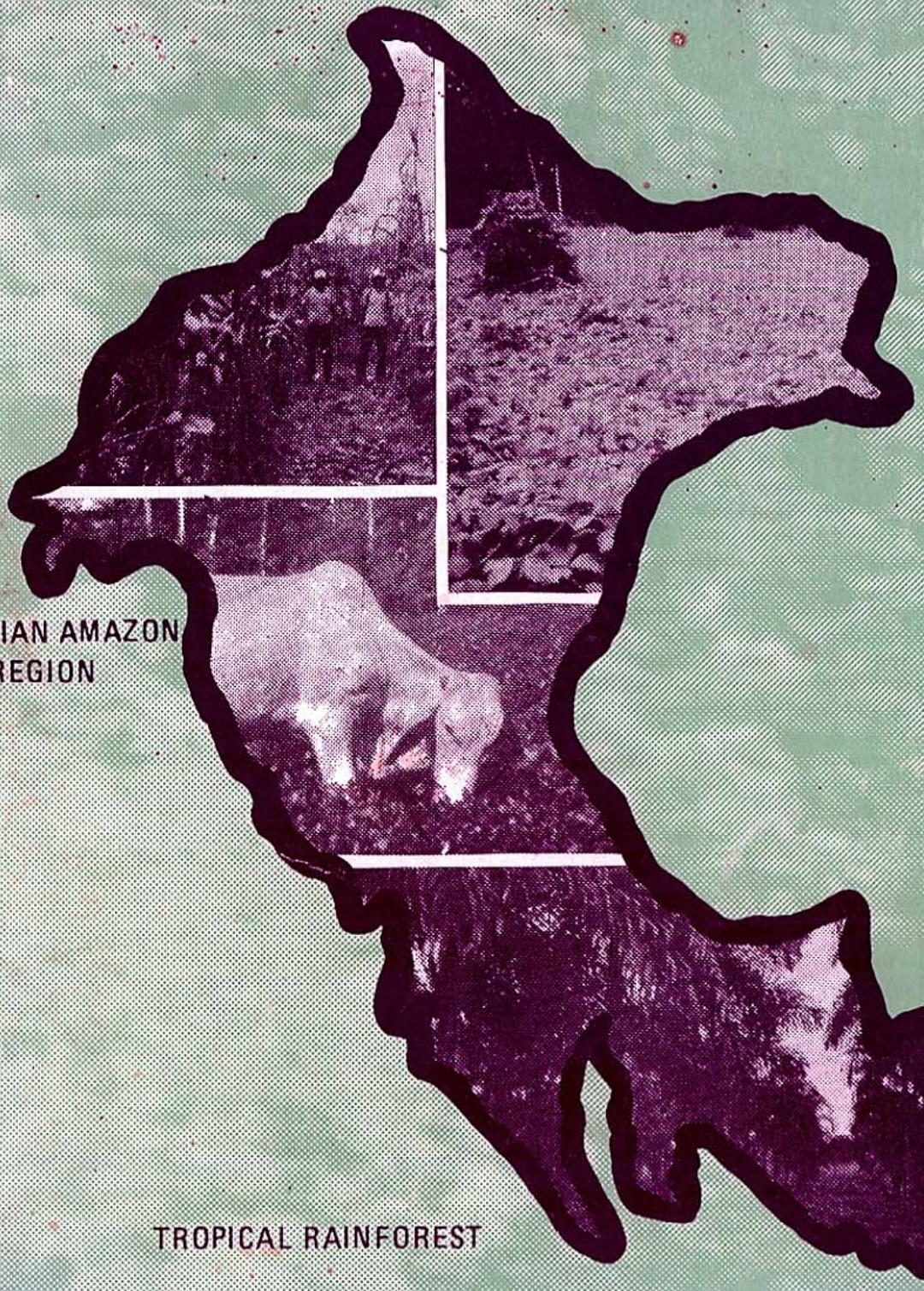


PERUVIAN AMAZON REGION

TROPICAL RAINFOREST

INSTITUTO NACIONAL DE INVESTIGACION Y PROMOCION AGROPECUARIA

NORTH CAROLINA STATE UNIVERSITY

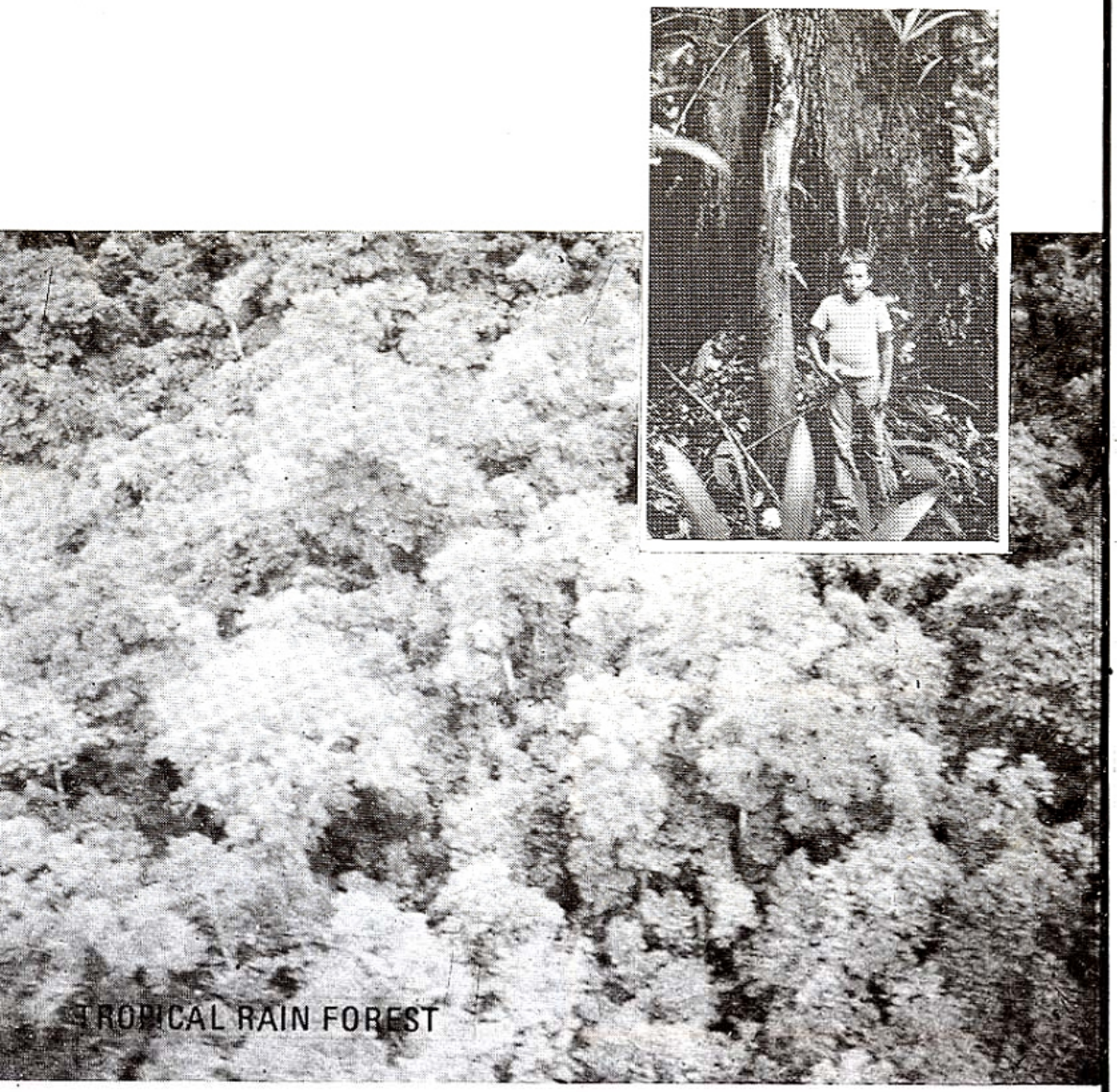
CIPA XVI

