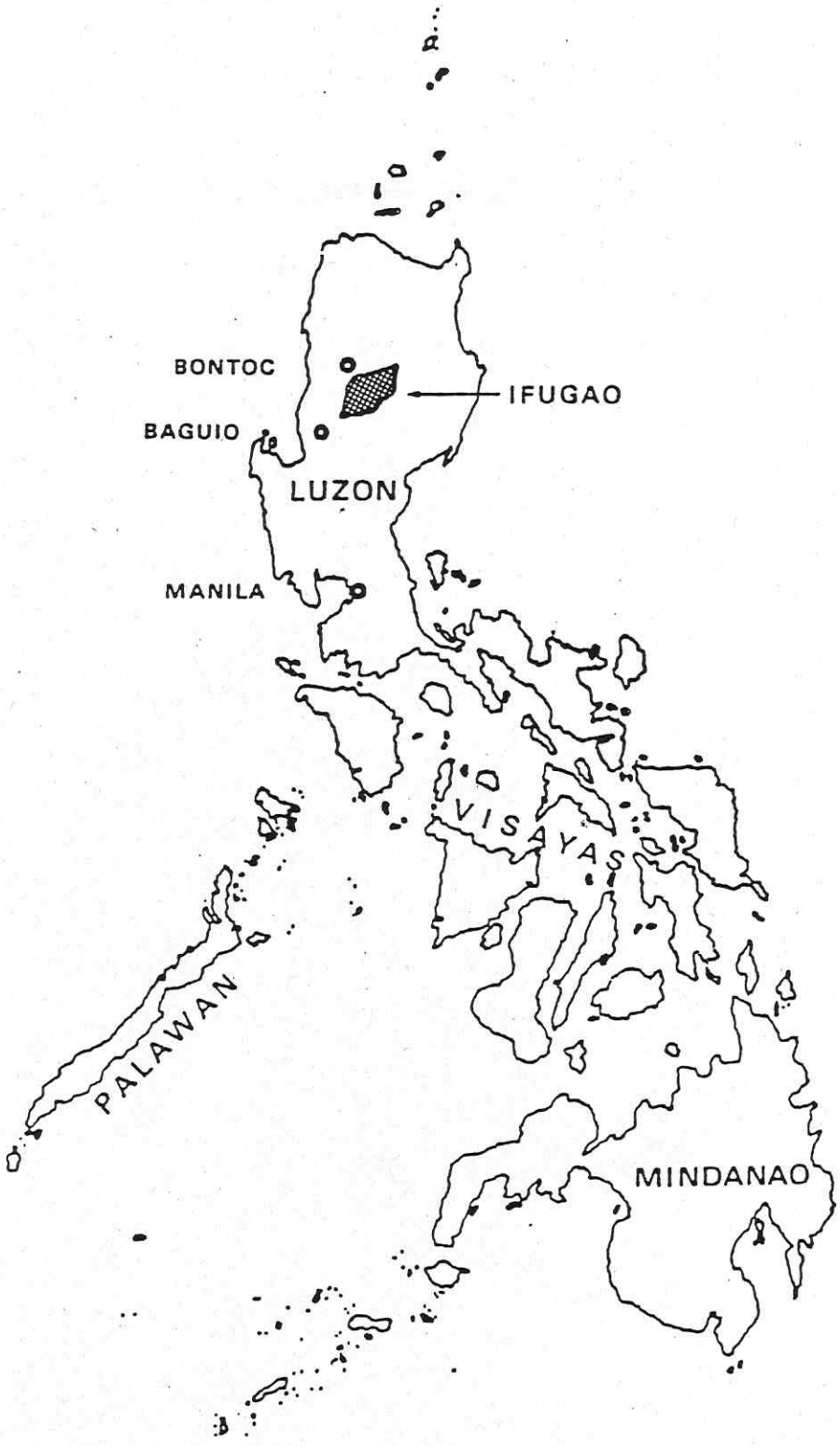


Figure 1: Ifugao Province (our 'study region') within the Philippine archipelago (taken from MARGRAF, 1988)

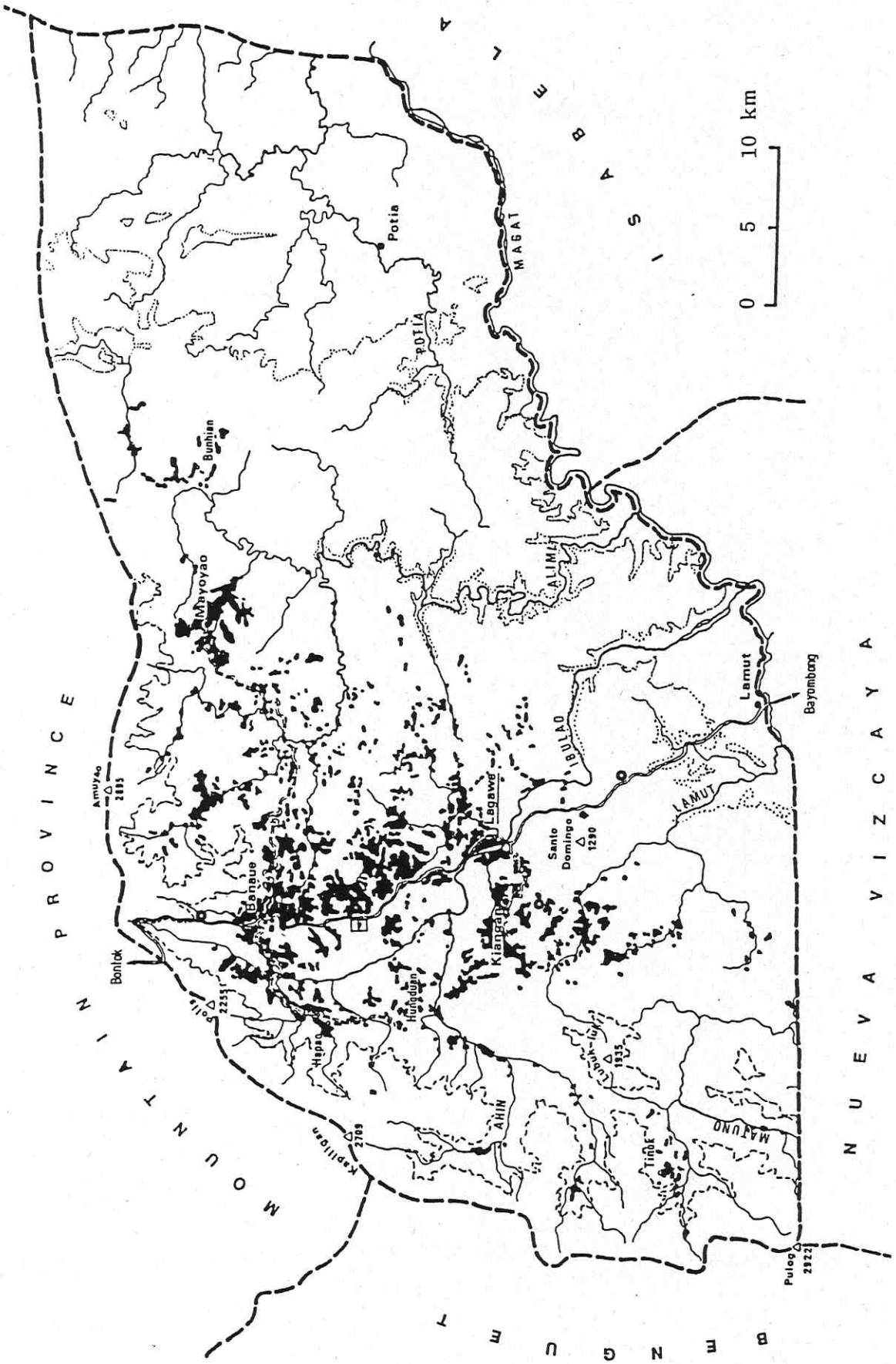


Figure 2: Distribution of irrigated rice terraces in Ifugao Province (taken from VOGGESBERGER, 1988)

4 Working groups

Field work was conducted in 5 working groups:

Socioeconomy: As new developments are only possible with the people implementing them, work of this group was of overall relevance for all other groups. The main task was to get some ideas about Ifugao people's own view of their future. What are their expectations and future plans, mainly concerning landuse? How is their nutritional perspective and how their rice supply from their own fields? Reliable information on some of these aspects is essential for future activities and scenarios of development (see SETTELE et al., this volume, pp. 91-98). The detailed results of the group are summarised by BARTHELMES et al. (this volume, pp. 29-42).

Nutrients: This group focussed on Nitrogen cycles in the Ifugao landuse system, especially on (inorganic) Nitrogen transported into the rice field water body. Calculations on the effects of increasing numbers of tourists (for example based on scenarios of ITC, 1994) have also been made. As a hypothesis it has been stated, that much of the nutrients reach the fields with surface runoff and thus fertile fields are especially below the villages (e.g. stated by MARGRAF & VOGGESBERGER, 1986, 1988; for details see JAHN et al., this volume, pp. 43-54).

Water snails: Since the last studies on the aquatic fauna of the terraces has been conducted around 1990 by MARTIN (published in 1994), an alien species - the Golden Snail (*Pomacea canaliculata*) - has reached the region. This species has been reported as an important rice pest in the lowlands of the Philippines and in many other parts of South East Asia (HALWARTH, 1994; NAYLOR, 1996). Aim of the study was to find out the impacts of the snail, especially on the snail community in the fields (including possible replacements of indigenous species). It also has been hypothesised, that the snail is a pest of young rice seedlings in the area. For further details see paper by MARTIN et al. (this volume, pp. 55-61).

Botany: Analysis of successional trends in the landscape and changes in species composition in relation to landuse. Data should complement the results of the compartment group for the different types of landuse distinguished. In the long term such data would be useful to analyse the effects of landscape structure and distribution of certain plants for the dynamics of insect pests and their natural enemies on a landscape level. It also could and should form a basis for the evaluation of the function of different compartments in terms of erosion control. Hypothesis has been, that in later successional stages widespread species are replaced by more regionally distributed ones, and that species number in the first years of succession declines, but in forested stages increases again. Due to time limitations, only some first stages have been investigated, therefore only parts of the hypotheses could be tested. Details of the research and its results are described in DIEFENBACH et al. (pp. 65-75).

Compartments: The objective was to analyse the changes in the distribution of different compartments of the Ifugao landuse system (mainly rice fields, swiddens in use, swiddens in fallow, grasslands, woodlots and forests) over a period of approximately 40 years. Analysis was based on the maps of CONKLIN (1972, 1980), aerial photographs from the early 1980's (provided by CECAP, which is gratefully acknowledged) and own field data. Investigations were concentrated on the Banaue villages of Tam-an and Poitan. According to presumptions of SETTELE (1994), basic hypotheses had been, that forest cover in the area is reduced and thus watershed problems could be expected, which should have led to decreased irrigated rice field areas. Details are summarised in the article of HERZMANN et al. (this volume, pp. 77-89).

5 Presentation of activities and results

The main presentation of our results took place on 18th of March 1997 in Banaue, to which the director of the Rice Terrace Commission 'Mr. Juan DAIT', extension officers, farmers' representatives, members of CECAP (Central Cordilleran Agricultural Program of the European Community), and further members of the Ifugao community have been invited.

Two articles by Mr. Juan DAIT mentioned the group's activities in Philippine newspapers (these articles can be found in the appendix of this volume, pp. 110-121, together with copies of 4 further German reports, which have been published by members of our group after we have returned from the Philippines). The public presentation of our results for most of us has been a completely new experience. For most of the students it has been the first time ever to present results in English language, and also the first time to present their ideas to people directly confronted with the consequences of such research and ideas.

This report is a final summary of our activities. We hope that it is of use as an additional source of information for decisions concerning the future development of the World Heritage Site of the Central Cordillera Rice Terraces.

Picture 3: Part of Tam-an valley, main research area during the excursion (March 1997)

IFUGAO: A BRIEF OVERVIEW

Rice Terraces of Ifugao (N-Luzon, Philippines) - Ecological History and Developments

by
Josef SETTELE & Konrad MARTIN

1 Introduction

For tourists the rice terraces of Ifugao Province (N-Luzon/Philippines; see Fig. 1, p. 9 and Fig. 2, p. 10) are well known as an attractive place to visit. That the beauty of the landscape is dependant on a highly complex "Agri-Culture" only becomes obvious if one looks more closely. Throughout the centuries the people of Ifugao have shaped this landscape and thus created a permanent basis for living. The village structure, with small groups of houses usually scattered across the terraced landscape, allows production and consumption of food in the same landscape units. Therefore nutrient cycles are oftentimes regarded as more or less closed (MARGRAF & VOGGESBERGER, 1986, 1988). This guarantees sustainability. One important component of this balanced system is a - compared to other agricultural landscapes - high biodiversity.

However, population growth, improved education and hope for better living conditions in other regions, among other factors, are responsible for the inevitable change of this subsistence system. Depending on mainly political circumstances, this ongoing change can be managed more or less in a sustainable way, but may on the other hand also result in the destruction of agricultural and - interrelated with these - primary forest areas.

2 History

Ethnic groups from Malaya reached the Philippine archipelago throughout the last millenia. This made people, who formerly inhabited the lowlands, to withdraw into mountainous areas. As irrigated rice production in the lowlands has been such an essential part of daily life, people maintained this type of cultivation in their new and at first extremely unfavourable steep environment. To achieve flooded fields, terraces had been built. Thus local conditions have been adjusted to cultural requirements. The formerly completely forested mountains have been cut - at least at lower elevations - severeal hundred (up to 2000) years ago and have been transformed into aquatic systems by terracing and irrigation. Permanent water supply was a precondition for a functioning terrace culture and was guaranteed by vegetation (watersheds covered by mossy forests) and climate (see CONKLIN 1980, DUMIA 1983, FRY 1983, VOGGESBERGER 1988).

3 Ifugao landuse system

Rice growing determines social, religious and economic life of the Ifugao people. It is regarded as the expression of partnership between man and his gods. Many rituals serve to satisfy the gods and to keep the "rice's soul" healthy. Many of these rituals are practiced depending on the time of the year. Thus the Ifugao landuse system and calendar is determined by rice growth and the accompanying rituals (CONKLIN, 1980; VOGGESBERGER, 1988; SCHRETZMANN & BARTHELMES, 1996).

A new year starts with a fallow season after rice harvest. During that time (rainy season; see Figure 3) remnants of the growing period (e.g. straw of rice plants and aquatic weeds) are mixed with mud and put together to small compost mounds on which vegetables are planted (locally called 'pinkol' - more commonly to be seen in the Kiangan area). From October to December terrace walls and dikes are reconstructed, seedbeds and later all terrace areas, on which rice will be transplanted, are prepared. For germination of the rice plant, complete panicles are put on the mud while the water level is kept extremely low. Grown seedlings are transplanted in February/March. Normally 2-4 seedlings are used for one hill. Rice then grows up to July/August. Human interference in this growth stage is restricted to weeding (2-3 times), cleaning of dikes to control rats, and preventing birds to get the grains at the ripening stage (e.g. by use of scarecrows). Harvest finally is the central event of the year. Only the panicles (approx. at the hight of the flag leaf) are cut and bound into bundles (see Pict. 12, p. 20). These are transferred to granaries and houses for drying. The rests of the rice plants remain in the fields and are put into the mud some time later, mostly at the end of the fallow period. The annual rice cycle now is completed.

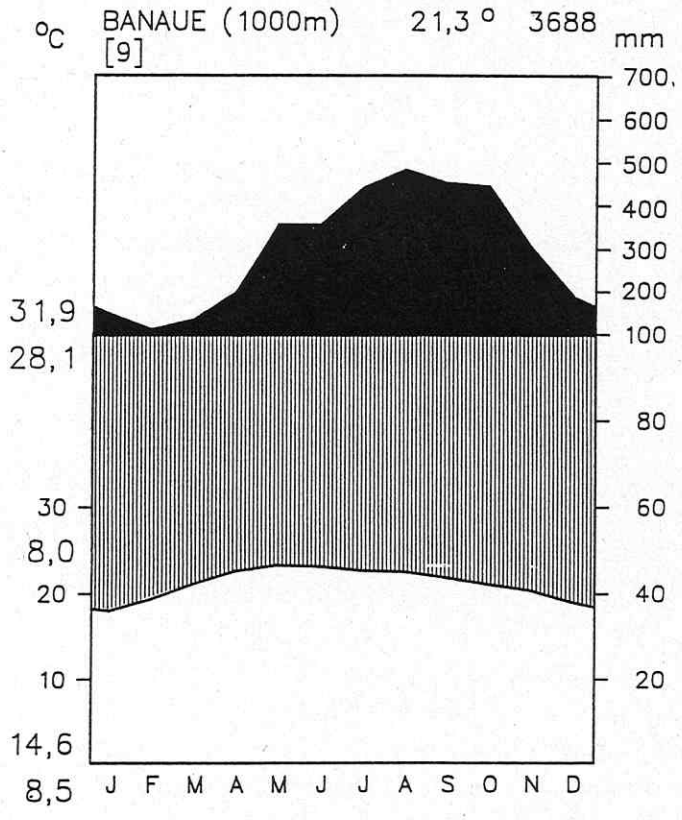


Figure 3: Climate diagram of Banaue/Ifugao (taken from SETTELE, 1992)

All activities within one growth cycle are performed more or less synchronously in the whole area (see Pict. 4-8, pp. 16-17). Timing of the growing period is oriented to a maximum use of climate (e.g. solar radiation). In difficult periods, like the main typhoon season, the fields are fallow.

The second important cultivated plant of the subsistence system is sweet potato, which is mainly grown in steep, dry areas, e.g. on the dikes or at steep mountain slopes, which are not suited for terraces (see Pict. 10, p. 18). Directly around houses and villages small forested areas (woodlots in the sense of CONKLIN, 1980) are maintained, where fruit trees are cultivated and firewood is harvested.

The whole cycle, however, is dominated by the rice crop. Work in sweet potato fields (swiddens in the sense of CONKLIN 1980) and woodlots only is performed if there is less work in the paddies (see CONKLIN 1980, MARGRAF 1988, VOGGESBERGER 1988). The annual distribution of working activities for the three types of compartments - rice/pond fields, swiddens, and woodlots - are summarized in Figure 4. The interlocking agricultural cycles are presented in Figure 5.

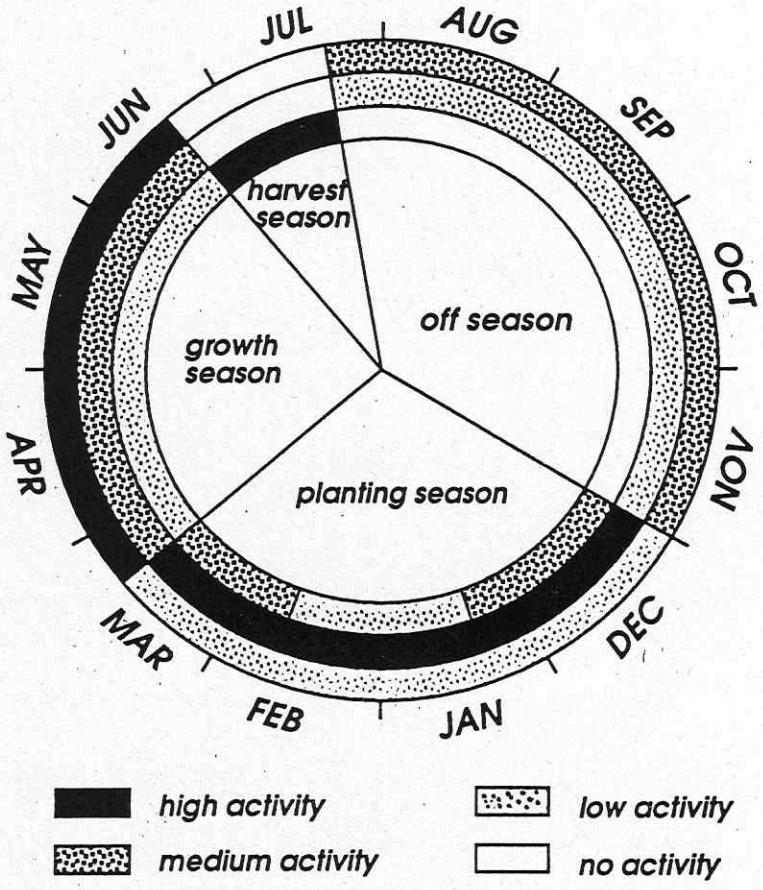
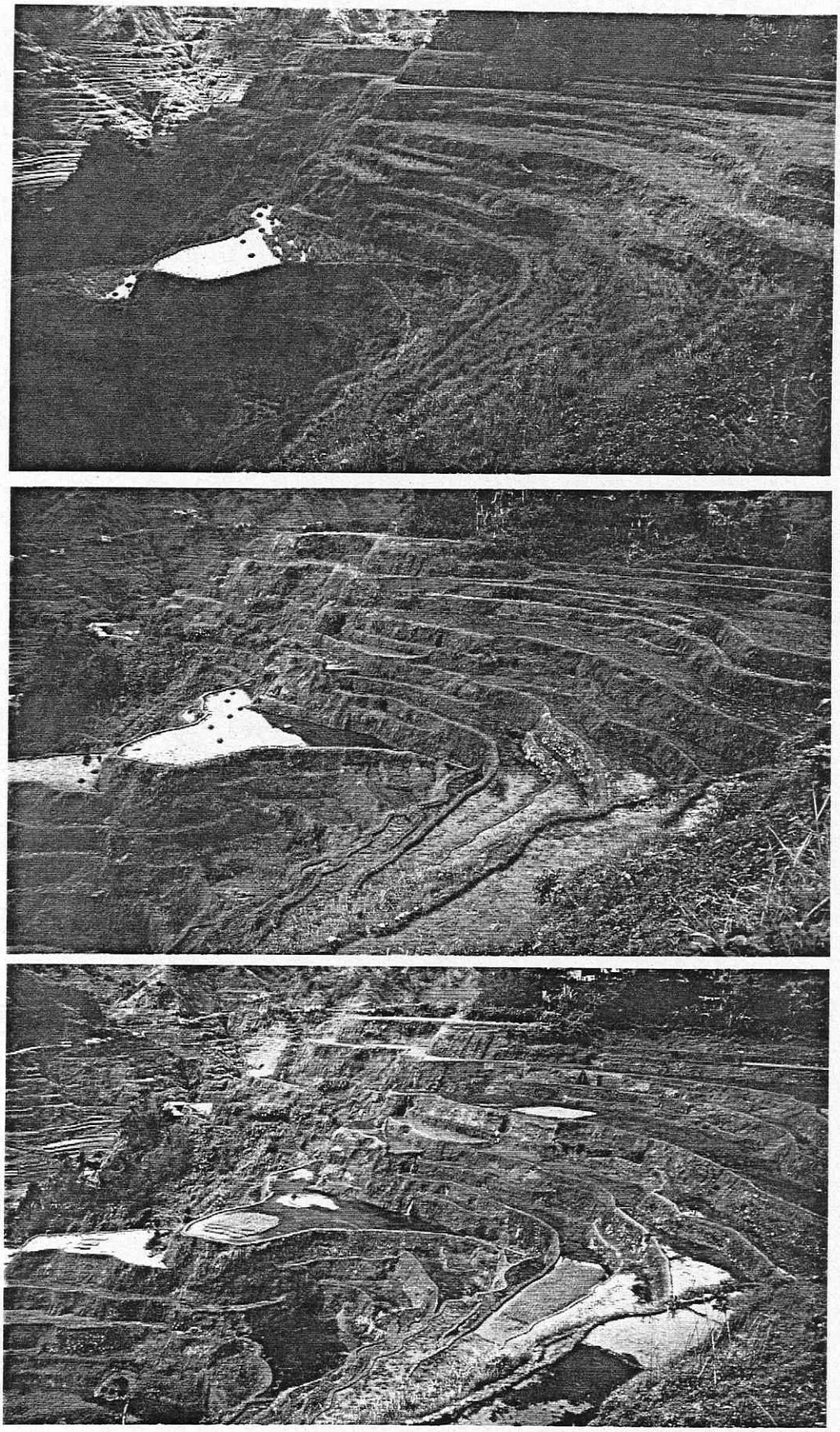
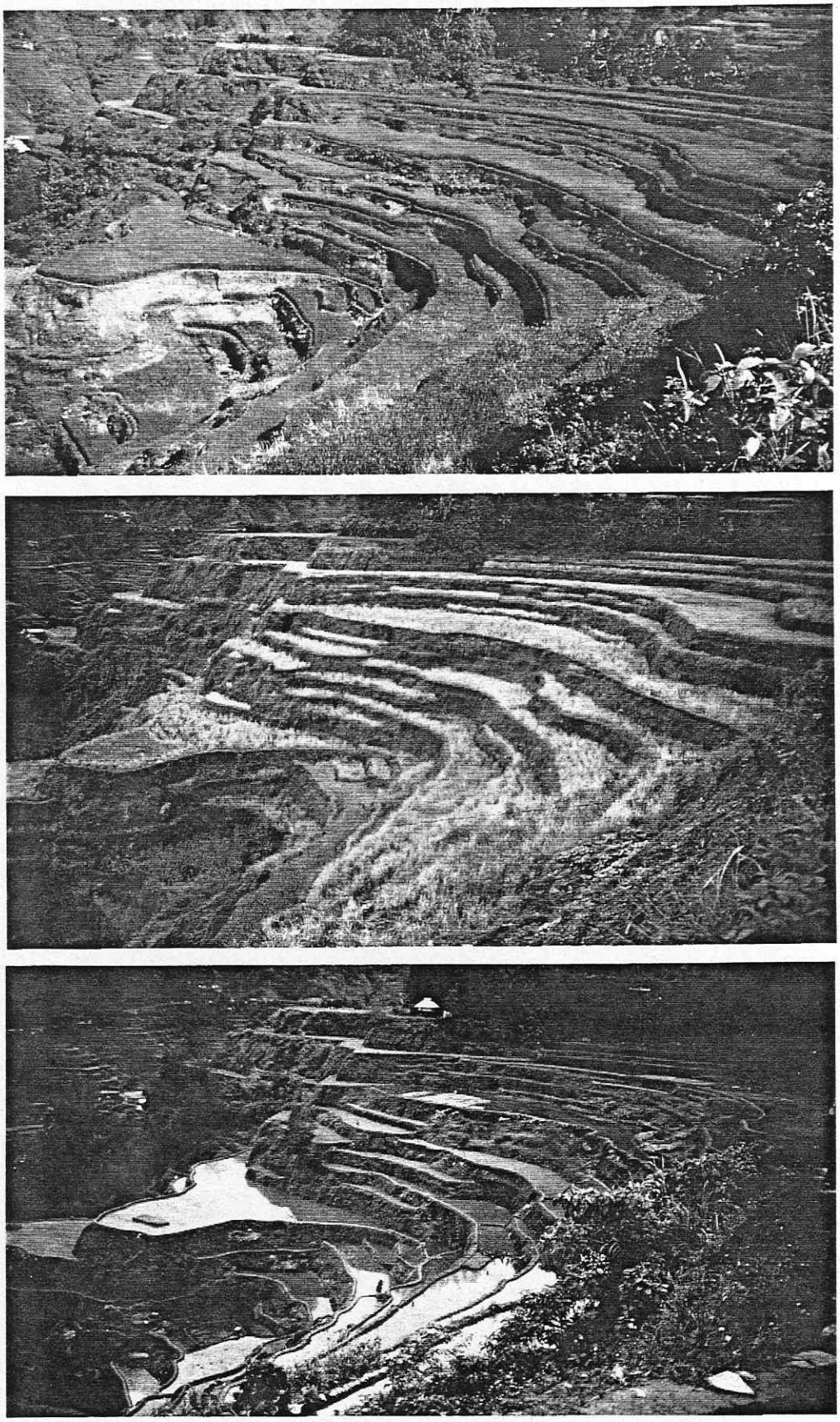


Figure 4: Distribution of working activities
(after CONKLIN, 1980, modified; graphics: K. GEYLER)



Picture 4-6: Seasonal variation and rice growing synchronicity in Ifugao 1988/89 (Itidung village above Banaue poblacion; 4: Feb.; 5: Feb./March; 6: March)



Picture 7-8: Seasonal variation and rice growing synchronicity in Ifugao 1988/89 (Itidung village above Banaue poblacion; 7: July; 8: Aug.)

Picture 9: Rice fields in Ifugao remain very constant for long time; here: same view as in Pict. 4-8, picture taken nearly 10 years later (March 1997)

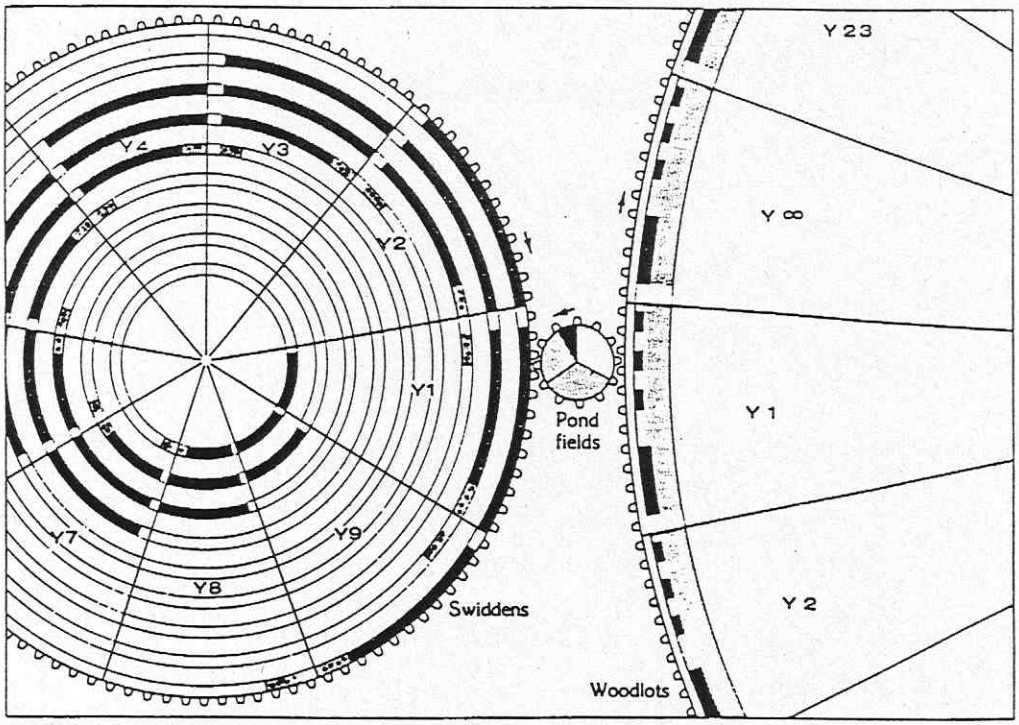
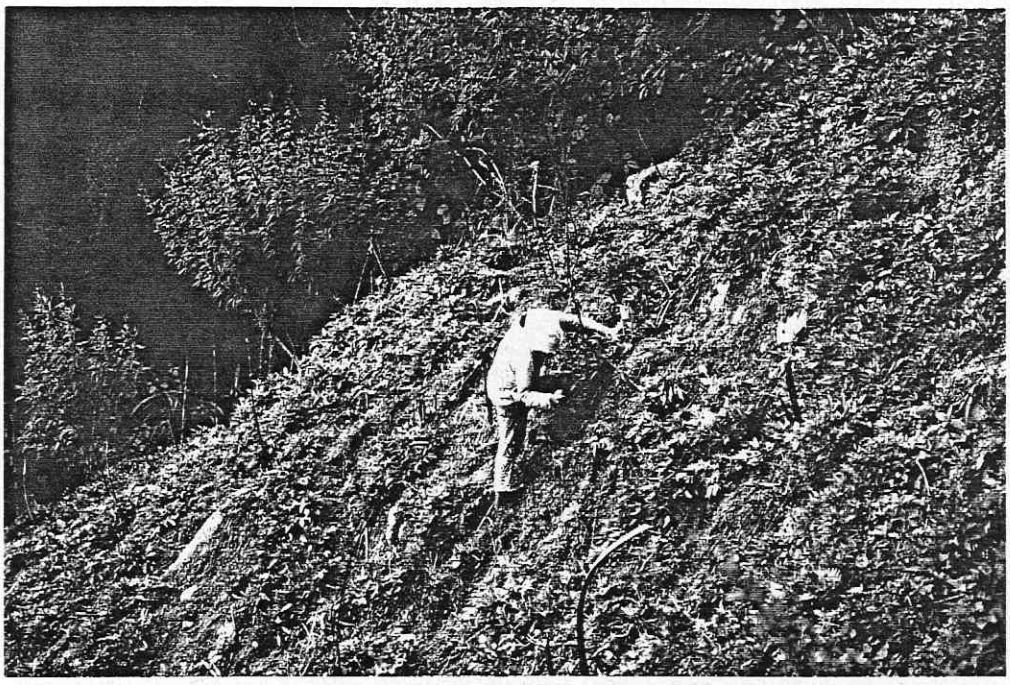


Figure 5: Interlocking agricultural cycles (after CONKLIN, 1980, slightly modified); compare also Figure 4



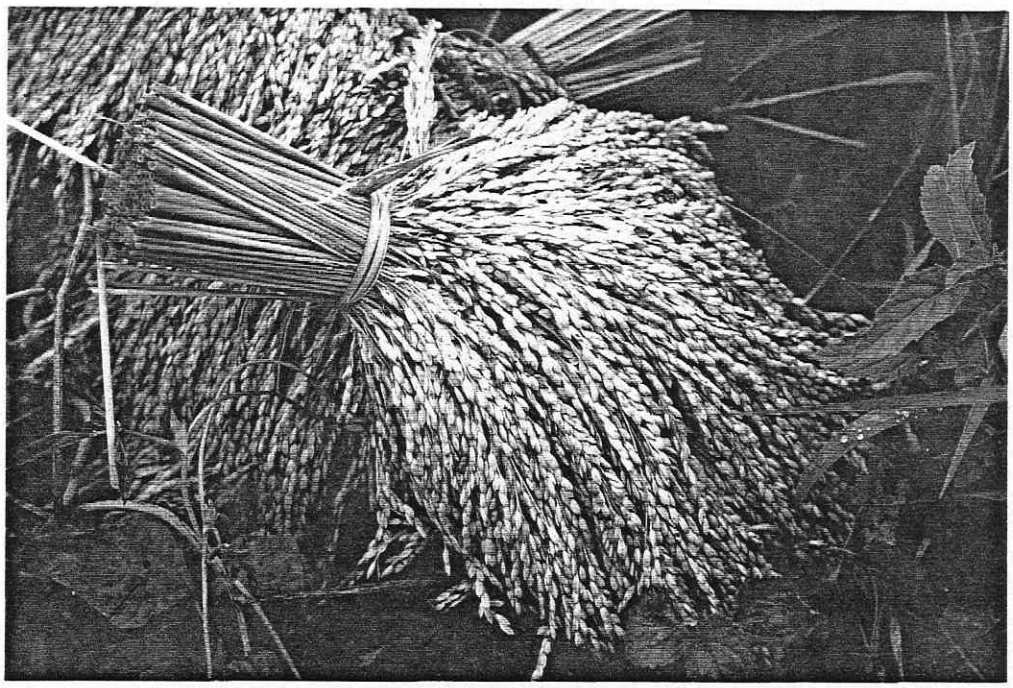
Picture 10: Swidden cultivation is physically hard work (near Batad, March 1997)

4 Genetic resources

The numerous traditional rice varieties (mainly of the "javanica" type) are characterised by tall growth, low grain/straw ratio, long panicles, large grains (often with long awns) and low photosensitivity (see Pict. 11). The farmers of Ifugao distinguish between sticky and non-sticky varieties. The sticky ones ('dayakot' or 'dayaot'), which have a high content of dextrin and amylopectin are nearly exclusively for rice wine brewing (mainly for celebrations). Approximately one third of the rice area in the traditional system is planted with such varieties. Each family grows several varieties - oftentimes even on one field. In total far more than 100 varieties are known in the province. The local varieties are adapted to climatical and pedological peculiarities of the region and determine the communities of plants and animals in the paddies (information based on VOGGESBERGER, 1988; WACKERNAGEL, 1985).

To use this potential, for example for rice breeding, an intensive inventory and description of the different varieties as well as measures for their preservation would be necessary. It seems however of limited use, if only the varieties are preserved as such, without the knowledge of ecological and socioeconomic frame conditions of their growth. For the development and introduction of new varieties for example, such aspects might be of crucial importance for the acceptance by local farmers.

Picture 11: Traditional rice variety (Kiangan, 1988)



Picture 12: Rice bundles of traditional rice harvest (Kiangan, 1985)

5 Species in the terrace system

First results show, that there are hundreds of species still to be discovered, not only in the natural forests (see chapter 6) but also in many terraced areas and other water bodies, as can be shown by the description of quite a number of new caddis flies discovered within the direct vicinity of Banaue (MEY 1990, 1995).

Besides that and besides the 'normal' terrestrial rice field invertebrate fauna (compare HEONG et al., 1991; ROGER et al., 1991; SETTELE, 1992; SETTELE et al., 1995; SCHOENLY et al., 1996) there is for example a quite high diversity of aquatic invertebrates - compared to other areas of irrigated rice production. Some important numbers have been mentioned by MARTIN (1994) and are shown in Table 1.

Figure 6 summarizes some of the major interactions within the food web of Ifugao rice fields. There, some of the species mentioned in Table 1 are shown as well as the more important groups of terrestrial arthropods.

Table 1: Species numbers of aquatic invertebrates in traditionally used rice fields of Banaue (Ifugao/Philippines), compared to inventories of other regions (from MARTIN, 1994)

Aquatic invertebrate group	A Philipp. (Banaue)	B Thai-land	C Laos	D Cali-fornia	E Egypt	F Hungary
Chironomidae	>20	5	1	>9	1	22
Culicidae	ca. 2	4	2	1	>2	2
Stratiomyidae	+	1	-	-	1	-
Ephemeroptera	ca. 2	1	-	1	1	2
Trichoptera	+	-	-	1?	-	-
Nymphulinae	ca. 3	1?	-	-	-	2
Notonectidae	ca. 3	3	4	2	1	1
Ceratopogonidae	+	1	1	1	-	-
Pleidae	2	2	-	-	-	-
Belostomatidae	1	2	-	1	3	-
Naucoridae	1	-	1	-	-	1
Ranatridae and Nepidae	2	2	3	-	1	2
Zygoptera	+	9	1	2	1	1
Anisoptera	+	12	3	1	1	3
Corixidae	1	1	2	1	2	2
Haliplidae	1	-	-	?	-	1
Dytiscidae	12	ca. 8	13	>9	6	4
Gyrinidae	1	1	1	-	-	-
Hydrophilidae	9	10	3	>4	5	2
Gastropoda	15	12	3	>2	*	6
Bivalvia	4	-	-	-	*	2

+: present, species number unknown; -: not present; *: no data available
sources: A: MARTIN (1994); B: HECKMAN (1979); C: HECKMAN (1974);
D: MIURA et al. (1981); E: EL-SHERIF et al. (1976); F: BERCZIK (1973).

6 The mossy forests, their watershed function and biodiversity

Although possibly being the largest remaining patches of the whole of the Philippines, the mossy forests of Northern Luzon have declined throughout the last decades. In some areas they are completely lost, like for example in the Baguio area. In regions where they still exist - as in higher elevated parts of Ifugao - they guarantee a constant water supply throughout the year. Precipitation is soaked like in a sponge, thus immediate surface runoff is rather limited even after strong downpours. Most of it is retained in vegetation and soils. At certain spots it appears again with quite some delay (springs) and thus guarantees satisfying water levels in the mountain creeks in times of less rain as well. The water of the creeks and rivers in Ifugao is diverted into the rice paddies through complex, community based irrigation systems. It passes many rice fields and finally - hundreds of meters downhill - flows back to the original river bed.

