Interim Reports of the Project

"Transformation of the Agricultural Landscape in Tropical Archipelagos"

Volume 5

Environment, Landuse and Society in Wallacea

Interim Reports of the Project
"Transformation of the Agricultural Landscape in Tropical Archipelagos"

Volume 1: Villages and the Agricultural Landscape in South Sulawesi, 1982

Volume 2: Transformation of the Agricultural Landscape in South India and Sri Lanka, 1984

Volume 3: Transformation of the Agricultural Landscape in Indonesia, 1984

Volume 4: Environment, Agriculture and Society in the Malay World, 1986

Volume 5: Environment, Landuse and Society in Wallacea, 1986

ENVIRONMENT, LANDUSE AND SOCIETY IN WALLACEA

Edited by

Koji Tanaka, Mattulada and Narifumi Maeda

Center for Southeast Asian Studies, Kyoto University

1986

The publication of this volume
was made possible by a grant from
the Ministry of Education, Science and Culture

First published in 1986 by
the Center for Southeast Asian Studies
Kyoto University
46 Yoshida Shimoadachi, Sakyo
Kyoto 606, Japan

CONTENTS

PREFACE

The Wallacea encircled by Wallace's and Weber's lines, and defined as the intermediate region between the Oriental subregion and the Australian and Papuan subregions, possesses a characteristic composition of fauna and flora. From the viewpoints of agriculture and ethnic culture, too, this region seems to form a distinguishable division from others in the Southeast Asian archipelago. The great diversity in agricultural patterns, culture and society among the people in this region has been a prominent characteristic, and, therefore, attracted attention from various fields.

This report is a collection of papers resulting from fieldworks conducted in Wallacea, and besides is the fifth and the last volume of interim reports on a project entitled "Transformation of the Agricultural Landscape in Tropical Archipelagos," which has been supported with a grant for overseas scientific research by the Ministry of Education, Science and Culture. This project, launched in 1980, has aimed at studying the interaction between man and his environment in a tropical archipelago, with special reference to the transformation of agricultural landuse. Of the six contributors to this report, four participated in the project, while the other two, Aris Poniman Kertopermono and Katsuya Osozawa, conducted their researches in close cooperation with the participants.

This report consists of six papers, of which the first four deal with the transformation of agriculture, either in the long-term or the short-term, in Cagayan, the Philippines, and North and South Sulawesi, Indonesia. In these papers, the crops characterizing the agriculture in Wallacea, such as upland

rice, wet rice, maize, sago palm, and coconut palm, are described with special reference to their roles in the changes of landuse and agricultural technologies. The other two papers deal with social and cultural aspects of the Bugis people, a dominant group in South Sulawesi, who have played an important historical role in transforming landuse and the landscape not just of Wallacea but of the Southeast Asian archipelago as a whole.

The first paper describes the environment and rice culture in the Cagayan valley in Northern Luzon. Furukawa divides the valley into five distinct subregions according to the natural conditions and gives detailed descriptions of rice culture and landuse in each subregion. His detailed observations in the field lead him to consider the historical process of changing agricultural landuse in relation to the diversity of ethnic groups in the region.

The following three papers deal with the special topics in agriculture in Sulawesi. Aris Poniman presents the results of a case study on the historical changes in landuse of a village in Gorontalo, North Sulawesi, where coconut and wet rice are dominantly grown by smallholders. This description of the role of coconut in the subsistence economy provides valuable material that contributes to an understanding of village life based on commercial crops.

Sago is still the main subsistence food in the lowland of Kabupaten Luwu, South Sulawesi. Osozawa's paper dealing with the technical improvement of sago production is an interim report on his ongoing experimental study in a village in Luwu. This village was studied in 1982 by Dr. Takaya, a participant in this project, who wrote on traditional sagc production there in the third volume of the project reports, Transformation of the Agricultural Landscape in Indonesia. While staying in the village, he was asked to help to improve the production process. It was as a result this request by the villagers that Osozawa embarked upon his study in the village.

Tanaka's paper dealing with spontaneous migrants to Kabupaten Luwu supplements his two earlier papers in the first and third volumes, in which he described agicultural adaptation among the Bugis and Toraja migrants. In the

third study conducted in the same migrants' settlements, he focusses on the process of migration and settlement.

Mattulada and Maeda make general observations on the basic social organization among the Bugis-Makassar. Mattulada's paper "Land and the Management of Traditional Entrepreneurs" deals with three important aspects of the Bugis-Makassar culture relating to the production system. Firstly he presents how land is perceived by the Bugis-Makassar; then he describes the patron-client (punggawa-sawi) relationship in traditional industries, which permeates through all levels of social transactions; and lastly he discusses land reform. Maeda deals with Bugis kinship and proposes the use of contrastive concepts of 'household' and 'kinship' instead of the ambiguous 'family'.