ESTACION EXPERIMENTAL DE YURIMAGUAS

THE TROPICAL SOIL RESEARCH PROGRAM

Yurimaguas, Perú

1985



TROPICAL RAIN FOREST

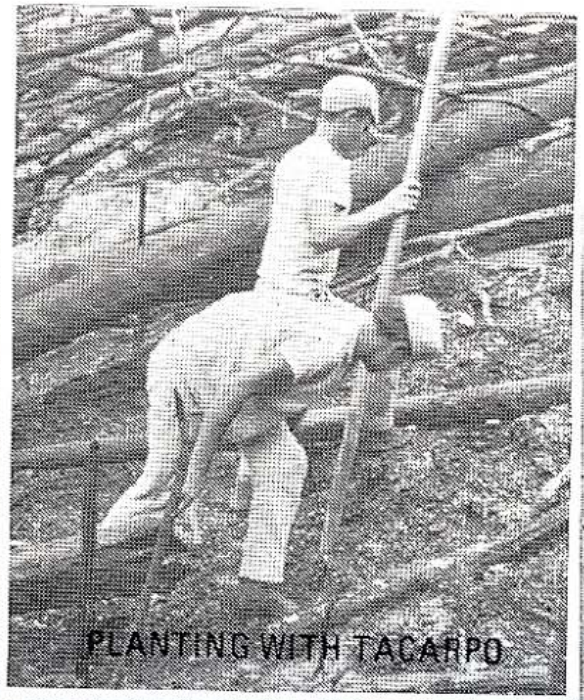
THE HUMID TROPICS

The humid tropics cover about 10 percent of the worlds area.