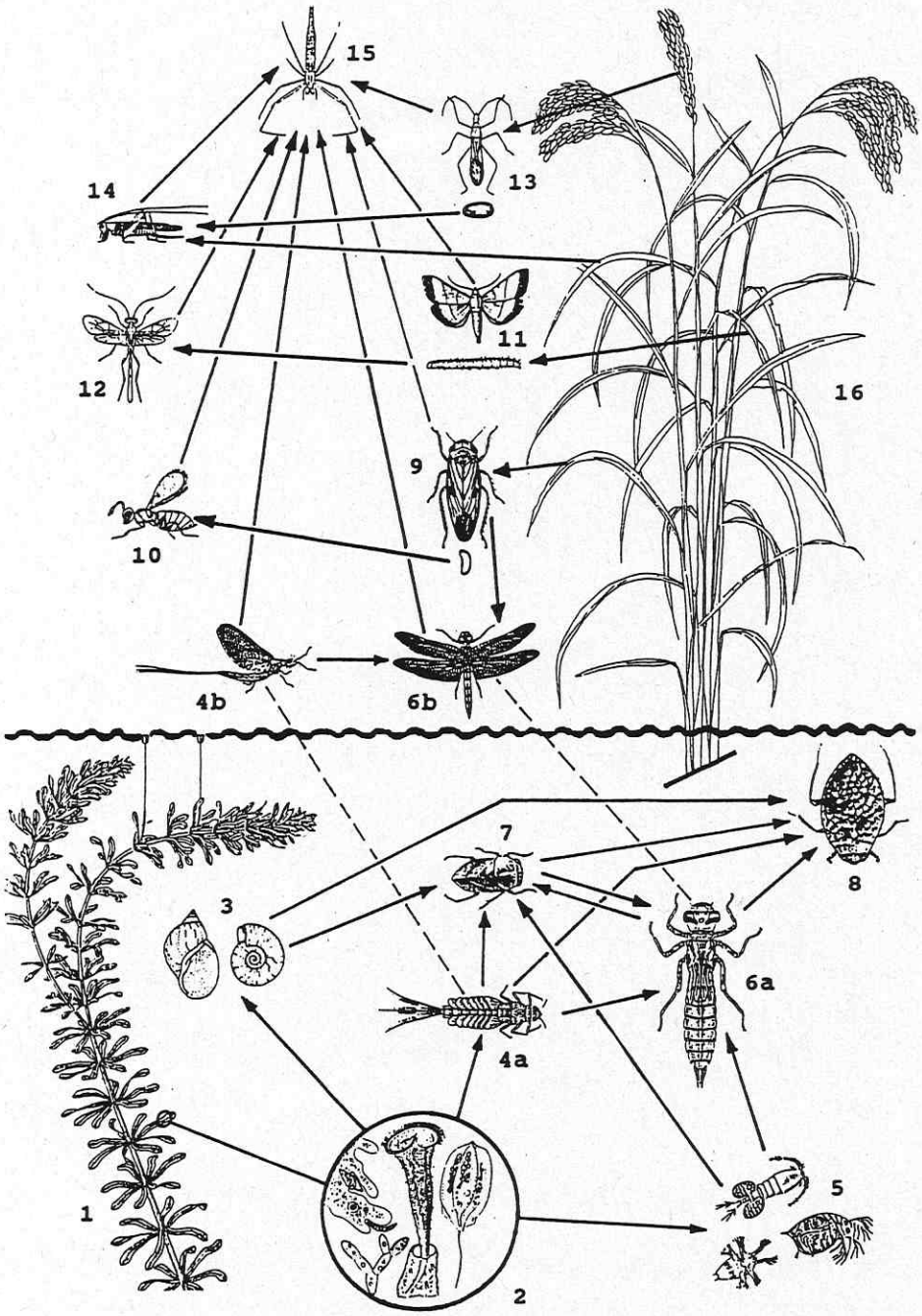
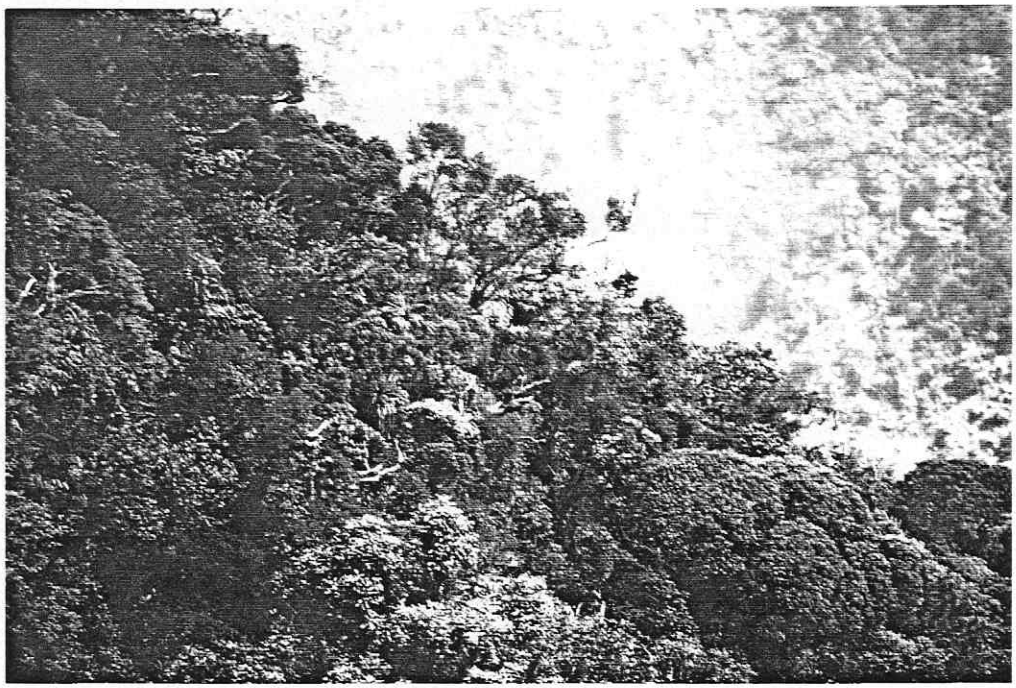


Figure 6: Simplified food web of an Ifugao rice field (from KOCH et al. 1990, modified); arrows indicate the trophic relationships (according to energy flow in the food chain)

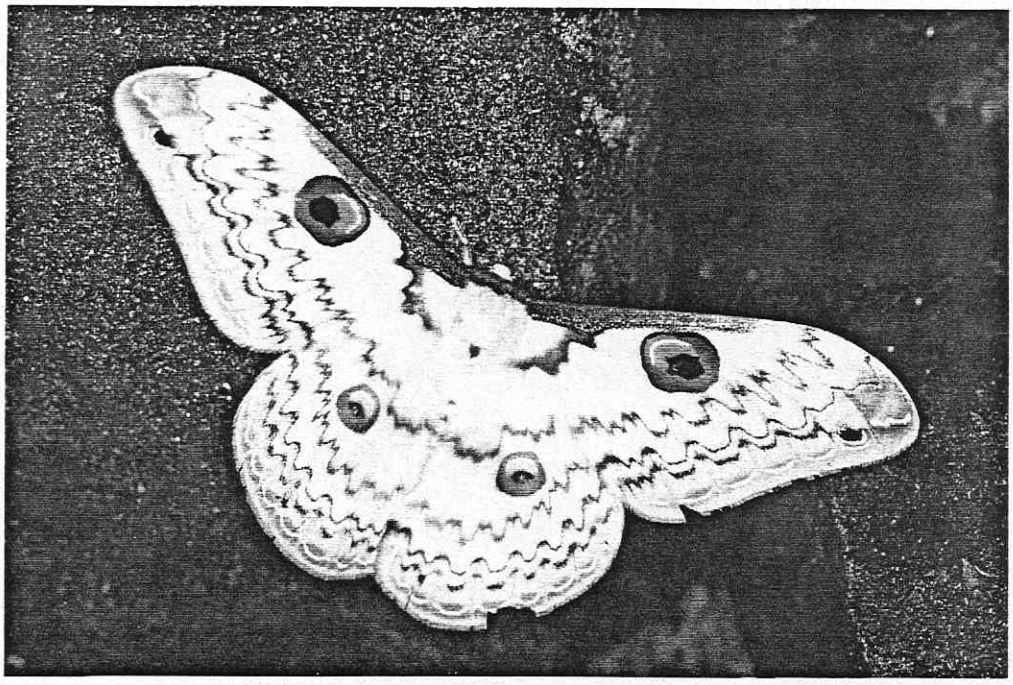
1: aquatic vegetation, in this case *Hydrilla* spp. (*Najas* spp. are also very common); *2:* microbiocoenosis of the leaf surface, consisting of e.g. algae, bacteria, protozoans and detritus; *3:* snails living on submerse vegetation (*Lymnaea*, Planorbidae); *4:* Ephemeroptera (a. larva, b: adult); *5:* zooplancton (small Crustacea); *6:* Odonata (a: larva, b: adult); *7:* aquatic bug (Pleidae); *8:* aquatic bug (*Sphaerodema* spp., Belastomatidae); *9:* leafhopper, egg and adult (*Nephotettix* spp., Cicadellidae), sucking on rice leaves, virus transmitter; *10:* egg parasitoid of leafhoppers (Trichogrammatidae); *11:* leaffolder larva and adult (*Cnaphalocrocis medinalis*, Pyralidae); *12:* larval parasitoid of leaffolders (Ichneumonidae, Braconidae); *13:* rice bug (*Leptocorisa* spp., Alydidae), sucking on seeds in milky stage; *14:* grasshopper (*Conocephalus longipennis*, Tettigoniidae), feeding on rice as well as on eggs of bugs and hoppers; *15:* spider (Tetragnathidae); *16:* rice (*Oryza sativa*)



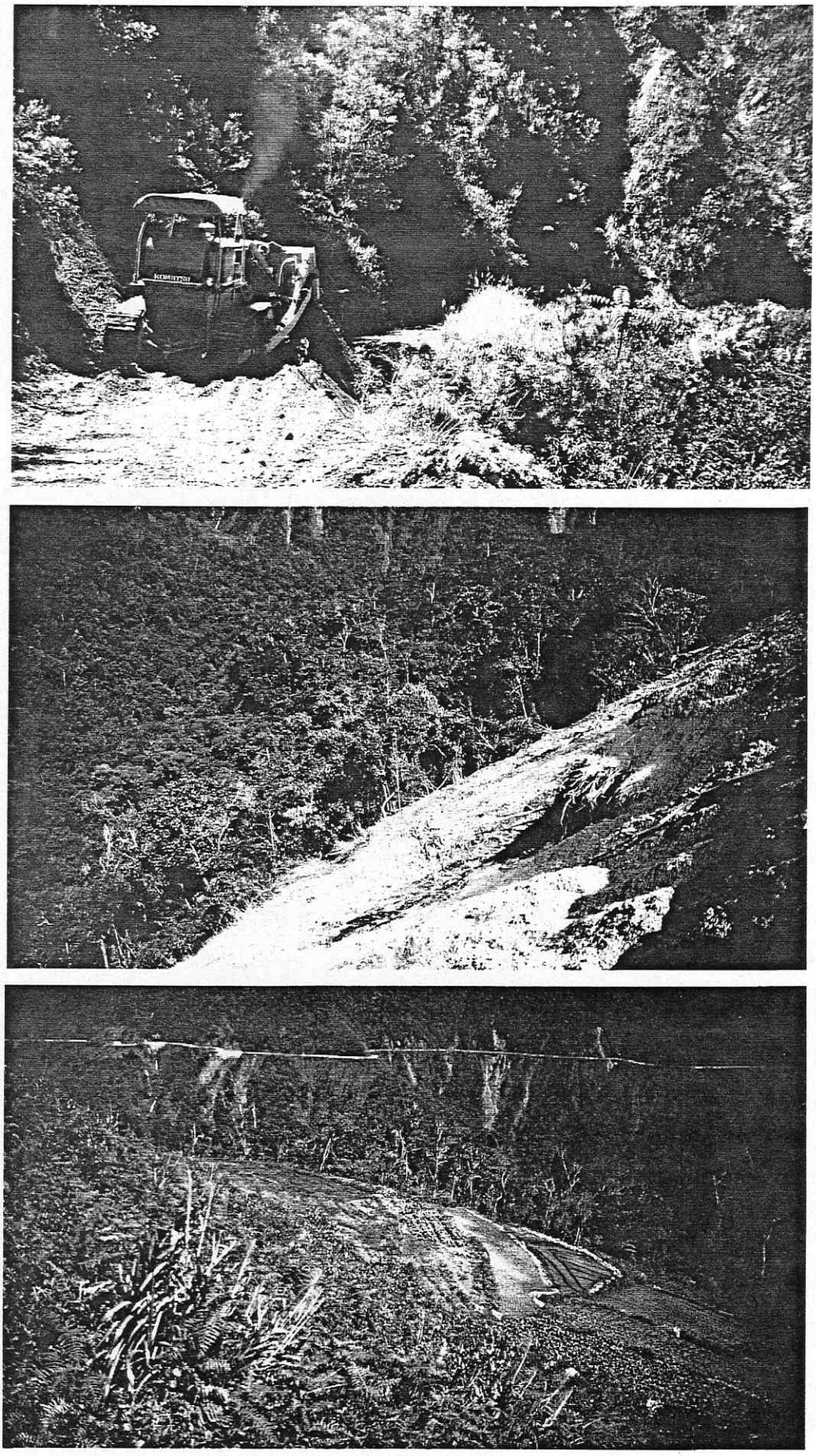
Picture 13-15: Impressions of the mossy forests of Mt. Pulis area (border of Ifugao and Mountain Province)

As the people of Ifugao in some areas already experienced the effects of cutting forests at mountainous sites (namely pronounced dry or wet periods, depending on the season; see e.g. EDER 1982), the remaining forests are valued by the people. Thus large scale impacts usually are prevented. However, the ongoing construction of roads (at present especially the Banaue-Bontoc road) is a major factor responsible for most of the decline of forest areas at certain locations. Construction directly is destructive, but erosion is enforced as well. In limited but increasing amount wood is also extracted from these forests, which among other sources, form the basis for local handicrafts (mainly for carving).

Besides their importance for the water regime of the region, the mossy forests also harbour a vast number of endemic and/or endangered plant and animal species (see Pict. 16). Inventory of species diversity has only started. First results however show, that there are hundreds of species still to be discovered (literature on species of butterflies and moths as an example: SETTELE et al., 1990; THOMAS, 1990; CERNY, 1993, 1995; SCHINTLMEISTER, 1993; NÄSSIG & TREADAWAY, 1988, 1997a, 1997b, 1998a, 1998b; TREADAWAY, 1995; HOGENES & TREADAWAY, 1998).



Picture 16: *Loepa nigropupillata* NÄSSIG & TREADAWAY 1988 - an endemic Saturniid moth of the Ifugao Rice Terrace area and the mossy forests of Ifugao and Mountain Province



Picture 17-19: Destruction of mossy forests of Mt. Pulis area (border of Ifugao and Mountain Province) by road construction and upland agriculture

7 Cultural change and ecological effects

Should the present development continue without alterations, drastic changes may be expected in the terraced landscape of Ifugao Province. Rice cultivation more and more fails to meet the requirements and expectations of people. Hard labour in the terraces, combined with low yields, as well as an increasing population, which can no longer live without imports, lead to the search of alternatives either in lowland areas or in the higher elevated mossy forests. Both in the long run leads to the destruction of irrigated agriculture. More extreme dry periods would make irrigation more difficult (including decreasing stability of terraces and thus increasing danger of erosion), leading to further emigration. This vicious circle can hardly be broken while maintaining the traditional system. A new adaptation and change of the system, combined with the adaptation of people to new frame conditions, as hundreds of years ago, might become necessary (compare SETTELE et al., 1993b).

8 Important prerequisites for future development

Projects aiming at improvements and adaptations of the system, as the EU funded CECAP (Central Cordillera Agricultural Programme), have no easy task. The more this holds true, as the space for optimisation in such a subtly balanced system might be rather small. Too enthusiastic improvements may accelerate the system's destruction. It's of major importance to enhance creativity and the openness to small scale experiments of the local people, instead of bringing in numerous solutions of vague applicability from outside.

Conservation of (mossy) forests is essential for the maintainance of irrigated terraces and in general nearly any kind of land use in the region. The different possibilities to achieve such a goal (as well as potential alternatives) are illustrated and discussed in the chapter „Scenarios" at the end of this booklet.

8.1 Characteristics of the system which should be maintained

A detailed knowledge of the traditional system (one of the central aspects of our research activities in the area), should form the basis for a search for modification possibilities. Major sources of information which are very useful for basic information are VAN BREEMEN et al. (1970), CONKLIN (1980), EDER (1982), DUMIA (1983), WACKERNAGEL (1985) and VOGGESBERGER (1988).

If change of production systems in Ifugao is intended, one always has to keep in mind the reasons for their constant yields throughout the centuries without input of mineral fertilizers and pesticides. Most of them derive from irrigated rice production with its

general characteristics (according to MARGRAF & VOGGESBERGER, 1986, 1988; ROGER et al., 1986):

- high sedimentation within fields, thus minimized erosion and nutrient loss,
- anaerobic conditions (no nitrification, thus favouring nitrogen conservation),
- blue-green algae growth (biological N-fixation), and
- animal production (snails, ducks, fish, etc.),

and

specific characteristics of the Ifugao production system (according to MARGRAF & VOGGESBERGER, 1986, 1988; SETTELE, 1992; SETTELE et al., 1993a, 1995):

- improved symbiosis of *Azolla* ferns and *Anabaena* algae due to high altitude (1000m), thus high efficiency of N-fixation,
- vegetable production on compost mounds during rice fallow, while fields are kept flooded,
- harvest only of upper portions of the rice plant (from panicles to flag leaves, which are bound together to bundles), thus most parts of the plants remain in the field and are decomposed after being worked into the mud of the paddy,
- experience in rice production and variety selection for generations of farmers, and
- highly structured landscape with generally small fields.
- Synchronous growing seasons on large areas with nearly rice free fallow periods, which have been generally propagated by LOEVINSOHN et al. (1988) and specifically for Ifugao by SETTELE et al. (1995). This, however, has to be questioned and needs further investigation (compare for example HEONG et al., 1992; WAY & HEONG, 1994; HEONG, 1996; see also chapter 8.2)

8.2 Possible changes of/within the system to improve production conditions

Due to the many advantages of the present aquatic system compared to upland farming, it may hardly be replaced within Ifugao. Only temporary growth of upland crops in small, terraced patches, as partly practiced with sweet potatoes and beans, could produce cash crops for the market. Large scale replacement of irrigated rice, e.g. by beans, is not advisable at all (ENGELHARD et al., 1991; MARGRAF & VOGGESBERGER, 1986).

Increasing yields by maintaining the irrigated system and thus maintaining the long-term sustainability will only be possible by introduction of a second growing period - as is practiced in the Philippine lowlands or in the neighbouring municipality of Bontoc (BOTENGAN, 1976). Failure of attempts to introduce a second crop in higher elevations so far have been due to climate, or to the non-availability of respective rice varieties, respectively. An introduction of new cold tolerant and fast growing varieties with low nutrient requirements would be necessary. This has been done successfully already in elevations of 700 m in the nearby Kiangan area (VOGGESBERGER, 1988; SETTELE, 1992). Pest problems within such modified systems are not to be expected. The efficiency of natural enemies might even increase due to larger asynchrony of the system (HEONG et al., 1992; WAY & HEONG 1994; HEONG, 1996). The rich landscape structure may have additional beneficial effects on the dynamics of pests and their natural enemies (SETTELE et al., 1993a). Thus, also in the future application of pesticides will most probably not be necessary. This would guarantee the survival of the aquatic biocoenoses and the production of animal protein also in the future.

However, we have to keep in mind, that for the success of new varieties not only physiological but also socioeconomic problems have to be solved (WACKERNAGEL, 1985; BARTHELEMES et al., this volume, pp. 29-42), which means that innovations should be initiated by the farmers themselves and only be assisted by outside expertise.

Another solution, besides the two rice crops per year, could be derived from the compost mound component of the traditional system (see CONKLIN, 1980). Enlarging these mounds (e.g. towards a linear arrangement as practiced in some neighbouring areas), would create possibilities for vegetable production while keeping the terraces flooded and thus physically stable. If water supply is irregular and the field areas dry up temporarily new flooding often might cause severe erosions of whole field complexes.

Appendix:

German research activities in Ifugao

Mainly masteral and PhD students conducted research in Ifugao Province. Most of them have been members of the Agroecology Section (headed by Prof. Dr. Werner KOCH) of the Institute of Plant Production in the Tropics and Subtropics, University of Hohenheim (Germany). The following list gives the names of the researches in a chronological sequence, together with their field of expertise and their respective published outputs (detailed references then may be depicted out of the references at the end of this booklet; contributions within the present volume are not repeated):

- Josef MARGRAF, 1992/1993; animal ecology, future of the Ifugao system (MARGRAF, 1988; VOGGESBERGER & MARGRAF, 1986, 1988; ROGER et al., 1986)
- Monika VOGGESBERGER, 1992/1993; plant ecology, future of the Ifugao system (VOGGESBERGER, 1988; VOGGESBERGER & MARGRAF, 1986, 1988; ROGER et al., 1986)
- Josef SETTELE, 1985, 1988/1989, 1991, 1996; applied entomology/pest dynamics, biodiversity studies, future of the Ifugao system (ACHILLES & SETTELE, 1990; ENGELHARD et al., 1991; SETTELE, 1992, 1994; SETTELE et al., 1990, 1993a, 1993b, 1995; NÄSSIG & SETTELE, 1993, 1995; NÄSSIG et al., 1998)
- Konrad MARTIN, 1988/1989/1990, 1996; ecology of aquatic animals in rice paddies, food web studies (SETTELE et al., 1993a, 1993b, 1995; MARTIN, 1994)
- Brigitte ENGELHARD & Joachim KECK 1988; agronomy: bean production (ENGELHARD et al., 1991)
- Thomas ACHILLES 1988/1989/1990/1991; entomology: especially stemborers and leaffolders (ACHILLES, 1993; ACHILLES & SETTELE, 1990; SETTELE et al., 1990, 1993a, 1993b, 1995)
- Beate SCHRETZMANN & Ralf BARTHELMES 1995, 1996; socioeconomic aspects

RESULTS OF THE WORKING GROUPS

Banaue - between Yesterday and Tomorrow - (socioeconomic conditions)

by

Ralf BARTHELMES, Carola BUSEMANN, Eva HEUSINGER, Christian OCHS,
Björn TROSOWSKI & Kerstin WELLERSHAUS

1 Introduction

Entering the municipality of Banaue means entering a unique landscape. The rice terraces of Banaue are known as a genuine masterpiece of craftsmanship, constructed during at least a couple of centuries, probable partly more than 2,000 years old. Especially in this region agriculture and society are strongly interconnected. Therefore, our working group focused on socio-economic aspects in the "8th wonder of the world".

2 Methods

To gather information we used a variety of qualitative and quantitative methods:

2.1 Semi-structured interviews

This was the most important tool. Interviews have been made with 22 officials, farmers and local people (see Table 6, page 41). The work of the group was facilitated by already existing contacts and the intentions of the group were known right from the beginning. The aim of semi-structured interviews is to create open communication processes where unforeseeable aspects could be included. Several topics of supposed importance were asked in each of the interviews still considering natural ways of communication.

2.2 Own observations (participating or passive)

The observations were concentrated basically on two villages (Poitan and Tam-an). This choice was made because Poitan is less frequented by tourists than Tam-an which was also the study area of the other groups. In Poitan part of the group was introduced in the community and had the chance to participate in the traditional rice wine processing. This was an excellent possibility to obtain a deeper insight into the cultural life of a village.

2.3 Exchange of information

The group was divided in several subgroups with changing group members. So it was necessary to exchange and discuss the obtained information. Of course this was also done with members of the other working groups to get as much information as possible and to avoid biases.

2.4 Secondary sources

Literature and statistics, maps (see pp. 41-42; also HERZMANN et al., this volume, pp. 77-89; references, pp. 103-108)

3 Hypotheses

According to the available literature (EDER, 1982; TID-ANG, 1983; PRESTON, 1985; MARGRAF & VOGGESBERGER, 1986, 1988; DE VILLA, 1988) and personal impressions (BARTHELMES, MARTIN, SCHRETZMANN, SETTELE, pers.comm.) we formulated a first hypothesis prior to the arrival in Banaue:

"The condition of the rice terraces became worse throughout the last decade"

The timespan was chosen to be able to compare the actual situation with the observations of K. MARTIN and J. SETTELE during their research ten years ago. The following possible reasons for this hypothesis have been extracted from literature:

⇒ Change of income sources
⇒ Lack of manpower for maintenance of the terraces
⇒ Change of water supply
⇒ Change of cultural values

In contrast to the prior assumptions, our own observations, the observations of K. Martin and J. Settele (who stayed in the region several times before) and especially the results of the compartment group (see HERZMANN et al., this volume, pp. 77-89) showed no visible change in the status of rice terraces so far. For example, transplanting is still done in time (referring to the atlas of CONKLIN, 1980), although less labourers are working in the fields (stated by several interview partners). This indicates that the maintenance of the fields can still be provided sufficiently. Therefore our first hypothesis was disproved. Consequently it was necessary to formulate a new hypothesis:

"Almost the same number of rice terraces is now maintained equally with less labour"

For this hypothesis the same reasons, named for the first hypothesis are valid. The aspect of water supply is covered by HERZMANN et al. (this volume, pp. 77-89). The change of cultural values could not be answered sufficiently in the given time, but there are several hints verifying it. As an example nowadays there are actually only very few ceremonies during harvest time (SCHRETZMANN & BARTHELMES, 1996). Formerly this period was of greatest cultural and social importance (CONKLIN, 1980; VOGGESBERGER, 1988). Hence we concentrated our work on the point of labour intensity and the connected change of income sources.

4 Decreasing investment of labour in the rice terraces

The interviews revealed several aspects which underline the fact that labour intensity has decreased and why it has decreased. The difficulty to find workers for transplanting and the high salaries for field work are strong indications for the lack of labourers.

4.1 Migration

Another reason often mentioned is the migration of people. Many owners of the terraces are not living in Banaue anymore. There seem to be several different types of migration. On the one hand people move from the villages to the roadside (compare increased areas of settlements along the road in maps of HERZMANN et al., this volume, pp. 77-89). Others move from the villages to the centre of Banaue or migrate out of the municipality to Baguio, Manila or other cities.

To verify the statements we examined the official data about the number of inhabitants and calculated the growth rate. Referring to the different types of migration we compared villages far from the centre to villages near the centre of Banaue.

Table 2: Population growth rates in Banaue municipality

Villages far from the centre	1990	1995	growth rate (%)
Batad	1.110	942	
Cambulo	1.528	1.280	
Kinakin	1.100	1.268	
total	**3.738**	**3.490**	**- 1,4 %**
Central Banaue	**1990**	**1995**	**growth rate (%)**
Población	1.691	2.369	
Tam-an	977	2.221	
Bocos	1.822	2.332	
total	**4.490**	**6.922**	**+ 9,0 %**

Source: Census of Population 1990 and 1995, National Statistics Office, Lagawe

As can be seen in Table 2, the growth rate for the villages far from the centre is negative, meaning that there is a migration out of theses villages. On the other hand the population of the centre is highly increasing, expressed by the very high growth rate of 9%. The average growth rate of the Philippine population was 2.35 % in 1994 (MÜNZINGER ARCHIV, 1995).

The figure of 9% growth rate seems to be unrealistically high. Even in the case some figures of the survey are incorrect, it shows a clear tendency that there is a migration from the distant villages towards the centre. Therefore migration is one major reason for the lack of labourers in the remote villages. But it cannot explain the decrease of labourers in the growing central part of Banaue. In this region the more relevant cause might be the alternative job opportunities.

4.2 Agricultural income sources

To analyse the current attraction of rice farming in a quantitative manner, we have chosen two different approaches which deal with the financial benefit of rice farming. The first calculation should show the carrying capacity of Banaue concerning rice. Because of different data two sources are used to show the range of the potential rice supply. The first source is the Masterplan designed by the Philippine Government as a base for the work of the Ifugao Rice Terrace Commission (ITC, 1994). The second source is the Socio Economic Profile published by the Municipality Planning and Development Office, Banaue (MPDO, 1994).

Table 3: Carrying capacity based on the Masterplan (ITC, 1994) and the Socio Economic Profile (MPDO, 1994)

	Masterplan	Socio Economic Profile
Population of Banaue	22,500 pers.	22,500 pers.
Total area of rice fields	4,327 ha	868 ha
Average yield	1.9 t / ha	2.1 t / ha
Consumption *(kg / person in 1 year)*:	119 kg	119 kg
⇨ total rice production	8,221 t	1,823 t
⇨ rice production *(kg / person in 1 harvest)*	365 kg	81 kg
⇨ duration of rice supply *(per harvest)*	**~ 3 years and 1 month**	**~ 8 months**

As it is visible from Table 3, the data are too divers in order to draw any conclusion. Taking into account the farmers' statements, that their rice lasts only for **three to six months,** it seems to be necessary to use a different approach which is based on the data of the Department of Agriculture of Banaue Municipality and the information of local people. The aim is to receive more valid information by using primary sources.

Table 4: Opportunity costs of an average rice harvest

Average yield 1996 (t / ha):	2.7 t / ha
Average area of rice fields / household:	0.25 ha
Average price / kg rice (March 1997):	16 Pesos
⇨ costs of opportunity : (2,700 kg / ha * 0.25 ha * 16 Pesos) =	**10,800 Pesos**

This figure (Table 4) expresses the opportunity costs which is the amount of money saved because it doesn't have to be spent for buying commercial rice. To get an idea of the profitability of these 10,800 Peso, we have to consider the amount of labour needed to produce this profit. Because it was impossible to obtain sufficient data from the local population we had to use the estimates of different authors (see Table 5).

Table 5: Labour requirement per household for one rice season
(based on an average area of rice field of 0.25 ha / household)

According to CONKLIN (1980):	at least 157 days
According to WACKERNAGEL (1985):	about 100 - 110 days
According to CECAP (1995):	about 60 days

Interestingly the days of labour required decrease chronologically. While CONKLIN (1980) describes a necessary time span of 157 days, data of CECAP (1995) states that only 60 days of labour are needed for the same work.

A closer look on the data of CONKLIN shows that a big portion of work days is spent for weeding and cleaning (70 days). Taking into account that the weeding intensity is now reduced to one third (according to interviews), it is possible to reduce CONKLIN's figure. Additionally other working days used for guarding, repairing and maintaining can be subtracted although it is not possible to give an exact number for that. Nevertheless this indicates that the CECAP data might be more realistic nowadays. This would indicate a high actual attraction and therefore confirm the second hypothesis - even with less manpower the rice terraces are still maintained.

Unfortunately it is not as easy as it seems to be. The work in the fields is not equally distributed over the whole year. There are working peaks mostly during transplanting and harvesting. Aggravatingly many of the male family members are going to other provinces as seasonal workers to provide enough cash income. In this context it has to be emphasised that the opportunity costs mentioned (see Table 4) are non-cash income so that cash is still needed to satisfy the increasing amount of modern needs as well as other costs of living like tuition fees, health care etc.

Even for the agricultural production money is needed, to pay for labour in the fields (e.g. repair work, transplanting and harvesting). Particularly the reconstruction of terraces and walls has become very expensive. Statements vary between 500 and 1,000 Peso for 2 meter of terrace wall excluding the price for material and carrier of the material.

Besides this another important aspect does not have to be forgotten. Even though the wage of field workers has increased it is very difficult to find enough labourers to cover the working peaks. In accordance to the majority of the statements, the decreased attraction is mainly due to the lost reputation of agriculture. This and the fact that field work is physically hard and workers are exposed to extreme weather conditions, might explain why people prefer other income sources instead of working in the terraces.

4.3 Alternative sources of income (with special emphasis on tourism)

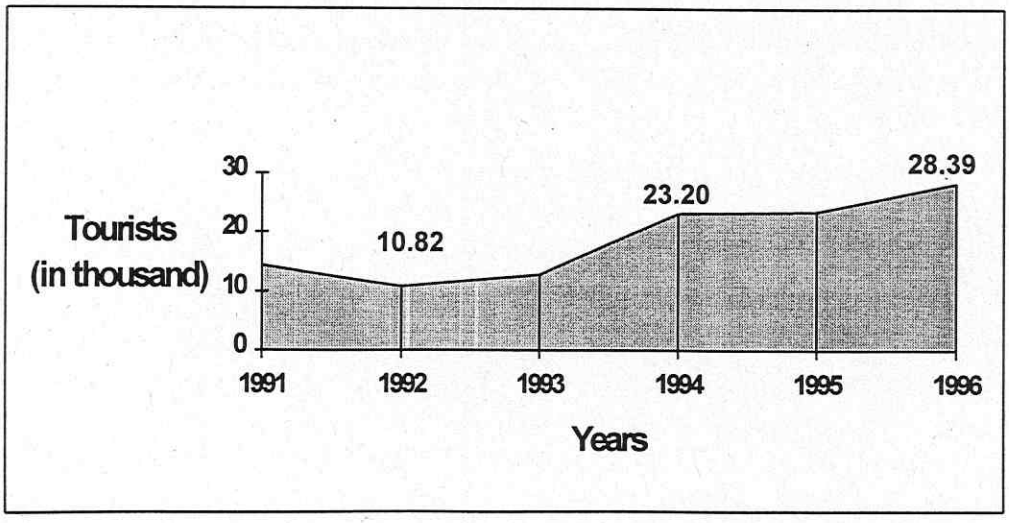
In former times the agricultural system of the Ifugaos was characterised by subsistence. Camote (sweet potatoe) was a so called security crop for times of misharvests in the rice fields. Nowadays there is a wide variety of non-agricultural income sources. This cash-income is a necessity because money is needed for health care, education and the everyday-life needs. Furthermore working in different jobs distributes the risk. Today the rice production takes over the role as security crop, which Camote played in the past. It lost its importance as the main source of income. Additionally in most of the families at least one member has to work as a seasonal worker out of the region to provide enough cash income.

To describe the multitude of sources of income we will give an example. At the time of the interview a young man helped his brother constructing a snack bar where he will be employed later on. Additionally he is an employee in a co-operative, sometimes works as a tricycle driver and tourist guide. Finally he cultivates his own rice terraces. This example is typical in so far as the cash income mostly derives from tourism. Due to tourism new fields of work developed and existing ones expanded. Tourism-related jobs are especially concentrated on very few localities like Banaue centre.

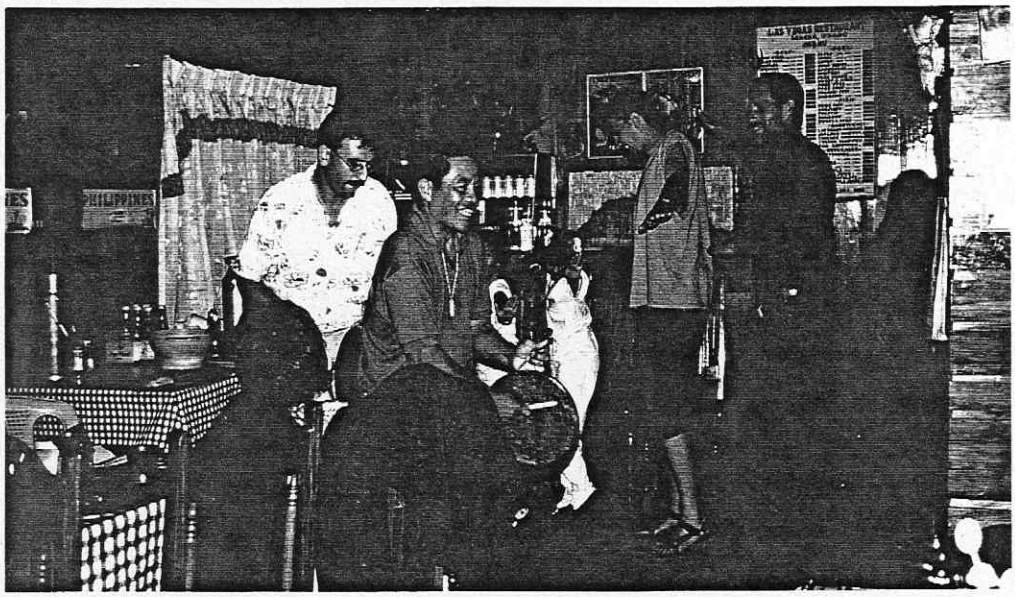
The Province Ifugao could register a steady increase of visitors as you can see in Figure 1. One hotel and 25 pensions offer accommodation and food in Banaue. Other directly related work opportunities are jobs as tricycle driver, tourist guide or waiter. There are as well possibilities indirectly related to tourism e.g. road construction, house building and communication. Additionally a handicraft industry developed. Especially woodcarving became an important part of the economy. Although the named aspects seem positive, tourism in Banaue has two sides. The accommodations are concentrated mainly in the centre of Banaue and are run generally by the few wealthy families. The salary of waiters is much below the subsistence level. There is no direct linkage between tourism and agriculture in the way that the farmers profit financially from tourism although the terraces are the reason for the visitors to come to Banaue.

Up to this point the part of the hypothesis has been proved which says that less labourers work in agriculture. It still has to be proven that the terraces are maintained equally.

Figure 7: Tourist arrivals in Ifugao Province



Source: Information References by the Department of Trade and Industry, Ifugao Province



Picture 20 (top): Tourism at scenic view (Bay-Yo, March 1997)
Picture 21 (centre): Party with local dances in restaurant (Banaue, March 1997)
Picture 22 (bottom): Traditional 'ikat'-weaving (South of Banaue, March 1997)

5 Terrace maintenance (innovations)

There are different ways how farmers compensate the decreasing labour intensity. The following aspects are not ordered chronologically. Some of them have been established quite some years ago, some developed more recently. It is a summary of aspects described by the interview partners and the results of own observations.

1. One major aspect is the decreased **intensity of weeding and cleaning in the rice fields**. CONKLIN (1980) estimated an amount of 285 workdays for one hectare of pond fields. The figure has been reduced remarkably since weeding is only done once a year not thrice as in former times. Another method to cope with weeds is to burn the walls.

2. Similarly the **guarding of the fields** in the dry season, to protect the plants against rodents and birds seems to be done very rarely. Instead scarecrows and plastic flags are placed on the dikes. As protection against birds strings are put up above the plants.

3. In the period before transplanting the seedbeds are sometimes surrounded by a plastic wall to hinder the „**Golden kuhol**" (*Pomacea canaliculata*) to feed on the seedlings. The adaptation to fight the kuhol is an interesting example of an innovative process: brought into the Philippines as additional protein source it developed into a rice pest. The only way to keep the damage low is to collect the snails and to crush the eggs. After a while it became evident that the farmers can benefit from the snails because in the fallow period they would feed on the weeds. (Details on the snail see MARTIN et al., this volume, pp. 55-61.)

Picture 23:

Old woman planting cassava on paddy dike (Banaue, March 1997)

4. A look upon other parts of the agricultural production reveals a shift in the form that **women work less** than before in the swiddens and more in rice cultivation.

5. Concerning mostly the **work of the male farmers**, rebuilding of collapsed terraces and the construction of new ones are done with a **minor labour intensity**. In some areas destroyed walls constructed previously with clay are set up with stones to prolong the durability.

6. The **maintenance of irrigation channels** is one duty often neglected. Small damages in the water system are temporarily bridged with hoses, plastic pipes or tubes. Sometimes the main irrigation channel is cemented lessening the necessary work force. In some villages one could even find deep water wells which have replaced the traditional system.

Due to these innovations the lack of labourers can be compensated. Therefore the hypothesis "Almost the same number of rice terraces is now maintained equally with less labour" has been proven to be valid.

6 The Masterplan - governmental plans for the future development of Banaue

6.1 What is the Masterplan?

The Six Year Masterplan of 1994 (ITC, 1994) was made to define an overall framework and integrated intention scheme for restoring and preserving the Ifugao Rice Terraces. It seeks to resolve the identified problems in an integrated manner. The following points are mentioned to guide the approaches in all the programs:

- terraces with high scenic and cultural value should be maintained for traditional rice production,
- other terraces will be considered for higher value multiple use,
- inducements are provided to communities which are maintaining the traditional rice terrace culture, and
- tourism will require spatial restructuring and support systems to enhance the cultural and scenic value, and the marketability of the rice terraces. It will provide economic benefits to the terraces' farmers and to the community as a whole.

The nine major programs planned are:

⇒ Watershed management program
⇒ Water management and irrigation program
⇒ Agricultural management program
⇒ Transport development program
⇒ Socio-cultural enhancement program
⇒ Spatial restructuring and Tourism program
⇒ Livelihood development program
⇒ Institutional strengthening

All this should be realised with a financial volume of 1.31 billion Pesos (≈50 million US$ in 1997).