Finally, we would like to express our deep gratitude to the Japanese Ministry of Education, Science and Culture, who supported this project with grants for overseas scientific research in the fiscal year 1984 and for publication in the fiscal year 1985. To Lembaga Ilmu Pengetahuan Indonesia, Universitas Hasanuddin, Universitas Tadulako, and the provincial governments of South and North Sulawesi, we are grateful for assistance provided at all levels.

A special note of thanks must go also to Mr. Peter Hawkes, who corrected the English of the original manuscripts, and to Ms. Keiko Maeda and Mr. Ken'ichiro Hayashi who typed the final manuscript.

ENVIRONMENT, LANDUSE AND SOCIETY

IN

WALLACEA

THE ENVIRONMENT AND RICE CULTURE IN THE CAGAYAN VALLEY OF NORTHERN LUZON

Hisao FURUKAWA

1. Introduction

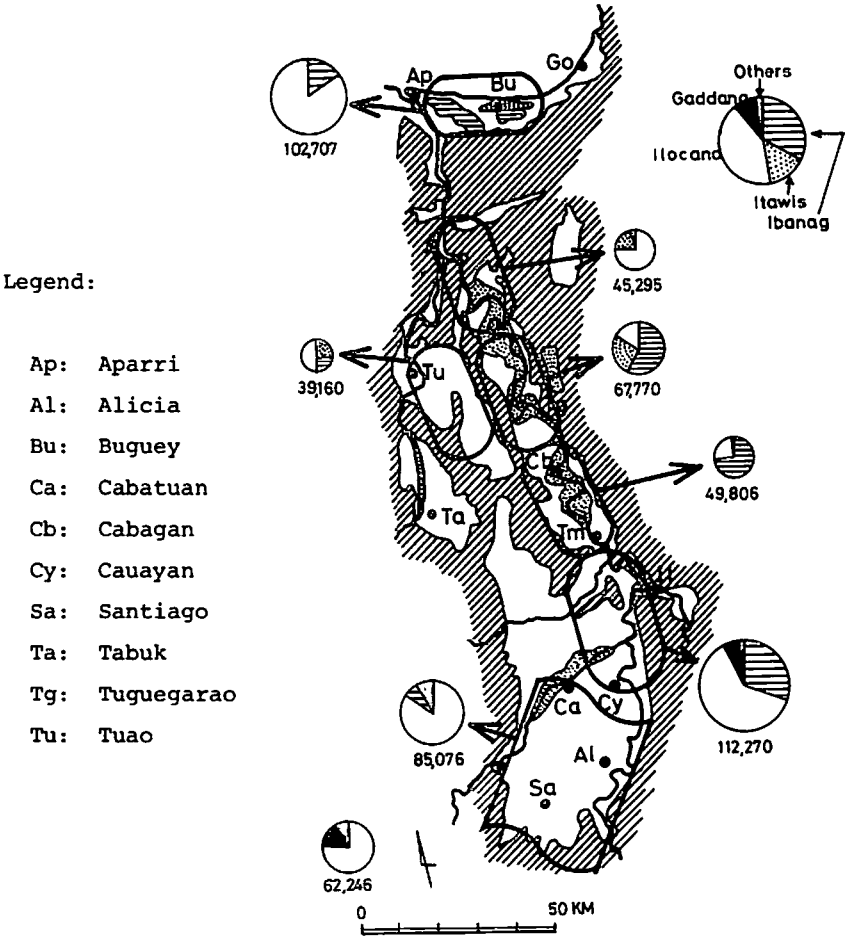
The vast area of Cagayan valley appears to have been evacuated as a result of the uprisings that followed the intrusion of Spanish colonists in the 16th century. Population surveys in 1591 and 1846 show that there was no population growth in the area in this 250-year period (Table 1). Since then the valley has seen an inflow of migrants composed of various ethnic groups. Keesing [1962] has reviewed the two important migration waves. The first was the Ibanagization of the late 18th century, which involved the southward movement of the Ibanag people who had previously been limited to the coastal area of the Cagayan valley. The second was the Ilocanization which was initiated in the late 18th century by the spanish government to support tobacco cultivation in the Cagayan valley. This movement accelerated spontaneously in the early 20th century, continuing until as late as the 1940s [Keesing 1962: 181].

The distribution of ethnic groups thus established shows a remarkable loclization, which seems to be related primarily to their behavior toward food-crop cultivation (Fig. 1). The Ibanag and Itawis, for example, are corn eaters and cultivators of dry fields, while the Ilocano and probably the Gaddang are wet-rice cultivators. The latter chose sites with ready access to irrigation water, whereas the former preferred lands more suitable for dry crop cultivation. The heterogenous distribution of various ethnic elements is related on one hand to differences in the ecological settings and on the other to the agricultural technologies which they could manipulate. Therfore, the Cagayan valley offers an interesting field for study of cultivation technologies and their relation to ethnicity and environment.