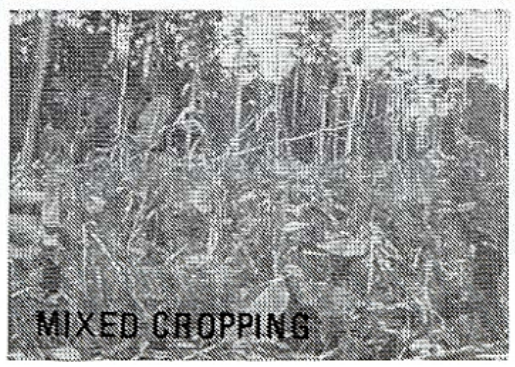
Currently, there is a great deal of concern about the use and management of these ecosystems. Indiscrimate deforestation and explorative forms of land use threaen the many valuable goods and services provided by tropical forests. Favorable temperature and moisture regimens and suitable topography on the other hand, give these lands a high potential for the production of food, fiber, and other products. The challenge lies in whether this potential can be realized in an economically and ecologically sound fashion.

THE SHIFTING AGRICULTURE SYSTEM

Shifting agriculture is practiced by more than 200 million persons on some 36 millions hectares, or approximately 44 percent of the potentially arable or grazable land of the tropics. In Peru, farmers fell 1 por 2 ha of forest with machetes during the least-rainy period (July-August). They then cut up the trees and brush to facilitate burning. Once burned, the area is planted to short-cycle food crops, with nutrients provided by the ash. Crops are planted with primitive instruments such as the "tacarpo" (planting stick) used to make openings in the soil where seed are placed. Crops species include maize, cassava, plantain, rice and cowpea.



PLANTING WITH TACARPO



MIXED CROPPING

Secondary Forest

Farmers continue using the site until production declines, usually two or three years. The land is then abandoned and the secondary forest regrows. Ideally, the cycle is repeated at 8-to-20 years intervals.

The system conserves an ecological balance when there is a high land-to-population ratio. But when population densities increase, whether due to spontaneus or directed migrations, the demands for food also increases, and the result is that the fallow part of the cycle becomes too short to maintain soil productivity.