6.2 Discussion of the objectives

If the objectives of the master plan were realised it would cause an enormous change in the region. Since tourism and spatial restructuring have the largest financial budget out of the nine major programs, their realisation should show the highest impact on the region. In 1997 already three years have passed and half of the Masterplans implementation time is over. Therefore we want to discuss some of the objectives concerning tourism in respect to the actual situation.

One intended purpose for Banaue is to serve as a 'jump off-point' for 'eco-tourism' and at the same time to provide crafts and cultural facilities for mass tourism. The two objectives are hard to combine since there have been only few if any successful attempts in combining mass tourism and eco-tourism at the same place.

A further aspect is that the access to Banaue will be facilitated by the new constructed airport in Bagabag (completion supposedly in 1998), which is only a two hours drive away from Banaue. This will reduce the travel time of 11 hours (Manila to Banaue) down to 3 hours. If we consider that there will be B737 aircraft operating on this route, this will be another step towards mass tourism.

Therefore sufficient accommodations for the high amount of expected tourists are needed. Also it is necessary to provide more facilities for garbage and wastewater disposal. There are several approaches proposed in the Masterplan to create the required infrastructure.

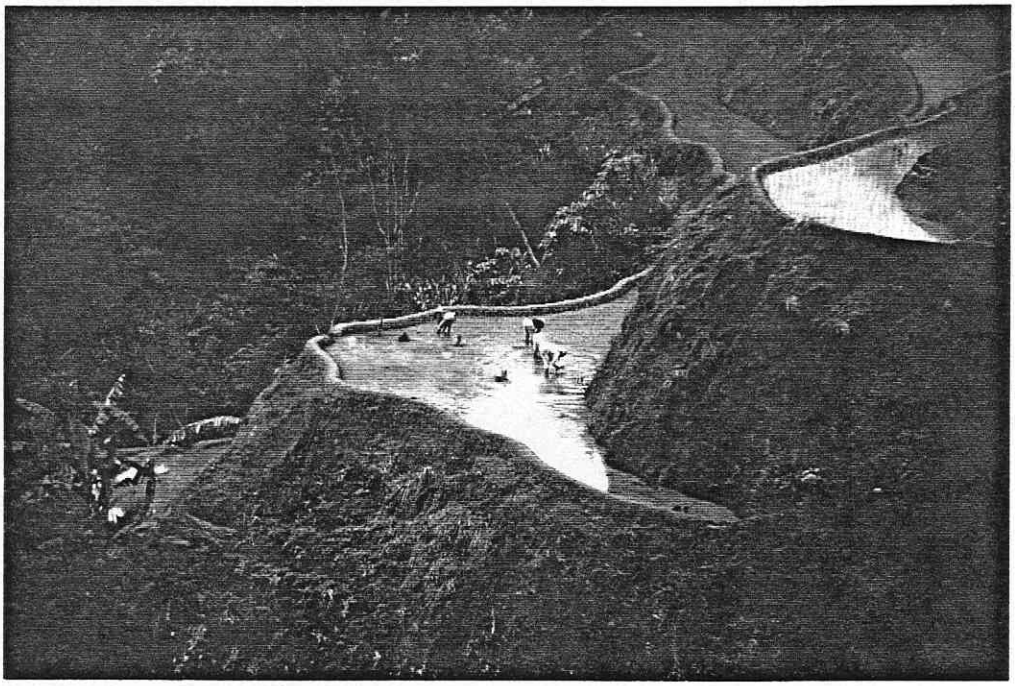
In contrast to these proposals no major changes in Banaue concerning the accommodations and the disposal management within the last decade could be observed (own observations; MARTIN & SETTELE, pers. comm.).

Taking into account that there are only 3 years left for the realisation we were surprised that most of the population is not informed about any projects. Most of the officials know about the existence of the Masterplan but are not informed about its exact content. This shows the gap between the objectives of the Masterplan and the actual situation.

7 Conclusion

The aim of the presented study was to prove that almost the same number of rice terraces is maintained equally as they have been in former times. The centre points of the observations and the interviews have been the two Barangays Tam-an and Poitan. Additionally interviews with officials and the use of secondary data widened the perspective, so that other areas of the Banaue Municipality could be included.

It can be stated that until today the terraces have been maintained in a similar condition. Even with less labour input the farmers found ways to compensate. However, there are indicators, that these innovations cannot cope much more. If the plans of the Philippine Government to propagate and strongly increase mass tourism will be realised, the traditional agricultural system, though modified, would be destroyed. As a result the sources of income would shift even more than today away from agriculture towards tourism. This would lead to a financial dependency of the population on tourism. Certainly a much higher number of abandoned terraces will result out of this which reduces the attraction of the area.



Picture 24: Rice transplanting between Bocos village and waterfall (Banaue, Feb. 1997)

A typical symptom of mass tourism is its short life, because it often withdraws its own base. Already some signs can be identified that the same may occur in Banaue.

Another aspect has to be pointed out again. As can be seen in Table 3, the reliability of the "official" data of the Masterplan is obviously very low. It has to be questioned how this data is obtained and even more important how it is used. We want to stress that one should be very careful using such figures because their correctness can not be taken for granted. This might lead to completely wrong assumptions and decisions which will not be of any help but disadvantageous for the people and for the whole Banaue area.

8 Open questions

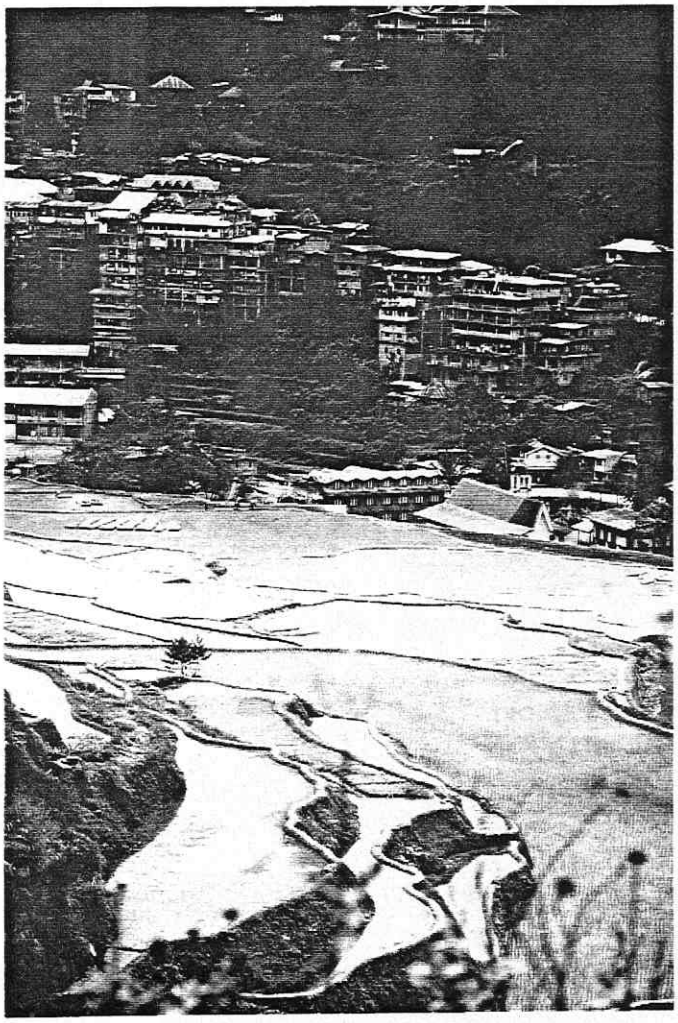
A two weeks study about the socio-economic situation of an area brings up more questions than it produces answers. It is therefore useful to note problematic aspects which to us seem to be of particular importance.

1. We proved that it is possible to maintain the rice terraces with less labour input. But this relates to the short-term condition only.
   - What effects do some of the introduced innovations (e.g. artificial irrigation, scarecrows, etc.) have in the long run?
   - How does the production of vegetables on former rice terraces influence rice production with regard to chemical fertilising and spraying, water management, soil structure, erosion?
   - To what extent does the abandonment of rice fields harm the balance between pests and predators?
   - What happens when CECAP will have left Ifugao?

2. Tourism was discussed only briefly. Still, it is the most important and most threatening element in Banaue.
   - To what degree is tourism beneficial to the region?
   - What consequences would derive from the implementation of the Masterplan?
   - Are there any alternative possibilities and what do they look like?
   - Which steps have to be realised so that as much persons as possible benefit from tourism?

3. Woodcarving also is an element worth to note. It is an industry exceeding the borders of Banaue and Ifugao.
   - How can a proposed increase of production be brought into line with a sustainable forest management?
   - Who is profiting from woodcarving?
   - What effects would have the establishment of a community-based woodcarving co-operative on the municipality level?

4. Culture has to be taken into account as well. Even though it is dynamic same values do exist for centuries and still form the Banaue society.
   - Is the cultural heritage a hindrance or a blessing for development?
   - Which elements of the tradition do the local people need and want to keep up?
   - To what extent does the loosening of the cultural norm have an effect on the agricultural production?



Picture 25:

"Urbanization" of Central Banaue (March 1997)

APPENDIX

Table 6: List of interview partners

Sign	Interview partner	Occupation
◆	Carmelita Mandigning	Department of Tourism, Manila
◆	Jimmy Cabigat	Technical Adviser of Agriculture of Banaue
◆	Jerry Damoyan	Supervising Agriculturist
□	George Pepe	Historian of Banaue
◆	Carmen Abayao	Technician of Agriculture of Banaue
◆	Dr. Wesley Dulawan	Municipal-Health-Officer
◆	Rudi Akangan	Principal of the ICS Highschool
□	Mariejane Attip	Saving Co-operative Bocos
□	Antoine Zenner	ILOB Foundation
◆	Bonifacio Yapyapon	Principal of the Elementary School
□	Clerk	Fertiliser / Pesticide-Shop
□	Farmer	Ricefield near Poitan
□	Joni Lorenzo + Family	Woodcarver
□	Helen	Female Worker in the rice fields, Tam-an
□	Mila Duccoy	Female Worker in the rice fields, Tam-an
□	Marry Pinkihan	Organic farm, lowland
◆	José Thomas	Tam-an Multipurpose-Co-operative
□	Juanita Baconging	Female Worker in the rice fields, Tam-an
□	Myrza Addug	Owner of the Hillside Inn (Lodge), Battad
□	Fermina Marquez	Inhabitant of Cambulo
□	Pilar Chorhangon	Guide of Battad and Cambulo
□	Member of the Luglug family	Member of the Ifugao Producer Association

Symbols: □ private person = 14 persons
◆ official person = 8 persons

Table 7: Number of persons and households of Banaue municipality

	1990		1995	
Barangay	**Persons**	**Households**	**Persons**	**Households**
Amganad	1.451	307	1.745	329
Anaba	523	130	568	131
Balawis	869	176	1.066	204
Banao	588	135	738	143
Bangaan	649	168	312	299
Batad	1.110	258	942	247
Bocos	1.822	332	2.332	410
Cambulo	1.528	356	1.280	319
Ducligan	862	192	1.050	253
Gohang	463	79	814	175
Kinakin	1.100	223	1.268	257
Ohaj	589	117	985	183
Poblacion	1.691	308	2.369	442
Poitan	1.158	247	1.300	258
Pula	[1]	[1]	1.019	207
San Fernando	615	104	1.115	128
Tam-an	977	162	2.221	538
Viewpoint	948	179	1.376	258
Total	**16.943**	**3.473**	**22.500**	**4.781**

Remarks [1] no data available, Pula probably belonged to Cambulo in 1990
Source: Census of Population 1990 and 1995, National Statistics Office, Lagawe

Table 8: Tourist arrivals in Ifugao Province in 1996

MONTHS	Province of Ifugao	Percentage (%)
January	3,011	10,60
February	2,650	9,33
March	3,633	12,80
April	3,319	11,70
May	2,525	8,89
June	1,581	5,57
July	1,929	6,79
August	872	3,07
September	2,086	7,35
October	1,863	6,56
November	2,218	7,81
December	2,705	9,53
Total	28,392	100.00 %

Source: Department of Tourism, Cordillera Administrative Region

Table 9: Tourist arrivals in Ifugao Province from 1991 to 1996

Year	Tourist arrivals
1991	14,405
1992	10,823
1993	12,837
1994	23,206
1995	23,502
1996	28,392

Source: Department of Tourism, Cordillera Administrative Region
Office of the Governor, North Lagawe, Ifugao

Nutrient Flux in the Rice Terrace System of Banaue (N-Luzon/Philippines)

by

Ulrike JAHN, Thorsten TIPPMANN, Katrin WEBER,
Ulrich WENDEROTH & Doris VETTERLEIN

1 Introduction

The people of Banaue have shaped the landscape through cultivation of rice on terraces for centuries. The rice growing system of Banaue is characterized by just one growing season followed by a fallow period during which the paddies remain flooded. Traditional local rice varieties are grown resulting in a yield level well below the one obtained in "modern, intensive" rice growing systems.

In the traditional rice growing system only the panicles are removed from the fields and (after threshing) form the basic food supply for the people apart from sweet potatoe. The rice straw remains in the paddy and thus in the nutrient cycle (compare CONKLIN, 1980; MARGRAF & VOGGESBERGER, 1986, 1988).

In the traditional system no mineral fertilizer is applied. Nutrient import is only in the form of green manure. Apart from rice straw this can be weeds from the rice terrace walls or any kind of organic residues from the settlements (own observations; CONKLIN, 1980; MARGRAF & VOGGESBERGER, 1986, 1988). For nitrogen an additional input to the system is derived from air born nitrogen fixed by symbiontic living organisms (i.e. the water fern *Azolla* in association with blue green algae; compare ROGER et al., 1986). However, it is very difficult to quantify the nutrient input through green manure or symbiotic N-fixation as the data base is even smaller than the one available for yield data.

An export of nutrients apart from the rice panicle could be through gaseous emission, leaching or runoff of irrigation water. Leaching is minimized in flooded rice paddies through the formation of a plough layer, however infiltration is not prevented completely. For example infiltration rates of 1.3 mm/day were measured in low land paddies in the Philippins (KAMPEN, 1970), which is by a factor of ten lower than what is observed in aerated fields (SCHEFFER & SCHACHTSCHABEL, 1992).

For irrigation water it is not clear whether it results in net import or export of nutrients. The amount of nutrients dissolved in the irrigation water is supposed to depend on the vicinity to the settlements (waste water inflow).

As the traditional rice terrace system is in existence for such a long time already, it can be assumed that it is sustainable in terms of nutrient cycling, i.e. that there is a balance between import and export. However it is an open question whether the nutrient flux from the settlements to the terraces via sewage water and/or irrigation water is an important component of the nutrient cycle. This question is of special relevance in terms of population increase, increasing number of tourists or change in the waste water management.

For our two week field research nitrogen (N) and phosphorus (P) were chosen as parameters as these two elements are macro nutrients for plants and thus have a strong impact on yield. In addition there are „quick-test-methods" available for the mineral forms of these nutrients which can be applied at the site without access to a laboratory.

As nitrogen is not derived from parent material by weathering like many other minerals, the nitrogen supply of plants depends exclusively on fixed air borne nitrogen or nitrogen import. The predominant form of nitrogen in soil is the organically bound nitrogen, mostly more than 95 % (SCHEFFER & SCHACHTSCHABEL, 1992). This organic nitrogen is transformed to ammonium through mineralization - a step which is much slower in flooded systems than in well aerated ones. Ammonium is then transformed by microbes to nitrate - again this is a step which requires oxygen and is thus slow in flooded systems. Ammonium and nitrate can be taken up readily by plant roots.

Phosphorus can be derived from parent material by weathering processes, thus the percentage of organic phosphorus in soil (25-65 %) is lower than the one for nitrogen (SCHEFFER & SCHACHTSCHABEL 1992). Organic phosphorus can be transformed to plant available ortho-phosphate through mineralization.

2 Aim of the field research

The nutrient flux in the existing traditional system was investigated taking nitrogen and phosphorus as key parameters. The investigations were based on the hypothesis that sewage water from the settlements has an impact on the nutrient balance of the rice terraces. As there is no central waste water collection and waste water treatment plant in the area, it was assumed that higher nutrient inputs could be measured in the rice terraces in the immediate vicinity of settlements. Based on these assumptions it was expected that a concentration gradient would be detectable in the irrigation water of rice terraces along a toposequence.

3 Materials and methods

3.1 Electrical conductivity

Electrical conductivity (EC) is a measurement for the amount of charged particles, irrespective of their chemical origin. The electrical conductivity of a solution depends on the concentration, the degree of dissociation and the valence of the ions formed. It can be measured directly in a water sample with an electrode. The measurement is given in [µS/cm].

To evaluate the measurement of electrical conductivity in respect to pollution some information on the geological background is required (i.e. measurement at the spring). Once the values measured are clearly above the background level, this can be interpreted as an indication for other sources apart from the geological formation. As the measurements can be made very quickly and at low cost the method was used to select the different sites for investigation.

3.2 pH-value

pH value, like electrical conductivity, was measured with an electrode. However, requirement for calibration made it less suitable for application in the field. In the present study pH measurements were conducted to secure that quick-test-methods could be applied without interference with high H^+ - or OH^- - concentrations.

3.3 Quick-test-methods

N could be detected in the form of NH_4^+ and NO_3^-, and P in the form of PO_4^{3-} with the quick-test-methods selected. The precision which can be achieved is not as high as the one with standard methods in the laboratory. However, as transport is easy and results are available quickly, they were used to group samples into different classes of concentrations. The system used was Reflektoquant® from MERCK, consisting of RQflex® and the Reflektoquant®-strips. The system is based on reflectometrie (Re-emissionsphotometrie). The sensor is able to detect the difference in intensity of emitted and reflected signals. The difference corresponds to the concentration of the respective chemical in the sample solution. The system was developed for the measurement of concentrations in soil extracts, sewage water and fertilizer. In the present study water samples were compared to water extracts of soil samples (1:10). The water extracts of soil samples had to be filtered before measurement could be conducted.

3.3.1 Ammonium-test

Ammonium-ions are transformed to mono-chloramin. This forms together with a phenol compound a blue indo-phenol-derivate, which can then be detected by reflectometry. The measurement range was 0.2 - 7.0 mg/l NH_4^+. (For comparison: The threshold value for ammonium in drinking water in Germany is 0.5 mg/l [TVO 5.12.1990]). A standard solution was used to check the function of the system upon each measuring period. No deviation was detected.

3.3.2 Nitrate-test

Nitrate is reduced to nitrite and then upon the addition of an acid buffer solution and an aromatic amin transformed to a diazonium-salt. This in turn forms a violett complex with N-(1-Naphthyl)-ethylendiamin which can be detected by reflectometry. The measurement range was 3 - 90 mg/l NO_3^- (For comparison: The threshold value for nitrate in drinking water in Germany is 50 mg/l [TVO 5.12.1990]). A standard solution was used to check the function of the system upon each measuring period. No deviation was detected.

3.3.3 Phosphate-test

Ortho-phosphate-ions form molybdate-ortho-phosphoric acid upon the addition of molybdate-ions. After reduction a blue complex is formed which can be detected by reflectometry. The measurement range was 5 - 120 mg/l PO_4^{3-} (For comparison: The threshold value for phophate in drinking water in Germany is 6.7 mg/l [TVO 5.12.1990]). A standard solution was used to check the function of the system upon each measuring period. The measurements were unreliable and clearly dependent upon the incubation time. The results can thus only be taken as a rough estimate and are not interpreted further.

3.4 Fertilizer experiment

In an artifical rice paddy without inflow or outflow for the duration of the experiment a liquid fertilizer ("Greenbee") was applied to the irrigation water. The fertilizer contained about 80 g/l of ammonium. For application it was diluted by a factor of ten. The application rate resulted in a theoretical concentration of the irrigation water of 8.7 mg/l as the depth of the water in the artificial paddy was 2 cm. The concentration in the irrigation water and soil water extract was measured several times for 48 hours after application.

3.5 Experimental sites

3.5.1 Tam-an

The rice terraces within the Tam-an area were just below the settlement of Lakhawan and Banaue-Hotel. A direct waste water inlet from the settlement or the hotel could not be found in the field. However, it could be observed that water from a „washing location" within the settlement contributed to the irrigation water of the terraces. The paddies were already planted at the time of sampling (Figure 8).

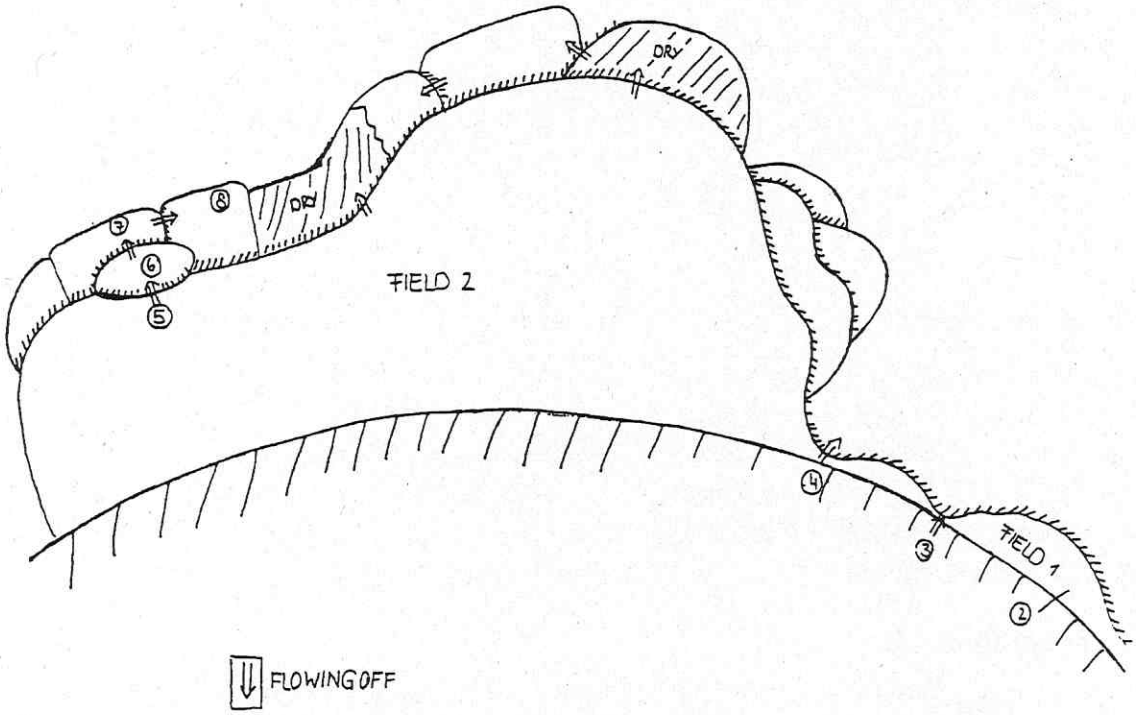


Figure 8: Investigated rice terraces in Tam-an
(numbers: sampling sites as in Table 10, p. 49)

3.5.2 Banaue

The rice terraces were located along a small affluent of Banaue-river beneath a number of multi-storey houses and the restaurant "Green Meadows". Waste water pipes from the houses to the affluent were visible. However, no clear information could be obtained whether the affluent is used for irrigation of the terraces. The paddies were not yet planted at the time of sampling, but a seed bed was established as well as a fish pond (Figure 9).

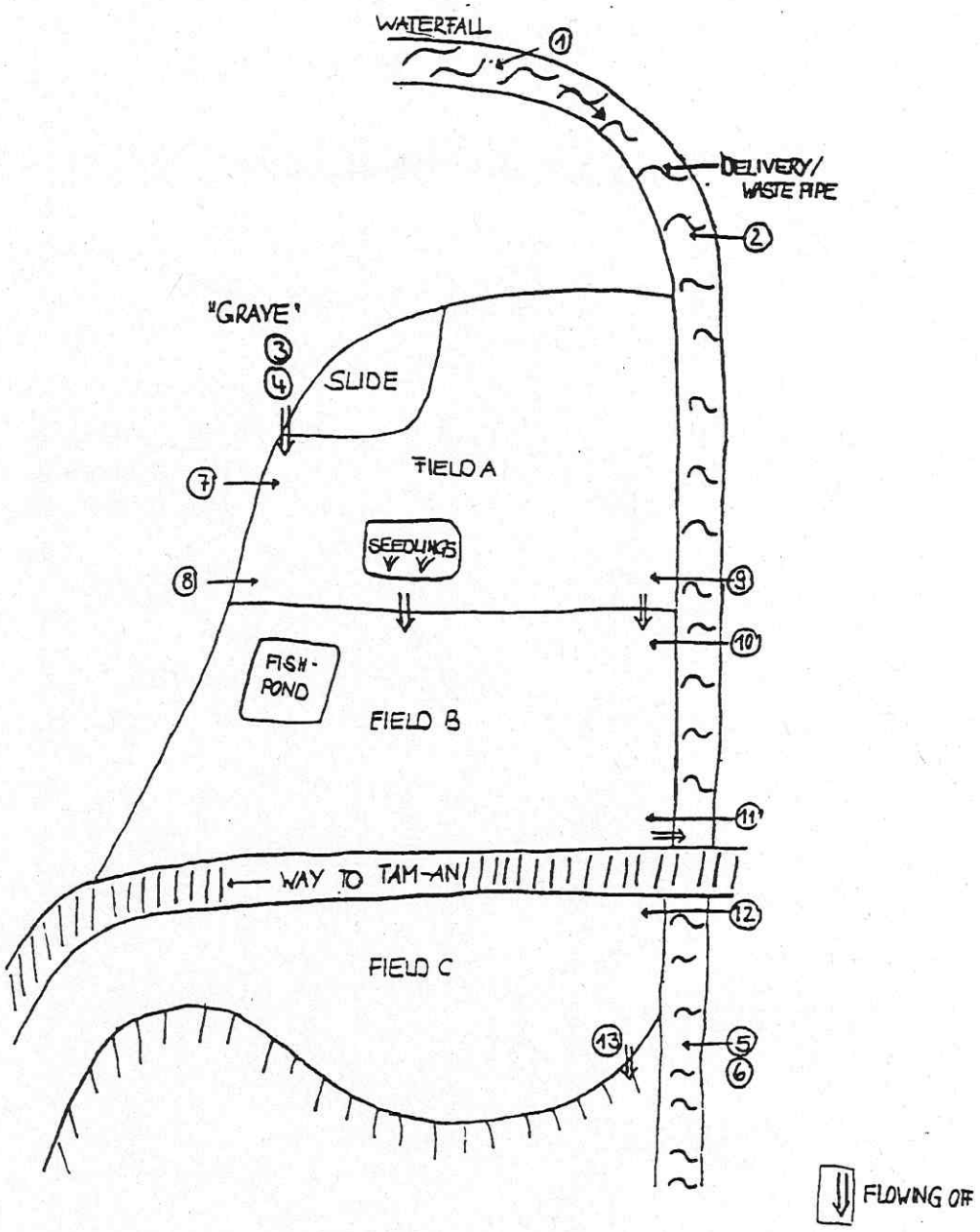


Figure 9: Investigated rice terraces in Banaue (poblacion)
(numbers: sampling sites as in Table 11, p. 49)

3.5.3 Lawig

The experimental site belongs to a low land farm which is managed according to the principles of organic farming in the local sense, i.e. reduction of the application of mineral fertilizer and increased application of organic fertilizer and farm yard. Sampling took place one week after the application of mineral fertilizer (Figure 10).

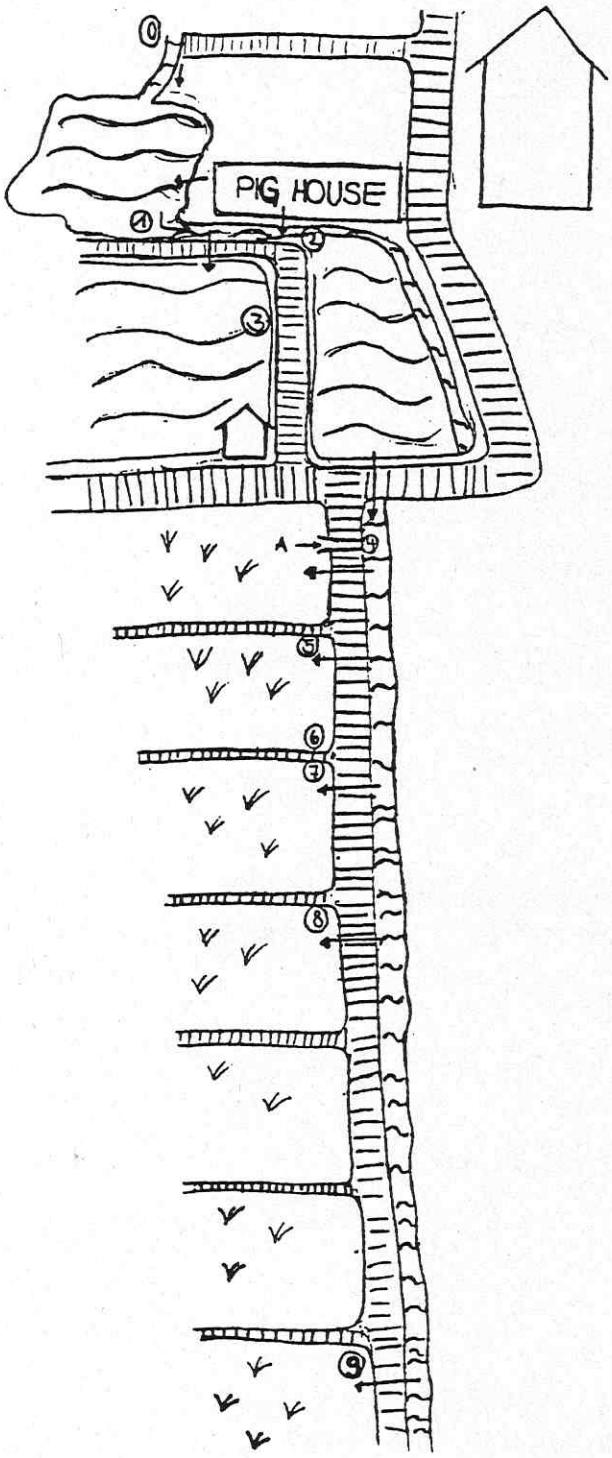


Figure 10:
Investigated rice fields in Lawig (numbers: sampling sites as in Table 12, p. 50)

3.5.4 Banaue-river

Water samples were taken above Banaue (close to View Point), in the center of Banaue (close to the school) and below Banaue.

4 Results and discussion

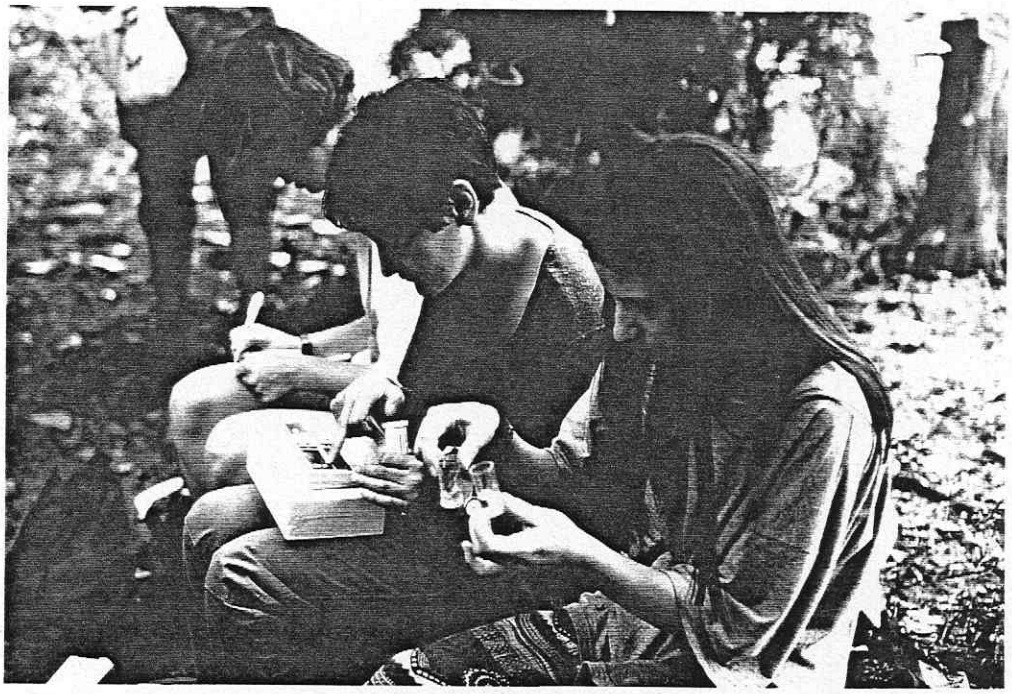
Neither in Banaue nor in Tam-an any substantial concentrations of ammonium, nitrate or phosphate could be detected in the irrigation water. Concentrations measured were well within the range given for drinking water (see TVO: 0.5 mg/l NH_4^+, 50 mg/l NO_3^- and 6.7 mg/l PO_4^{3-}). In Tam-an ammonium concentrations were below the measuring range, in Banaue (below "Green Meadows") the average concentration was 0.23 mg/l. In the lowland increased concentration of ammonium was measured 5 days after fertilizer application (0.78 mg NH_4^+/l). In the fertilizer trial already 1 day after the application no ammonium or nitrate could be detected any more in the irrigation water.

Table 10: Parameters measured in the irrigation water along a toposequence in Tam-an in March 1997 (compare Figure 8, p. 46).

Sample	NO_3^- [mg/l]	NH_4^+ [mg/l]	PO_4^{3-} [mg/l]	EC [µS/cm]	pH	Temp. [°C]
1	2	0,1	19	183	7.9	25.0
2	3	0,1	14	181	8.1	24.2
3	2	0,2	20	178	8.2	27.6
4	1	low	7	178	8.6	34.8
5	0	low	21	143	8.6	35.7
6	0	low	23	139	8.2	33.9
7	0	low	0	139	8.5	33.6
8	0	low	10	138	8.7	33.8
threshold valu (TVO, 1990)	50	0.5	6.7			

Table 11: Parameters measured in the irrigation water along a toposequence in Banaue (below "Green Meadows") in March 1997 (compare Figure 9, p. 46).

Sample	NO_3^- [mg/l]	NH_4^+ [mg/l]	PO_4^{3-} [mg/l]	EC [µS/cm]	pH	Temp. [°C]
1	3	0	3	191	8.2	20.3
2	3	0	4	191	8.3	19.9
5	4	0.3	7	202	8.1	20.2
7	5	0.4	6	197	7.7	21.6
8	3	0.3	8	192	7.4	21.4
9	3	0.3	9	183	7.6	22.0
10	5	0.2	6	182	7.8	21.7
11	3	0.3	6	182	7.6	23.2
12	4	0	6	141	8.0	21.9
13	4	0.2	6	141	7.4	23.0
threshold value (TVO, 1990)	50	0.5	6.7			



Picture 26: Field work with application of the quick test method (Lawig, March 1997)

Table 12: Parameters measured in the irrigation water 5 days after fertilizer application in Lawig in March 1997 (compare Figure 10, p. 48).

Sample	NO_3^- [mg/l]	NH_4^+ [mg/l]	PO_4^{3-} [mg/l]	EC [µS/cm]	pH	Temp. [°C]
Spring	low	0.4	2	310	6.8	24
1	0	1.5	4	311	7.3	27.4
2	1	2.4	3	315	7.4	18.0
3	0	0.7	4	301	7.8	28.2
4	low	0.2	0	301	9.0	34.7
5	low	0.4	low	391	8.5	31.9
6	0	0.6	low	428	8.4	32.9
7	1	1.5	1	308	7.5	32.7
8	0	1.8	1	293	7.9	36.4
9	0	0.2	1	303	8.3	32.7
threshold value (TVO, 1990)	50	0.5	6.7			

Table 13: Parameters measured in the water of Banaue river in different locations in March 1997.

Sample	NO_3^- [mg/l]	NH_4^+ [mg/l]	PO_4^{3-} [mg/l]	EC [µS/cm]	pH	Temp. [°C]
1	1.0	0.1	3	79	8.0	19.3
2	2.0	0.1	4	113	8.1	19.9
3	1	0	7	123	7.9	
threshold value (TVO, 1990)	50	0.5	6.7			

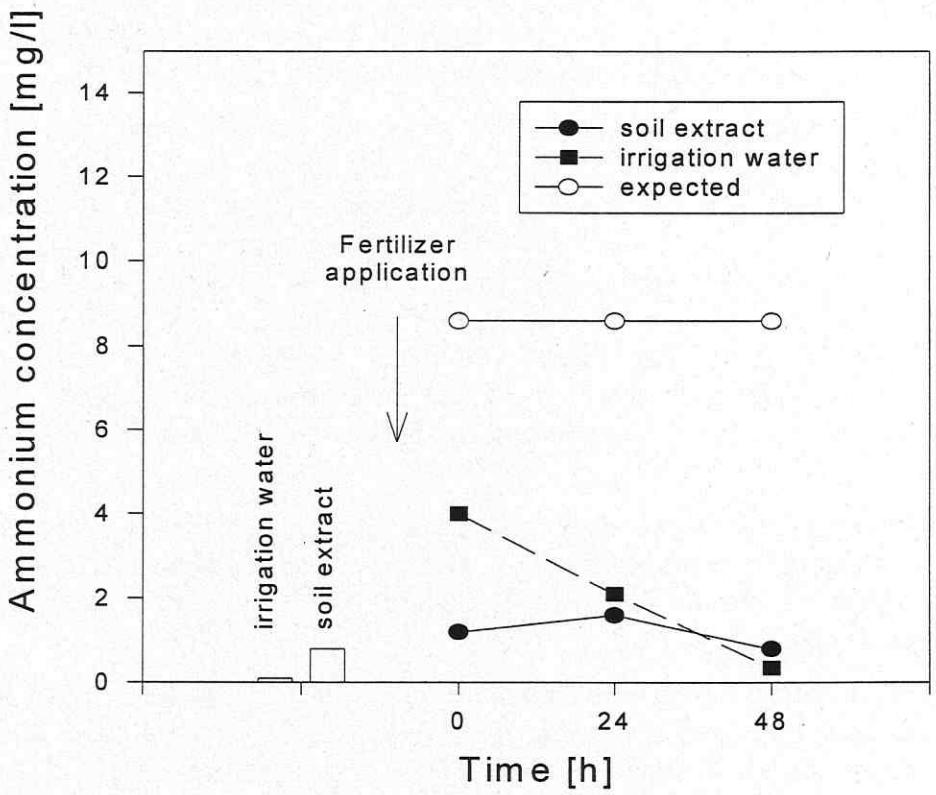


Figure 11: Concentration of NH_4^+ and PO_4^{3-} in irrigation water and soil water extract, as well as expected concentration in water after fertilization with "Greenbee" in mg/l.

A rough calculation of expected nitrogen-concentrations was conducted for the affluent shown in Figure 11 to check the correctness of the order of magnitude found in the field measurements. For the case of a waste-water-input caused by 50 persons above the measurement-points and a flow rate of 50 m^3/h in the affluent the calculation resulted in a nitrogen concentration of 0.3 mg/l in the river water. The measured concentrations ran up to 0.9 mg N/l. Differences between calculated and measured values may result from waste water inlets further up the toposequence, changes in population density and the transfer from literature data to the specific site.

Probably as a result of the low concentrations in general, no concentration gradient of ammonium, nitrate or phosphate along the toposequence could be detected on either site. Despite this a slight gradient in the electrical conductivity was found in Tam-an (181 µS/cm → 138 µS/cm; compare Table 10, p. 49). This gradient is in the similar order of magnitude than the one described by VOGGESBERGER (1988). Thus supporting the hypothesis that the electrical conductivity declines along the toposequence due to adsorption of minerals to soil particles. As there was no correlation observed between the decline of electrical conductivity and the concentration of ammonium, nitrate or phosphate no information is available on the chemical origin of the ions adsorbed by the paddy soil.

The hypothesis that the nutrients transported by irrigation water provide a substantial contribution to plant nutrient requirement could not be confirmed by the results of field measurements. On the contrary it has to be assumed that the nutrient status of the plants is independent of the nutrient concentrations in the irrigation water. The pale green colour of the rice plants grown in the areas of former seed beds, which can be interpreted as symptom of nitrogen deficiency, are an additional indicator for this theory. Such heterogenity within one paddy could not develop if nutrients would be supplied by irrigation water.