Table 1. Population of the Cagayan Valley in 1591 and 1846 [Keesing 1962]

	1591	1846
Lower Cagayan	16,200	14,000
Middle Cagayan	21,400	41,000
Upper Cagayan	18,200	12,555*
Northwest Cagayan	12,000	8,194
Chico river	16,000	7,622
Total	83,800	83,371

* Value for 1818



Legend:

Ap: Aparri
Al: Alicia
Bu: Buguey
Ca: Cabatuan
Cb: Cabagan
Cy: Cauayan
Sa: Santiago
Ta: Tabuk
Tg: Tuguegarao
Tu: Tuao

Fig. 1. Distribution of Main Ethnic Groups in the Cagayan Valley Based on population data of 1948 as cited by Keesing [1962].

Similar situations have attracted my interest in other parts of the insular Southeast Asia. Migration of ethnic groups and the creation of new agricultural spheres through either adaptation or a strict transfer of technology have repeatedly taken place in this part of the world. This paper describes the environment and rice culture in the Cagayan valley as a case study on this topic from Northern Luzon.

2. Ecological Backgrounds and Five Different Regions

Rainfall controls crop cultivation. Fig. 2 illustrates the rainfall pattern in Luzon island. It shows two types; one has a rainfall peak in summer due to the southwest monsoon, and this type predominates on the west coast; the other has rainfall peak in winter due to the northeast monsoon, and this type predominates on the east coast.

Legend:

AP: Aparri	2314	LA: Laoag	2044
BA: Baguio*	4298	LE: Legazpi	3365
BT: Batangas*		LU: Lucena	2088
	1684	MA: Manila*	2083
CA: Cabanatuan		NA: Naga*	2352
	1810	SI: Silan*	2294
CS: Casiguran		TA: Tarlac	1933
	3546	TU: Tuguegarao	
DA: Dagupan	2330		1709
DE: Daet	3624	VI: Vigan	2319
EC: Echague*	1831		
IB: Iba	3668		

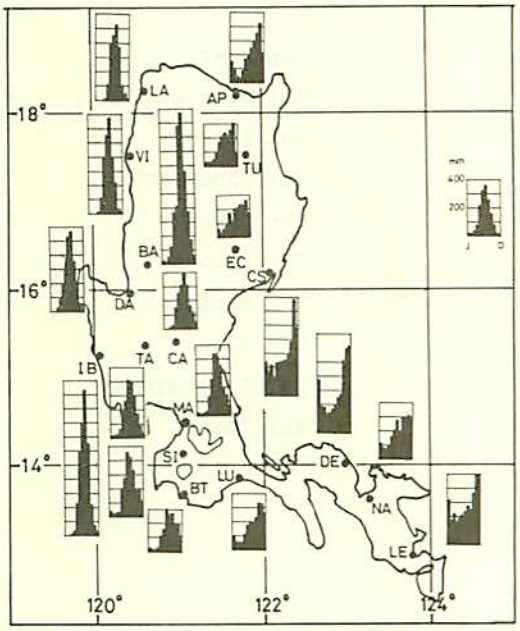


Fig. 2. Rainfall Pattern in the Luzon Island

Based on rainfall data by Climatological Division 1975.
Those with * are cited from Wernstedt and Spencer [1967].

The rainfall pattern of the Cagayan valley belongs to the east-coast type, except for the small basins in the south.

The cropping calendar of rice and off-season crops is entirely reversed on the east and west coasts. In addition, the dry season is marked on the west coast, but less so on the east coast. The difference between these rainfall patterns is particularly important in understanding the psychological motivation of Ilocano farmers to undertake seasonal migration to the Cagayan valley. If they left their country after the harvest for their fields in the Cagayan valley, they could start another main-season crop there.

On the basis of its landform, soil, hydrology, the history of exploitation, and land use, the Cagayan valley can be divided into five regions: the lower valley, the middle valley, Magat, the upper valley, and Chico (Fig. 3).