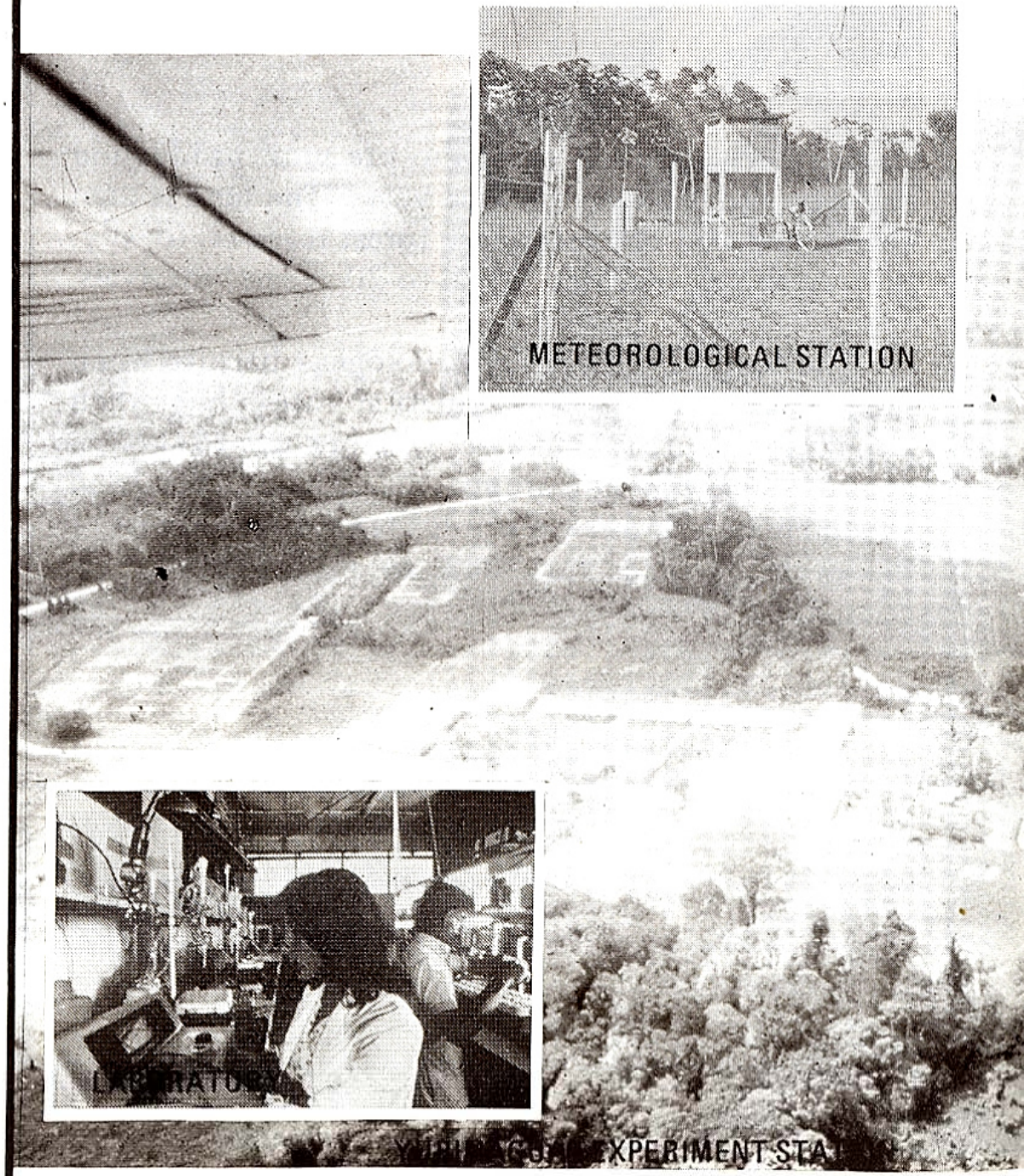
MECHANIZED LAND CLEARING

LAND CLEARING BY HAND

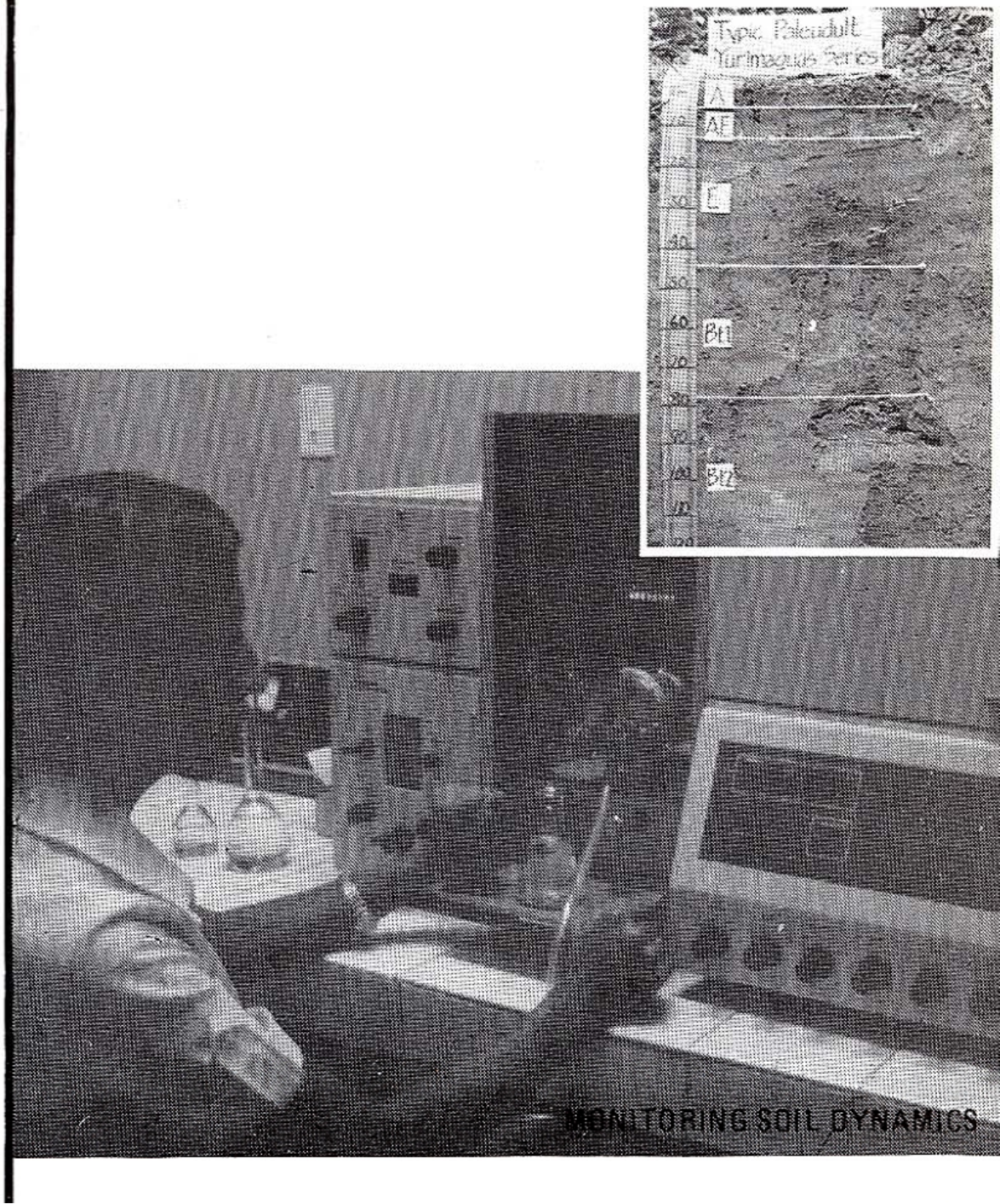
TROPICAL SOILS RESEARCH PROGRAM

Since 1971, North Carolina State University's Tropical Soils Research Program has been working on meeting this challenge. The bulk of the research has concentrated on well-drained, low fertility Ultisol or Oxisol the predominant soils of the humid tropics. In cooperation with Peruvian counterparts - the Instituto Nacional de Investigación y Promoción Agropecuaria (INIPA) and its predecessors - The Program has sought to develop and transfer improved soil management technologies for economically productive and ecologically sustainable farming systems in the humid tropics.