From the field measurements it can be suggested, that the major part of nutrients required by the rice crop is bound in the organic soil fraction and is slowly released by mineralization. Nutrients released are then either taken up immediately by plant roots or adsorbed to clay particles (i.e. ammonium). The adsorbed nutrients are not readily extracted by the irrigation water. This is supported by the higher ammonium concentration in KCl-extract and the rapid decline in ammonium concentration in the fertilizer trial as well as the low concentrations detected after fertilization in the lowlands. Unfortunately the KCl-extraction method, which is the standard method for determination of ammonium in soil, could not be applied as a routine measurement as KCl was not available in larger quantities in Banaue.

Although it is likely that the nutritional status of the actual rice crop is independent of the nutrient concentration in the surrounding irrigation water, even on the basis of the low concentrations found in the present study substantial N-Input into the system could result from the irrigation water.

During the field studies it was frequently observed that the water table in the rice terraces was reduced by two to five centimeters within only a couple of days. Based on this observation it was assumed that the total amount of water above the soil is 'lost' by evaporation and leaching about 50 times during the 6 month cropping period. If all the nitrogen contained in this amount of water would be adsorbed to soil particles this would sum up to about 13 kg N/ha as nitrate and 4 kg N/ha as ammonium.

From literature data it can be assumed that depending on the amount of organic matter accumulated in soil, the temperature and the duration of flooding 17 - 70 kg of mineral nitrogen can be released by mineralization of organic matter during the growing period of 6 months. In addition about 2 - 7 kg N/ha might be derived from atmospheric deposition in remote areas without industry (DE DATTA, 1981). For the *Anabaena-Azolla* symbiosis there is a large variation in literature data, a maximum of 50 kg/ha for 6 months is given by DE DATTA (1981). Own calculations based on the biomass data given by VOGGESBERGER (1988) and an average nitrogen concentration in the plant material resulted in just 0.2 kg/ha of nitrogen. The nitrogen requirement of a rice crop is about 30-40 kg for a panicle yield of 1.5 to 2.0 t/ha (REHM & ESPIG, 1991).

From the numbers given above it is obvious that mineralization of organic matter could be sufficient in the present system to supply one crop per year, provided the organic matter pool in the soil is maintained by application of green manure. For a second crop in one year release of nitrogen by mineralization might be to slow thus mineral fertilizer would be required.

To provide more reliable information on the nutrient cycling in the present system it would be necessary to collect data on green manure application and to analyse soil samples for organic matter content. In addition more reliable yield data (compare BARTHELMES et al., this volume, pp. 29-42) would be helpful for defining the nutrient requirement of the rice crop.

5 Outlook on waste-water-management in Banaue

Concerning the present waste water management in Banaue two different systems have to be distinguished. Waste water transport via sewage pipes directly to Banaue river or smaller affluents on the one hand, local waste water outlet in the backyard and infiltration into the soil on the other hand. Concentrations in the waste water observed during the 2 weeks field research were by a factor of 25 higher than the concentrations found in the irrigation water. However the processes of dilution and immobilization were apparently sufficient to avoid pollution of Banaue river as no increased concentrations were found in the river water.

As future scenarios according to the Master Plan (ITC, 1994) suggest an increase in tourism a calculation was made taking into account an increasing number of people within the same area.

Table 14: Scenario for the amount of nitrogen derived from waste water - comparison between present day situation in Banaue poblacion and expected values based on possible future development of tourism according to the Master Plan (ITC, 1994).

	Inhabitants + tourists	Nitrogen in waste water [kg/year]	Potential N-input to rice-paddy [kg/ha]	Pot. N-concentr. in Banaue-river water [mg/l]	Potential volume of feces and urine [m^3]
present situation	2,900	7,685	9.0	0.10	1,276
Masterplan	7,200	19,080	22.0	0.24	3,168

The present situation with an estimated number of 500 tourists a day was compared to the most extreme scenario in the Master Plan (ITC, 1994), which allows two tourists for one inhabitant of the area. If for the present situation the total nitrogen output by the community would be evenly distributed to the area of Banaue-Poblacion the N-input per ha is equivalent to the N-removal by 0.5 t of rice.

This amount increases by a factor of 2.5 in the second scenario. However this picture is by far to optimistic, as there is no logistic for such an even distribution of waste-water and not the total area is used for agriculture purposes and there is no precise timing between crop-nutrient requirement and waste-water production.

The problem of nutrient surplus would still remain, even if modern technology like two or three-cell septic tanks could be introduced to all the households of Banaue-Poblacion, as the collected waste-water needs to be managed. In addition it is difficult to imagine how waste-water could be distributed in the traditional rice-terrace system, visited by so many people without offending them. Export of the waste-water might be a local solution for Banaue, but of course no alternative for the whole region.

Picture 27: Analysis of electric conductivity in the field (Tam-an, March 1997)

Field Studies on the Golden Snail in the Ifugao Rice Terraces

by

Konrad MARTIN, Henrik GRÖLZ & Stephanie HOLZHAUER

1 Introduction

When private entrepreneurs introduced the so-called "Golden Snail" or "golden apple snail" (*Pomacea canaliculata*; Pilidae) from South America to Taiwan and the Philippines in the 1980s, it was to make financial profits through snail farming. Snails were grown for a putative export market in Europe and Japan. In addition, easy rearing methods, fast growth, and high protein contents made snails an excellent supplement in the low protein diet of the rural poor. However, introductions had been made without any analysis of ecological impacts. Even marketing information was apparently lacking as consumers did not like the taste of the snail, despite the mollusc being propagated as a delicacy. The initially expensive snails quickly lost their commercial value. When snails escaped or were discarded, they rapidly spread through natural waterways and irrigation canals and also invaded rice fields, where they started to feed on young rice plants. The aquatic habitat planted with rice seedlings provided optimal conditions, as the species is well adapted to marshland and floodplain habitats in South America. Constrained by only a few natural enemies, populations increased freely and soon the Golden Snail developed into a serious pest. Now a considerable portion of the cultivated rice land in Asia is affected.

Like most invasions of exotic species, the Golden Snail invasion occurred in an human-altered and simplified ecosystem, with a lower number of species and predator-prey relationships than in natural, undisturbed communities.

Provided with both gills and a lung-as breathing organ, snails are well adapted to life in alternating wetland and dryland habitats such as seasonal swamps or rice fields. They disperse through moving bodies of water such as irrigation canals and rivers. Snails follow receding water to low-lying areas and stop feeding and mating when the water level drops below their shell height. They may even survive months of drought by digging deep into the mud and closing their operculum, surfacing again after renewed flooding. In the same way snails hibernate at the northern border of their distribution in Japan.

Additional characteristics of successful invaders are that they often have high reproductive output, short juvenile periods, and high rates of dispersal. In the life cycle of the snail, sexual maturity is attained in 60-90 days after hatching, at which time the females begin laying eggs. Females lay about 300 eggs in a pink egg mass outside of the water on rice plants, the walls of irrigation canals or fences at any given time. A female typically produces between 2400 and 8700 eggs per year. The neonate snails drop into the water and soon start moving around, feeding on algae and detrital aggregates in this lifestage.

The fast growth and reproduction of the Golden Snail in rice fields leads to population levels which can destroy entire crops. Interviews conducted in the major rice growing areas of the Philippines disclose that 75-100% of the rice farmers consider the Golden Snail to be their most serious pest problem, with about 40% of the farmers applying pesticides. To date, there is no known specific parasitoid or predator of the Golden Snail from South America that might be used for biological control in Asian paddy environments. Snail damage can be limited by good field levelling and water management, but this gets increasingly difficult in larger fields. Most small-scale farmers hand-pick snails during the vulnerable stage of the rice crop.

Some farmers have made good use of Golden Snails in their fields. Philippine farmers have found that ducks do not only control snails in rice fields but lay higher quality eggs when fed with snails. In the Philippines, duck eggs are highly valued as "balut" -incubated eggs which get a higher price with a hard shell. The high protein contents of snails also makes them an excellent food for broilers and pigs (HALWARTH, 1994; NAYLOR, 1996 and references therein).

The feeding on rice seedlings became a serious problem in the intensive lowland rice production areas. In the Ifugao rice terraces, the Golden Snail was first observed in 1990 (MARTIN, 1994). The following study was carried out to asses the influence of this species on the traditional Ifugao rice growing system. For this purpose, the aim was to quantify the density per area of field, the extend of damage and to investigate the impact of the Golden Snail on the native snail fauna.

2 Materials and Methods

The study was carried out in a two weeks period in March 1997 during transplanting time.

Seven rice fields (or rice field areas, respectively) have been selected to record the aquatic snail fauna quantitatively. They include the district of Tam-an (4 fields), and the districts of Bocos, Poitan, and Banaue (one field each). All of the fields have been cleaned and prepared for transplanting, or have been transplanted short before sampling.

In the fields, samples were taken in the following way: A flat-bottomed sieve (mesh size: 0,5 mm, diameter: 20 cm, height: 5 cm) has been used and pressed into the mud upside down. Then it was covered from below with a flat metal disc and removed from the field. The contents of the sieve (muddy soil material) was packed into a plastic bag. In each field, four of these samples have been taken. After this, the muddy sample material has been washed out in a double sieve set (mesh sizes: 5 mm and 0,5 mm). The remaining sample material (stones, sand, and plant material) was given in a flat plate and all living snails were selected out. After identification and counting, the snails were weighed (fresh weight; Golden Snails and native snails separately).

3 Results

3.1 Numbers and biomasses of snails

Table 15 shows the numbers of snails identified and counted from the 4 samples of each field (total of 4 samples = 0.125 m^2 of area). *Radix quadrasi* and members of the family Thiaridae (at least 3 species, which could not be distinguished in the juvenile stages) were found to be the most common species. With the exception of one field, the numbers of Golden Snail did not go beyond a maximum of 5 Individuals per 0,125 m^2.

Table 15: Numbers of snails per 0.125m^2 from different fields of the Ifuago Rice Terraces (total area of 4 samples). Fields 1 - 3 are in the Tam-an area (3a: at the mouth of an irrigation canal; 3b: center of the field). Field 4: Bocos; Field 5: Banaue; Field 6: Poitan.

Gastropoda	Field-No.						
	1	**2**	**3a**	**3b**	**4**	**5**	**6**
Gyraulus chinensis	5	-	5	-	-	2	5
Radix quadrasi	28	10	106	1	5	17	8
Bellamya spec.	1	-	-	-	-	1	-
Thiaridae	-	97	6	8	293	123	141
Pomacea canaliculata	-	1	3	3	5	2	34
Total	**34**	**108**	**120**	**12**	**303**	**145**	**188**

Table 16 shows the comparison of numbers and biomasses between native snails and Golden Snail, calculated for the area of 1 m^2 per field. Although the portion of Golden Snail individuals from the whole is relatively low in most communities (average: 8.0 %), the proportion of biomasses reaches more than one third in average (36.6 %). This is due to the fact that mainly older (and bigger) individuals of the Golden Snail have been found, whereas the young stages are almost completely lacking.

Table 16: Numbers and biomass of snails, calculated for the area of 1m^2 per field

Field-No.	Total Individuals/m^2	Golden Snail Individuals/m^2	% Golden Snail individ.	Total biomass (g/m^2)	Golden Snail biomass (g/m^2)	% Golden Snail biomass
1	136	0	0.0	no data	0.0	0.0
2	432	4	0.9	90.4	9.2	10.2
3a	480	12	2.5	54.0	10.4	19.2
3b	48	12	25.0	21.2	16.4	77.3
4	1,212	20	0.2	103.2	19.2	18.6
5	580	8	1.4	134.8	48.0	35.6
6	752	136	18.1	202.8	119.6	58.9
average			**8.0**			**36.6**

In the fallow period of 1988, in some fields in the Tam-an area the snail fauna has been recorded by the same method applied in this study. Table 17 shows the comparison in numbers from the same fields between 1988 and 1997:

Table 17: Numbers of snails per 0.125 m^2 from the fields in Tam-an (comparison between 1988 and 1997)

Gastropoda	Field-No.					
	1		2		3	
	1988	1997	1988	1997	1988	1997
Gyraulus chinensis	5	5	0	0	0	5
Radix quadrasi	7	28	0	10	22	106
Bellamya sp. 1	0	1	3	0	7	0
Bellamya sp. 2	0	0	5	0	0	0
Bullastra cummingiana	1	0	0	0	0	0
Thiaridae	59	0	131	97	287	6
Helicorbis umbilicalis	0	0	0	0	1	0
Pomacea canaliculata	0	0	0	1	0	3
Total	**72**	**34**	**139**	**108**	**317**	**120**

First, it can be seen that *Radix quadrasi* and Thiaridae were the most common species in both records. But it seems that the ratio of the both groups has changed: *Radix* occurred more abundantly in 1997, and Thiaridae were higher in numbers in 1988. However, in the fields outside of Tam-an, the Thiaridae occur at present in higher numbers, comparable to those recorded in Tam-an in 1988 (see Table 15). Second, the number of individuals is obviously lower in the samples taken in 1997. However, it has to be considered that the samples have not been taken during the same periods in each of the years. In 1988, the investigation was carried out in December at the end of the fallow period. That is, the aquatic communities were able to develop undisturbed for several months. In contrast, the study in 1997 took place during transplanting time and the communities were heavily disturbed by the preparation of the fields and the transplanting itself. For this reason, it can be assumed that in 1997 the individual numbers have been reduced temporarily, because many snails have been burried in the soil due to the activities in the fields.

3.2 Damage by the Golden Snail and its feeding behaviour

The feeding of Golden Snails on young rice plants has very rarely been observed in the fields. In addition, damaged rice plants as a result of snail feeding have very rarely been seen in the seed beds or in newly transplanted fields.

This observations are in accordance with the opinion of some farmers interviewed. None considered the Golden Snail to be a major economic problem, at least they are able to manage the situation by collecting the snails and throwing them out of the fields and by destroying the egg masses. Seed beds are sometimes protected by walls out of mud. In contrast, one farmer woman even regarded the Golden Snail as useful, because it feeds on dead plant materials, which remained in the fields after weeding and the preparation of the fields for transplanting. So the snails help to clean the fields. Field observations on the feeding behaviour confirmed this assessment. Furthermore, some farmers even feed the snails with fresh or rotten plant materials to prevent them feeding on newly transplanted rice plants. In such cases, aggregations of Golden Snail individuals around such fodder can be seen.

Golden Snails have also been observed feeding on *Azolla* and other aquatic plants in the field. In stomach analysis, different types of plants could be identified. In feeding experiments, snails was given the choice between *Azolla*, *Najas graminea*, *Nasturtium officinale* and young rice plants. In all repeats, the rice plants remained untouched, whereas all the other plants have completely been eaten up. Only after two or three days without alternative food the snails started to feed on the rice plants.

4 Discussion

All our results indicate that the situation concerning the presence of the Golden Snail in the Ifugao Rice Terraces is different from that reported from the lowlands, especially concerning the impact on the rice farming system. For example, NAYLOR (1996) reports that a density of 1 snail per m^2 can reduce the crop stand by roughly 20%, whereas a density of 8 snails per m^2 can reduce the stand by over 90%. In many fields of the terraces, numbers of 8 or more snails per m^2 are not exceptional (see Table 16). However, even it was the time that the rice plants were most vulnerable, no damage comparable with the situation described by NAYLOR has been observed. What is the reason for that?

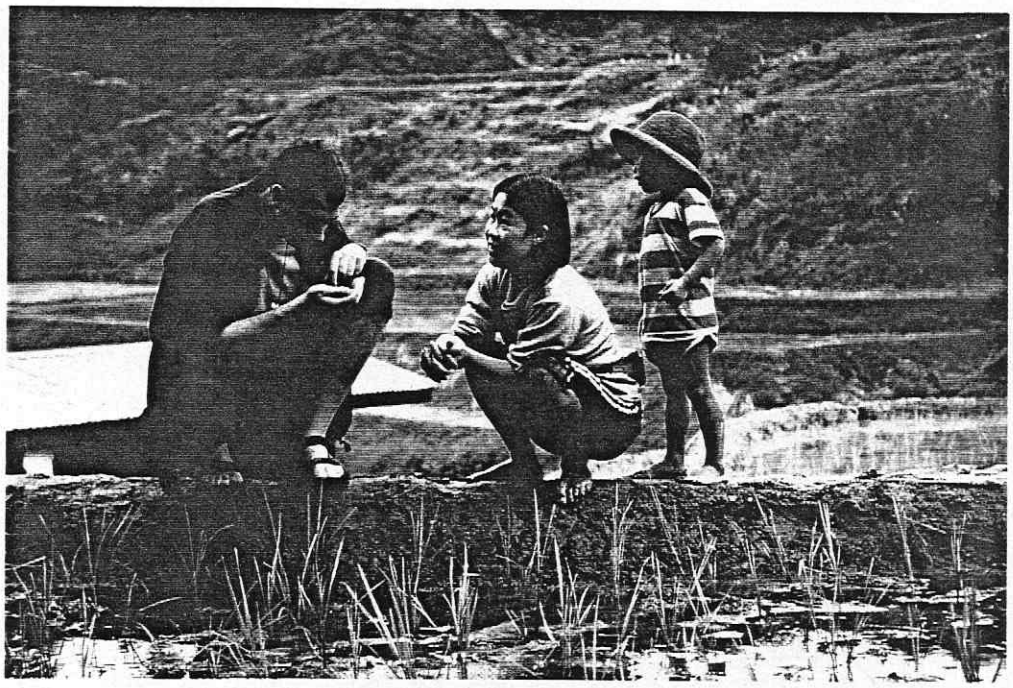
First, we have to ask for the differences between the Ifugao rice growing system and the farming systems of the lowlands.

The traditional Ifugao system has one crop per year, traditional rice varieties, no input of pesticides and fertilizers, and a long fallow period from August to February with flooded fields, where the aquatic communities, including weeds, can develop undisturbed. A typical lowland situation is characterised by 2-3 rice crops per year, based on the use of modern varieties, the use of mineral fertilizers and pesticides and intensive weeding. The fallow periods are short and the fields usually dry up.

Therefore, one important difference is the diversity and biomass of wild plants, which is much higher in the traditional Ifugao system compared to the lowlands. This is mainly due to the long fallow period, during which large patches of *Najas* and *Nasturtium* come to exist. In addition, many fields are covered with *Azolla pinnata*, which is able to develop during the cooler month from November to February, and does not occur naturally in the warmer lowlands. Even during the rice growing period, many aquatic plants are present in the fields, because weeding is done very extensively (MARTIN, 1994).

These plants offer a large spectrum of food resources for the Golden Snail. In accordance with the results of our field observations, feeding experiments and stomach analysis, BASILIO & LITSINGER (1988) report that the Golden Snail has a wide host range and feeds on almost all kinds of weeds. They tested 8 common species of lowland weeds and found that all of them were consumed by the snails, preferably the young and soft parts of the plants. For this reason, it cannot be assumed that the Golden Snail prefers rice as a favourite food resource. Rather, it can be argued that rice is mainly consumed when alternative food is rare or absent. This is not the case in the Ifugao system, and may be the main reason for the fact that rice is usually not attacked by the Golden Snail there. In addition, one can speculate that the "taste" of the traditional Ifugao rice varieties is different from the high yield varieties in the lowlands. For example, it might be that the lowland varieties are richer in their nitrogen contents because of high fertilisation rates and so are more attractive for the snails than the Ifugao rice plants. Differences in the plant tissue due to breeding-specific characteristics may also come into consideration. However, we have no evidence for this idea.

The influence of the Golden Snail on the native snail fauna is not easy to asses. First of all, it had been noticed that all snail species recorded in the Tam-an area in 1988 are still present today, although not all of them have been found in the quantitative samples, and their population sizes may have changed. The changes in the composition of the communities, as it is shown in Table 17, can most probably not be attributed to the appearance of the Golden Snail. This is indicated by the fact that the Golden Snail is not present in Field 1, and despite of this changes between the years have been detected. On the other hand, in fields outside the Tam-an area, the composition of the native snail community was again different, and no relation to the presence or to the numbers of the Golden Snail can be detected.



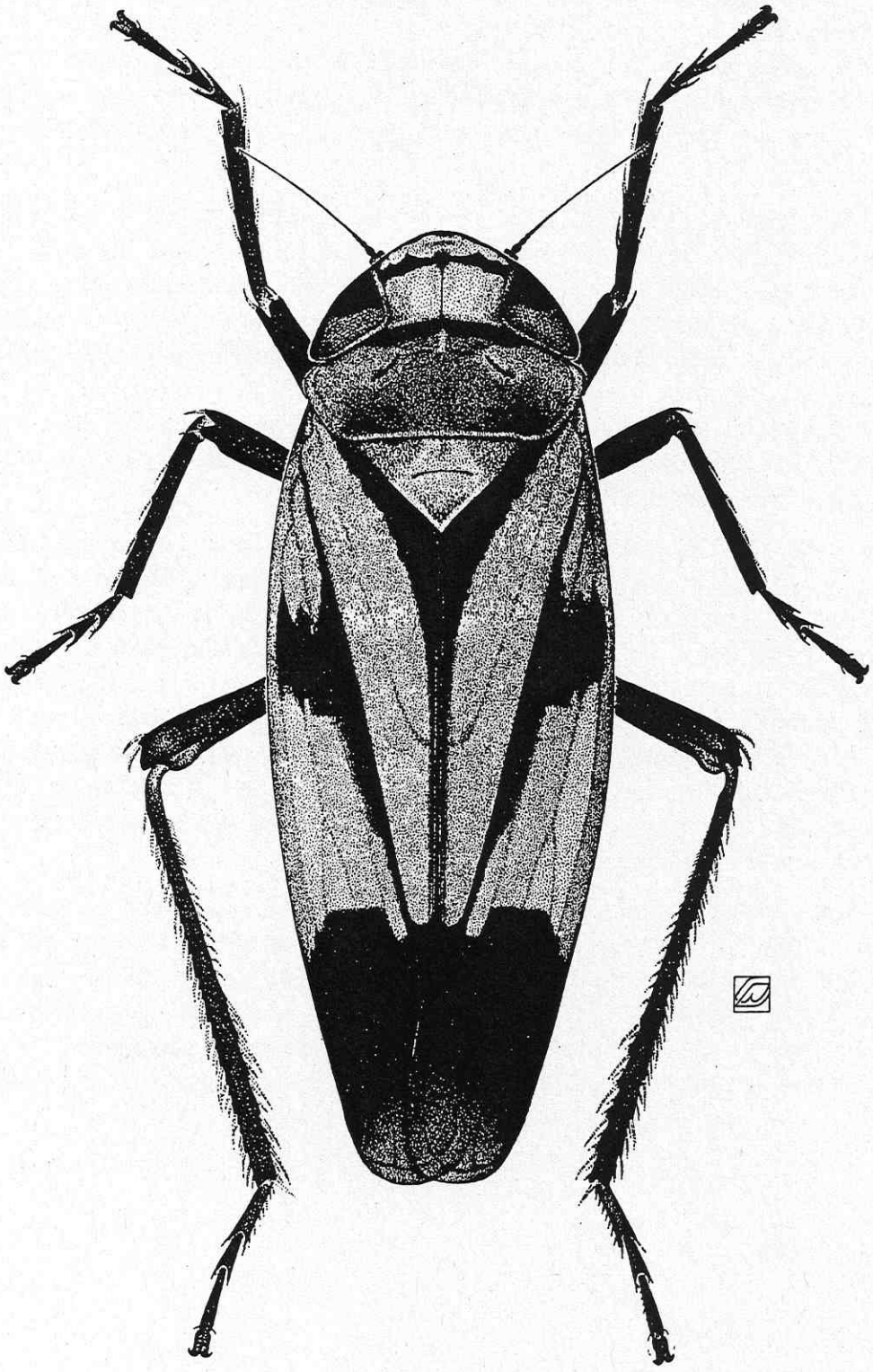
Picture 28: Field expert discussion on Golden Snail and related problems (Tam-an, March 1997)

In general, a negative influence of an invading species on native ones can only be expected, if the process of competition takes place. This means that the invader has at least one resource in common with one or more of the native species, and it is able to take over the "niche" of a native species, if it is more successful in terms of reproduction and resource utilisation. Therefore, it has to be proven that the Golden Snail captures certain resources from the native snails, like food or space, and, in addition, is able to spread and reproduce faster than the natives.

In 1988, stomach analysis and observations on the feeding behaviour of the native snail species have been carried out. The results indicate that in all species living on the muddy ground of the rice fields (Thiaridae, Pilidae, Lymnaeidae, Viviparidae) detritus forms the main part of their diet, i. e., they feed on dead or decaying particular matter from the soil surface. Other species as *Gyraulus* and *Pettancylus* are mainly attached on the surface of submerged plants, where they feed on 'Aufwuchs', but not on the plants themselves (MARTIN 1994; compare Figure 6, p. 22). This observations are in accordance with the results of a study carried out by REAVELL (1980), who also stresses the importance of detritus in the food of aquatic snails, which normally do not feed on living plants.

This is the most important difference in the feeding behaviour of the Golden Snail, which is able to feed on living plant materials. In addition, most of the dead plant materials consumed by the Golden Snail is relatively fresh and not yet decomposed to detritus. Altogether, the overlap in the diet of native snails and the Golden Snail is very small, if it exists at all. That is, competition for food is negligible and cannot be a factor which may lead to a repression or to the extinction of native snail species. Rather, the answer on the question why the Golden Snail successfully invaded the aquatic community of the Ifugao Rice Terraces is most probably that they met an empty food niche. This niche is made up by living aquatic plants, which are rarely used as food by other aquatic animal species (MARTIN, 1994). This fact also explains the rare damage observed on rice seedlings.

However, the survey reported here was carried out only seven years after the first observation of the Golden Snail in the Ifugao Rice Terraces, and therefore this conclusion drawn is still preliminary, because the process of invasion might still be going on. If the numbers of Golden Snail will still increase and the biomasses of aquatic weeds are reduced significantly, strong influences on the whole aquatic communities are to be expected, because the production of detritus, coming from the decomposition of plants, would be reduced.



Picture 29: *Nephotettix nigropictus*, one of the more common green leafhopper (GLH) species in Ifugao ricefields (drawing: W. LANG, taken from SETTELE & BRAUN, 1986)

The Rice Terrace System and the Earthworm Problem (brief overview and impressions)

by

Josef SETTELE & Harald PLACHTER

Already during the first visits of some members of our group an "earthworm problem" was mentioned. The topic seems to have kept people of Ifugao busy up until now. Although within the work of our group we did not encounter any signs of a real problem, we've tried to follow up the development and keep our eyes open, as there have still been many people talking about it. Unfortunately we have not even been able to spot any single earthworm which might have been regarded as being of extraordinary size (as the reported troublemakers are said to be huge!).

Reports on such an earthworm problem have been published by CONKLIN (1980). He writes:

> "Large earthworms, of a type known as *'olang 'an 'o''ongal* (*Pheretima elongata*; Gates 1972) have spread from regions south of North Central Ifugao into much of the survey area, including Bayninan, during the past three decades. Boring under and into the outer layers of clayey pond-field soil from dikes, walls, and earth embankments, this worms seriously weaken the retaining capacity of pond-field bunds and outer terrace structures by causing excessive seepage.... During this late dry season investations can lead to destructive slumping and washouts even where retaining-wall masonry shows few defects... Such slippage does not require heavy rainfall. To prevent recurrence, coarse gravel and broken shale fill must be substituted for the regolithic earthen layer just beneath the outer sections of muddy soil and against the upper part of the terrace rim and dike. If worm-caused seepage increases alarmingly during the dry season, a temporary mud dike may be formed a few meters back from the bund to prevent further loss of irrigation water." (CONKLIN, 1980, pp. 29-30)

The only new published information within the scientific community on this issue which we could trace, was a just recently published paper by BARRION & LITSINGER (1997). Their field data date back to 1989 and have been assessed in Abra Province. Some of the more important passages of their article on the worm (*Dichogaster* nr. *curgensis* MICHAELSEN; Annelida: Octochaetidae) are quoted in the following passages:

> "...the problem was as an unusually high population of earthworms in the wetland rice fields. Missing hills (blank mounds), uneven plant height, and wilted plants were observed. The earthworm tunneling caused leaks in ricefield levees and banks disrupting irrigation."
>
> The earthworm "40 to 75 mm long and 1.5 to 2.0 mm in diameter, has become a widespread pest of rice in Abra, Kalinga-Apayao, and mountain provinces...."

"The evidence suggests that heavy floods due to monsoonal rains on the deforested Abra River watershed eroded the deforested hillsides, transporting the earthworms down the river system through the irrigation canals and ultimately depositing them in rice fields."

"*D.* nr. *curgensis* can therefore be classified as an epigeic species that lives in rich organic soil horizon subsisting on organic matter".

On the possible control methods BARRION & LITSINGER (1997) write:

"...submergence would probably have to exceed 35 days to effectively control the very high populations at Abra and prevent injury to rice plants."

"Farmers may want to consider a preventative program of constructing holding ponds for the river water to trap the earthworms coming into the farm before releasing to the rest of the fields. Placing screens at the pond outlets would also help contain the worms. Attempts to reduce the resident earthworm population could be tried by flodding the fields for 2-3 months under 14 cm or deeper water."

"Transplanting would be a preferred planting method over direct seeding as 3 weeks of seedling growth in the former can take place in a location free of earthworms. Older seedlings (45 to 55 days) should be transplanted to further minimize field time."

"Farmers should avoid adding any plant material to the field in the form of rice straw or weeds as earthworms feed on organic materials."

How is the situation in Ifugao?

If we consider all the latter informations, it is hardly possible that the same kind of problem is affecting the rice terraces, especially as some of the cultivation activities in Ifugao are already preventive against this pest. However, already in 1989, during the field studies of BARRION & LITSINGER (1997), Abra farmers told, "that similar symptoms and high yield losses were observed in nearby provinces including the scenic Banawe rice terraces." (BARRION & LITSINGER 1997: 89).

For sure the problem is not a very new one in Ifugao (a picture by CONKLIN, 1980, p. 30, which shows damage allegedly caused by worms, was for example taken in 1963). Just the same it seems to be hard to get conclusive information on what is really happening in the rice terraces. The worms mentioned by CONKLIN (1980) and by BARRION & LITSINGER (1997) are obviously different species. If the problem in Ifugao should refer to the same species like in Abra, there is the inconsistency that this species never causes huge holes and reaches the length people talk about. On the other hand, if the reported huge worms are really that important and destructive, they should be clearly visible - either directly or via the damage they cause. Maybe during our stay we just have not been at the right places at the right time to come across it.

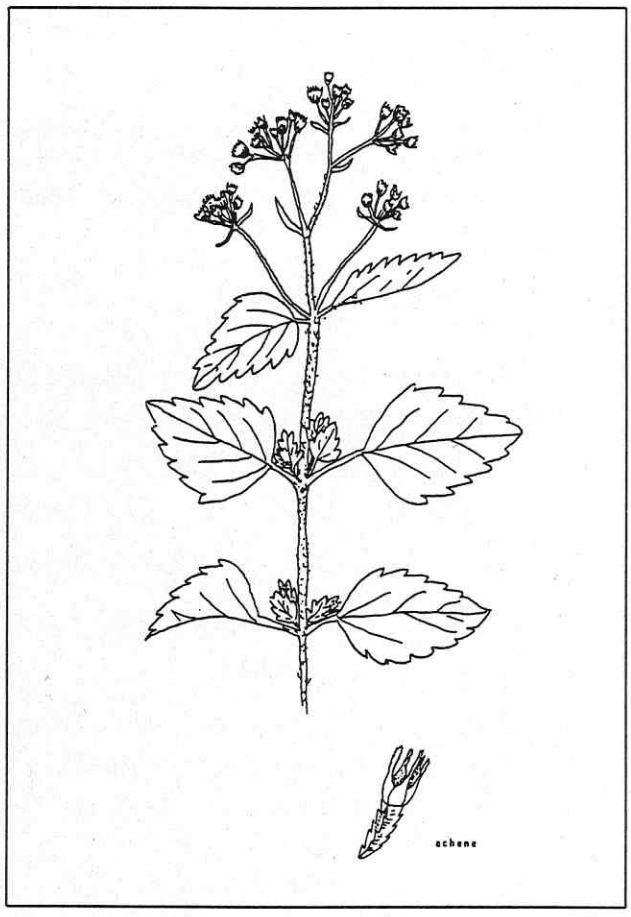
Plant Species, their Occurrance and Importance in Fallow Fields in the Tam-an Valley (Banaue, Ifugao)

by

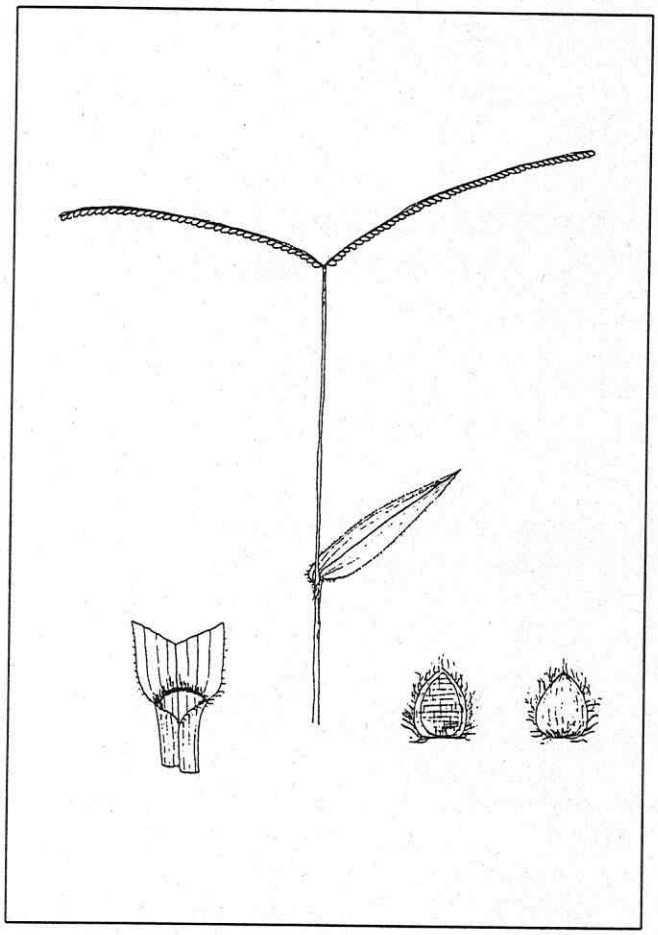
Christoph DIEFENBACH, Silke ROTHER, Michaela STRÜMPELER,
Nicolas WALTHER & Joachim SAUERBORN

1 Introduction

Rice production and its maintenance in Ifugao is characterized by a fallow system. Woody as well as herbaceous plant species of the spontaneous vegetation can be found in the fallow fields. During the fallow period this vegetation supports the restoration of the productivity of the site. The floral composition of the vegetation changes with an increase in the duration of the fallow period. Many of these plant species are known by the local people for their beneficial effects and are used for several purposes (e.g. medicine, house-construction, green manure). Nevertheless a distinctive mark of fields overused are high populations of aggressive plants which can be repressed during fallow.



Picture 30: *Ageratum conyzoides*
(from SAUERBORN & SAUERBORN, 1984)



Picture 31: *Paspalum conjugatum*
(from SAUERBORN & SAUERBORN, 1984)

It was the objective of this study to identify the given plant species of fallowed fields in its quality and quantity. This knowledge should be used to characterize the vegetation of fallow land in general and to describe the different stages of succession, starting from the first year of fallow up to the transitional stage of the *Miscanthus* dominated grass fallow into the forest. The derived information was put at the disposal of a second working group (see HERZMANN et al., pp. 77-89) which extensively recorded the given landuse and now had a detailed information on the compartments.

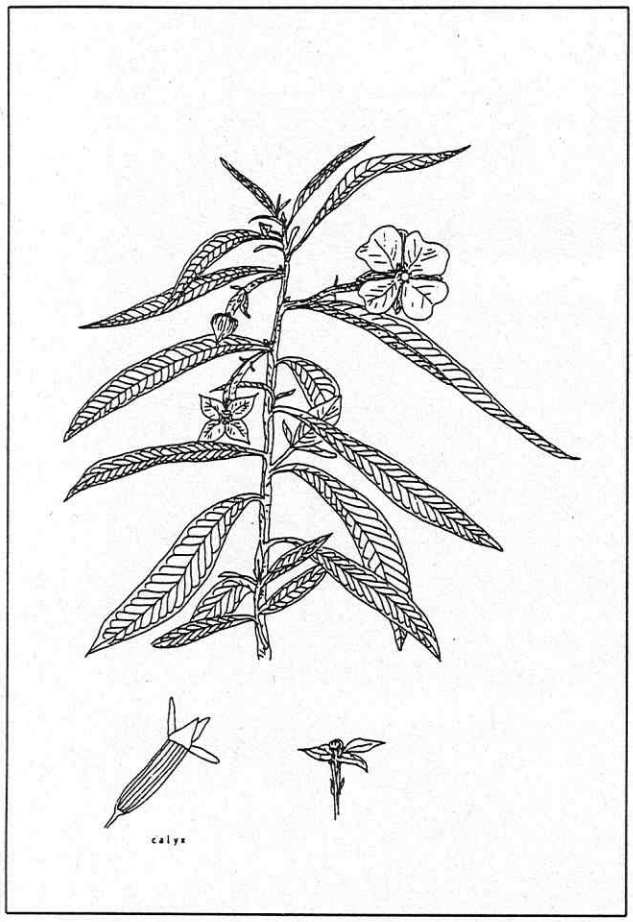
2 Materials and methods

Plant sampling took place in the first two weeks of March 1997 in the Tam-an valley (Banaue, Ifugao). Rice and sweet potato fields left fallow were subdivided into four categories:

1. **dry fallow** with a humid to dry soil, the dikes of the rice fields were still in good condition; fields have been drained artificially or were dried out naturally
2. **wet fallow** with a flooded to wet soil
3. **fallow of sweet potato fields**
4. **sweet potato fields**

In 27 fields the spontaneous flora was collected and identified. Each field was walked through diagonally to list the species encountered and to estimate the coverage levels of plants. To analyse the flora in the field, the seven steps cover-abundance scale of BRAUN-BLANQUET (1964) was used. The scale is as follows:

- r = solitary with small cover
- x = few with small cover
- 1 = numerous, but cover below 5%
- 2 = very numerous or at least cover 5 - 25%
- 3 = >25 - 50% cover
- 4 = >50 - 75% cover
- 5 = >75 - 100% cover



Picture 32: *Ludwigia octovalvis*
(from SAUERBORN & SAUERBORN, 1984)

The relative area of ground covered by total vegetation and by individual species was estimated. The individual species were defined with the help of various flora reference works and collected in a herbarium. For that purpose a piece of the fresh plant was placed on a cardboard as flat as possible and covered with a piece of transparent sticking foil. On the backside the scientific name was noted together with the site and date of discovery. The cards were exposed to the sun to dry the plants. The species in the herbarium served as a specimen copy.