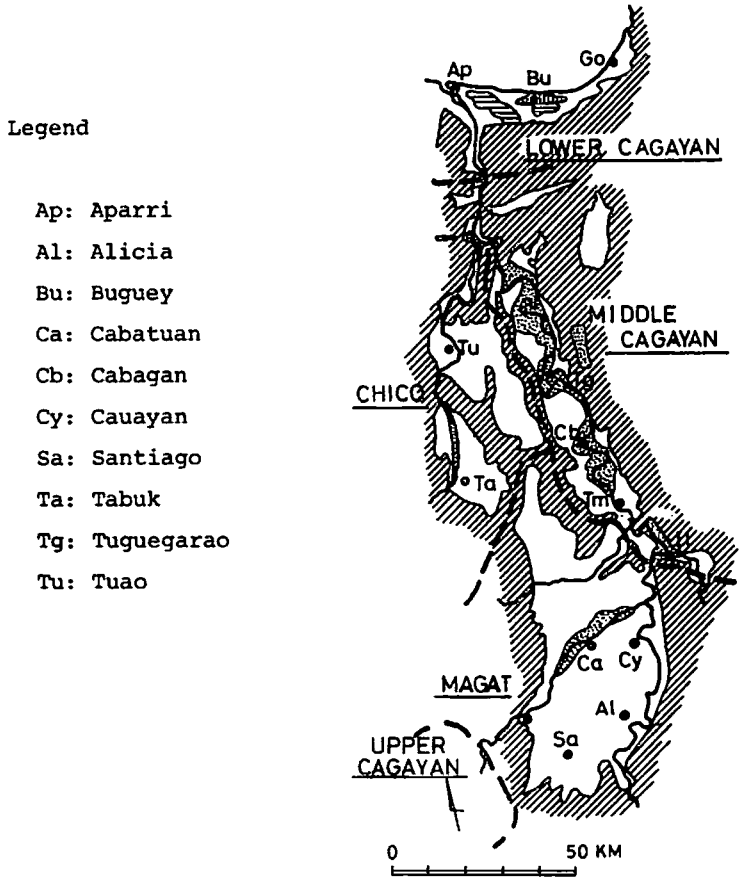


Fig. 3. Sub-regions in the Cagayan Valley

The lower Cagayan valley is a coastal lowland with a large portion of tidal and freshwater marsh. Although flooding is rare, drainage of the marsh

is prerequisite for the improvement of community welfare.

The middle Cagayan valley is the area along the Cagayan river between Alcala and Ilagan. This area is hit yearly by high floods due to the constriction of the teeming river water by the narrows at Alcala. Silt deposition has led to the remarkable development of an active floodplain in the river bed and levee on the low terrace. Ethnically, this area is predominated by Ibanag and Itawis groups.

The Magat region covers the Magat, Siffu and Mallig river area, stretching from Gamu-Quezon to Echague-Santiago. High floods are rare here since higher terraces predominate. The terrace landform has high escarpments on the eastern and northern margins along the Cagayan river, and is being aggraded at the western margin by newer fan formations due to the silt transported from the Cordillera Central mountains.

The upper Cagayan valley includes such small basins as Bagabag, Solano, Bayombong, Bambang, Aritao, and Santa Fe. The river is shallow and broad, and a floodplain is well developed along the main course. Since the shallow gravelly rivers with steep gradient can easily be tapped for irrigation water, communal irrigation systems have been formed, in earlier periods by Gaddang people, and later by Ilocano migrants.

The Chico region covers the Chico river area and includes the basins of Tabuk and Tuao. These basins are separated from the Cagayan river by tilted and elevated ranges running north-south. The gentle slope of the tilted blocks are incised by the Chico river, and terraces are well developed. This region was sparsely populated by Kalinga groups until recently, and used for grazing. The exploitation of the region by other migrants started very late, at the earliest in the 1930s.

3. Description of the Regions

Each region will be described in terms of landform, soil, hydrology, crop cultivation, and the history of exploitation or settlement.

3.1. Lower Cagayan Valley

3.1.1. Landform

The flat, level plain of the lower Cagayan valley is separated from the main body of the Cagayan river basin by mountains which run east-west and form bottlenecks at Alcala, Nassiping, and Magapit. After crossing these narrows

the Cagayan river forms a small coastal plain. The height of river bank is no more than 4 m at Lallo in December. In the dry season the water level drops several meters, and the intrusion of salt water is perceptible at Lallo. Farmers say that water buffaloes do not drink the river water in March, April and May because it is salty (Fig.4).

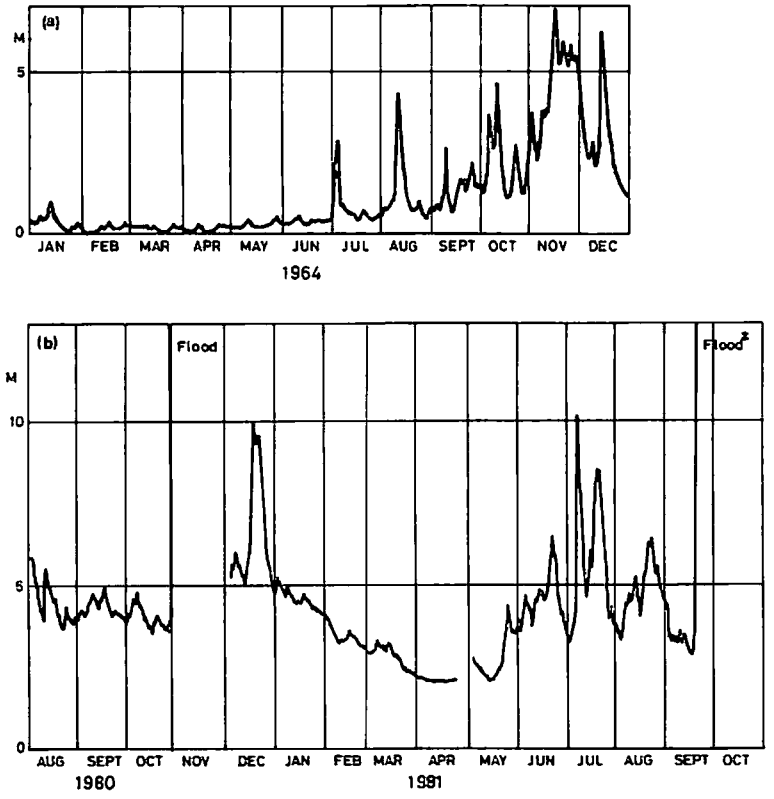


Fig. 4. River Water Level at (a) Lallo in 1964, and (b) Baculud, Amulung in 1980-81

The original data were obtained at NIA office of Alcala-Amulung.
Gauge O is taken at mean sea level.
* This flood reached to 22 m above mean sea level.