The Program's center is located in the low selva, approximately 4 kms from the town of Yurimaguas, Peru (5º 45'S, 76º 5'W, 182 m. above sea level). Secondary research sites are found in Pichis Palcazu (high selva) and Pucallpa (low selva) in Peru.



The Yurimaguas area receives and average annual rainfail of 2100 mm with no pronounced dry season but with occasional short-term droughts. The predominant soil is classified as the Yurimaguas series - a fine loamy, siliceous, isohyperthermic Typic Paleudult with a sandy topsoil over a loamy subsoil. It therefore has a low capacity to retain nutrients, high levels of exchangeable Al, and low reserves of P and K.



MONITORING SOIL DYNAMICS

STRATEGY

The Program's strategy is to forcus on different management options for the principal soils, with due regard to landscape position and level of infrastructure development. Some management options are illustrated in Figure 1.

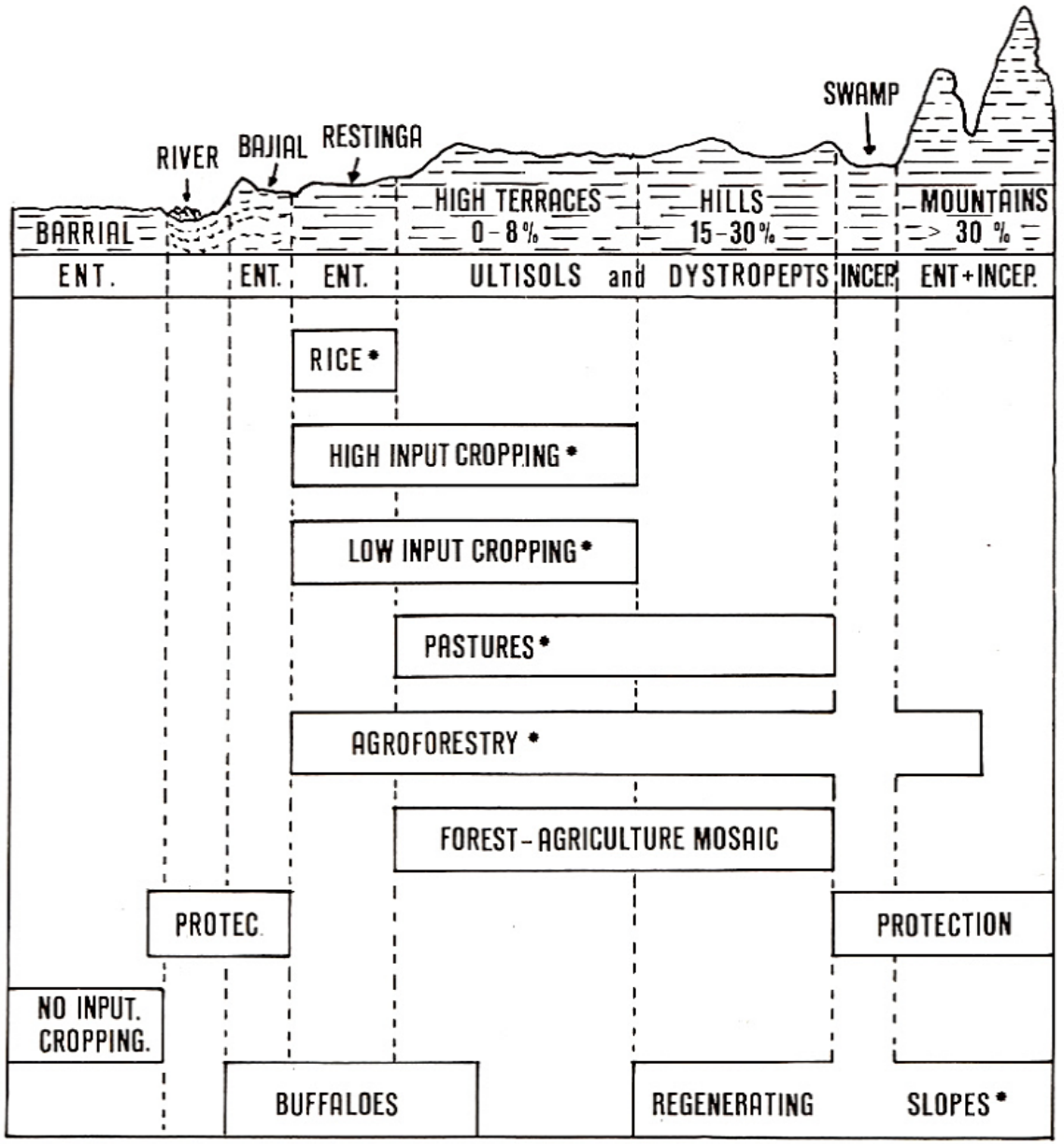


Figure 1: Soil Management Options for the Peruvian Amazon (From Sanchez and Benites, 1983) Tropical Program only involved in those marked with asterisks.