The data interpretation started with calculating the steadiness s:

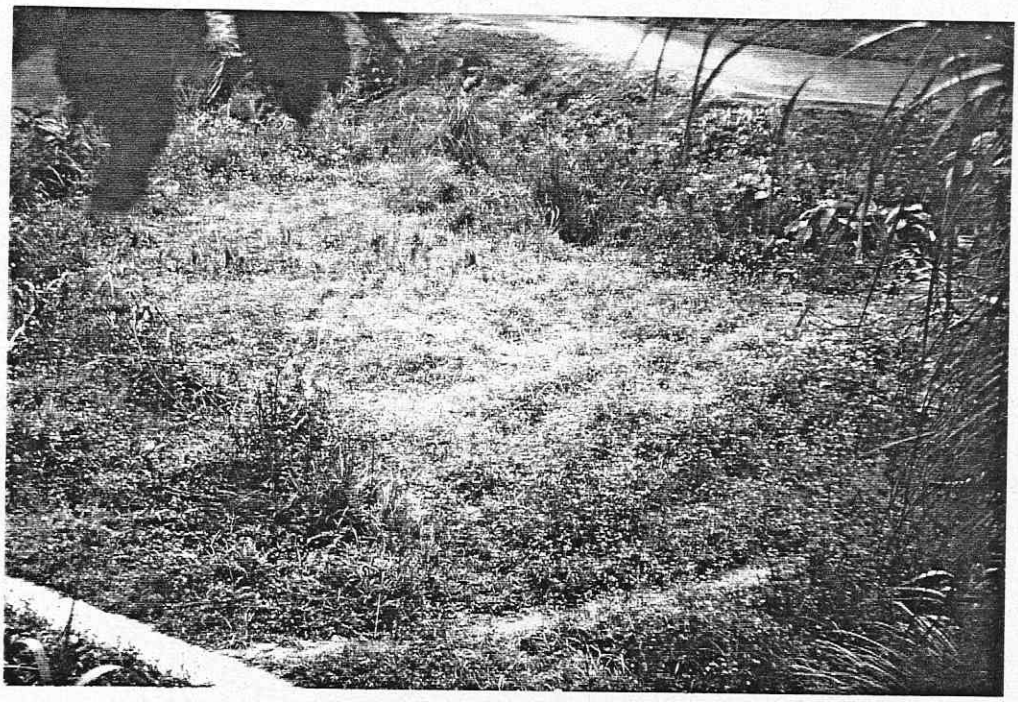
$$s = \frac{100 \times n}{m}$$

n = number of fields, where the respective species was found

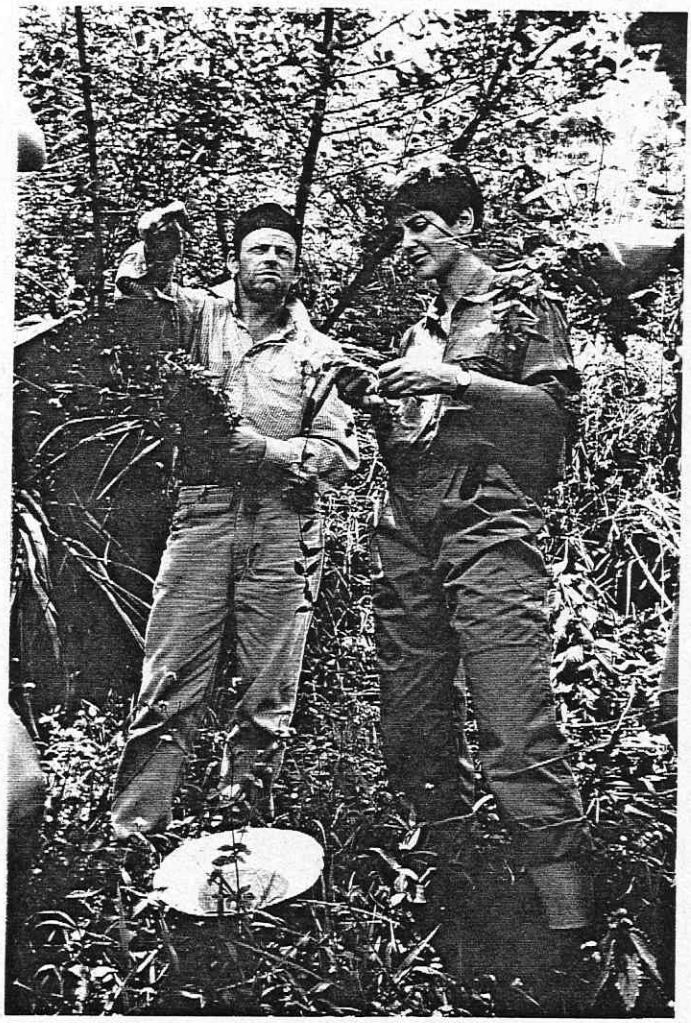
m = total number of fields

Furthermore, the specific coverage ratio (sCR) was calculated:

$$sCR = \frac{\Sigma \text{ average cover}}{s}$$



Picture 33: Example of a dry fallow (former rice field; Tam-an, March 1997)



Picture 34: Field experts in botanical discussions (Tam-an, March 1997)

To provide a better basis for calculation, the BRAUN-BLANQUET scale values were converted into an average cover expressed in percentage ELLENBERG (1956):

- r, x = 0.5%
- 1 = 2.5%
- 2 = 15.0%
- 3 = 37.5%
- 4 = 62.5%
- 5 = 87.5%

3 Results and discussion

3.1 Major plant families in fallow land

In the analysed fields 72 plant species out of 25 families were found (Table 18). The family with the most species is Poaceae (23.2 % of all species; compare Figure 12). This is equivalent to 16 species. The Asteraceae have 16.4% (12 species), Cyperaceae 16.1 % (9 species) and Fabaceae 3.5 % (5 species). 16 further families are each represented by three or less species (40.8 % of all species).

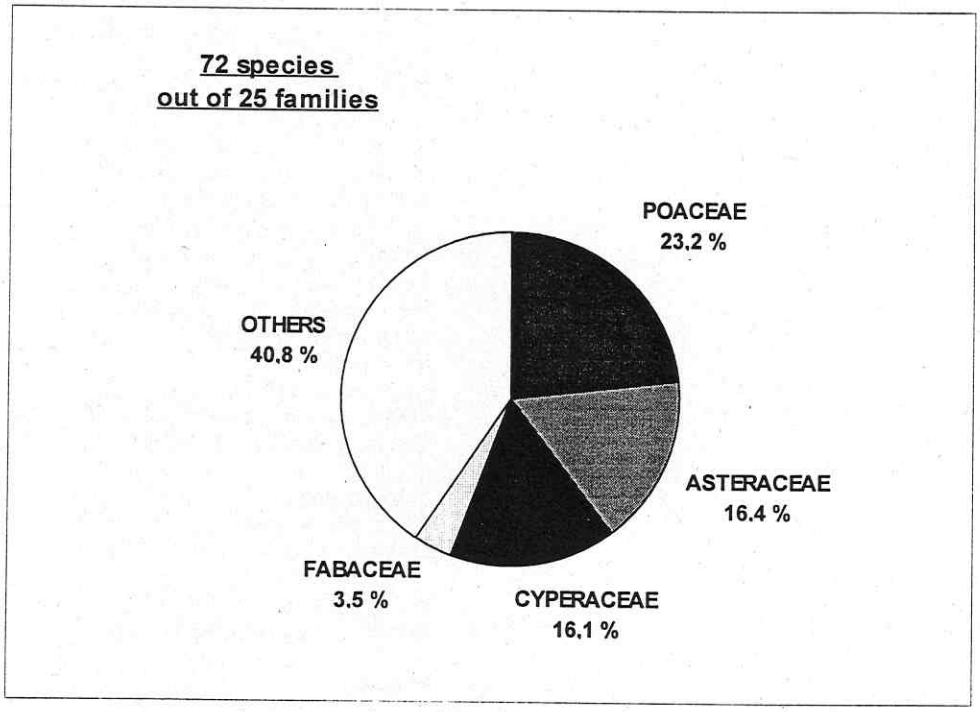


Figure 12: Most important plant families found in surveyed fields

Table 18: Scientfic names of plants (listed according to their families) encountered during the field studies around Banaue (Ifugao, Philippines)

Apiaceae
Centella asiatica (L.) Urban

Araceae
Colocasia esculenta (L.)Schott.

Asteraceae
*„Asteraceae"*sp.
Ageratum conyzoides L.
Artemisia vulgaris L.
Bidens pilosa L.
Chromolaena odorata (L.) R.M. King
Crassocephalum crepidioides (Benth.) Moore
Eclipta alba (L.) Hassk.
Galinsoga parviflora Cav.
Mikania micrantha Kunth.
Pseudoelephantopus spicatus (Juss.) Vahl.
Senecio sp.
Wedelia biflora (L.) DC.

Betulaceae
Alnus sp.

Azollaceae
Azolla pinnata R.Br.

Brassicaceae
„Brassicaceae" sp.
Nasturtium officinale R.Br.

Caryophyllaceae
Drymaria cordata (L.) Willd. ex Roem.&Schult.

Commelinaceae
Commelina diffusa Burm. f.

Convolvulaceae
Ipomoea batatas (L.) Poir.

Cyperaceae
Cyperus brevifolius (Rottb.) Hassk.
Cyperus compressus L.
Cyperus cyllingia Endl.
Cyperus cyperoides (L.) O.Kuntze
Cyperus esculentus L.
Cyperus iria L.
Fimbristylis cymosa R. Brown
Scirpus mucronoides L.
Scleria lithosperma (L.) SW.

Equisetaceae
Equisetum ramosissimum Desf.

Euphorbiaceae
Euphorbia hirta L.
Phyllanthus amarus Sch. & Thon.

Fabaceae
Arachis hypogaea (S.W.) Beauv.
Calopogonium mucunoides Desv.
Crotalaria incana L.
Phaseolus sp.
Pisum sativum L.

Lamiaceae
Hyptis brevipes Poit.
Hyptis capitata Jaqc.

Lythraceae
Cuphea carthagenensis (Jacq.) MacBr.

Malvaceae
Sida rhombifolia L.

Melastomataceae
Clidemia hirta (L.) D. Don.

Mimosaceae
Mimosa pudica L.

Onagraceae
Ludwigia adscendens Hara
Ludwigia hyssopifolium (G.Don.) Exell.
Ludwigia octovalvis (Jacq.) Raven

Oxalidaceae
Oxalis acetosella L.
Oxalis corniculata L.

Poaceae
Axonopus compressus (S.W.) Beauv.
Bambus sp.
Brachiaria reptans (L.) Gard. & Hubb.
Croix lacryma-jobi L.
Cyrtococcum patens (L.) Camus
Digitaria ciliaris (Retz.) Koel.
Echinochloa colona (L.) Link.
Echinochloa crus-galli (L.) P. B.
Echinochloa glabrescens Munno
Eleusine indica (L.) Gärtn.
Imperata cylindrica (L.) Raeusch.
Miscanthus floridulus Warb.
Oryza sativa L.
Paspalum conjugatum Berg.
Paspalum scrobiculatum (L.) Berg.
Setaria palmifolia (Koen.) Stapf

Polygonaceae
Polygonum barbatum L.
Rumex acetosa L.

Pontederiaceae
Monochoria vaginalis (Burm. f.) Presl.

Rosaceae
Rubus sp.

Scrophulariaceae
„Scrophulariaceae " sp.
Limnophila rugosa (Roth) Merr.
Lindernia sp.

3.2 Categories of fallow land

The distribution of the plant families in the four different categories (dry fallow, wet fallow, fallow of sweet potato fields) are shown in Figure 13. The family Poaceae is homogenously represented in all catogories ranging between 21.5 and 26.4 %. The Asteraceae family varies from 17.8 to 20.9 % in dry fields while in wet fields only 7.7 % of the species belong to this family. Most differences are found for the family Cyperaceae ranging from 8.9 to 12.4 % in dry fields and reached a value of 30.8 % in wet fields. Compared to the other families the Fabaceae (0 -7 %) are not very frequent. It can be concluded that a high number of Asteraceae species characterize dry fields while species of the Cyperaceae family occur mainly in wet fields. It is therefore not necessary to divide dry fields into dry rice field fallow and fallow of sweet potato fields.

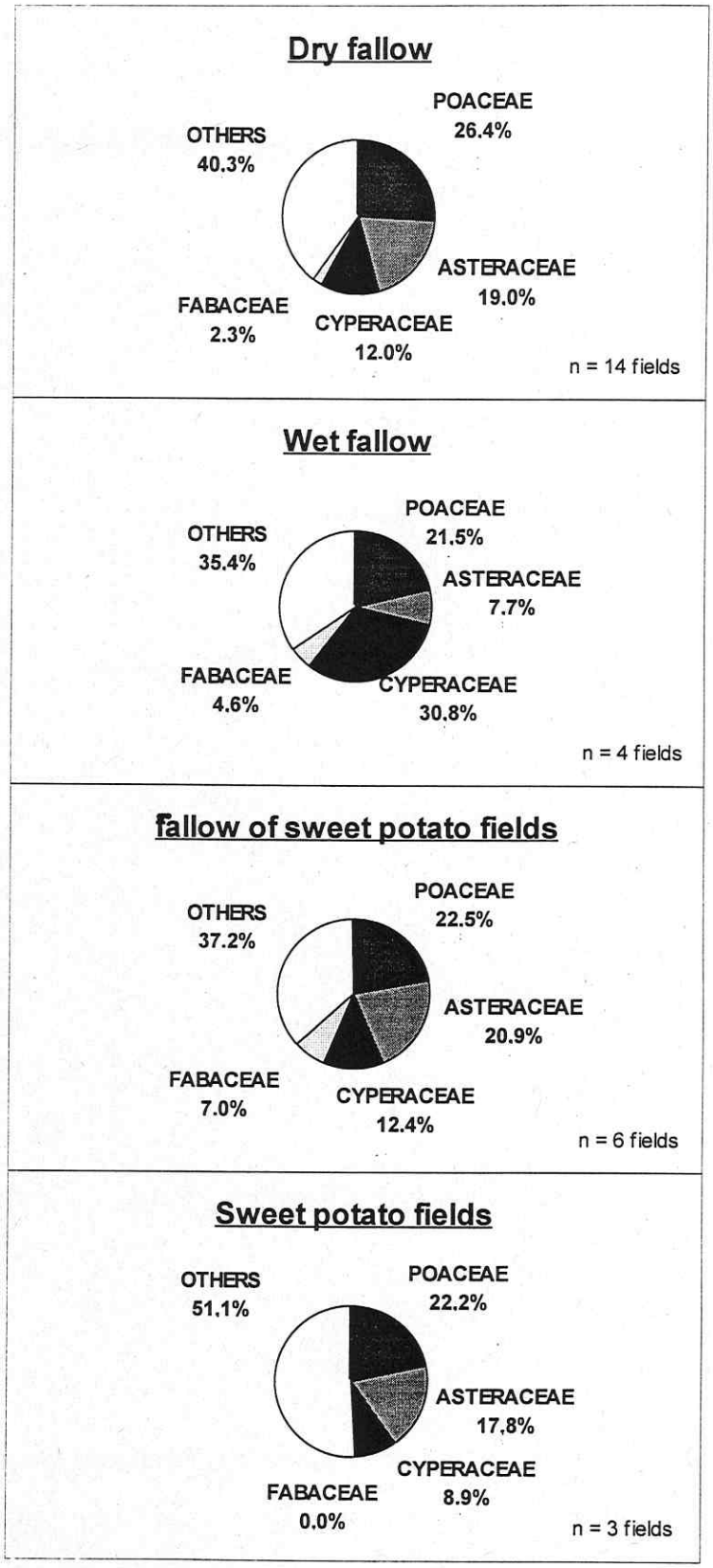
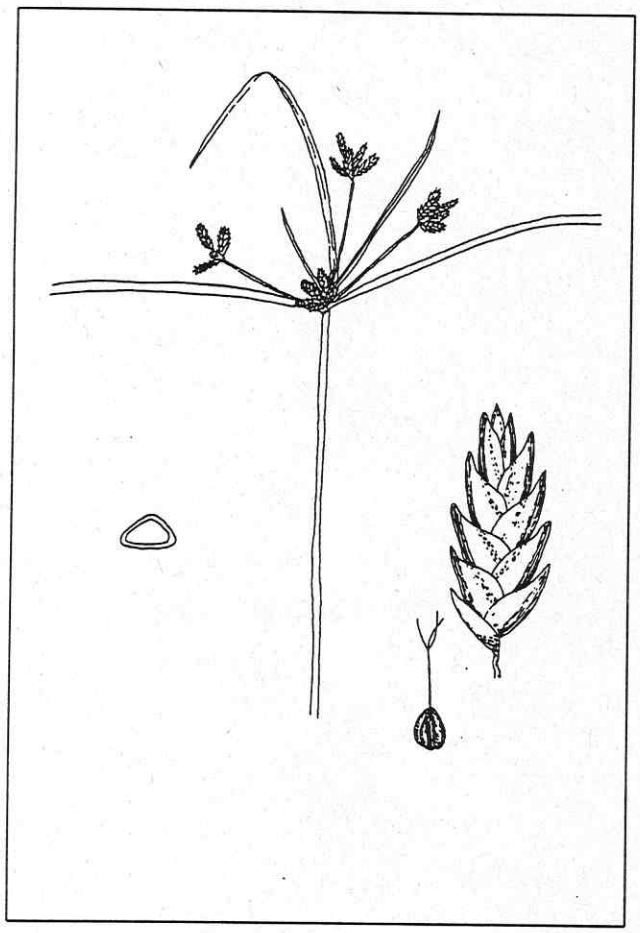


Figure 13: Occurrance of important plant families within the four different categories

3.3 Steadiness and specific degree of coverage

Of the 72 plant species identified, 22 had a steadiness of ≤ 30 % (compare Table 19). Special mention should be made of high values recorded for *Ageratum conyzoides, Cuphea carthagenensis* and *Paspalum conjugatum*.



Picture 35: *Cyperus compressus* (from SAUERBORN & SAUERBORN, 1984)

The order of the species in the two columns is completely different. The column for the steadiness says in how many fields a species was found, but nothing about their coverage ratio. In contrast the second column includes the steadiness and degree of coverage on a given field. The specific degree of coverage does not state if the plant is frequent with low coverage or seldom with high coverage. One has to look at steadiness and specific degree of coverage simultaneously to make a reasonable statement.

Ageratum conyzoides is for example the species with the highest steadiness (s = 93 %) but its specific coverage ratio amounts to only 2.3. In contrast to this, *Imperata cylindrica* with s = 30 % has a relatively low steadiness but the specific coverage ratio is quite high (sCR = 5.6). The reason for this is that it was not found very often but if so, then with a high degree of coverage.

3.4 Correlation between *Miscanthus floridulus* coverage and number of plant species

Fields which were left fallow for several years were dominated by *Miscanthus floridulus*. With an increasing coverage ratio of *Miscanthus* the number of species found per field decreased (Figure 14).

Table 19: Plant species found in fallow fields, ranked according to steadiness (s; left column) and specific coverage ratio (sCR; right column).

Species	s [%]	Species	sCR
Ageratum conyzoides	93	*Imperata cylindrica*	5.6
Cuphea carthagenensis	93	*Paspalum conjugatum*	5.5
Paspalum conjugatum	93	*Mikania micrantha*	4.3
Clidemia hirta	67	*Calopogonium mucunoides*	4.3
Drymaria cordata	59	*Cyrtococcum patens*	3.5
Cyperus brevifolius	59	*Ipomoea batatas*	3.0
Limnophila rugosa	56	*Phaseolus* sp.	2.9
Cyrtococcum patens	48	*Ageratum conyzoides*	2.3
Bidens pilosa	44	*Miscanthus floridulus*	2.2
Colocasia esculenta	44	*Echinochloa crus-galli*	1.8
Ludwigia octovalvis	44	*Cyperus brevifolius*	1.6
Hyptis capitata	44	*Cuphea carthagenensis*	1.1
Mikania micrantha	41	*Axonopus compressus*	1.1
Eleusine indica	37	*Crotalaria incana*	1.0
Phyllanthus amarus	37	*Eleusine indica*	0.9
Crassocephalum crepidioides	37	*Cyperus compressus*	0.7
Calopogonium mucunoides	37	*Galinsoga parviflora*	0.5
Ipomoea batatas	33	*Colocasia esculenta*	0.2
Miscanthus floridulus	33	*Crassocephalum crepidioides*	0.2
Fimbristylis cymosa	30	*Limnophila rugosa*	0.2
Galinsoga parviflora	30		
Imperata cylindrica	30		

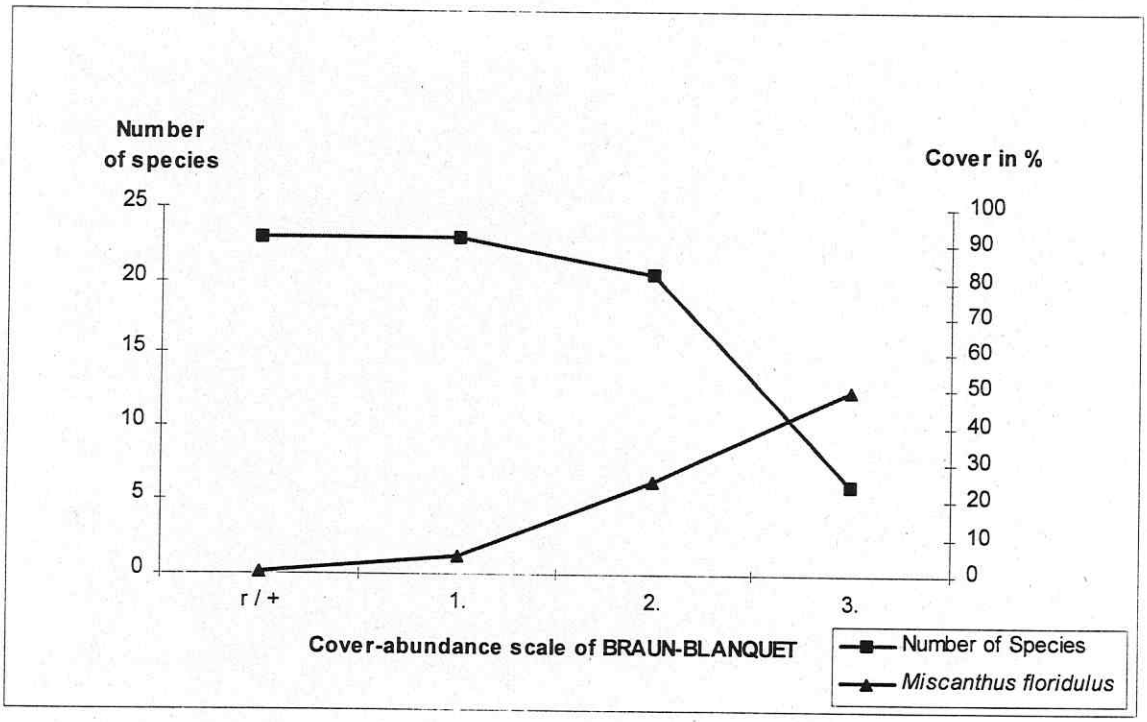


Figure 14: Cover ratio of *Miscanthus floridulus* and number of occurring plant species in fallow land

3.5 Plant communities and rice field succession

Despite much desktop-work we did not find any comprehensible plant community characterizing special sites or stages of succession. Because of missing reliable plant communities we only can suggest an order of succession by visual impression, as it is shown in Figure 15.

We think that there are usually two different ways of further development for a rice field left fallow: either it is used as a sweet potato field after artificial drainage or it is merely abandoned but still wet. In wet fallows Cyperaceae are dominating. However, after some period these fields will drain naturally. Following this, the vegetation gets more or less the same as the vegetation of an abandoned patch. The vegetation can only become different if the sites were grazed by animals. Most of the fields are grazed irregularly. Consequently it is not possible to draw a sharp line. Grazed sites are more dominated by grasses, ungrazed or seldom grazed are more dominated by herbs. Nevertheless, after several years it can be observed that all fallow land is covered by *Miscanthus floridulus*. HERZMANN et al. (pp. 77-89) found that the area which was covered by forest in this region has been increasing since the 1960s. We suppose that after a *Miscanthus*-dominated stage, forest will regrow.

Picture 36: Grass dominated area, grazed by Carabaos
(Tam-an, near Banaue Hotel, March 1997)

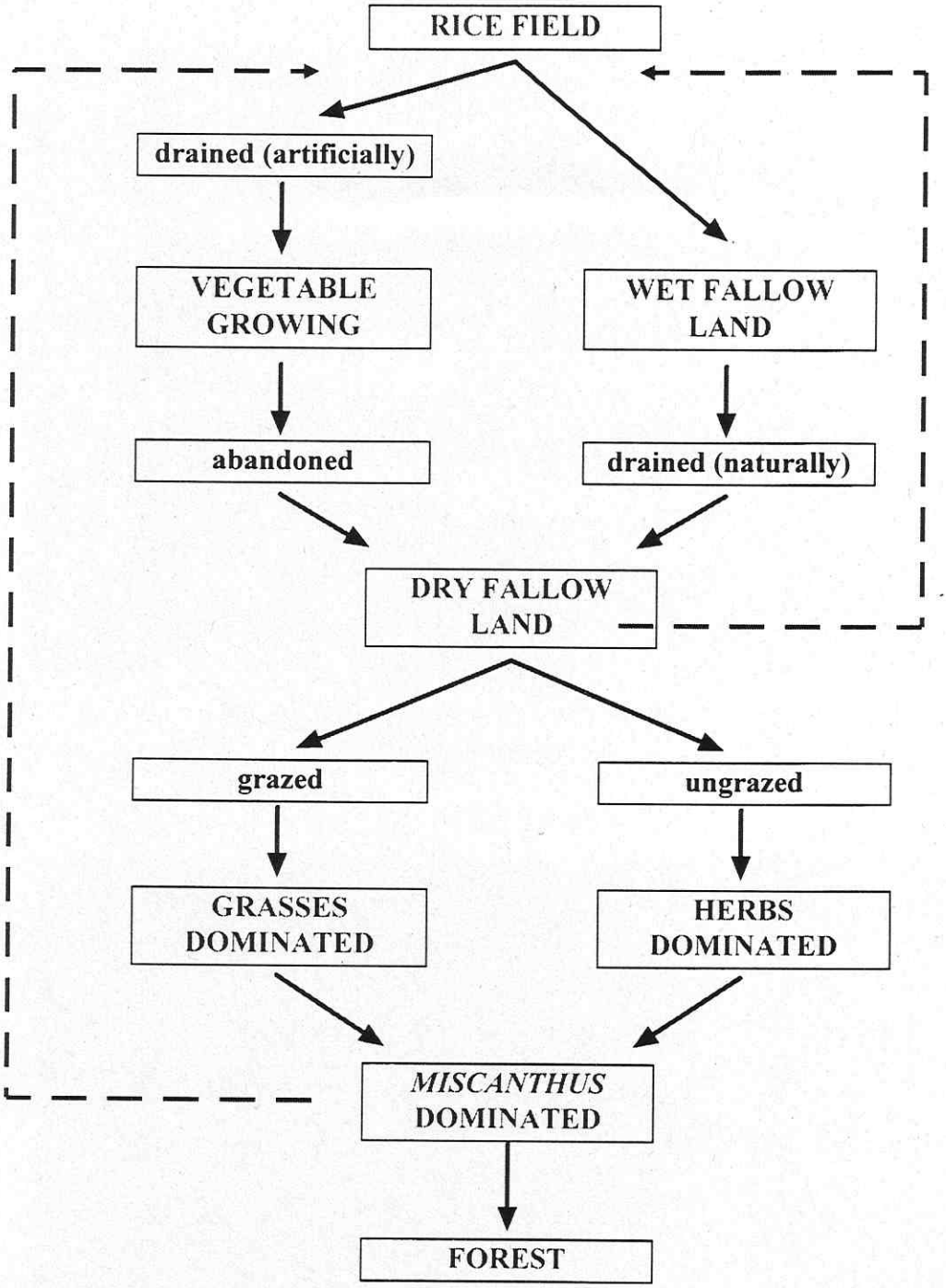
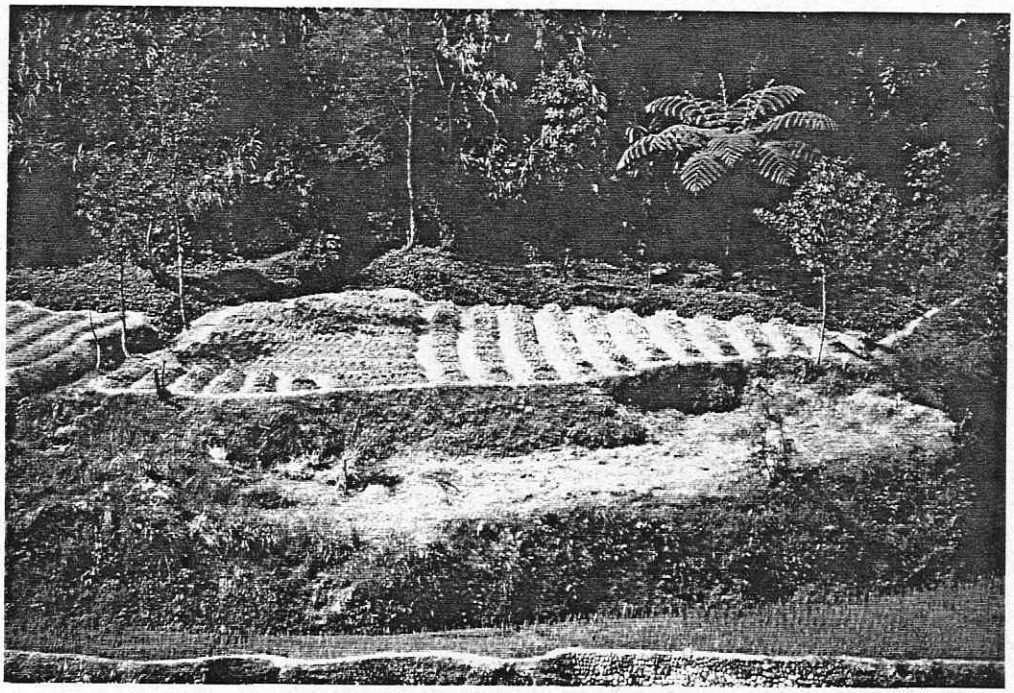
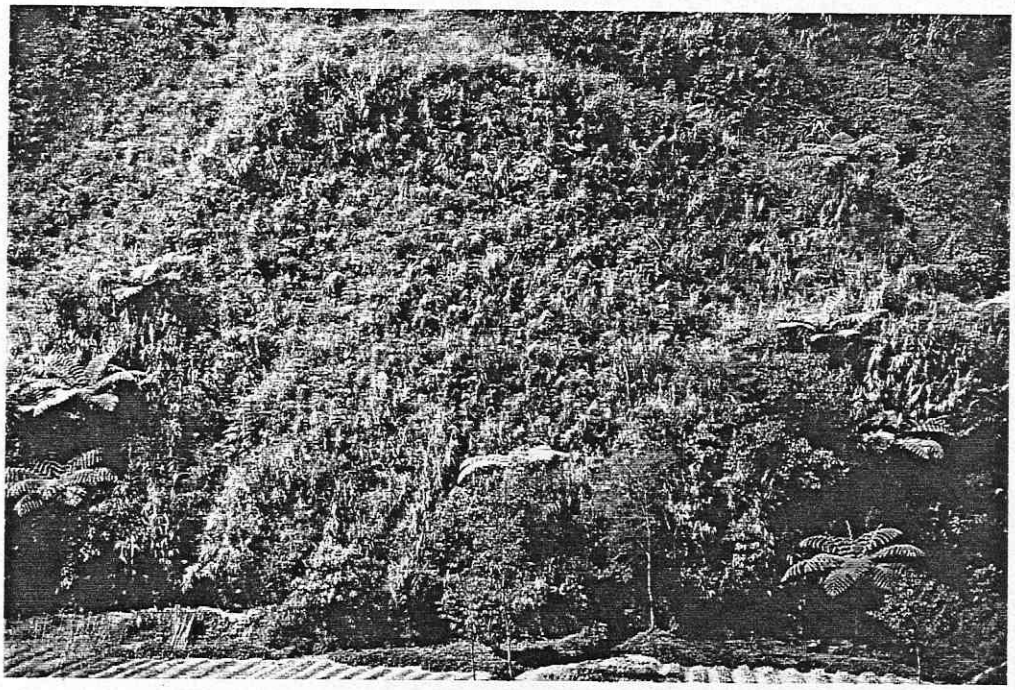


Figure 15: Hypothetical sequences of vegetational succession in fallow land around Banaue.



Picture 37: Vegetables on former rice fields
(Tam-an, March 1997)



Picture 38: 'Mixed caneland' (compare p. 81)
(Tam-an, March 1997)

Ifugao Rice Terraces - Landuse Changes in a Traditional Agroecosystem from 1963 to 1997

by
Sabine HERZMANN, Andrea JOST, Thomas KORBUN, Christian WILLERDING,
Josef SETTELE & Harald PLACHTER

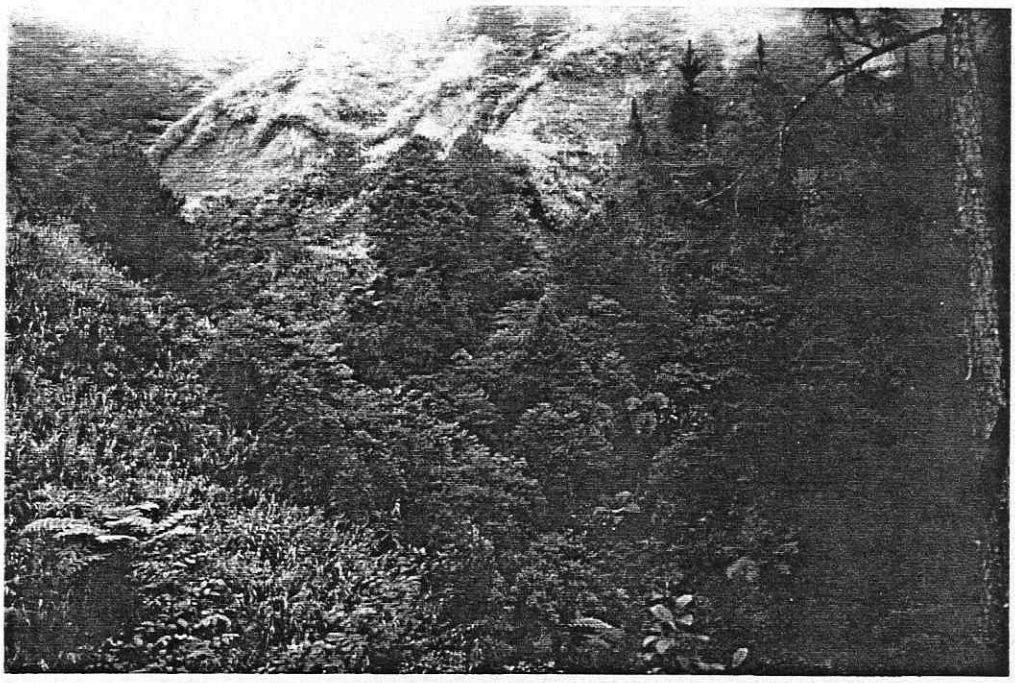
1 Introduction

Traditional rice cultivation on irrigated terraces has mainly influenced the ecological and sociological system in the province of Ifugao (N-Luzon, Philippines). More than thousand years of human-nature-interactions generated a unique cultural landscape with extraordinary value for nature conservation due to its high local biodiversity and its sustainable landuse. This has been underlined by the inscription of the "Ifugao Rice Terraces" as World Heritage Site by the UNESCO in 1995.

Throughout the last decade the continuous vanishing of the traditional single-crop system based on irrigated rice which is characterised by comparatively low yields and high labour inputs was postulated (EDER, 1982; MARGRAF & VOGGESBERGER, 1986, 1988; SETTELE et al., 1993b, 1995). According to these authors a growing population has been searching for alternative food and income sources. This should have led to increasing cultivation of former mossy forest areas. In the traditional system forest provides the water supply for the aquatic rice fields throughout the year. Reduction of their water holding capacity is seen as the major reason for a postulated serious reduction of the rice terrace area. This should affect the high level of biodiversity in the region supported by the traditional landuse system.

These reported trends in landuse changes in Ifugao evoked world-wide attention. UNESCO, the Government of the Philippines and local authorities are willing to maintain and to develop the traditional landuse system. Taking the right decision depends on an actual and precise database. The latest systematic analysis of landuse patterns in Ifugao dates back to 1963 (CONKLIN, 1972, 1980). The reported trends in landuse changes are therefore mainly based on rough assumptions and were not quantified until now. The aim of the present investigation is to provide data on the landuse in the Banaue region in 1997 and to assess its changes compared to 1963 and 1980.

Picture 39: Landuse categories 'shrub caneland' and 'settlement' (compare chapter 3.1, p. 81)



Picture 40: Landuse categories 'mixed caneland' on the left, 'forest succession' in the centre, and 'pine forest' on the right (compare chapter 3.1, p. 81)

2 Materials and Methods

2.1 Investigation area and survey period

The investigations were conducted in the surrounding of Banaue (Province of Ifugao, Philippines) from 4th to 14th of March 1997. The total area surveyed amounts to 149 ha (see Fig. 18, p. 84). It includes parts of the Tam-an Valley (Barangay of Tam-an) and of the Poitan Valley (Barangay of Poitan). The altitude ranges from 880 m to 1180 m above sea level.

2.2 Basic maps

Mapped information for the investigation area was made available in different quality for 3 time levels covering 34 years. The sources are summarized in Table 20.

Table 20: Sources of landuse maps

1963	Landuse map of the Ifugao region on the scale 1:5,000 (Fig. 16, p. 82); published by CONKLIN (1972); based on aerial photographs taken on 23rd of April 1963.
1980	Landuse map of the investigation area on the scale 1:5,000 (Fig. 17, p. 83); based on aerial photographs taken in March 1980 (provided by CECAP Banaue) through interpretation by stereoscope; for creation of map CONKLIN (1972) was used as reference.
1997	Landuse map of the Ifugao region on the scale 1:5,000 (Fig. 18, p. 84); based on field mapping of the investigation area; within this study the map of CONKLIN (1972) was used as reference.

2.3 Classification of landuse

CONKLIN (1972, 1980) defined 6 main categories of landuse:

- Pond field terrace (irrigated terrace, mainly cultivated with rice)
- Drained field terrace (dry terrace, cultivated with vegetables)
- Swidden (slope field area cleared and under cultivation; mainly sweet potato)
- Caneland (light to intermediate secondary growth vegetation, esp. *Miscanthus* spp.)
- Woodland and Forest
- Settlement Site.

For the mapping of the actual landuse in 1997 a more detailed subdivision of these categories was used (details see chapter 3.1). However, most of them had to be summarised in order to facilitate the analysis of landuse changes since 1963.

Due to the limited quality of the aerial photographs of 1980, only 4 categories could be distinguished for this period. They are not in all cases compatible to the previous classifications and were used only for some specific questions (see Table 21).

2.4 Method of analysis

A weighing method was used to determine the absolute area of the different land use categories. Each map produced was cut by hand into pieces according to the categories, symbolised by different colours. All pieces of the same category were weighed together, using a electronic balance with a scale of 1 mg. In addition several squares representing a known area (e.g. 2x2 cm is equivalent to 1 ha) were cut and weighed, in order to standardize the weight-area-equivalent of the different maps. 1 mg represented slightly less than 150 m².

Table 21: Landuse categories in 1963 (CONKLIN, 1972, 1980; based on aerial photographs), 1980 (own analysis of aerial photographs) and 1997 (own field mapping). The mapping key for 1997 is the most differentiated and is based in principle on CONKLIN (1972, 1980). The rather unsufficient quality of the aerial photographs taken in 1980 only permitted the differentiation of the mentioned summarized categories.