Below Dugo, a flat coastal plain stretches on both sides of the river. The coast is fringed by high sand dunes, which are more developed on the left bank. Coconut groves abound on the sand dune strips between Abulug, Ballesteros and Limao. Behind the dunes tidal and freshwater marshes are developed, more so on the right bank because the river-born silt tends to deviate to the left bank. This has retarded the aggradation of Buguey lagoon. Fig. 5 shows a cross section of the landform on the right bank area from

Camalaniugan to Buguey.

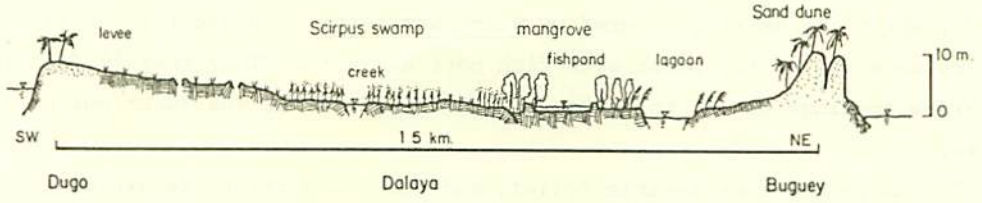


Fig. 5. Schematic Cross Section in the Lower Cagayan from Camalaniugan to Buguey

3.1.2. Soil

The levee area has riverine deposits while a part of the coastal marsh has brackish deposits. The characteristic sub-soil in this case has a gray-colored silty clay matrix and straw-yellow mottles, which indicate the presence of toxic acidity. This brackish marsh is sporadically utilized for fish ponds. The brackish marsh is readily distinguishable from the fresh-water marsh, since the former has a rather barren surface with clusters of Achrosticum aureum, while the latter is densely covered by Scirpus grossus.

3.1.3. Land use

The land use of the coastal lowlands differs in each of the following habitats.

3.1.3.1. Levee area

The levee area is mainly used for rice cultivation. The first ploughing is done in August on dry soil. The second ploughing is done after several days when water has ponded on the field. Then the harrow is applied two to three times to break soil clods and puddle the soil. With these operations the weeds die out. Finally, the harrow or a leveller (padulan, rotary harrow) is once more applied before planting. Sometimes, four or five farmers cooperate to plough each one's fields in turn. Nursery beds are prepared with pre-germinated seeds broadcast on mud. Transplanting is done at random in late September and October depending on the water conditions. Weeding is rarely done. Harvesting begins in January and continues until March. Farmers use a sickle and cut the plants 30 cm above the ground.

Popular rice varieties are 6-month varieties like raminad, ganding, makapunu, leppeng, and Los Banos. All are indica type and strongly seasonal. If planting is delayed due to the drought, farmers tend to switch to early-maturing varieties, namely, IR-36 and 42.

3.1.3.2. Freshwater marsh

Four km east of Dugo lies a vast freshwater marsh. Many creeks and small natural channels are full of water and are hardly distinguishable from the rice fields, which are densely covered by Scirpus grossus. In the rainy season many farmers move around the marsh with fish pots and nets. They install fish traps at narrow openings cut in the dikes of rice fields or at the junctions of small creeks.

The marsh has considerable relief, and the low portions remain as ponds or creeks in the dry season. For transport people use a boat-shaped sledge drawn by a water buffalo. A special type of rice is planted in these ponds and the surrounding fields when the water is receding. Called bansoroy, it is a kind of Ilocano rice (pagay Iloko) which has tall and thick culms with hairy roots up to the higher nodes, and reddish brown husks and awns. One ear has 15 to 20 rachises, with more than 20 grains per rachis. The planting season varies from place to place, but falls in the drier months from March to October. In March to May, when the water level falls, farmers apply the plough or harrow once and plant seedlings. Sometimes they employ row-seeding (inyras) if the soil is not ponded. In October, they harvest with a hand knife (rakem or ani).

A considerable area of the Scirpus marsh provides sites which can be planted twice with short-term varieties. The tall grass is first cut with a long knife (tebas). The topsoil is soft humiferous mud. Tillage is finished with one passage of the plough and harrow. No tillage is also customary. The main crop is planted in December and January, and harvested in April and May. The second crop is planted in July and harvested in October and November. Nursery beds are prepared on the dry soil of the southern hills. IR-36 and other short-term varieties allow this double cropping. But most of the marsh is planted only intermittently. Inhabitants are engaged partly in rice culture and partly in fishing.