CONTINUOUS CROP PRODUCTION

Long –term continuous– cropping experiments showed that acceptable and sustainable yields of short-cycle food crops are possible when inherent fertility are corrected with lime and fertilizers. Limitations of this high input approach were recognized as being limited to areas with ready accesibility to essential inputs and good market infraestructure.

If a continuous cultivation system is to evolve in this environment, however, methodologies for incorporating soil amendments (eg. lime and phosphorus) and crop residues, adequate and affordable weed control, and maintenance of soil tilith are also essential. Experience has shown that these goals cannot be realized with the "machete" and "tacarpo".

LIMING

CORN HARVEST

Many of them can be achieved with tractor-mounted tools, however; and observations on the feasability of mechanized land preparation have been made.

With so much rainfail, two questions are pertinent:

1. **Can** land preparation and planting be accomplished with tractor-mounted tools?

2. **Should** land be prepared with tractor-mounted tools?

To date, the answer to the first question is a definite "yes"; but quantifiable data for answerling the second have not yet been generated.

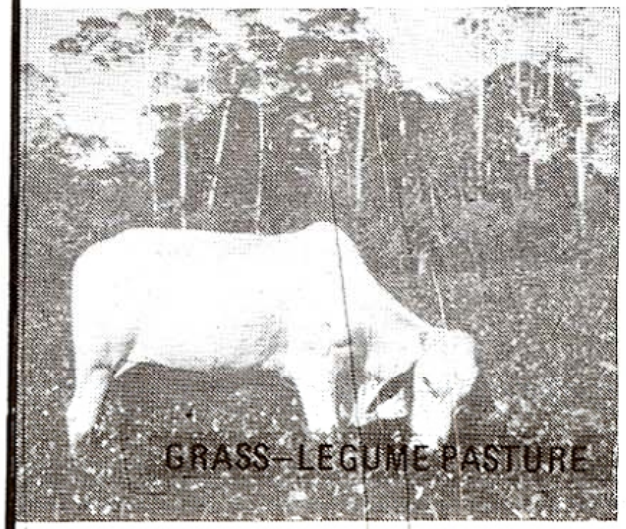
SEED BED PREPARATION

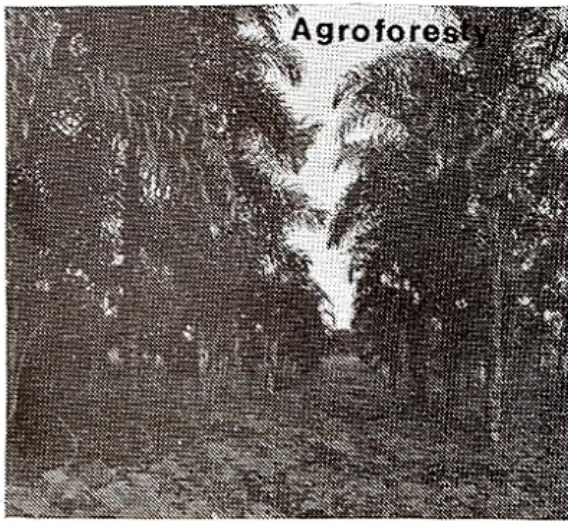
LOW INPUT CROP PRODUCTION

The low input strategy is based on selection of acid-tolerant cultivars, minimum tillage and fertilization, weed control and managed fallows. Upland rice and cowpea cultivars from IITA that combine high yields, high quality, acceptable tolerance to pests and diseases, and tolerance to high levels of Al are being widely teste through an INIPA network. Work with minimum tillage, residue management and their fertility interactions have yet to provide clear evidence of the superiority of minimum or zero tillage. The promotion of faster downward movement of Ca and Mg us being tested but no conclusive results are yet available. The fertility-weed control interactions are now being studied. A farm level demonstration, on upland soil has shown the feasibility of a rice.

cowpea rotation staring with recently-cleared forest, zero tillage, and no soil amendments has produced a total of 12.3 tons/ha of grain in 29 months.

We have learned that the low in put system, is unstable as far as continous croping is concerned. It may last one or two years, but then a decision will have to be made about the permanent tole of the field. Alternative are 1) high input cropping, 2) managed fallow, 3) grasslegume pastures, or 4)agroforestry.





LEGUME BASED–PASTURE PRODUCTION

For years of grazing trials using acid tolerant germplasm from CIAT have demostrated the high productivity and persistence of acid tolerant grass and legume mixtures such as **Andropogon gayanus -- Stylosanthes guianensis; Brachiaria decumbens -- Desmodium ovalifolium; Brachiaria humidicola -- Desmodium ovalifolium and Centrocema** hybrid alone.

Annual liveweight gains have reached up to 700 kg/ha under alternate grazing systems and with minimum fertilizer inputs have been recorder.
Generation of degraded **Panicum maximum** on farmers fields has been accomplished by broadcasting Bayovar rock phosphate. Pasture establishement methods in degraded pastured are under study.