1963	1980	1997
Pond field terrace (rice)	-	Rice terrace
		Fallow rice terrace
Drained field terrace (cultivated with vegetables)	-	Vegetable terrace
-	-	Abandoned terrace
Swidden (Sweet potato cultivation)	Swidden or grass caneland (Caneland A)	Swidden
Caneland (*Miscanthus* spp. dominated area)		Grass caneland
	Mixed or shrub caneland (Caneland B)	Mixed caneland
		Shrub caneland
Woodland, forest	Forest	Forest succession
		Forest
		Pine forest
Settlement site	Others	Settlement site
Others		Erosion site
		Others

3 Results

3.1 Landuse classification in 1997

3.1.1 Terraces

The pond field terrace of CONKLIN (1972, 1980) was differentiated in

- rice terrace (1963 and 1997)
- new rice terrace (new terrace at all)
- rice terrace (dry cultivation in 1963)
- fallow rice terrace (irrigated fallow in 1997)
- new fallow rice terrace (new terrace at all)
- fallow rice terrace (dry cultivation in 1963)

The drained field terrace of CONKLIN was differentiated in

- vegetable terrace (1963 and 1997)
- vegetable terrace (rice in 1963)

Additionally, terraces with broken walls were classified as

- abandoned rice terrace (rice in 1963)
- abandoned vegetable terrace (dry cultivation in 1963)

3.1.2 Caneland

The further subdivision of CONKLIN's (1972, 1980) type 'caneland' was chosen due to differences, which are obvious by view from a certain distance. Binoculars were used, whenever necessary. The categories were checked by surveying sample sites on the dominant plant species and by botanical surveys (see DIEFENBACH et al., pp. 65-75) on succession types of fallow.

grass caneland	dominated by *Miscanthus spp.* (e.g. *M. floridulus*) (Pict. 40, p. 78)
mixed caneland	*Miscanthus* reduced and mixed with mainly fern species (e.g. *Pteridium aquilinum*, *Napholisis bissarata*) (Pict. 38, p. 76)
shrub caneland	wooden plants and shrubs in the dominating grass, herbs and fern vegetation (Pict. 39, p. 78)

3.1.3 Forest

CONKLIN's (1972, 1980) type 'forest' was divided in 3 subcategories.

forest succession	last succession stage to forest, dominated by shrubs species, scattered tree individuals (Pict. 40, p. 78)
pine forest	dominated by *Pinus insularis* (Pict. 40, p. 78), mainly around settlement areas
forest	dense forest areas with mixed tree species

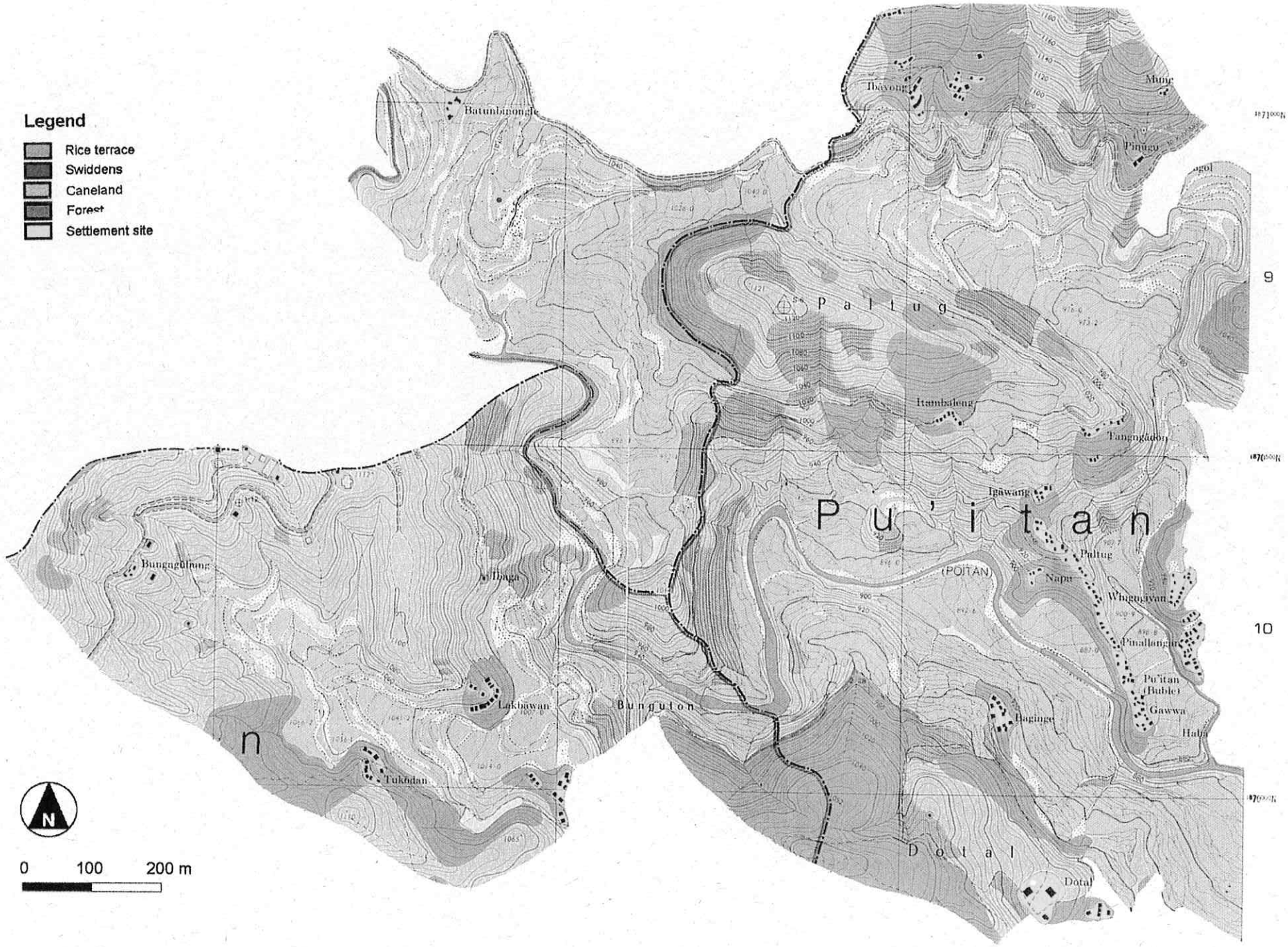


Figure 16: Banaue landuse in 1963 (investigation area of Tam-an and Poitan; taken from CONKLIN, 1972, slightly modified)

Figure 17: Banaue landuse in 1980 (investigation area of Tam-an and Poitan)

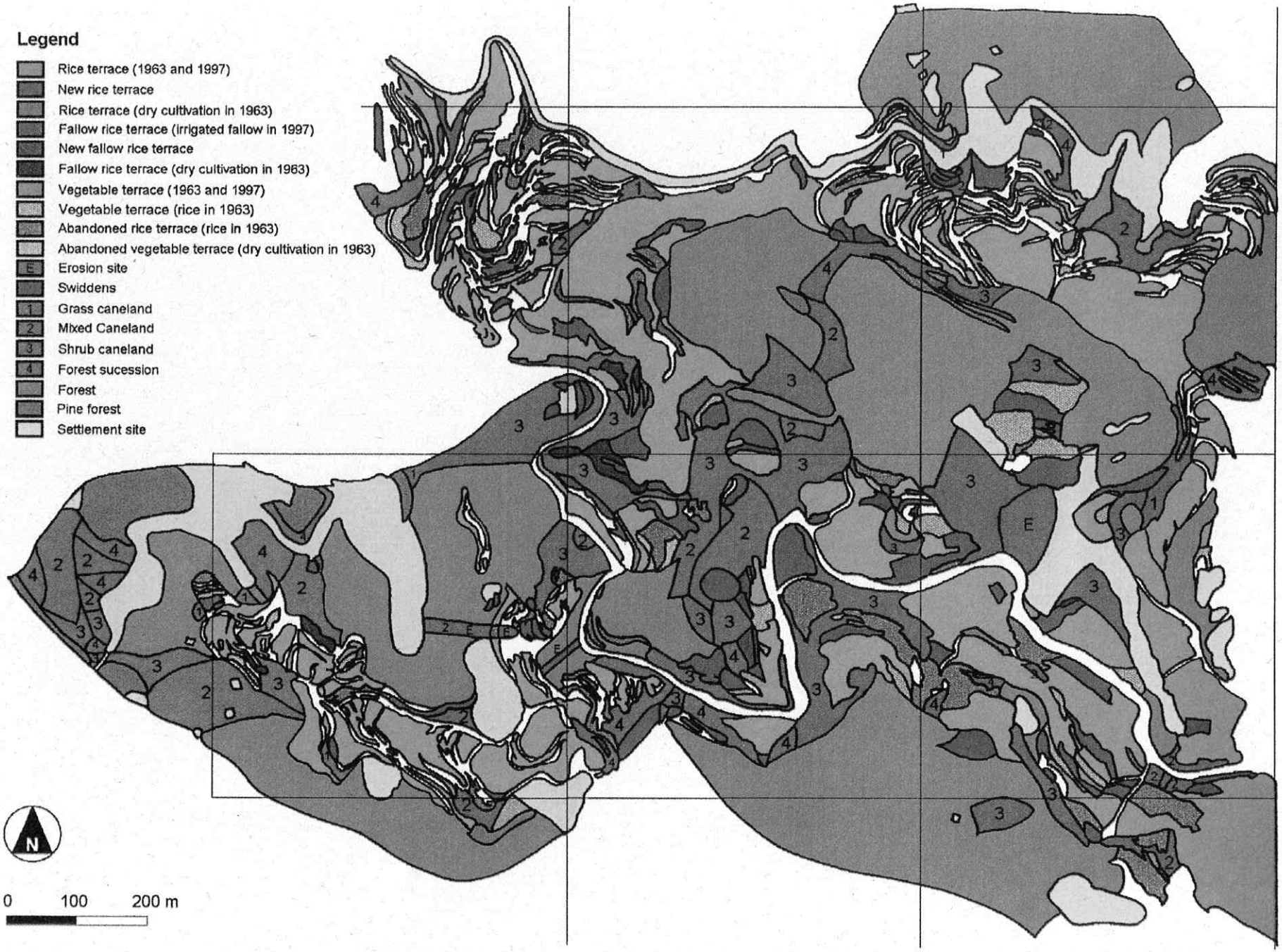


Figure 18: Banaue landuse in 1997 (investigation area of Tam-an and Poitan)

3.2 Landuse development

3.2.1 Landuse in the investigation area 1963 and 1997

Forest extended remarkably between 1963 and 1997 from 15 to 35% of the total area, whereas caneland and swiddens declined from 35 to 14% and 7 to 1%, respectively (Fig. 19). Changes of the rice terraces are moderate with a decrease from 35 to 29% of the total area. Especially, the extension of settlements is striking with 2 to 8% of the total area. In this context, the increase of the category "Others" from 7 to 9% has to be noted as well.

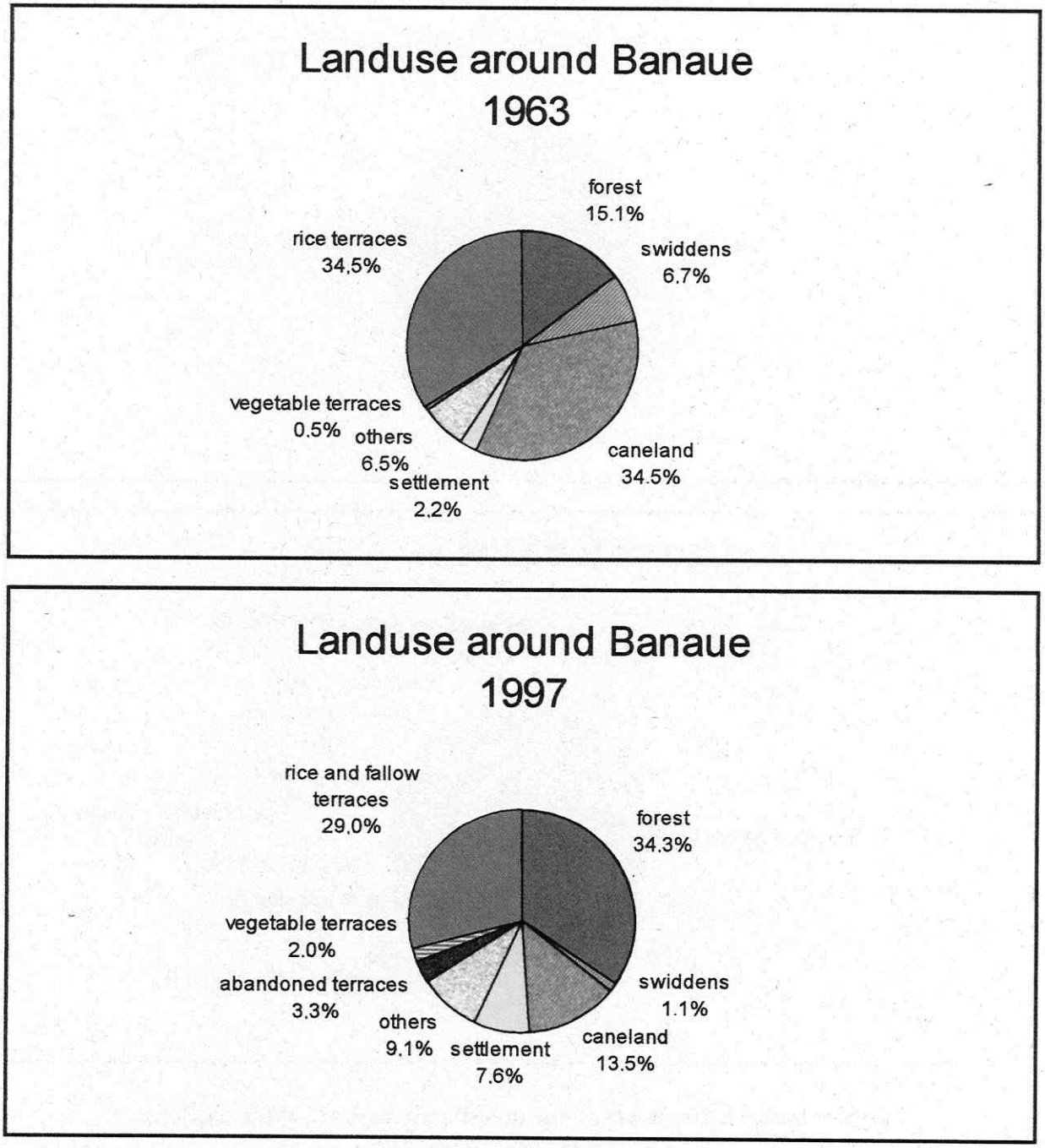


Figure 19: Total landuse in the investigation area in 1963 and 1997 (compare Fig. 16 and 18)

3.2.2 Changes in the use of terraces from 1963 to 1997

In 1963, 51.4 ha of the investigation area (total area: 149 ha) were terraced. In 1997, 5.0 ha of the former terraces are abandoned, which is a loss of about 10% (Fig. 20). Although new terraces were established, the extent of about 1.0 ha was too small for a compensation. The net loss of terrace area was therefore 8% in 34 years.

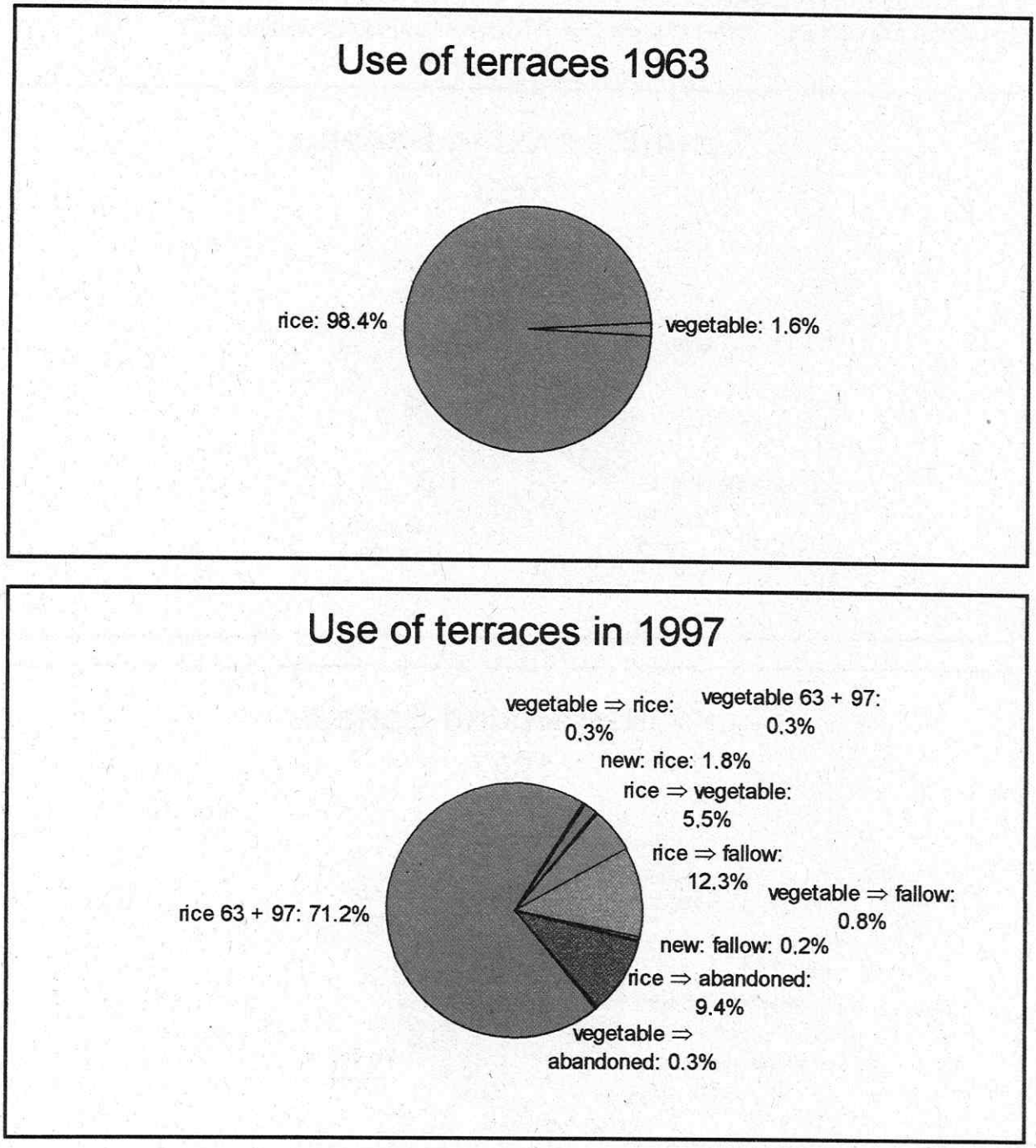


Figure 20: Use of terraces in the investigation area in 1963 and 1997 (compare Fig. 16 and 18)

Rice cultivation covered 50.6 ha of the terraced area in 1963. This area decreased to 44.0 ha in 1997. For 1997 rice terraces (37.6 ha) and fallow rice terraces (6.4 ha) were treated together. This is due to the still ongoing preparation of rice fields during the investigation period (which made it difficult to distinguish between rice terraces in use and in fallow). During the period of investigation numerous "fallow" rice terraces were planted with rice again. They are therefore regarded as parts of the active rice cultivation system. Consequently, the loss of rice area within the total terrace area was between 13 and 15% from 1963 to 1997.

The abandoned terraces had broken walls and were frequently covered with shrubs, occasionally with trees. Mostly, abandoned terraces are clustered (see Fig. 18, p. 84). Some terrace clusters were obviously destroyed by landslides (compare Pict. 43, p.93). In the case of other clusters, farmers reported the breakdown of the irrigation system subsequently to earthquakes. Only few single abandoned terraces surrounded by active rice paddies could be found.

In the same period the percentage of dry crops on the terrace area increased from only 2% (0.8 ha) to 5.8 % (3.0 ha). The increase mainly originated from the conversion of former rice terraces.

The irrigation system of the rice fields in the investigation area in general doesn't seem to depend on a defined local watershed. Several long-distance channels provide water from distant mountain areas (partly from mossy forests of the Mt. Pulis range).

3.2.3 Changes of forests, canelands, and swiddens

Swiddens, which covered traditionally the slopes above the terraces, decreased by 84% from 9.8 ha to 1.6 ha, and the area of caneland by 57% from 60 ha in 1963 to 26 ha in 1997. On the abandoned swiddens caneland successions up to forests could develop. Recently, forests and forest succession covers an area of 52 ha in contrast to 33 ha in 1980 and only 22 ha in 1963. This is an increase of more than double within 34 years (see Fig. 21).

A comparison of the forest distribution in 1963 and 1997 (Fig. 16, 18, 21) proves that most forest areas existing in 1963 were still present in 1997. New forest areas are covering former caneland and swidden areas.

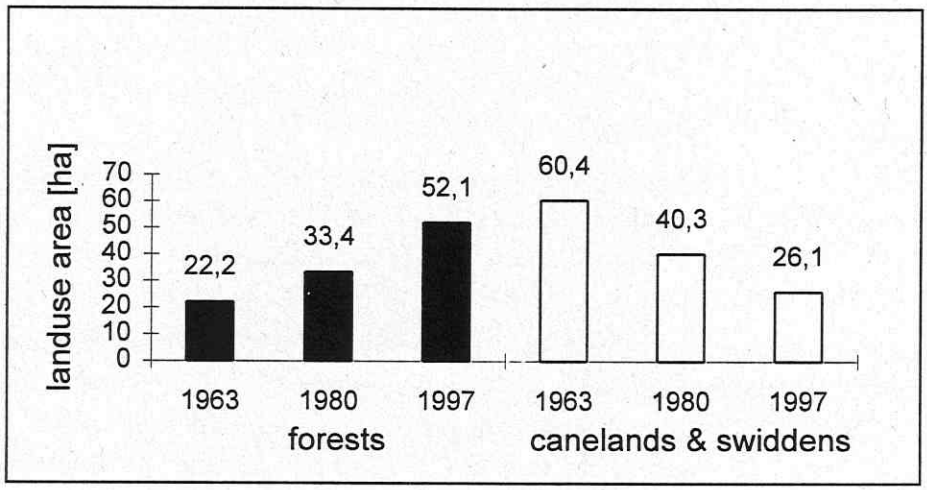
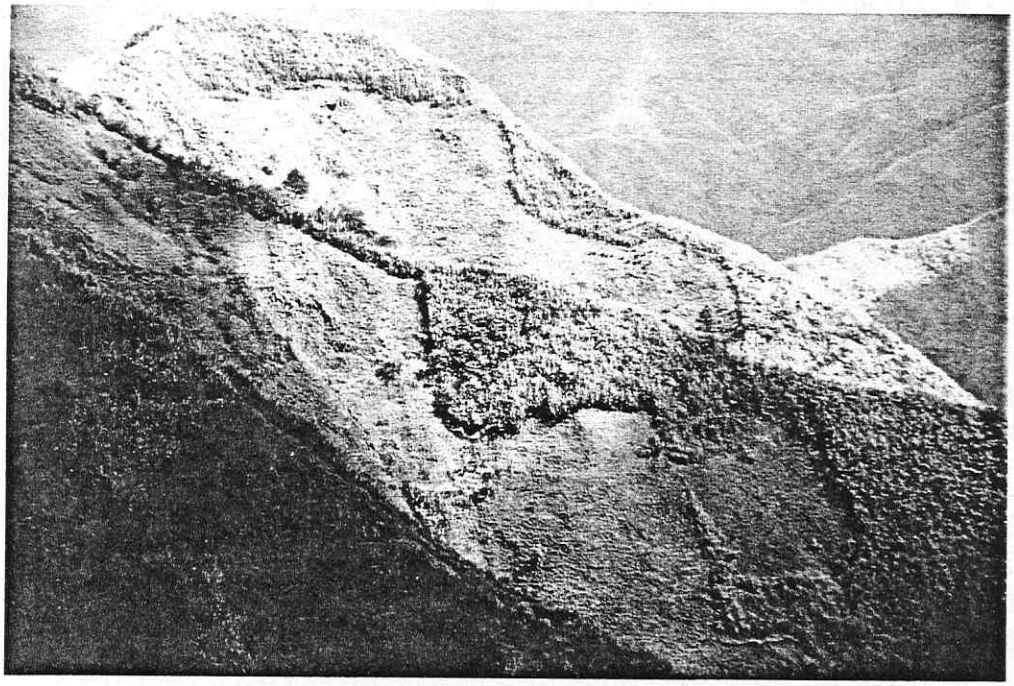


Figure 21: Development of forests, canelands, and swiddens in the investigation area from 1963 to 1997 (compare Fig. 16 and 18)



Picture 40: Typical swidden in use near Batad (March 1997)

4 Conclusions

The results do not correspond with the hypothesis described above. The first main observation was that rice terraces in the investigation area were not as far reduced as expected by some authors (e.g. MARGRAF & VOGGESBERGER 1986, 1988). In general, stone and loam walls of active rice terraces were kept in good shape. This is valid for the irrigation system, too. In addition, construction of new terraces could be observed. Numerous farmers reported, that they would try to maintain rice cultivation on their family fields as long as possible (see also BARTHELMES et al., this volume, pp. 29-42). One reason for this attitude could be the close relationship between rice cultivation and the culture and religion of the Ifugaos, as described e.g. by DUMIA (1983). This conclusion is supported by Mr. J. Dait, Director of the Ifugao Terrace Commission (ITC; personal communication, 19th March 1997).

Nevertheless, since 1963 a net loss of 8% of the terraces was found in the investigation area. The reasons for abandoning rice terraces could however not be clearified. According to farmers, reconstruction of completely destroyed walls or irrigation systems is not carried out due to immense costs and work requirements.

The second important and unexpected result is the high increase of forests in the investigation area. This conflicts with the general opinion that reduced forest area should have led to insufficient water supply for the irrigation of terraces. In contrast, the increase of forest is accompanied by the observed decrease of caneland and swiddens in percentage of the total landuse. This leads to the conclusion that sweet potato cultivation was given up to a large

extent in the investigation area. In consequence, slopes were no more cultivated and the vegetation developed in succession to forest. Caneland mapped 1963 by CONKLIN (1972, 1980) and by the present survey are to be interpreted as fallow stages of swiddens with different age.

The changes in landuse discussed so far cannot be understood without their specific socio-economic frame. As the general hypothesis described at the beginning is not corresponding to the received results, a new explanation had to be developed.

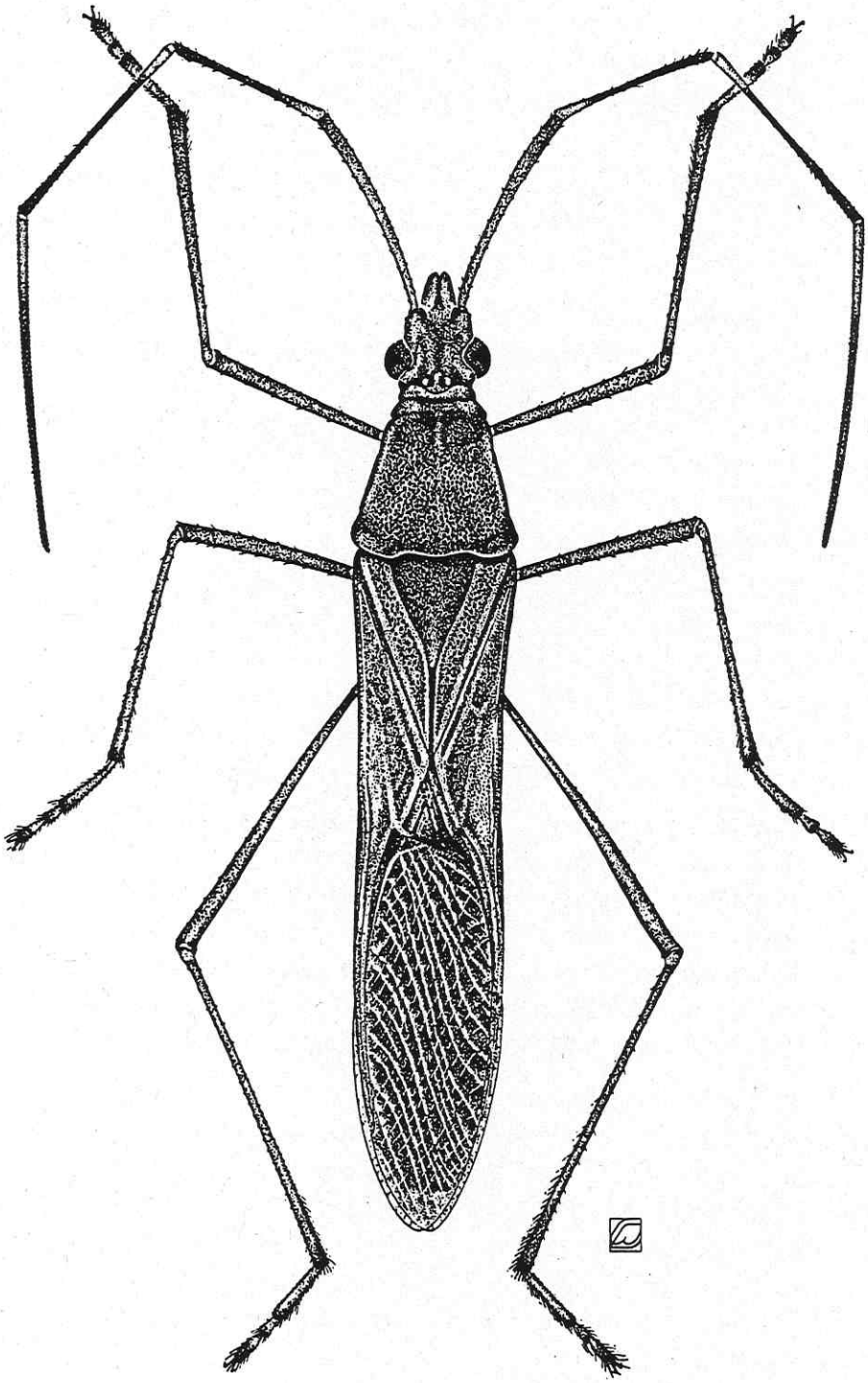
In 1963 and before, the agricultural system of the Ifugaos was subsistence farming dominated by rice cultivation. Sweet potato cultivation and forestry covered those months in which labour requirement in the rice fields was low (CONKLIN 1980, MARGRAF 1988, VOGGESBERGER 1988). If any at all, there must have been few cash income sources. The yields had to satisfy the need of the population for food. Increasing population and low yields in the traditional rice growing system promoted the extension or at least maintenance of sweet potato cultivation on the slopes.

In the last three decades, Banaue developed into a congested area in which also tourism became an important economic factor. The position of Banaue as regional and touristic centre provides additional income sources. The inhabitants of Banaue increasingly receive cash by weaving, wood-carving and/or employment in the service sector. Field work is reduced due to limited time and low profit expectations. Cash income allows to buy additional food e.g. imported from the lowlands. In consequence, sweet potato cultivation was given up first.

In contrast, the rice terraces were not affected in the same extent by the socio-economic changes until now. Terraces are only abandoned if the need of investment in reconstruction of destroyed walls or irrigation systems is extremely high. Also, abandoned rice terraces due to new building activities (settlement) were observed. Cultivation of sweet potatoes and other vegetables ("cash crops") on former rice terraces increased, but is only of secondary importance. In contrast to the explanation of EDER (1982), a general lack of water, which might have led to abandoning of terraces, was not reported in recent times.

However, the water supply for the terraces in the investigation area is not only depending on the forests of the local watershed. Several long-distance channels provide water from distant mountain areas and are already mentioned by CONKLIN (1980). It cannot be excluded that, despite the increase of forest on the local level, insufficient water supply could result from negative influence in the mossy forests of far away regions. Investigations in valleys, where socio-economic changes did not happen in such high extent, could possibly clarify this suggestion. Due to the limited time, an extension of the investigation area unfortunately was not possible.

Predicting the development of the rice terraces in future is quite difficult, as there are many influencing factors. Without any other changes, the observed situation could completely change as a result of the generation cycle. At the time of our research mainly elder people were observed working in the terraces. Anyhow, we could not find out, whether this was usual in former times as well or whether the young generation is nowadays much less interested in these activities (see also BARTHELMES et al., this volume, pp. 29-42).



Picture 42: The rice bug *Leptocorisa acuta* attacks rice panicles at the milky stage; its one of the more common species in Ifugao
(drawing: W. LANG; taken from SETTELE & BRAUN, 1986)

PERSPECTIVES FOR THE FUTURE

Scenarios for the Future Development of the Ifugao Rice Terraces (N-Luzon, Philippines)

by
Harald PLACHTER, Joachim SAUERBORN, Doris VETTERLEIN & Josef SETTELE

1 Introduction

As already stated in the paper on the history and ecology of Ifugao (SETTELE & MARTIN, this volume, pp. 13-28), drastic changes may be expected in the terraced landscape of Ifugao Province, should the present development continue without alterations. Rice cultivation alone or in combination with swidden-culture increasingly seems not to meet the needs and expectations of the local people. Hard labour in the terraces, low rice yields, increasing population, and food imports are the major problems Ifugao people have to face. This for example leads to the search for alternatives in other areas (either in the lowlands, for example Quirino Province, or in the higher elevated regions with their mossy forests).

Among these preconditions we accepted rice shortage in the area as a given fact. However, the data available, as shown in BARTHELMES et al. (this volume, pp. 29-42), are not at all consistent. Depending on the sources used, we have a high variation in rice yields per hectare and the consumption per head. If we look at rice yields of irrigated systems in general, we dare to state, that the system in Ifugao - at least at higher elevations from about 800m upwards - surely can't yield as much rice as needed for the local population. To put this very important precondition on solid ground it would however be desirable to get more reliable data on rice production and consumption in Ifugao.

To deal with these problems and to derive options of future development, it is useful to apply scenarios. In this contribution we will concentrate on four scenarios which are somehow extreme versions of what could happen. Of course there are components in each scenario which could be exchanged with the respective components of others. Therefore we subdivided all scenarios into the following components: watershed, agriculture, tourism, and handicrafts (esp. wood carving). We summarize the medium-term effects of each scenario (including effects on biodiversity). The scenarios presented refer to the conditions we found around Banaue, as most of our experience (as a group) is derived from field work there.

2 Scenarios

2.1 Scenario 1: Continuation of the present state

2.1.1 Preconditions:

watershed:

Road construction (for example the Banaue-Bontoc road; see Pict. 17, p. 25) and foundation of human settlements in mossy forests (which can be found some kilometers from Banaue in higher elevations (see Pict. 19, p. 25); wood extraction for handicraft industry.

agriculture:

Local and partly new rice varieties are planted in traditional or slightly modified systems for a period of 6-8 months; additionally vegetables are grown; total area of agriculture decreases as young people leave from the region.

tourism:

Numbers of tourists increase slightly; average time a tourist spends in the area is 1 - 3 days, visits are concentrated around touristic spots (like Viewpoint, Batad, Bangaan).

handicrafts:

Cash income, especially for wood carvings, is based on decreasing natural resources (according to own observations, respectively interviews with wood carvers, wood is harvested in mossy forest or imported from the lowlands).

2.1.2 Medium-term effects:

watershed:

Mossy forests gradually vanish.

agriculture:

More water shortage especially in drier seasons, which would result in a loss of irrigated terraces (e.g. due to erosion after cracks, which resulted from drying of terraces) and problems in supply of drinking water, because mossy forests are the main factor for constant water supply; reduced maintainance of irrigated terraces because of emigration of young people; possibilities for agricultural innovations are limited due to watershed and erosion problems.

tourism:

More local people work for tourism industry, thus time invested for terrace and swidden cultivation decreases; majority of people, including most of the farmers, won't have access to the income created by tourism (compare MARGRAF & VOGGESBERGER, 1986); tourism will decrease as the scenery of the terraces gets worse (due to less maintainance, see below).

handicrafts:

Prices of natural resources (e.g. wood and rattan) will rise and cash income will decrease as these resources are more and more depleted and thus get rare (and expensive); less people will be able to make a living out of handicrafts.

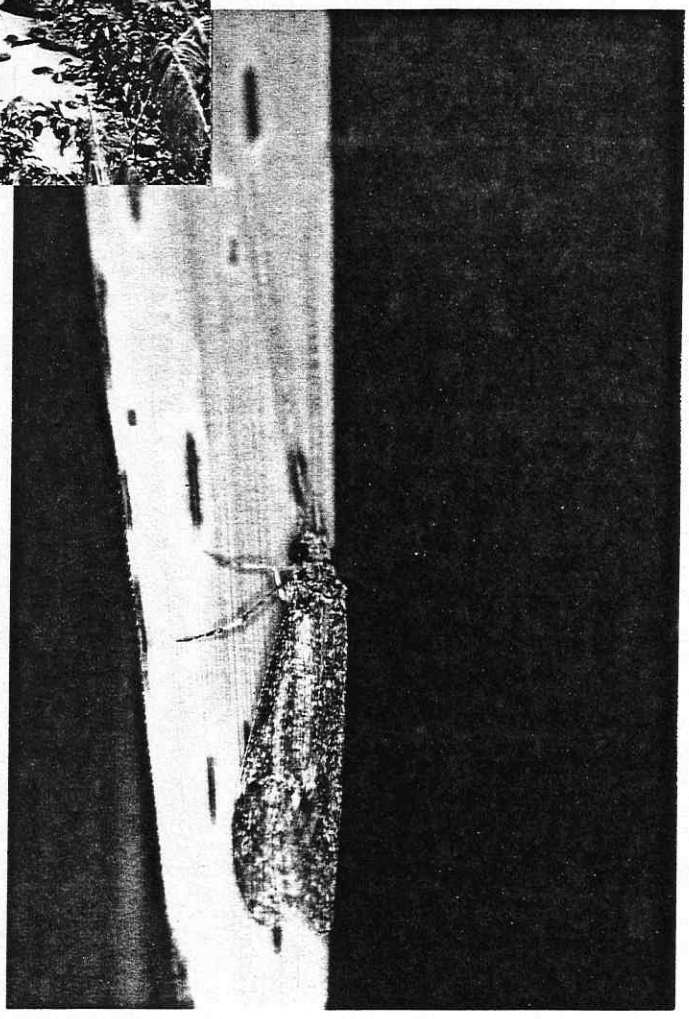
biodiversity of agricultural areas:

Diversity of flora and fauna of irrigated rice fields will decrease, including the extinction of local rice varieties and some endemic species (e.g. caddis flies).

biodiversity of natural areas (mainly mossy forests):

Due to gradual destruction of forests the loss of many endemic species is to be expected (which means global extinction of a number of species)

Picture 43:
Erosion due to temporal drought within rice fields (Banaue, 1988)



Picture 44:
Caddis fly (Trichoptera) from the Ifugao Rice Terraces

2.2 Scenario 2: Short term mass tourism

2.2.1 Preconditions:

watershed:

In forested areas increased road construction and human settlements (tourists buy products along the roads); harvest of wood for handicraft industry (e.g. for carvings).

agriculture:

Continuation of irrigated rice terrace system (traditional or modified) concentrates around touristic spots (museum-type of rice production); rest of the region will be used in very different ways, e.g. for vegetables and fruit trees.

tourism:

Average time a tourist spends in the area is 1-3 days (like in scenario 1);
number of tourists increases drastically; strong concentration of large parts of the population on tourism; more waste and garbage produced; construction of new hotel facilities and a nearby airport in Bagabag.

handicrafts:

Increase in production of wood carvings - especially locally sold ones.

2.2.2 Medium-term effects:

watershed:

Depletion of mossy forests even faster than in scenario 1: mainly due to 'improvements' of infrastructure (especially if not made in a technologically appropriate way, see extremely negative example of widening of Banaue-Bontoc road in 1997 in Pict. 17 and 19, p. 25), shifting cultivation (in combination with human settlements; Pict. 19, p. 25) and increasing wood demand for carvings.

agriculture:

Irrigated terraces in large parts of the region (except the ones directly at tourist spots) get lost due to reduced maintainance and the destruction of the watersheds; conditions for agriculture will hardly be suitable for any further development.

tourism:

Strong concentration on tourism of large parts of the population leads to a decrease in time invested in terraces and swiddens; major income will be created "out of the area" (e.g. large hotel entrepreneurs); waste and garbage problems will increase (see JAHN et al., this volume, especially Table 14 and pp. 53-54); drinking water supply will soon be problematic due to forest destruction; tourism might destroy its own basis and vanish in the longer term.

handicrafts:

For increased wood carving there will be an increasing demand on woods, which accelerates the depletion of natural resources; prices will increase and profits be reduced in the medium- and longer term due to lack of resources; quality of carvings might decrease, as locally sold products do not have to meet the same quality criteria as exported ones.

biodiversity of agricultural areas:

Especially species diversity of irrigated rice fields will get lost, including the extinction of many endemic species.

biodiversity of natural areas (mainly mossy forests):

Due to destruction of forests complete loss of many endemic species.

2.3 Scenario 3: Further agricultural intensification and technical modifications

2.3.1 Preconditions:

watershed:

Protected (to guarantee a continuous water supply throughout the year).

agriculture:

a) Irrigated rice: introduction of a second rice crop (expecially in areas of lower elevations like e.g. around Kiangan, where it has been partly introduced already); synchronicity of crop cycles will be reduced;
b) Introduction of rice-vegetable-intercropping (like in Bay-Yo, Mt. Province, see Pict. 46, p. 98):
c) Exclusive growth of vegetables (or fruit trees) on terraces.

tourism:

Continued like in scenario 1 (maintainance of breathtaking views in central areas).

handicrafts:

Wood carving industry is improved; forests are intentionally planted for wood production.