Closer to the lagoon, the influence of salt is clearly perceptible in the cropping calendar. The situation at Dalaya is an example. Farmers there, after cutting Scirpus in June to September, till the land in October and November, and plant in November and December. They plant short-term varieties like Sandiego (3-month variety) and Los Banos (4-month variety). Harvesting is in February, when the fields has dried out. Planting in this case is clearly later than normal in order that the soil can be washed free of salt.

Marshes which have many groves of Achrosticum aureum are not used for crop production but are left for grazing of water buffaloes.

3.1.3.3. Tidal marsh and lagoon

Fish ponds have recently been dug in the tidal marsh around the Buguey

lagoon. The first were dug in 1964 by a migrant from Pampanga, who was also engaged in raising fish there. He obtained idle land near Buguey lagoon, and opened 280 ha of fish ponds, where he cultivated mainly milk fish and shrimp. The fingerlings of milk fish are obtained in the clear sea of Sances Mira. He also has 24 ha of fish ponds in Quinawegan, where the dominant species are Tilapia, mudfish, eel and crab. The structure of fish ponds is illustrated in Fig. 6. The main canal takes in brackish water from the Buguey lagoon. The moats up to 1 m deep in each pond are important in guaranteeing a certain amount of water in the dry season when the water level goes down.

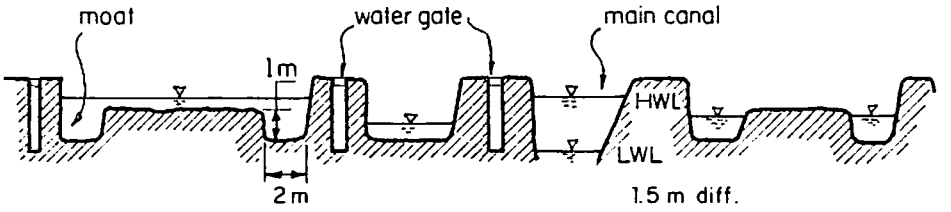


Fig. 6. Design of Fish Ponds in the Proximity of Buguey Lagoon

3.1.3.4. Fan

At Gonzaga, the coastal lowlands end and small fans dominate. Small streams traversing the fans have gravelly beds in which farmers have installed simple diversion dams made of stones. From these, small channels irrigate small areas along the streams. Santa Cruz and Santa Maria area have small areas of double-cropped rice fields planted with early varieties. The yearly typhoons, however, cause wind damage to crops every year, particularly coconut, banana, and corn. In 1981, typhoon Rubin severely damaged coconut trees. The west bank of the Cagayan river suffers less severe wind damage than the east bank.

3.2. Middle Cagayan Valley

3.2.1. Landform and hydrology

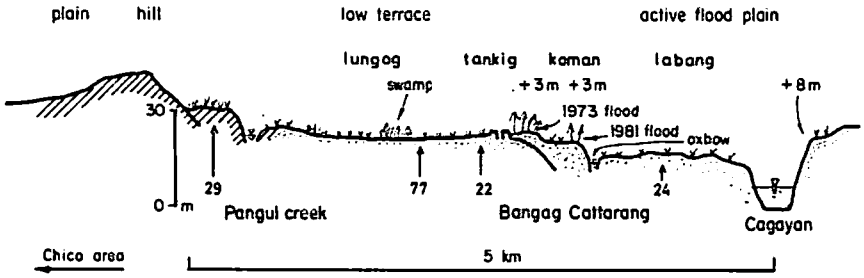
The middle Cagayan valley includes the area along the Cagayan river from the Chico river junction to the Ilagan river junction. Several tributaries join the great Cagayan river, including the Chico river at Nassiping, the Pared river at Baybayog, the Pangul creek at Palaya, Pinacanuwan Tuguegarao river at Tuguegarao, the Pinacanuwan river at Cabagan, Tumawini river at Tumawini, and the Ilagan river at Ilagan.

It is in this area that the Cagayan river floods most fiercely every year. The water level records at Baculud indicate the normal water levels and

"abnormal" floods in 1980 and 1981 (Fig. 4). The maximum water level in 1981 reached ca. 22 m above mean sea level. This means that the flood level stood 7 m above the river bank.

To accommodate this immense water volume, the Cagayan river has deep and wide course. In the low-water period, the Cagayan river flows between cliffs up to 14 m high at Tuguegarao. The river bed confined by these high banks is up to 5 km wide, and wide sandbanks have developed along the river course. Although the sandbanks, which constitute an active floodplain, are submerged during the high-water period, they emerge in the dry season, and provide a vast and important arable area which is tilled and planted with several upland crops. It is on this active floodplain that the Cagayan farmers were forced to plant tobacco by Spanish colonists in the 18th and 19th centuries.