This provides a promising alternative to traditional grazing systems characterized by low productivity (100 kg/ha/yr liveweight gains) overgrazing, and subsequent ecosystem degradation.

TREE – BASED PRODUCTION SYSTEMS

High priority is been given to research on tree-based production system. Early work was observational trials on **Gmelina arborea** and peach palm (**Guilielma gasipaes**). Recent work has centered on establishing the nutrient response pattern of **Gmelina** and peach palm **Guilielma gasipaes**).

Alley cropping began in 1983 with the overall purpose of finding tree or bush species that can be grown in association with annual food crops and whose prunning would serve as a green fertilizer. Guava (**Inga edulis**) appears promising. It prunes well and produces large amounts of slowly decomposing mulch ll at soil pH values of 4.2 and 80 o/o. All saturation. f left to grow it produces fruit and the wood is wide

ALLEY CROPPING

ly used for firewood and for charcoal. Similar work has been initiated with pigeon pea (**cajanus cajan**) **Erythrina**, and **Desmodium gyroides**.

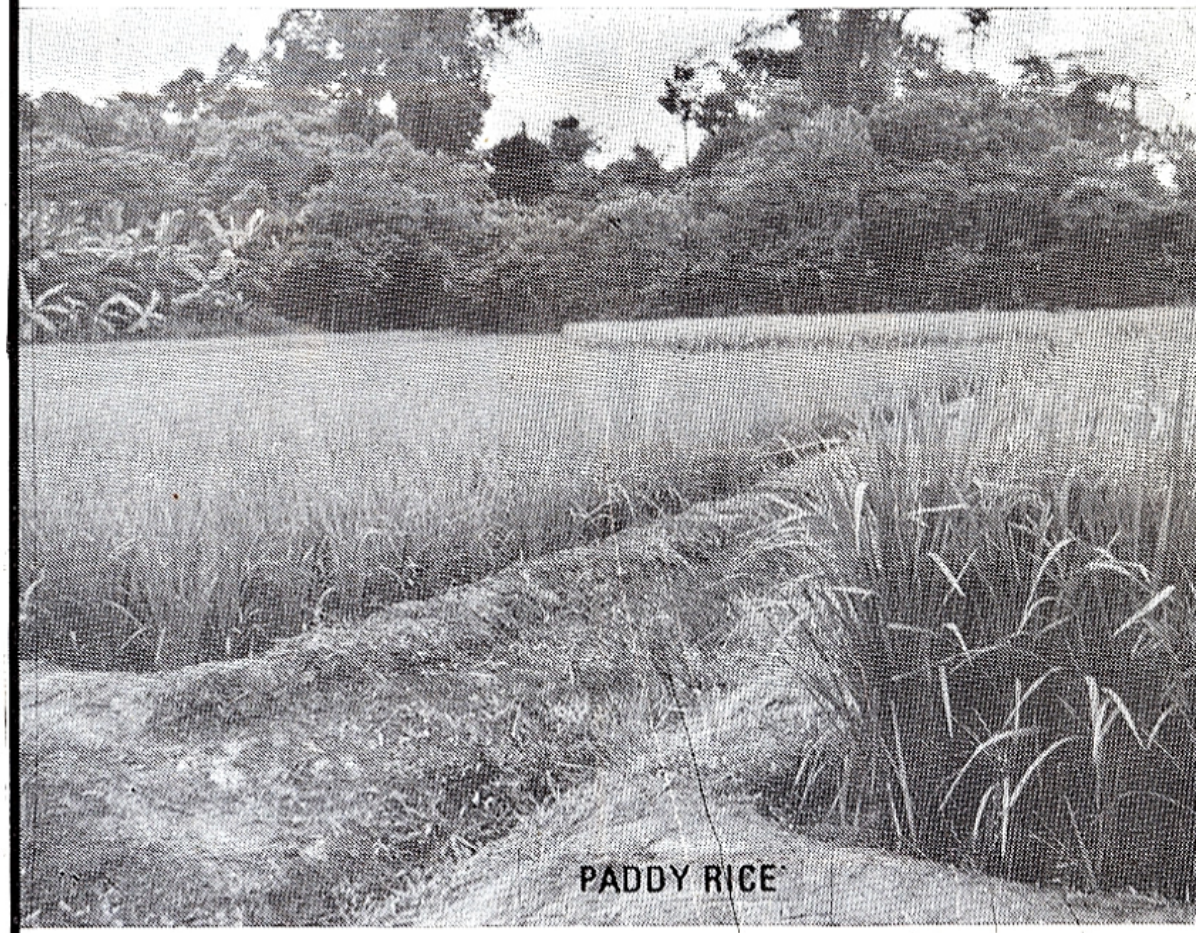
Several managed fallows are bein studied to see if it's possible to speed up the process of soil fertility regeneration. These studies are complemented by basic search of soil and vegetation dynamics during early succession, to provide a better basis for the design of improved agroforestry syntems.