2.3.2 Medium-term effects:

watershed:

Maintained if relation to agriculture is recognized, which leads to protection efforts of official and private people. However, certain danger for the watershed, as the dependence on the forests for water supply will decrease and it might still be possible to grow vegetables in rainy season.

agriculture:

a) Reduced synchronicity of rice crop cycles most probably will not create problems in insect pests (WAY & HEONG, 1994; HEONG, 1996). Nutrient supply for two rice crops might not be sufficient (additional input of fertilizers!);
b) In rice-vegetable-intercropping systems soil erosion is more likely to occur (due to temporarily dry conditions); terrace stability will severely be reduced due to cracks in dried up clay walls (unless stones replace the clay terrace walls, like e.g. in Bay-Yo or Batad); increased dependence on the market, especially for trading cash crops and for buying fertilizers and partly also pesticides (potential health problems); changes are to a certain extent reversible.
c) Exclusive vegetable or fruit tree growth on terraces will result in the application of fertilizers and pesticides (like in Kiangan); increased dependence on the market, especially for trading cash crops and for buying fertilizers and partly also pesticides (potential health problems); the rice system will be lost irreversibly to a considerable extent (e.g. due to nutrient loss, destruction of irrigation systems and erosion; see Pict. 45, p. 96).

tourism:

Depending on the intensity effects might be like in scenario 1 or scenario 2; a reduction in medium- to long-term tourism could result, if large portions of area are devoted to upland agriculture (e.g. vegetables)

handicrafts:

The chance for cash income will lessen the effects on natural resources.

biodiversity of agricultural areas:

a) Diversity of local rice varieties most probably will be reduced, 'modern' varieties will be introduced; depending on the respective agricultural changes, species

composition especially of the aquatic fauna in rice fields might be affected, including a certain risk of extinction of endemic species like for example some caddis flies; terrestrial invertebrate fauna composition will remain more or less constant, as it basically seems to be the same all over the Philippines, irrespective of growing systems (SCHOENLY et al. 1996).

b) Diversity of local rice varieties most probably will be reduced, further 'modern' varieties will be introduced; species compositions (esp. the aquatic fauna) will be totally different (including the extinction of endemic species).

c) Local rice varieties will be lost completely (except some preserved seeds in germplasm centers); aquatic fauna will be completely lost and many endemic species will go extinct

biodiversity of natural areas (mainly mossy forests):

a) Biodiversity will be preserved due to efforts of watershed protection, which is due to the dependence on water supply for the irrigated terraces.

b) Same as a).

c) Risk for loss of diversity larger than in a) and b), as vegetable system is more independent from continuous water supply and negative effects of forest destruction are not obvious as early as in irrigated rice systems.

Picture 45: Former irrigated rice terraces converted into bean fields (near Kiangan, 1985)

2.4 Scenario 4: Integrated Development

2.4.1 Preconditions:

watershed:

Mossy forests strictly protected; no wood is taken out of these forests; reestablishment of the woodlot system in areas of agricultural production (compare CONKLIN, 1980).

agriculture:

Traditional rice growing system maintained in major/some parts of Ifugao (rice production for own consumption as well as for sale of traditional rice varieties for a regional or even global market); modified rice system (e.g. two rice crops per year in lower elevations; SETTELE et al. 1993b, 1995) contributes to increased production of high yielding varieties; parts of imports of rice from the lowlands are replaced; vegetable growing introduced in restricted areas (percentage of land cover herefore orientated at the traditional swidden system; compare CONKLIN, 1980).

tourism:

Tourists are charged with certain entrance fees; tourism concentrates on certain areas for the majority (a reduced kind of mass tourism) - especially for short to medium term visitors; 'high quality tourism' (like for example ecotourism) is introduced for long term visitors; it includes a set of guided tours through the region, combined with central informations on the respective systems and their compartments or components; a 'tourist academy' promotes traditional handicrafts and skills, like e.g. weaving, carving, basketing, music and dances as well as cooking; it could also contribute to maintain the knowledge of the religious basis of the system.

handicrafts:

If industry-like enterprises are developed; as the local supply with wood is not at all sufficient, it shall be combined with forest plantations in lower elevations (e.g. within Ifugao Province around Lawig?).

[As an example we just could make very simple calculations: if such an industry would need 10,000 logs/year and we have 20 logs/ha one would require 500ha of forest/year. If we further calculate around 80 years for the regrowth, we would end up with an area of 40,000 ha as a basis for the wood supply for a wood carving industry.]

2.4.2 Medium-term effects:

watershed:

Mossy forests will survive and guarantee the long term stability of water supply for terraces and people (drinking water).

agriculture:

Sustainable development; traditional systems based on local rice varieties survive in certain areas; modified rice system contributes to increased production; dependence from imports of rice from the lowlands decreases; vegetable growing creates additional sources of food and cash income; maintenance of terraces possible because of economic feasability due to production as well as tourism.

tourism:

Contributes more essentially to local improvements, as financial income from entrance fees goes back to people and especially farmers; sale of handicrafts creates some additional cash income (similar or higher than at present)

handicrafts:

The 'tourist academy' and industry-like enterprises contribute to maintenance of skills and create jobs, they guarantee cultural integrity; wood supply for carving in the longer term is save due to forest plantations

biodiversity of agricultural areas:

Species diversity of irrigated rice fields will be preserved, especially in areas of traditional rice production (including local rice varieties and many - partly endemic - species of the aquatic fauna).

biodiversity of natural areas (mainly mossy forests):

Mossy forests are preserved, including their large number of endangered and/or endemic species; thus an important contribution to the protection of global biodiversity results.

2.4.3 Possibilities for the implementation of an integrated development

Tool for the implementation of such an integrated development could be the declaration of protection and development zones, like the zones defined for Biosphere reserves in the ***MAB-programme*** of the UNESCO:

- Zone 1: core zone (here especially the mossy forests)
- Zone 2: traditonal land-use zone (areas of traditional rice/swidden culture, like e.g. around Banaue and Batad)
- Zone 3: development zone (landuse according to the principles of sustainability; areas with more intensive production of rice or vegetables, e.g. around Kiangan)

Such a scenario only will become true (in the suggested or somehow modified versions), if local people are the driving force for its implementation.

Picture 46:
Intercropping fields (rice - sweet potato) in the sweet potato stage (Bay-Yo, Mt. Province, March 1997)

SUMMARY

Rice Terraces of Ifugao (N-Luzon, Philippines) - Conflicts of Landuse and Environmental Conservation

(Summary of the major findings of a scientific students' excursion in 1997)

In March 1997 a group of 25 scientists and students conducted research on some central aspects of the Ifugao Rice Terraces, focussing on possibilities of future development. This report contains a general introduction into the area and a short overview of German research activities throughout the last 15 years. Detailed results of our investigations are presented below. The last chapter deals with scenarios for the future development of this unique cultural landscape, which is inscribed in the World Convention of UNESCO since 1995. To highlight the most important aspects we will present key statements in this summary:

Agriculture:

- The rice terrace landscapes of Ifugao are one of the most outstanding examples of the interaction between man and the sensible environment of high mountainous regions all over the world.
- **Irrigated rice terraces are well adapted and the most sustainable way of land use** in the area (low nutrient losses, low external inputs).
- Other forms of agriculture are more difficult to manage and put a high risk on the fragile landscape. Options for agricultural development are limited and should be applied only in selected areas.
- To improve cash income a marketing system for local rice varieties could be a solution.
- For increasing yields an introduction of a second growing season of irrigated rice should be possible in a sustainable way, especially at lower elevations.

Forests:

- Irrigated rice terraces of Ifugao depend on the forested watersheds of the Mt. Pulis - Mt. Amuyao area as most irrigation water as well as drinking water originates in this area.
- The **forests have to be protected** to guarantee **water supply** for any kind of agriculture, to prevent **erosion**, to preserve the unique **biodiversity** of the mossy forests.

Tourism:

- **Irrigated terraces are the most important prerequisite for any kind of tourism in the region**.
- In the long-term only a combination of "**high quality" tourism** (like for example ecotourism), for tourist who stay for longer periods, with a somewhat more intensive short-term tourism in selected areas seems feasible.
- **Mass tourism will deplete most of the natural as well as cultural resources** of Ifugao in a rather short time, as experience from many other areas of the world has shown.

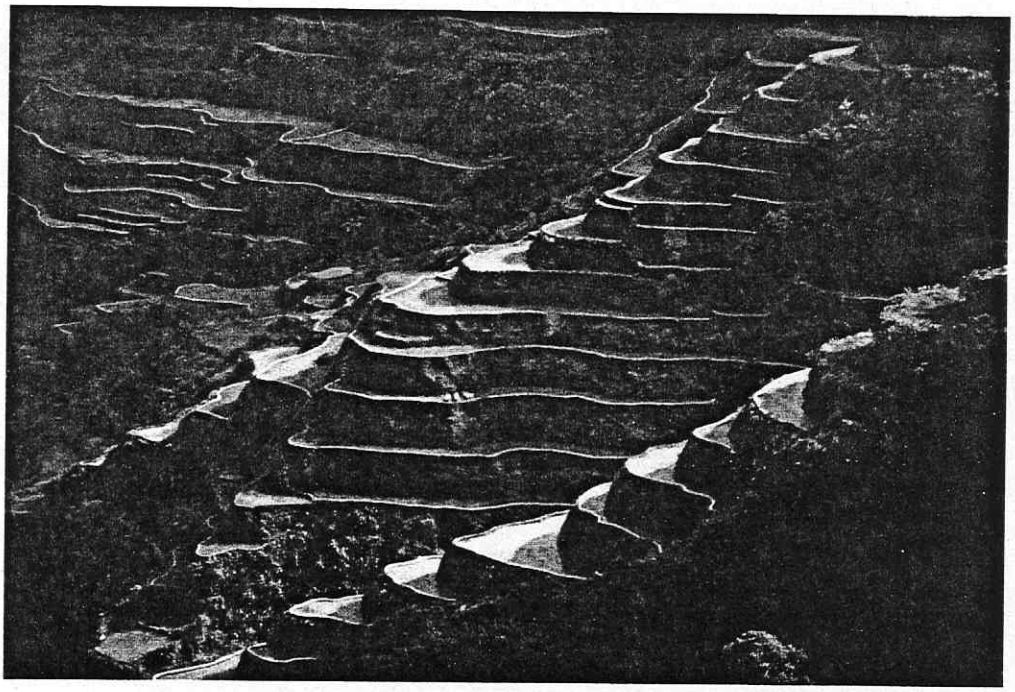
Social and further economic aspects:

- To **create cash income** for people, and thus make also the younger ones stay in the area, options for industrial activities have to be carefully evaluated. A kind of woodcarving industry with replantation forests in the lowlands, production of cash crops for the market, combined with touristic activities could be possibilities in this direction.
- Income from such activities has to stay in the area and farmers have to be given a chance to participate in these, as the uniqueness of the region is based on the rice farmers, who maintain the scenic terraces.
- **Skills and knowledge** of Ifugao could at least partly be preserved and valued by marketing of traditional products out of carving, weaving, rice growing (traditional varieties as a speciality in restaurants).

Integrated development

Basis for the implementation of an integrated development could be the declaration of a Biosphere Reserve with zones, as defined by the ***MAB-programme*** of the UNESCO:

- Zone 1: core zone (here e.g. the mossy forests)
- Zone 2: traditonal land-use zone (areas of traditonal rice/swidden culture, like e.g. around Banaue and Batad)
- Zone 3: development zone (principles of sustainability; areas with more intensive production of rice or vegetables, e.g. around Kiangan)



Picture 47: Stairway to the sky (Banaue, near viewpoint, 1988)

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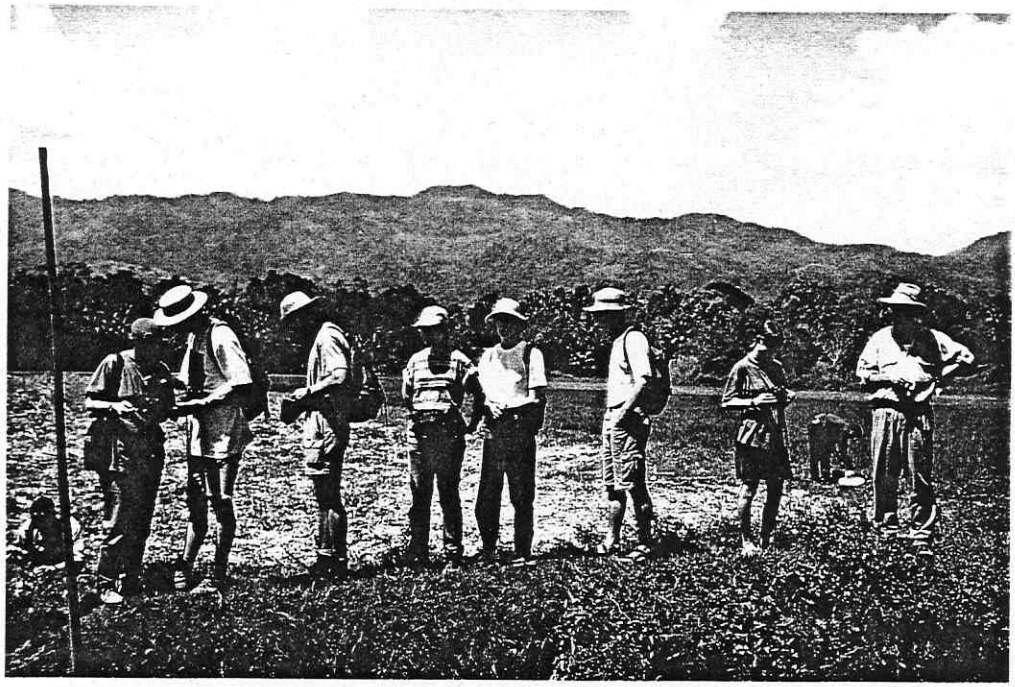
Finally, we thank all the ones, who followed our invitation to the public presentation of our results at the end of the excursion. This was one of the most important parts of our work, and we hope that for some of the people of Ifugao it was worthwhile attending.



Picture 48: Field work in Lawig (March, 1997)

Picture 49: Friendly hosts during our stay in Banaue (March, 1997)

REFERENCES

ACHILLES, T. (1993): Untersuchungen zur Ökologie der Reisterrassen von Banaue (Ifugao, Philippinen): Schadlepidopteren und deren Parasitoide. - PLITS 11(6). W. & S. Koch Verlag, Stuttgart.

ACHILLES, T. & J. SETTELE (1990): Lepidopterologische Forschung auf den Philippinen (1): Zur Ökologie reisschädigender Lepidopteren im traditionellen Landnutzungssystem der Ifugaos in Nord-Luzon (Philippinen). Verh. Westd. Entom. Tag 1989, Düsseldorf, 135-149.

BARRION, A.T. & J.A. LITSINGER (1997): *Dichogaster* nr. *curgensis* MICHAELSEN (Annelida: Octochaetidae): An earthworm pest of terraced rice in the Philippine Cordillera. Crop Protection 16: 89- 93.

BARRION, A.T., G.B. AQUINO & K.L. HEONG (1994): Community structures and population dynamics of rice arthropods in irrigated ricefields in the Philippines. - Philippine Journal of Crop Science 19(2): 73-85.

BASILIO, R. P. & J. A. LITSINGER (1988): Host range and feeding preference of golden apple snail. - IRRN 13:3; 44-45.

BEINLICH, B. & H. PLACHTER (1995): Schutz und Entwicklung der Kalkmagerrasen der Schwäbischen Alb. - Beih. Veröff. Naturschutz Landschaftspflege Bad.-Württ. 83.

BERCZIK, A. (1973): Periodische Aspektenveränderungen der Zoozönosen auf Reisfeldern in Ungarn. - Verh. Internat. Verein Limnol. 18: 1742-1750.

BOTENGAN, K.C. (1976): Bontoc Life-Ways. Manila.

CECAP (Central Cordillera Agricultural Programm, 1995): 1994 Annual Report to the Ifugao Province Public. Banaue.

CERNY, K. (1993): A contribution to the knowledge of the genus *Doliche* WALKER (Lepidoptera: Arctiidae, Lithosiinae) from the Philippines. - Nachr. entomol. Ver. Apollo Frankfurt/Main, N.F., Suppl. 12: 31-97.

CERNY, K. (1995): A contribution to the knowledge of the Arctiidae (Lepidoptera) of the Philippines. - Nachr. entomol. Ver. Apollo Frankfurt/Main, N.F., Suppl. 14: 149-174.

CONKLIN, H.C. (1972): Land Use in North Central Ifugao. A set of eight large-scale (1:5,000) sheet maps. New York: American Geographic Society.

CONKLIN, H.C. (1980): Ethnographic atlas of Ifugao: a study of environment, culture and society in Northern Luzon. New Haven.

DE DATTA, S. K. (1981): Principles and practices of rice production. John Wiley & Sons

DE VILLA, J.G. (1988): E. MASFERRÉ - People of the Philippine Cordillera, Photographs 1934-1956, Devcon I. P. Inc., Manila.

DUMIA, M.A. (1983): The Ifugao World. - New Day Publishers, Quezon City, Philippines; 122 pp.

EDER, J.F. (1982): No water in the terraces: agricultural stagnation and social change at Banaue, Ifugao. Philippine Quarterly of Culture & Society, 10 (3): 101-116.

EL-SHERIF, S.I., A.L. ISA & A.F. LUTFALLAH (1976): Survey of aquatic insects in rice nurseries and fields. - Agr. Res. Rev. 54: 93-98.

ELLENBERG, H (1956): Grundlagen der Vegetationsgliederung. 1.Teil: Aufgaben und Methoden der Vegetationskunde. - Eugen Ulmer, Stuttgart, Germany.

ENGELHARD, B., J. KECK & J. SETTELE (1991): Bean growing in Ifugao province, Philippines: a preliminary survey of socio-economic conditions and plant protection problems in *Phaseolus vulgaris* L. The Philippine Agriculturist 74(4), 471-477.

FRY, H.F. (1983): A history of the Mountain Province. Quezon City.

HALWARTH, M. (1994): The golden apple snail Pomacea canaliculata in Asian rice farming systems: present impact and further threat. - International Journal of Pest Management 40(2): 199-206.

HECKMAN, C.W. (1974): The seasonal succession of species in a rice paddy in Vientiane, Laos - Int. Revue ges. Hydrobiol. 59: 489-507.

HECKMAN, C.W. (1979): Rice field ecology in northeastern Thailand. - Monographiae Biologicae 34. Junk, The Hague.

HEONG, K.L. (1996): Pest management in tropical rice ecosystems: New paradigms for research. In: N. HOKYO & G. NORTON (eds.): Proc. Int. Workshop on Pest Management Strategies in Asian Monsoon Agroecosystems. Kyushu National Agric. Expt. Station, Min. Agric. Forestry and fisheries, Japan: 139-154.

HEONG, K. L., AQUINO, G. B., & A. T. BARRION (1991): Arthropod community structure of rice ecosystems in the Philippines. - Bulletin of Entomological Research 81: 407-416.

HEONG, K. L., AQUINO, G. B., & A. T. BARRION (1992): Population dynamics of plant- and leafhoppers and their natural enemies in rice ecosystems in the Philippines. - Crop Protection 11: 371-379.

HOGENES, W. & C.G. TREADAWAY (1998): The Sphingidae (Lepidoptera) of the Philippines. - Nachr. entomol. Verein Apollo, Frankfurt/Main, N.F., Suppl. 17 (in press).

ITC (OFFICE OF THE PRESIDENT, IFUGAO RICE TERRACE COMMISSION; 1994): The Six- Year Master Plan for the Restoration and Preservation of the Ifugao Rice Terraces. Volume 1. Assessment Report; Volume 2: The Plan.

KAMPEN, J. (1970): Water losses and water balance studies in lowland rice irrigation. - PhD dissertation. - Cornell University, Ithaca, New York

KOCH, W., SAUERBORN, J., KUNISCH, M., & L. PÜLSCHEN (1990): Gedanken zur Agrarökologie in den Tropen und Subtropen. PLITS 8 (2): 109-130.

LOEVINSOHN, M. A., J.A. LITSINGER, & E. A. HEINRICHS (1988): Rice insect pests and agricultural change. - In: M.K. HARRIS & C. E. ROGERS (eds.): *The Entomology of Indigenous and Naturalized Systems in Agriculture*. Westview, Boulder: 161-182

MARGRAF, J. (1988): Faunistische Untersuchungen an Ifugao Reisterrassen in den Philippinen. - PLITS 6 (3)(Part II): 1-142.

MARGRAF, J. & M. VOGGESBERGER (1986): Traditionelle Agrarökosysteme der Ifugaos (Provinz Ifugao, Philippinen) aus biologischer Sicht. - In: H. VOGTMANN, E.

BOEHNKE & I. FRICKE (eds.): *Öko-Landbau - eine weltweite Notwendigkeit.* Alternative Konzepte 50: 306-319 (C.F. Müller, Karlsruhe, Germany).

MARGRAF, J. & M. VOGGESBERGER (1988): Traditionelle Agrarökosysteme der Ifugaos (Provinz Ifugao, Philippinen) aus biologischer Sicht. - PLITS 6 (3)(Part III).

MARTIN, K. (1994): Struktur und Nahrungsnetze aquatischer Reisfeld-Biozönosen im traditionellen System der Ifugao (N-Luzon, Philippinen). PLITS 12(5): 1-124 (W. & S. Koch Verlag, Stuttgart, Germany).

MEY, W. (1990): Neue Köcherfliegen von den Philippinen (Trichoptera). Opuscula zoologica fluminensia 57, 1-19.

MEY, W. (1995): Beitrag zur Kenntnis der Köcherfliegenfauna der Philippinen, I (Trichoptera). - Dtsch. entomol. Z., N.F. 42: 191–209.

MIURA, T., R.M. TAKAHASHI & H. WILDER (1981): The selected aquatic fauna of a rice field ecosystem with notes on their abundance, seasonal distributions and trophic relationships. - Proceedings and papers of the annual conference, California Mosquito and Vector Control Association 49: 68-72.

MPDO (MUNICIPAL PLANNING AND DEVELOPMENT OFFICE; 1994): Socio Economic Profile, Municipality of Banaue, Province of Ifugao (unpublished).

MÜNZINGER ARCHIV (1995): Philippinen, Internationales Handbuch - Länder aktuell. Ravensburg.

NÄSSIG, W.A. & J. SETTELE (Hrsg./eds., 1993): Beiträge zur Kenntnis der Lepidopteren der Philippinen, I. "Philippinen-Sonderheft" Nr. 1 / Contributions to the knowledge of the Lepidoptera of the Philippines, I. "Special Philippine Issue" no. 1. Nachr. entomol. Verein Apollo, Frankfurt/Main, N.F., Suppl. 12. 174pp.

NÄSSIG, W.A. & J. SETTELE (Hrsg./eds., 1995): Beiträge zur Kenntnis der Lepidopteren der Philippinen, II. / Contributions to the knowledge of the Lepidoptera of the Philippines, II. Nachr. entomol. Verein Apollo, Frankfurt/Main, N.F., Suppl. 14. 188 S.

NÄSSIG, W.A. & C.G.TREADAWAY (1988): Bemerkungen über die *Loepa*-Arten der Philippinen (Lepidoptera, Saturniidae). Nachr. ent. Ver. Apollo, Frankfurt, N.F. 9 (3): 159-176.

NÄSSIG, W.A. & C.G. TREADAWAY (1997a): Neue Saturniidaen von den Philippinen (Lepidotpera). - Nachr. entomol. Ver. Apollo, Frankfurt/Main, N.F. 17 (4): 323-366.

NÄSSIG, W.A. & C.G. TREADAWAY (1997b): Eine neue Unterart aus der *selene*-Gruppe der Gattung *Actias* von den Philippinen (Lepidoptera: Saturniidae). - Nachr. entomol. Ver. Apollo, Frankfurt/Main, N.F. 18 (1): 89-100.

NÄSSIG, W.A. & C.G. TREADAWAY (1998a): The Brahmaeidae (Lepidoptera) of the Philippines. - Nachr. entomol. Verein Apollo, Frankfurt/Main, N.F., Suppl. 17 (in press).

NÄSSIG, W.A. & C.G. TREADAWAY (1998b): The Saturniidae (Lepidoptera) of the Philippines. - Nachr. entomol. Verein Apollo, Frankfurt/Main, N.F., Suppl. 17 (in press)

NÄSSIG, W.A., C.G. TREADAWAY & J. SETTELE (Hrsg./eds., 1998): Beiträge zur Kenntnis der Insekten der Philippinen, III. / Contributions to the knowledge of the insects of the

Philippines, III. Nachr. entomol. Verein Apollo, Frankfurt/Main, N.F., Suppl. 17 (in Druck)

NATIONAL STATISTICS OFFICE: Census of Population 1990 and 1995, Lagawe.

NAYLOR, R. (1996): Invasions in agriculture: Assessing the cost of the golden apple snail in Asia. - Ambio 25(7): 443-448.

NORTON, G. A., HOLT, J., HEONG, K. L., CHENG, J., & D. R. WAREING (1991): System analysis and rice pest management. - In: E.A. HEINRICHS & T.A. MILLER (eds.): *Rice Insects: Management Strategies*. Springer, New York: 287-321.

PANCHO, J.V. & S.R. OBIEN (1995): Manual of rice field weeds in the Philippines. - Philippine Rice Research Institut (PhilRice), Manila, Philippines.

PRESTON, D. (1985): Changes in farming and household livelihood strategies in two areas in the Cordillera of Luzon, Philippines, University of Leeds, 1985

REAVELL, P. E. (1980): A study of the diets of some British freshwater gastropods. - Journal of Conchiology 30: 253-271.

REHM, S., & G. ESPIG (1991): The Cultivated Plants of the Tropics and Subtropics. - Verlag Josef Margraf, Weikersheim.

ROGER, P.A., M. VOGGESBERGER & J. MARGRAF (1986): Nitrogen-fixing phototrophs in the Ifugao rice terraces (Philippines). - The Philippine Agriculturist, 69, 4B (Special BGA Issue): 599-609.

ROGER, P.A., K.L. HEONG & P.S. TENG (1991): Biodiversity and sustainability of wetland rice production: role and potential of microorganisms and invertebrates. In: D.L. HAWKSWORTH (ed.): *The Biodiversity of Microorganisms and Invertebrates: Its Role in Sustainable Agriculture* (CAB International): 117-136.

SAUERBORN, E. & J. SAUERBORN (1984): Plants of cropland in Western Samoa with special reference to taro. - PLITS 2 (4).

SCHEFFER, F. & P. SCHACHTSCHABEL (1992): Lehrbuch der Bodenkunde. 13. Auflage, Ferdinand Enke Verlag, Stuttgart.

SCHINTLMISTER, A. (1993): Die Zahnspinner der Philippinen - Ergebnisse zweier Sammelreisen 1988 (Lepidoptera: Notodontidae). - Nachr. entomol. Ver. Apollo Frankfurt/Main, N.F., Suppl. 12: 99-174.

SCHOENLY, K., J.E. COHEN, K.L. HEONG, J.A. LITSINGER, G.B. AQUINO, A.T. BARRION & G. ARIDA (1996): Food web dynamics of irrigated rice fields at five elevations in Luzon, Philippines. - Bulletin of Entomological Reserach 86: 451-466.

SCHRETZMANN, B. & R. BARTHELMES (1996): Banaue gestern - heute - morgen, Eine Studie über das Leben im 8. Weltwunder. - Stuttgart (unpublished report).

SETTELE, J. (1992): Auswirkungen der Intensivierung des Naßreisanbaus auf die terrestrischen Arthropodengemeinschaften philippinischer Reisterrassen. - PLITS 10 (3). Margraf, Weikersheim, Germany.

SETTELE, J. (1993a): Lepidopterological research in the Philippines - a short survey. Nachr. entomol. Verein Apollo, Frankfurt/Main, N.F., Suppl. 12, 12-24.

SETTELE, J. (1993b): Priorities in Lepidoptera conservation: a comparison of the German and the Philippine butterfly faunas. Nachr. entomol. Verein Apollo, Frankfurt/Main, N.F., Suppl. 12, 25-30.

SETTELE, J. (1994): Das Ende der Reisgötter? - Die Bedeutung der Biodiversität für die Terrassenkultur philippinischer Bergvölker. Ökozid*journal* Nr. 7 (I/1994): 33-37.

SETTELE, J. & M. BRAUN (1986): Effects of weed management on insect pests of agricultural crops - with special reference to rice in the Philippines. In: BRAUN, M. & J. SETTELE (eds.): Weed management of upland crops in the Philippines - proceedings of seminars. PLITS 4 (3), 83-100.

SETTELE, J., T. ACHILLES & S. GEISSLER (1990): Lepidopterologische Forschung auf den Philippinen (2): Philippinische Nachtfalter - Erfassungen in den Jahren 1985, 1988 und 1989. - Verh. Westd. Entom. Tag 1989, Düsseldorf, Germany: 150-160.

SETTELE, J., K. MARTIN & T. ACHILLES (1993a): Philippine rice terraces - investigations into the fauna of a traditional agroecosystem and the effects of agricultural change. In: BARTHLOTT, W., C.M. NAUMANN, K. SCHMIDT-LOSKE & K.-L. SCHUCHMANN (eds.): Animal-plant-interactions in tropical environments. Results of the Annual Meeting of the German Society for Tropical Ecology, held at Bonn, February 13-16. 1992, 219-227.

SETTELE, J., K. MARTIN, T. ACHILLES & W. KOCH (1993b): Philippinische Reisterrassen - zur Zukunft einer tropischen Kulturlandschaft. In: KOHLER, A. & R. BÖCKER (Hrsg.): Die Zukunft der Kulturlandschaft. Hohenheimer Umwelttagung 25, 167-173.

SETTELE, J., K. MARTIN, T. ACHILLES & W. KOCH (1995): Philippine rice terraces - conservation of biodiversity by agricultural intensification. In: Bissonette, J.A. & P.R. Krausman (eds.): Integrating people and wildife for a sustainable future. Proceedings of the first International Wildlife Management Congress. The Wildlife Society, Bethesda, Md., 630-632.

SOMMER, M., J. SETTELE, H. MICHELSEN, B. UNMÜSSIG & P. SANDNER (1990): Countdown für den Dschungel - Ökologie und Ökonomie des tropischen Regenwaldes. Stuttgart.

THOMAS, W. (1990): Die Gattung *Lemyra* (Lepidoptera, Arctiidae). Nachr. ent. Ver. Apollo, Frankfurt, Suppl. 9.

TID-ANG, Lourdes D.: The profile of the typical famila of Banaue, Ifugao Province and its implication to education, MS Thesis, Baguio Central University, 1983.

TREADAWAY, C.G. (1995): Checklist of the butterflies of the Philippine Islands (Lepidoptera: Rhopalocera). Nachr. ent. Verein Apollo, Frankfurt/Main, N.F., Suppl. 14, 7-118.

TVO (1990): Trinkwasserverordnung der Bundesrepublik Deutschland; Fassung vom 5.12.1990.

VAN BREEMEN, N., L.R. OLDEMAN, W.J. PLANTIGA & W.G. WIELEMAKER (1970): The Ifugao rice terraces. - In: *Aspects of Rice Growing in Asia and the Americas*. Miscellaneous papers 7, Landbouwhogeschool Wageningen, The Netherlands: 39-73.

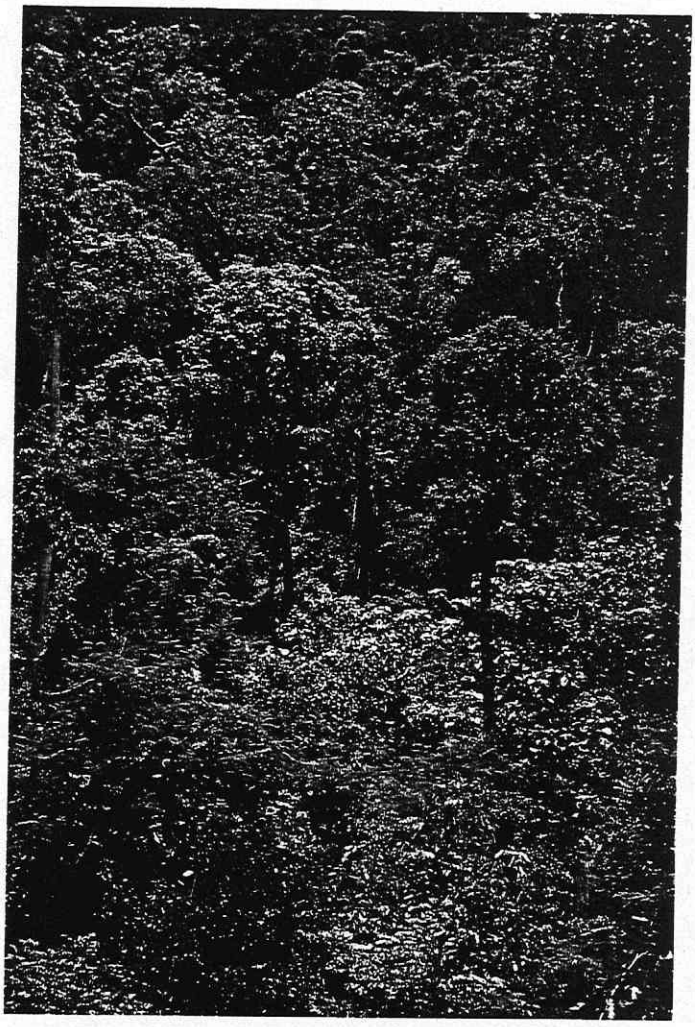
VILLALON, A.F. (1995): The cultural landscape of thr Rice Terraces of the Philippine Cordilleras. In: B. VON DROSTE, H. PLACHTER & M. RÖSSLER (eds.). Cultural Landscapes of Universal Value - Components of a global strategy, 108-113. Gustav Fischer Verlag, Jena, Stuttgart, New York.

VOGGESBERGER, M. (1988): Zur Ökologie der Reisfeldflora verschiedener Höhenstufen in Ifugao (Luzon, Philippinen). - PLITS 6(3) (Part I): pp. 1-145. (Margraf, Weikersheim, Germany)

VON DROSTE, B., H. PLACHTER & M. RÖSSLER (1995): Cultural Landscapes of Universal Value - Components of a global strategy. - Gustav Fischer Verlag, Jena, Stuttgart, New York.

WACKERNAGEL, F.W.H. (1985): Rice for the terraces: cold-tolerant varieties and other strategies for increasing rice production in the mountains of Southeast Asia. Ph.D. thesis, Cornell University.

WAY, M.J. & K.L.HEONG (1994): The role of biodiversity in the dynamics and management of insect pests of tropical irrigated rice - a review. - Bulletin of Entomological Research 84: 567-587.



Picture 50:
Primary lowland forest in the Sierra Madre (Quirino Province, 1998); parts of this forests are inhabited by Ifugao people, who hoped for a better living there; creating alternative income in Ifugao thus also helps to preserve tropical lowland forests, as people are not forced to emigrate

APPENDIX: PROGRAM OF A VISIT AT IRRI

IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE

Program for the Visit of

20 German Students and 4 Supervisors
c/o Prof. J. Sauerborn

20 March 1997, Thursday

1000H	Welcome/briefing (*Auditorium, Chandler Hall*)	**Mr. R.D. Huggan** Head, Information Center
1030H	Audiovisual presentation of the "Rices of IRRI" - an overview	**Mr. M.M. Movillon** Manager Visitors, Exhibition and Conference Services (VECS)
1100H	Tour the IRRI Riceworld	**Self-guided tour**
1200H	Lunch at the Riceland Cuisine	
1300H	Meeting/discussion	**Dr. A. Dobermann** Soil Nutrient Specialist Soil and Water Sciences Division
1400H	Visit to IRRI Experiment Station	**Mr. T. Clemeno** Manager
1445H	Agricultural Engineering Technologies	**Mr. E. Castro** Assistant Engineer
1530H	Visit Phytotron	**Mr. B. Manimtim** Assistant Supervisor
1600H	Visit to Library	**Ms. M. Ramos** Assistant Librarian
1700H	Depart for Manila	

GERSTUD/19mar97

APPENDIX: EXCURSION-ARTICLES IN NEWSPAPERS

Juan B. DAIT Jr.:
ITC bares findings on Banaue (The Baguio CITY DIGEST; March 16, 1997)

The Baguio
CITY DIGEST

March 16, 1997

ITC bares findings on Banaue

THE 24-MAN German research team who have been conducting field studies on the conditions of the Banaue Rice Terraces will be presenting their findings to the Ifugao Terraces Commission (ITC) and local officials and farmer-leaders of Banaue on March 17 at the Banaue Hotel, Ifugao province.

The research team is headed by Dr. Harald Plachter of the University of Marburg. He is the German delegate to the UNESCO World Heritage Center. Other team members are Professors Joachim Saverbarn of the University of Giessen, Donj Vetterlein of the University of Cottbus, Konrad Martin of the University of Hohenheim and Josef Settele of the German Center for Environmental Research. **

APPENDIX: EXCURSION-ARTICLES IN NEWSPAPERS

Juan B. DAIT Jr.:
Team readies Ifugao findings (MANILA BULLETIN; March 17, 1997)

THE EXPONENT OF PHILIPPINE PROGRESS SINCE 1900
MANILA BULLETIN
THE NATION'S LEADING NEWSPAPER
MONDAY, MARCH 17, 1997

Team readies Ifugao findings

By JUAN B. DAIT JR.

BANAUE, Ifugao — A 24-man research team from the academe of Germany who is conducting field researches in the terraces areas here will present their findings to the Ifugao Terraces Commission (ITC) and local officials and farmer-leaders on March 17 at the Banaue Hotel.

The research group is headed by Dr. Harald Plachter of the University of Marburg and German delegate to the UNESCO World Heritage Center.

The other research leaders are Professors Joachim Savebarn of the University of Giessen, Donj Vetterlein of the University of Cottbus, Konrad Martin of the University of Hohenhein and Josef Settele of the German Center for Environmental Research in Leipzig.

Divided into groups of six representing various research disciplines, the German researchers started field work last March 2. Their areas of research work include watersheds, field nutrients, golden apple snail, floristic inventory and socio-economics.

In a conference with officials of the ITC at the Banaue Hotel, the German researchers agreed to furnish the Philippine government with the results of their two-week research work, including their recommendations to address current problems encountered by Ifugao terraces farmers.

From Ifugao, the research group will proceed to the International Research Institute (IRI) in Los Baños and the University of the Philippines (UP) in Los Baños for the presentation of their Banaue research studies to the two institutions.

APPENDIX: EXCURSION-ARTICLES IN NEWSPAPERS

Josef SETTELE:
Bericht über eine Projektstudie in philippinischen Reisterrassen
(ATSAF-Circular 50/97: 43-45)

Deutsche Forschungsinstitutionen/Organisationen

UFZ Leipzig-Halle/Universitäten Marburg, Giessen, Cottbus und Hohenheim: Bericht über eine Projektstudie in philippinischen Reisterrassen im Rahmen eines interdisziplinären Praktikums, 28.02. - 22.03.97 in Banaue, Ifugao/Philippinen

(von Dr. Josef Settele, UFZ Leipzig-Halle)

Im März 1997 wurde vom UFZ Leipzig-Halle und den Universitäten Marburg, Giessen, Cottbus und Hohenheim in Banaue, Ifugao, Nord-Luzon, Philippinen ein 3-wöchiges interdisziplinäres Praktikum durchgeführt. Die Veranstaltung lief im Rahmen der Lehre an diesen Universitäten und ging von einer Seminarveranstaltung an der Universität Marburg aus, die den Titel „Aspekte des Konfliktfeldes Landwirtschaft und Naturschutz in den Tropen und Subtropen" trägt.

An dem Praktikum beteiligten sich 19 Studenten und sechs Betreuer. Folgende Studiengänge und Schwerpunkte waren vertreten:
- Agrarwissenschaften (Schwerpunkte: Pflanzenproduktion, Agrarökologie, Umweltsicherung, menschliche Ernährung, Agrarsoziologie);
- Biologie (Schwerpunkte: Naturschutz, Botanik, Zoologie) und
- Umweltingenieurwissenschaften (Schwerpunkt: Bodenschutz).

Untersuchungsregion: Ifugao/Philippinen

Am Beispiel der seit jeher traditionell bewirtschafteten Reisterrassen der Provinz Ifugao (Nord-Luzon/Philippinen) konnten vor Ort die Aspekte des genannten Konfliktfeldes konkret erfahren und bearbeitet werden. Die Region wurde ausgewählt, da sich vier der Betreuer zum Teil mehrere Jahre dort bereits für eigene Forschungsarbeiten aufhielten. Diese Region kann als der Inbegriff für eine Kulturlandschaft gelten, die komplett von Menschenhand geformt wurde.