Fig. 7 illustrates the landform and landscape of the Solana area in cross section, and Fig. 8 shows landform classification of this area. The land element called labang in these figures is the active flood plain. It is 6 km wide at the widest portion. Malanag creek, one of the oxbows, defines the western edge of the active floodplain. The oxbows are important water sources for upland crops on the labang in the dry season. The land element koman is natural levee, which lies a few meters higher than labang. The high floods of 1981 reached the shoulder of the koman, and extraordinarily high floods of 1973 overtopped its crest. These two land elements are jointly called bankag, or dry fields, and are utilized for upland crops.



The valley floor consists of the active floodplain and low terrace. Numbers 24, 22, 77 and 29 indicate the location of soils illustrated in Fig. 10.

Fig. 7. Schematic Cross Section of Solana, Middle Cagayan Region

The land elements resting on the low terrace are called tanap or wet fields, and further subdivided into tankig and lungog. Tankig is that part of

the terrace surface which is accreted by silt flowing over the levee. It occupies the highest elevation of the lands adjacent to river, and, therefore, offers housing sites for villagers. The ground elevation decreases to the backswamp. The center of the backswamp, which is 4 to 5 m lower than the tankig, has a permanent pond which is vegetated by leguminous shrubs. The water depth in the saucer-shaped backswamp is governed by the discharge from the Pangul creek. Since the Pangul creek drains from the Chico river basin beyond the west hill, abrupt flash floods hit this backswamp with no relation to the weather at Solana.

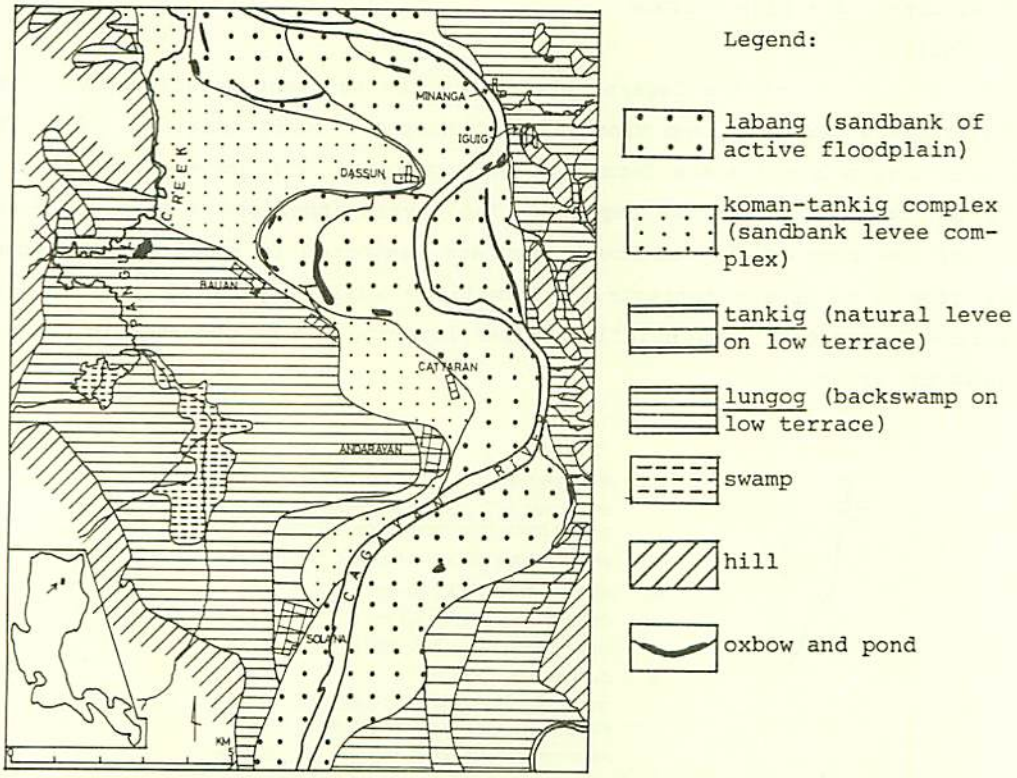


Fig. 8. Landform Classification Map of Solana Area

The high banks of the Cagayan river make it difficult to tap the water of the main stream. For irrigation of the Solana and Tuguegarao, the NIA (National Irrigation Agency) installed a vertical pump in 1977. The lift is 15.5 m, and the target irrigation area is 2,800 ha. Since the pump often breaks down, however, and the energy supply from the Electricity Board is quite often cut, the area actually irrigated has not yet exceeded one-third of the target. The failure is caused by the size of the equipment. Much smaller

pumps have been successfully operated elsewhere. In Cabagan, for example, small pumps with irrigating capacities of up to 100 ha were quite popular, and were in operation more than 50. With the rise of the kerosene price in 1978, however, their use was abandoned. Ultimately, it is difficult and costly to pump up the water from the Cagayan river. Instead, it is more feasible to tap water from smaller creeks like the Pangul and the Malanao.

Besides the low terrace, there are older ground surfaces. Although the middle and high terraces are well developed in the Magat region, they are eroded out in the middle Cagayan valley. The rolling surface located at the shoulder of the dividing hill, as illustrated in Fig. 7, is an example of the erosinal phase of a high terrace.