FLOODED RICE ON ALLUVIAL SOILS

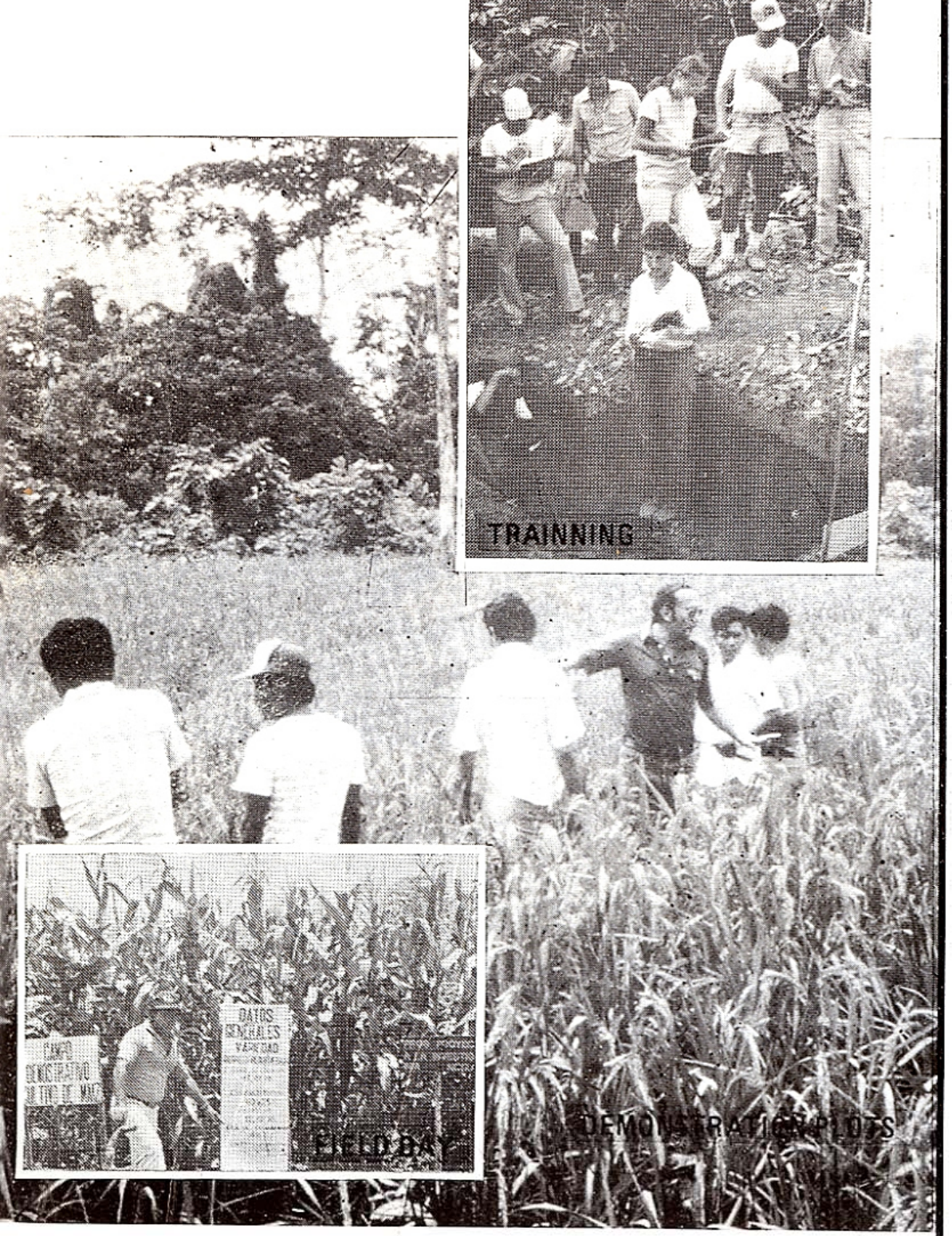
Paddy rice production on high base status alluvial soils has been an unqualified success. Five crops of irrigated rice have been grown during two years with an average production of 16.5 tons/ha/year.

Replacing transplanting with broadcasting pre-germinated seed reduced yields by 20 o/o but decreased labor input for crop establishement from 20 man-days/ha to 3 man-days/ha.

Its impact around Yurimaguas continues to grow. Across the Shanusi, the Tupac Amaru Cooperative is increasing its area planted to paddy rice. New developments are also underway along the Yurimaguas-Tarapoto highway and the principal rivers (Huallaga, Shanusi and Paranapura).



PADDY RICE



SOIL MANAGEMENT RESEARCH NETWORK FOR THE HUMID TROPICS

TROPSOILS has developed the technology for improved soil management in acid soils of the humid tropics during the las 12 years. Some examples are improved land clearing methods, acid-tolerance crop cultivars soil constraint determinations, monitoring soil dynamics and improved grass-legume pastures. Many of these findings are ready to be tested across the humid tropics in order to ascertain their validity and determine the necessary modifications for specific physical and socioeconomic situations.

Several national institutions responsible for research and extension in humud tropical environments wish to apply TROPSOILS technology in their development program. Attemps at doing so have identified the lack of on-side trained personnel as one major constrain to the validation and transfer of technology.