Wie viele von solcher Nutzung geprägte Regionen, wird auch die Provinz Ifugao in der nahen Zukunft einem drastischen Wandel unterliegen. Die weltweit bekannten Probleme, angefangen von starker Bevölkerungszunahme über Landflucht hin zum Verlust traditionellen Wissens und genetischer Ressourcen, finden auch dort ihren Niederschlag. Mit der Intention, diese Landschaft auch für die Nachwelt zu erhalten, wurden die Reisterrassen von Nord-Luzon im Dezember 1995 in die Liste der Weltkulturerbestätten der UNESCO aufgenommen. Dies ist als eher symbolischer erster Schritt zu werten, zumindest auch auf diese Region aufmerksam zu machen (zumal die generelle Situation der UNESCO keine finanziellen Unterstützungen zuläßt). Auswege aus dem zu erwartenden Dilemma werden beispielsweise im Tourismus (der dort bereits jetzt eine gewisse Rolle spielt) oder in der Veränderung landwirtschaftlicher Anbausysteme gesehen.

Aufgaben/Fragestellungen für die Arbeit vor Ort

Zu ermitteln, welche Folgen derartige Entwicklungen für die Einwohner und die Ökosysteme dieser Region haben könnten, war ein Ziel der studentischen Gruppenarbeit im Rahmen der Fallstudie.

Angegangen wurde dies durch Arbeit in 5 Gruppen, die sich den folgenden Themen zuwandten:

- ***Landnutzungsveränderung***
  Kartierung von Kompartimenten wie z.B.: Reis- und Gemüsefeldern, Brachen, Waldbereichen und Beurteilung der Veränderung der Verteilung in den letzten 40 Jahren; *Ziel*: Beurteilung der Auswirkung neuer Einkommensquellen auf die Landnutzung. *Ergebnis*: Gemüseanbau geht zugunsten des Tourismus stark zurück, auch Reisfelder abnehmend (Arbeitskräfte!);
- ***Botanische Inventarisierung***
  Pflanzenaufnahmen in Gemüsefeldern und deren Brachen; *Ziel*: Beurteilung von Veränderungen in der Landnutzung bezüglich Biodiversität und Populationsdynamik von Schaderregern von Kulturpflanzen; Untermauerung des ersten Themas. *Ergebnis*: zunehmende Sukzession führt zu Artenverarmung auf der Fläche; Bedeutung für Populationsdynamik noch nicht ausgewertet;
- ***Stickstoffkreislauf***
  Stickstoffanalysen in Reisfeldern und Fließgewässern; *Ziel*: Ermittlung von Nährstoffeinträgen in die Reisfelder über das Wasser; Auswirkungen starker Erhöhung von Touristenzahlen im Hinblick auf Abwasserproblematik. *Ergebnis*: Stickstoffzufuhr über Wasserkörper vernachläßigbar, Versorgung der Reispflanzen erfolgt überwiegend durch Gründüngung, geringe Belastung der Gewässer durch anorganischen Stickstoff selbst im Ortsbereich.
- ***Neu eingewanderte Schadschnecke***
  Analyse der Bedeutung einer im Tiefland seit längerem als Schädling bekannten Schnecke. *Ziel*: Beurteilung der Relevanz für das System und damit der Bekämpfung. *Ergebnis*: regional als Reisschädling von geringerer Bedeutung; Einfache Bekämpfungsmöglichkeiten zur Verminderung von Ertragsverlusten konnten aufgezeigt werden.
- ***Sozioökonomische Studien***
  Einschätzung der derzeitigen Lage durch die Einwohner. *Ziel*: Ermittlung von Präferenzen und Angaben zu den drängendsten Problemen. *Ergebnis*: offizielle Statistiken und Angaben aus der Bevölkerung klaffen bereits bei Basiszahlen weit auseinander, so sind z.B. keine brauchbaren Angaben zu den Reiserträgen ermittelbar; Ernährungslage vor Ort undurchsichtig, damit Grundlage für geplante Maßnahmen wie z.B. Ertragssteigerung sehr vage.

Die genannten Ergebnisse haben bislang nur vorläufigen Charakter, da sich alle Gruppen derzeit in der Phase der Nachbereitung befinden. Ein noch zu erstellender (englischsprachiger) Bericht soll im Spätsommer fertig sein und dann auch den Entscheidungsträgern und interessierten Einzelpersonen wie Organisationen vor Ort zur Verfügung gestellt werden.

Erfahrungen vor Ort

Die Forschungsaktivitäten der interdisziplinären Gruppe wurden von den Einwohnern und den lokalen Behörden mit regem Interesse verfolgt und fanden auch in der philippinischen Presse ihren Niederschlag. Eine Vor-Ort-Präsentation der vorläufigen Ergebnisse vor Farmern und Vertretern verschiedener Organisationen rundete den Aufenthalt ab und war für die meisten Studenten eine völlig neue Erfahrung. Dies da sie zum einen ihre Ergebnisse auf Englisch präsentierten und zum anderen, da sie sehr offene und diskussionsfreudige Zuhörer hatten, die von dem Vorgestellten direkt betroffen sind, weshalb der ansonsten gewohnte universitäre Spielwiesencharakter nicht gegeben war.
Ein sonst nicht gegebenes Maß an direkter Praxisrelevanz der eigenen Aussagen veranlaßte zu einer selbstkritischen und tiefergehenden Vorbereitung dieser Veranstaltung. Somit war die Zeit der Freilandarbeit stets auf ein bestimmtes Ziel hin orientiert, was zu konsequentem Herangehen aus eigenem Antrieb veranlaßte.
Nicht zuletzt die Einordnung der eigenen Ergebnisse in den landschaftsökologischen Kontext ermöglichte es, die Wichtigkeit der eigenen Detailarbeit zu bewerten und im Gesamtrahmen zu relativieren. Diese Einordnung erfolgte anhand von Szenarien der zukünftigen Entwicklung der Region (Tourismus, Reisanbau und dessen Intensivierung, gänzlich neue landwirtschaftliche Systeme, Biosphärenreservat als Integrationsszenario).

Zur Abrundung des Praktikums wurden an einigen Tagen benachbarte Regionen mit ähnlichen Anbausystemen ebenso wie einige der noch verbliebenen Bergregenwälder besucht. Dies war zur Einordnung der eigenen Arbeiten von besonderer Relevanz.
Zum einen konnte man das Spektrum der Varianten des Reis- und Gemüseanbaus der Region erfahren, woraus Vorschläge für weitere Entwicklungsoptionen für die untersuchte Zielregion ableitbar sind. Zum anderen konnte so die Bedeutung des Regenwalderhalts für das dortige Anbausystem deutlich vor Augen geführt werden. Die noch geschlossenen Regenwälder auf den Bergen der Region garantieren eine kontinuierliche Wasserversorgung und sind so für die Reisterrassen wie auch für die Trinkwasserversorgung der lokalen Bevölkerung essentiell. Um so tragischer wurde daher auch die Tatsache empfunden, daß Tag für Tag große Flächen dieser einzigartigen Ökosysteme durch unsachgerechte Methoden des Straßenbaus unwiederbringlich verloren gehen. Hier könnte alleine durch technisch aufwendigere (und langfristig nicht teurere) Vorgehensweisen große Regenwaldbereiche vor der Vernichtung bewahrt werden.

Besuch von Einrichtungen der Agrarforschung

Zur Einstimmung in Thema und Region wurde am ersten Exkursionstag das nationale philippinische Reisforschungszentrum PhilRice in Maligaya besucht. Abschluß des gesamten Praktikums bildete ein Tag am IRRI, wo durch ein ganztägiges Programm ein guter Überblick über die Aktivitäten eines internationalen Agrarforschungszentrums gewonnen werden konnte.

Bewertung der Lehrveranstaltung

Insgesamt war diese Form der Lehrveranstaltung, der eine 1½-jährige intensive Vorbereitung durch Vorlesungen und Seminare vorangegangen war, nicht nur eine gelungene Abwechslung vom Universitätsalltag in exotischem Ambiente, sondern ermöglichte eine effiziente Anwendung des bislang erworbenen theoretischen Wissens. Durch den Austausch mit den anderen Disziplinen war das Denken in Zusammenhängen bei der Analyse eines Systems für viele erstmals konkret geworden. Nach Einschätzung des beteiligten Lehrpersonals wird durch eine derartige Vorgehensweise in kürzester Zeit mehr Wissen vermittelt als in vielen Einzelveranstaltungen (vor allem Einzelvorlesungen) an den Universitäten, weshalb in derartigen Unternehmungen - kombiniert mit den bereits erwähnten Vorzügen - eine Möglichkeit gesehen werden kann, der universitären Lehre eine neue Qualität zu geben.

Aufgrund der positiven Erfahrungen wird derzeit für das kommende Jahr eine vergleichbare Fallstudie in einer anderen Zielregion (voraussichtlich südliches Afrika) vorgeplant. Im Unterschied zum zurückliegenden Praktikum soll hierbei auf eine noch stärkere Beteiligung der Sozialwissenschaften geachtet werden. Ebenso ist vorgesehen, Studenten des Gastlandes zu integrieren, was sich bei der zurückliegenden Veranstaltung aufgrund einer kurzfristigen Absage dann leider nicht mehr realisieren ließ.

Für weitere Informationen wenden Sie sich an:
Dr. Josef Settele
UFZ-Umweltforschungszentrum Leipzig-Halle
Permoserstr. 15
D-318 Leipzig
Tel: 0341/235-2003
Fax: 0341/235-2534
E-Mail: settele@pro.ufz.de

APPENDIX: EXCURSION-ARTICLES IN NEWSPAPERS

Carola BUSEMANN, Christoph DIEFENBACH, Eva HEUSINGER, Christian OCHS, Nicolas WALTHER & Katrin WEBER:
Auf den Reisterrassen von Ifugao (Uni-Forum, Giessen, 4/97: 4. July 1997)

Ausgabe 4 · 4. Juli 1997 Seite 7

Später Nachmittag auf den Philippinen an den Reisterrassen von Ifugao. Schon vor 2.000 Jahren wurden die ersten Reisfelder an Steilhängen angelegt – sie sind inzwischen von der Unesco zu einem Weltkulturerbe erklärt worden. Foto: Kerstin Wellhausen

Auf den Reisterrassen von Ifugao

Philippinisches Weltkulturerbe im Umbruch

Auf den Reisterrassen von Ifugao

Philippinisches Weltkulturerbe im Umbruch

Im März reisten 20 Studierende und fünf Betreuer auf die Philippinen, um für drei Wochen die Theorie mit der Praxis zu vertauschen. Sie wollten im Rahmen einer interdisziplinären Projektstudie »Aspekte des Konfliktfeldes Naturschutz und Landwirtschaft am Beispiel der Reisterrassen in Banaue (Ifugao-Region)« untersuchen.

Vor circa einem Jahr begannen wir mit den Vorbereitungen für die Studie. Wir organisierten mehrere Treffen in Marburg und Gießen, die es ermöglichten, bereits frühzeitig näheren Kontakt zu den Mitreisenden aufzubauen, was sich dann auf den Philippinen als sehr positiv herausstellte. Der besondere Anreiz für uns war die Chance, einen Blick aus dem »Elfenbeinturm« zu wagen und in praxisorientierten und interdisziplinären Arbeitsgruppen das bisher erworbene Wissen aktiv einzubringen. Sicherlich lockte auch der Reiz des Fremden und die Möglichkeit, eine zweitausend Jahre alte Kulturlandschaft kennenzulernen.

Die Teilnehmer und Teilnehmerinnen der Exkursion auf die Philippinen gehörten verschiedensten Universitäten und Fachrichtungen an, angefangen von Agrarwissenschaften und Umweltsicherung sowie Ökotrophologie über Biologie/Naturschutz bis hin zum Umweltingenieurswesen. Organisiert und betreut wurde die Projektstudie von Prof. Joachim Sauerborn vom Wissenschaftlichen Zentrum Tropeninstitut der Universität Gießen, Dr. Josef Settele vom Umweltforschungszentrum Leipzig/Halle, Prof. Harald Plachter vom Fachbereich Biologie in Marburg, Dr. Doris Vetterlein vom Institut für Bodenschutz und Rekultivierung der TU Cottbus, Dr. Conrad Martin und Ralf Barthelmes von der Universität Hohenheim. Finanzielle Unterstützung gab es von Seiten der Universitäten Gießen und Marburg sowie vom Stifterverband für die deutsche Wissenschaft.

Das Untersuchungsgebiet Banaue liegt in einer Höhe von etwa 1.200 Meter über dem Meeresspiegel und ist Ausgangspunkt für das sogenannte »Achte Weltwunder«, die Reisterrassen von Ifugao. Banaue liegt etwa 300 km nördlich von Manila in der Zentral-Cordillera, was einer Tagesreise entspricht. In dieser Bergregion wurden vor 2000 Jahren Reisterrassen an Steilhängen mit oft mehr als zehn Prozent Steigung errichtet, die bis heute in Monokultur und traditioneller Weise bewirtschaftet werden. In dieser einzigartigen Kulturlandschaft wird der Reis auch heute noch ohne den Einsatz von chemischen Pflanzenbehandlungsmitteln und mineralischem Dünger angebaut. Der Erhalt der Terrassenlandschaft ist zunehmend gefährdet, wenn sich zum Beispiel die jüngeren Generationen vom leicht verdienten Peso in den Tourismus locken lassen oder in die Großstädte abwandern.

Welche Auswirkungen diese veränderte Situationen auf das Agrarökosystem, die Natur und den Menschen haben und welche Perspektiven für die Zukunft der Region vorstellbar wären, stand im Mittelpunkt unserer Projektstudie. Um die Thematik von den verschiedensten Seiten beleuchten zu können, bildeten wir fünf interdisziplinäre Arbeitsgruppen. Eine Arbeitsgruppe beschäftigte sich mit der Entwicklung der Landnutzung, indem sie 30 Jahre altes Kartenmaterial durch eigene Kartierungen aktualisierte und Veränderungen dokumentierte. Zur Klärung der Frage, wie das gegebene Reisökosystem funktioniert, befaßte sich eine weitere Gruppe mit dem Nährstoffhaushalt und analysierte vornehmlich die Nährstoffsituation von Wasser und Boden in den Terrassen. Eine weitere Gruppe beschäftigte sich mit der Frage, was mit brachliegenden Reisfeldern oder nach Hangrutschungen passiert und erfaßte dazu auf diesen Flächen die Vegetation. Die Verbreitung und Bedeutung von jüngst eingeschleppten Schnecken (Golden Apple Snail) im Reisfeld war Gegenstand intensiver faunistischer Erhebungen. Abgerundet wurden die Untersuchungen durch eine Erfassung des sozio-ökonomischen Umfeldes mittels Befragungen, Gruppengesprächen und Interviews mit sogenannten Schlüsselpersonen.

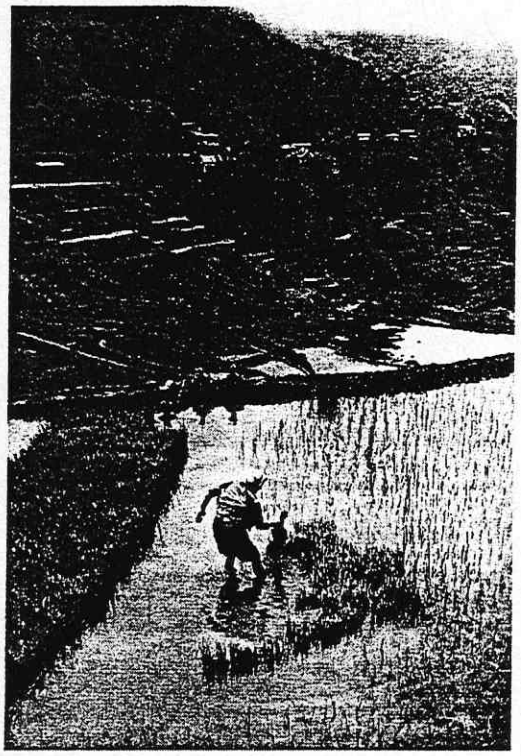
Regelmäßige Treffen in der Gesamtgruppe dienten dazu, die neugewonnenen Informationen der Kleingruppen in englischer Sprache auszutauschen und die übergeordneten Themen, wie die Auswirkungen auf das Reisökosystem, die Veränderung der Landnutzung und die sich daraus ergebenden Zukunftsszenarien gemeinsam zu diskutieren. Eine besondere Herausforderung für die Studenten war die abschließende Präsentation der Ergebnisse vor den örtlichen Entscheidungsträgern und Landwirten mit einer anschließenden Diskussion. Fraglich bleibt jedoch, ob die Begeisterung des Publikums gegen Ende der Darstellung auf den Resultaten der Untersuchungen oder auf dem von den Studierenden selbst gebrauten Reiswein beruhte.

Neben den Arbeiten in den Kleingruppen unternahmen wir einige Tagesexkursionen. Unvergeßlich war für uns die Möglichkeit, die artenreiche Vegetation eines primären Bergnebelwaldes kennenzulernen. Gleichzeitig konnte wir eindrücklich dessen Funktion als Wasserreservoir für das Reisökosystem erleben. Beeindruckend war ebenfalls, daß durch den Besuch auf einer Farm bei Lawic im Tiefland die enormen Unterschiede der Naßreisanbausysteme der Philippinen erkennbar wurden. Vertieft werden konnten diese Eindrücke durch die Besichtigung des Internationalen Agrarforschungsinstitut IRRI in Los Baños, das für die Züchtung und den Erhalt des Genmatrials sowie für die wissenschaftliche Begleitforschung der Reisökosysteme vor allem in Asien zuständig ist.

Besonders hervorzuheben ist der gute Kontakt zur Bevölkerung in Banaue, die mit ihrer Gastfreundschaft und Herzlichkeit eine fruchtbare Zusammenarbeit ermöglichte, was gegenüber einer solch großen Gruppe nicht selbstverständlich ist und durch die schon vorher bestehenden Kontakte einiger Organisatoren erleichtert wurde. Nicht minder wichtig für das Gelingen der Projektstudie war die gute Betreuung während des Aufenthaltes als auch die Organisation vor Ort. Ein bleibender Eindruck wird für alle Beteiligten die interdisziplinäre Teamarbeit sowie die rege Gruppendynamik sein.

Es wäre wünschenswert, daß solche Exkursionen wie in diesem Rahmen weitere Unterstützung finden und auch in den nächsten Jahren realisiert werden.

Carola Busemann, Christoph Diefenbach, Eva Heusinger, Christian Ochs, Nicolas Walther und Katrin Weber



Die Aufgaben im Reisanbau sind streng nach Geschlechtern getrennt: Eine Frau pflanzt Setzlinge im Saatbeet so um, daß sie mehr Platz und Licht erhalten.

Foto: Kerstin Wellhausen

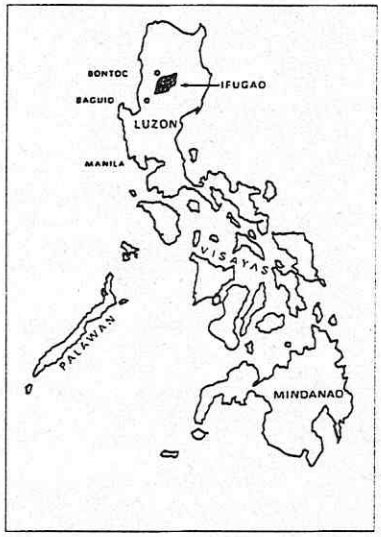
APPENDIX: EXCURSION-ARTICLES IN NEWSPAPERS

Josef SETTELE:
Oryza sativa - der Anbau einer der ältesten Kulturpflanzen im Mittelpunkt eines ungewöhnlichen Praktikums (UFZeitung, Leipzig, 1/1997)

Oryza sativa - der Anbau einer der ältesten Kulturpflanzen der Menschheitsgeschichte im Mittelpunkt eines ungewöhnlichen Praktikums

Vorgeschichte
Im März 1997 wurde vom UFZ und den Universitäten Marburg, Cottbus, Giessen und Hohenheim ein 3wöchiges interdisziplinäres Praktikum auf den Philippinen durchgeführt. Die Veranstaltung lief im Rahmen der Lehre an diesen Universitäten und ging aus von einer Seminarveranstaltung, die von Dr. Joseph Settele, PB Naturnahe Landschaften und Ländliche Räume, im Rahmen seines Lehrauftrages an der Universität Marburg geleitet wird und den Titel trägt:
„Aspekte des Konfliktfeldes Landwirtschaft und Naturschutz in den Tropen und Subtropen".
Am Praktikum beteiligten sich 19 Studenten aus verschiedenen Fachrichtungen (Agrarwissenschaften, Biologie, Umweltingenieurwissenschaften) und sechs Betreuer (siehe Seite 14).

Untersuchungsregion: Die Reisterrassen der Provinz Ifugao
Am Beispiel der seit jeher traditionell bewirtschafteten Reisterrassen der Provinz Ifugao (Nord-Luzon/Philippinen) konnten



Die Philippinen, eine mehr als 7000 Inseln umfassende Inselgruppe Südostasiens

vor Ort die Aspekte des Konfliktfeldes Landwirtschaft und Naturschutz konkret erfahren und bearbeitet werden. Die Region wurde ausgewählt, da sich 4 der Betreuer z.T. mehrere Jahre dort bereits für eigene Forschungsarbeiten aufhielten. Diese Region kann als der Inbegriff für eine Kulturlandschaft gelten, die komplett von Menschenhand geformt wurde.
Wie viele von solcher Nutzung geprägte Regionen, wird auch die Provinz Ifugao in der nahen Zukunft einem drastischen Wandel unterliegen. Die weltweit bekannten Probleme, angefangen von starker Bevölkerungszunahme über Landflucht hin zum Verlust traditionellen Wissens und genetischer Ressourcen, finden auch dort ihren Niederschlag. Mit der Intention, diese Landschaft auch für die Nachwelt zu erhalten, wurden die Reisterrassen von Nord-Luzon im Dezember 1995 in die Liste der Weltkulturerbestätten der UNESCO aufge-


Das Dorf Bangaan im Zentrum der Terrassenlandschaft. Die Wälder der umliegenden Berge garantieren eine kontinuierliche Wasserversorgung.

nommen. Dies ist als eher symbolischer erster Schritt zu werten, zumindest auch auf diese Region aufmerksam zu machen (zumal die generelle Situation der UNESCO keine finanziellen Unterstützungen zuläßt).
Auswege aus dem zu erwartenden Dilemma werden beispielsweise im Tourismus (der dort bereits jetzt eine gewisse Rolle spielt) oder in der Veränderung landwirtschaftlicher Anbausysteme gesehen.

Ergebnisse der Freilandarbeit
Zu ermitteln, welche Folgen derartige Entwicklungen für die Einwohner und die Ökosysteme dieser Region haben könnten, war ein Ziel der studentischen Aktivitäten. Angegangen wurde dies durch Arbeit in fünf Gruppen, die sich den folgenden Themen zuwandten und deren Ergebnisse kurz genannt seien:
Landnutzungsveränderung
Es bestätigte sich, daß der Gemüseanbau zugunsten des Tourismus stark zurückgeht, auch die Anzahl der Reisfelder ist abnehmend (Arbeitskräfte!).
Botanische Inventarisierung
Die zunehmende Sukzession führt zu Artenverarmung auf der Fläche; die Bedeutung für Populationsdynamik wurde noch nicht ausgewertet.
Stickstoffkreislauf
Die Stickstoffzufuhr über Wasserkörper ist vernachlässigbar, die Versorgung der Reispflanzen erfolgt überwiegend durch Gründüngung. Es herrscht eine geringe Belastung der Gewässer durch anorgischen Stickstoff, selbst im Ortsbereich.
Neu eingewanderte Schadschnecke
Als Reisschädling ist sie regional von geringerer Bedeutung. Es konnten einfache Bekämpfungsmöglichkeiten zur Verminderung von Ertragsverlusten aufgezeigt werden.
Sozioökonomische Studien
Offizielle Statistiken und Angaben aus der Bevölkerung klaffen bereits bei Basiszahlen weit auseinander, so sind z.B. keine brauchbaren Angaben zu den Reiserträgen ermittelbar. Die Ernährungslage vor Ort ist undurchsichtig, damit ist die Grundlage für geplante Maßnahmen, wie z.B. Ertragssteigerung, sehr vage.

Erfahrungen vor Ort
Die Forschungsaktivitäten der interdisziplinären Gruppe wurden von den Einwohnern und den lokalen Behörden mit regem Interesse verfolgt und fanden auch in der philippinischen Presse ihren Niederschlag. Eine Vor-Ort-Präsentation der vorläufigen Ergebnisse vor Farmern und Vertretern verschiedener Organisationen rundete den Aufenthalt ab und war für die meisten Studenten eine völlig neue Erfahrung. Dies, da sie zum einen ihre Ergebnisse auf Englisch präsentierten und zum anderen, da sie sehr offene und diskussionsfreudige Zuhörer hatten, die von dem Vorgestellten direkt betroffen sind, weshalb der ansonsten gewohnte universitäre Spielwiesencharakter nicht gegeben war.
Ein sonst nicht gegebenes Maß an direkter Praxisrelevanz der eigenen Aussagen veranlaßte zu einer selbstkritischen und tiefergehenden Vorbereitung dieser Veranstaltung. Somit war die Zeit der Freilandarbeit stets auf ein bestimmtes Ziel hin orientiert, was zu konsequentem Herangehen aus eigenem Antrieb veranlaßte.

Detailausschnitt der Terrassenlandschaft bei Banaue

Nicht zuletzt die Einordnung der eigenen Ergebnisse in den landschaftsökologischen Kontext ermöglichte es, die Wichtigkeit der eigenen Detailarbeit zu bewerten und im Gesamtrahmen zu relativieren. Diese Einordnung erfolgte anhand von Szenarien der zukünftigen Entwicklung der Region (Tourismus, Reisanbau und dessen Intensivierung, gänzlich neue landwirtschaftliche Systeme, Biosphärenreservat als Integrationsszenario).
Zur Abrundung des Praktikums wurden an

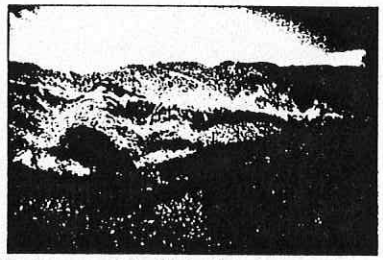
einigen Tagen benachbarte Regionen mit ähnlichen Anbausystemen sowie einige der noch verbliebenen Bergregenwälder besucht. Dies war zur Einordnung der eigenen Arbeiten von besonderer Relevanz.
Zum einen konnte man das Spektrum der Varianten des Reis- und Gemüseanbaus der Region erfahren, woraus Vorschläge für weitere Entwicklungsoptionen für die untersuchte Zielregion ableitbar sind. Zum anderen konnte so die Bedeutung des Regenwalderhalts für das dortige Anbausystem deutlich vor Augen geführt werden. Die noch geschlossenen Regenwälder auf den Bergen der Region garantieren eine kontinuierliche Wasserversorgung und sind so für die Reisterrassen wie auch für die Trinkwasserversorgung der lokalen Bevölkerung essentiell. Um so tragischer wurde daher auch die Tatsache empfunden, daß Tag für Tag große Flächen dieser einzigartigen Ökosysteme durch unsachgerechte Methoden des Straßenbaus unwiederbringlich verloren gehen. Hier könnten alleine durch technisch aufwendigere (und langfristig nicht teurere) Vorgehensweisen große Regenwaldbereiche vor der Vernichtung bewahrt werden.

Besuch von philippinischen Forschungszentren

Die Exkursion begann und endete jeweils mit dem Besuch eines Reisforschungszentrums. Zur Einstimmung in Thema und Region wurde am ersten Exkursionstag das nationale philippinische Reisforschungszentrum PhilRice in Maligaya besucht. Abschluß des gesamten Praktikums bildete ein Tag am IRRI (der vormaligen Wirkungsstätte von Prof. Neue, Leiter der Sektion Bodenforschung), wo durch ein ganztägiges Programm ein guter Überblick über die Aktivitäten dieses internationalen Agrarforschungszentrums gewonnen werden konnte.

Resümee - eine neue Qualität der universitären Ausbildung

Insgesamt war diese Form der Lehrveranstaltung, der eine 1,5jährige intensive Vorbereitung durch Vorlesungen und Seminare vorangegangen war, nicht nur eine gelungene Abwechslung vom Universitätsalltag in exotischem Ambiente, sondern ermöglichte eine effiziente Anwendung des bislang v.a. theoretisch erworbenen Wissens. Durch den Austausch mit den anderen Disziplinen war das Denken in Zusammenhängen bei der Analyse eines Systems für viele erstmals konkret geworden. Nach Einschätzung des beteiligten Lehrpersonals wird durch eine derartige Vorgehensweise in kürzester Zeit mehr Wissen vermittelt als in vielen Einzelveranstaltungen (vor allem Einzelvorlesungen) an den Universitäten, weshalb in derartigen Unternehmungen - kombiniert mit den bereits erwähnten Vorzügen - eine Möglichkeit gesehen werden kann, der universitären Lehre eine neue Qualität zu geben.
Aufgrund der positiven Erfahrungen wird für das kommende Jahr eine vergleichbare Fallstudie in einer anderen Zielregion (voraussichtlich südliches Afrika) derzeit vorgeplant. Im Unterschied zum zurückliegenden Praktikum soll hierbei auf eine noch stärkere Beteiligung der Sozialwissenschaften geachtet werden. Ebenso ist vorgesehen, Studenten des Gastlandes zu integrieren, was sich bei der zurückliegenden Veranstaltung aufgrund einer kurzfristigen Absage dann leider nicht mehr realisieren ließ.



Straßenbau durch den Nebelwald der Region vernichtet große Flächen dieses einmaligen Ökosystems

In einem im Spätsommer fertiggestellten englischsprachigen Bericht sollen die ausführlichen Ergebnisse den Entscheidungsträgern und interessierten Einzelpersonen sowie Organisationen vor Ort zur Verfügung gestellt werden.

Aus der Forschung

Prof. Plachter und Dr. Settele bei der wohlverdienten Pause

Dr. Josef Settele
UFZ Leipzig-Halle
PB Naturnahe Landschaften und Ländliche Räume

Prof. Harald Plachter
Philipps-Universität Marburg
(FB Biologie, FG Naturschutz)

Prof. Joachim Sauerborn
Justus-Liebig-Universität Gießen
(Wiss. Zentrum Tropeninstitut)

Dr. Doris Vetterlein
Brandenburgische Technische Universität Cottbus

Dr. Konrad Martin, Ralf Barthelmes
Universität Hohenheim
(Inst. für Pflanzenproduktion in den Tropen und Subtropen, FG Agrarökologie)

Dr. Joseph Settele
PB Naturnahe Landschaften und
Ländliche Räume

APPENDIX: EXCURSION-ARTICLES IN NEWSPAPERS

Thorsten TIPPMANN & Doris VETTERLEIN:
Das 8. Weltwunder als Forschungsobjekt „Philippinische Reisterrassen der Provinz Ifugao"
(TU Profil; BTU Cottbus 1997)

Das 8. Weltwunder als Forschungsobjekt "Philippinische Reisterrassen der Provinz Ifugao"

Interdisziplinäre Exkursion mit Teilnehmern aus fünf verschiedenen Universitäten

Wie Interdisziplinarität in der Lehre funktionieren kann, zeigte jüngst eine dreiwöchige Exkursion auf die Philippinen, die gemeinsam von Uni Cottbus, Lehrstuhl Bodenschutz und Rekultivierung, Dr. D. Vetterlein, Uni Gießen, Wissenschaftliches Zentrum Tropeninstitut, Prof. Dr. J. Sauerborn, Uni Hohenheim, Fachgebiet Agrarökologie, Dr. K. Martin, R. Barthelmes, Uni Marburg, Fachgebiet Naturschutz I, Prof. Dr. H. Plachter unter Leitung des UFZ Leipzig-Halle, PB Naturnahe Landschaften, Dr. J. Settele getragen wurde.

20 Studenten aus den Fachrichtungen Bodenschutz, Umweltsicherung, Ernährungswissenschaften, Agrarwissenschaften und Naturschutz untersuchten (unter Anleitung der genannten Wissenschaftler) am Beispiel der seit Hunderten von Jahren ohne Einsatz von Dünger, Pestiziden oder Maschinen traditionell bewirtschafteten Reisterrassen Aspekte des Konfliktfeldes "Naturschutz und Landwirtschaft in den Tropen".

Die Reisterrassen, die aufgrund ihrer bizarren Anordnung in der Bergregion häufig als "stairway to the sky" bezeichnet werden, stellen seit langem das Ziel von Rucksacktouristen dar, die neben den Einblicken in die von Menschenhand geschaffene Landschaft auch die unberührten Bergwälder genießen. 1995 wurden die Reisterrassen durch die UNESCO in die Liste der Weltkulturerbestätten aufgenommen. Seit einigen Jahren bemüht sich die philippinische Regierung um eine Intensivierung des Tourismus, wobei dessen sozialen und umweltrelevanten Auswirkungen unklar sind und auch noch Wege gefunden werden müssen, wie der Tourismus der lokalen Bevölkerung und dem Erhalt der Terrassen zugute kommen können.

„Stairway to heaven" - die Reisterrassen von Banaue *(Foto: Thorsten Tippmann)*

Interdisziplinärer Gänsemarsch durch die Reisfelder *(Foto: Thorsten Tippmann)*

Zu ermitteln, welche Folgen das für die Einwohner und die Ökosysteme dieser Region haben könnte, war daher ein Ziel im Rahmen der Fallstudie. So wurde z. B. eine Kartierung der verschiedenen Landnutzungskompartimente durchgeführt, um zu sehen, ob durch alternative Einkommensquellen wie dem Tourismus eine Vernachlässigung und damit ein Verfall der Reisterrassen eintritt. Detaillierte botanische Untersuchungen zur Sukzession untermauerten diesen Ansatz. Eine weitere Studentengruppe, die Untersuchungen zum Stickstoffkreislauf im System durchführte, widmete sich zum einen der Frage, woher die über den Reis entzogenen Nährstoffe nachgeliefert werden, zum anderen wurde untersucht, welche Nährstoffeinträge von steigenden Touristenzahlen beim bestehenden Entsorgungssystem zu erwarten sind. Weiterhin wurde die Anfälligkeit des Systems gegenüber der Einwanderung einer im Tiefland als Reisschädling bekannten Wasserschnecke untersucht sowie durch Umfragen und Auswertung von Statistiken die sozioökonomische Situation der Einwohner erfaßt. Die dabei gewonnenen, z.T widersprüchlichen Ergebnisse waren teilweise sehr überraschend und machten mitunter deutlich, daß über die Funktionsweise solcher Systeme noch erhebliche Wissensdefizite bestehen.

Neben der Forschungstätigkeit waren natürlich auch Abstecher ins Umland auf dem Programm. So wurden sowohl das staatliche Reisinstitut "PhilRice" als auch das internationale Forschungsinstitut IRRI besucht. Beide Institute beschäftigen sich mit der Züchtung von neuen Reissorten und der Entwicklung neuer Strategien der Feldbearbeitung. Beeindruckend war auch der Besuch der letzten intakten Regen- und Nebelwaldgebiete der Philippinen. Um so desillusionierender war die Tatsache, daß Tag für Tag große Flächen dieser einzigartigen Ökosysteme durch unsachgerechte Methoden des Straßenbaus unwiederbringlich verloren gehen. Hier könnte alleine durch technisch aufwendigere (und langfristig nicht teurere) Vorgehensweisen große Regenwaldbereiche vor der Vernichtung bewahrt werden.

Die Forschungsaktivitäten der interdisziplinären Gruppe wurden von den Einwohnern und den lokalen Behörden mit regem Interesse verfolgt und blieben auch von der Presse nicht unbemerkt. Daher war die abschließende Präsentation der gewonnenen Ergebnisse auch so gut besucht, daß der hierfür angemietete Saal für den Besucheransturm kaum ausreichend Platz bot. Damit das neu erworbene Wissen auch weiterhin einen praktischen Nutzen für die Bewohner von Ifugao hat, werden die noch zu erstellenden Abschlußberichte ebenfalls den örtlichen Behörden zur Verfügung gestellt.

Insgesamt war diese Form der Lehrveranstaltung nicht nur eine gelungene Abwechslung vom Vorlesungsalltag in exotischem Ambiente, sondern ermöglichte eine effiziente Anwendung des bisher Erlernten und, durch den Austausch mit den anderen Disziplinen, das Denken in Zusammenhängen bei der Analyse eines Systems. Es wäre schön, wenn diese Form der Veranstaltung, z.B. im Rahmen des geplanten Studienganges "Landnutzungssysteme", als eine effiziente Form der Lehre Berücksichtigung fände.

Für das kommende Jahr ist eine vergleichbare Fallstudie in einer anderen Zielregion angedacht (Ansprechpartner: Dr. D. Vetterlein, Lehrstuhl Bodenschutz und Rekultivierung).

(Thorsten Tippmann und Doris Vetterlein)

Picture 51: Banaue valley from Viewpoint in April (1988)

Picture 52: Banaue valley from Viewpoint in July (1988)

SPECIAL APPENDIX: IFUGAO-BANAUE-SONG [1]

(This song in German language was composed by the students during the excursion. It deals with the excursion and specifically with characteristics of the supervisors.)

In Deutschland trafen sich Studenten,
ganz interdisziplinär.
Die wollten alles drehen und wenden
und Banaue gab dazu viel her.
Zunächst war alles verregnet
doch bald schlug der Sonnenbrand zu,
mit Verstopfung wurden manche gesegnet
und Durchfälle kamen noch hinzu.

Der Plachter, der kam nach Manila
und wurde hier „Plätscher" genannt.
Er rannte mit seinem Terminkalender
und faxte quer durch's Land.
Des Abends wurde er lustig,
die Stimmung war voll entbrannt,
ohne Doppelkopf war es furchtbar frustig,
so flogen Seehasen an Land.

Die Bevölkerung interessierte nicht minder
eine ganz andere Geschicht:
Haben Sepp und Doris denn schon Kinder?
NEIN, NOCH NICHT!

Ein Bett im Reisfeld
und den Kescher dabei,
doch dann kam Doris
und die Falter war'n frei ... [2]

Die Nutrients, die hatten derweilen
das Wasser evaluiert.
Der N-Test brachte kein Ergebnis
und das hat niemand kapiert.
Ob Tiefland oder Hochland,
ob Dünger oder nicht,
hielt man die Stäbchen quer oder hochkant,
das fiel nicht ins Gewicht.

Einmal nach Batad wir liefen,
das Wasser wurde knapp.
Natürlich nur Herr S. aus Gießen
sagte die Wanderung ab.
Die ganzen Pflanzendrogen
hatten seinen Körper geschwächt.
Drum ist er auch schon abgeflogen und
hinterließ nur seinen Knecht.

Die Schnecken krochen schnell durch's Wasser,
der Henrik kam kaum hinterher.
Die Sachen wurden immer nasser,
da half auch der Gin nicht mehr.
Die Eimer wurden voller
und Steffi kam kaum noch mit.
Die Stories um „Kuhol" wurden toller
and that was not so the hit.

Die Sozis hatten schlechte Karten,
die Fakten gaben nichts her.
Es wurde hin und her geraten,
der Reis wurde mehr und mehr.
So wurde schließlich beschlossen
den Überschuß als Wein zu brau'n.
Das war eine gute Chance,
zu gewinnen verlor'nes Vertrau'n.

Über den Wolken
muß der Watershed grenzenlos sein,
alle Ängste, alle Sorgen, sagt man,
blieben im Reisfeld verborgen *oh Mann !*
Die Seilbahn wird kommen *nur wann,*
mit dem Tourismus im Schlepptau
und dann?! [3]

[1] Melodie: altes Volkslied „ Lieschen war ein Frauen..."
[2] Melodie: J.Drews „ Ein Bett im Kornfeld..."
[3] Melodie: R. May „ Über den Wolken..."

Authors of Pictures:

Ulrike JAHN:	Picture 21, 22, 28, 34, 48, 49.
Wolfgang LANG:	Picture 29, 42 (both drawings).
Elke & Joachim SAUERBORN:	Front Drawing; Picture 30, 31, 32, 35 (drawings).
Thorsten TIPPMANN:	Picture 26.
Doris VETTERLEIN:	Picture 3, 10, 13, 25.
Christian WILLERDING:	Picture 23, 37, 38, 39, 40.

all other Pictures by Josef SETTELE

UFZ-Umweltforschungszentrum Leipzig-Halle GmbH
Projektbereich Naturnahe Landschaften und Ländliche Räume
Permoserstraße 15
D-04318 Leipzig
Telefon 0341/235-2519
Telefax 0341/235-2534