3.2.2. Soil

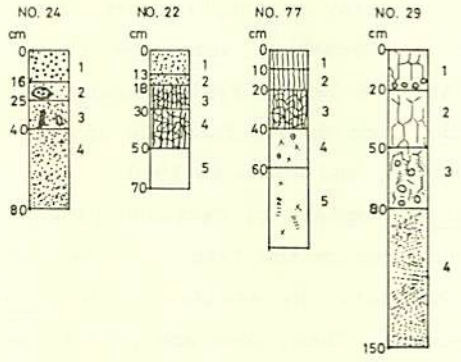
The high banks of the Cagayan river show the sediment stratigraphy. Fig. 9 illustrates an example from Minanga, 1 km north of Iguig (soil No. 58). The dark soil layers b and e are former ground surfaces. The gray-colored layer k at the bottom is a lacustrine deposit. The layers immediately above k (i and j) are of the same origin, although they are weathered to some extent. Thus, layers from a to h are terrestrial formations while layers i, j and k are lacustrine formations. Essentially similar layering can be observed in Cabagan and Tumawini areas.

a dull brown SCL
b dark brown SiCL, 60 cm moderate medium angular blocky, continuous cutan, 40 cm
c yellowish brown SiCL continuous cutan, 50 cm
d yellowish brown SiCL, 30 cm
e dark brown, prismatic, 50 cm
f bright reddish brown SiC, 100 cm
g dull brown SiC, 100 cm
h mosaic of reddish brown and grey, SiC, iron pipe abundant in standing position, 100 cm
i mosaic of yellowish brown and grey, SiC, 100 cm
j yellowish brown SiC many sand pipes, 80 cm
k gley SiCL, marine clay, 50 cm.

Fig. 9. Stratigraphy of Low Terrace Deposits at Iguig

Variation of soil layering is illustrated in Fig. 10 for the Solana area. Soils of the labang are sandy Regosol (No. 77). The upper layers show a vertic nature. Soils at the foot of hills are very dark clay and typical Vertisol, which are developed on the calcareous colluvial material transported from the hill. The reaction of these vertic soils and Vertisols is weakly alkaline, refrecting the nature of the Pliocene hills, which involve calcareous layers

interbedded in partly consolidated silt and clay. Soil on the erosional high terrace (No. 29) is very compact and gritty with abundant quartz grains. Gravelly subsoil uncomformably overlies the semi-consolidated sand, which belongs to the Ilagan formation. This soil is highly leached, and shows acid reaction (Acrisol). Clay mineral composition differs distinctly in different



No. 24 sandbank
1 olive brown FLS, loose, single-grained, with some gley mottles;
2 brown SiL, with sand lense, loose, single-grained, good for tobacco;
3 brown SiCL, massive, many biopores;
4 brown SiCL, massive.

No. 22 tankig (natural levee on the low terrace)
1 brownish black SiCL, friable, coarse blocky;
2 brownish black SiCL, transitional to
3 brownish black LiC, moderate coarse blocky breaking into strong fine angular blocky, with shining ped faces, firm;
4 dark brown LiC, same structure as above;
5 dull yellowish brown HC, with many brown mottles, very firm.

No. 77 lungog (backswamp on the low terrace)
1 olive black LiC, muddy and soft;
2 olive black LiC;
3 olive black HC, with many olive brown mottles, strong, fine angular blocky, with shining ped faces;
4 brownish black HC, with many brown mottles, a few pisoliths;
5 grayish olive HC, with abundant brown mottles, and coarse gray mottles.

No. 29 eroded phase of high terrace
1 brownish black SCL, with many coarse grains of quarts, coarse columnar, with stone line at the bottom,
2 bright yellowish brown SC, coarse columnar with shining ped face, very firm;
3 variegated SC, columnar, abundant, rounded andesitic gravels, very firm;
4 dull yellowish brown LS, extremely firm, semi-consolidated, with remarkable cross-lamination.

Fig. 10. Variation of Soils in the Solana Area

soil types. Vertic soils and Vertisols on the low terrace have predominantly montmorillonite in the clay fraction, while the gritty Acrisols on the erosional high terrace have kaolin minerals.

3.2.3. Land use in Solana

3.2.3.1. Bankag (Dry field)

Labang (sandbank) is exclusively planted with upland crops. Since it is usually flooded during the rainy season, farmers leave it idle from August to November. In November or December, when the flood danger is almost nil, farmers start to cultivate the land. Field boundaries, which are erased every year, are marked by bamboo rods driven into the ground. Sand deposition by the annual flood was 1 m in 1973, and 60 cm in 1980.

In 1981, the barrangay captain of Cattaran ploughed his labang field once on 14 December and second time on the 17th. On the 19th and 21st he applied a paragos (bamboo-pegged harrow). He stands on the paragos, which is drawn by water buffalo, to add weight. Then, corn and peanuts were row-seeded (inyras). Young plants of tobacco and water melon were also planted. Corn and peanuts are harvested in March; tobacco in April and May; watermelon in April to June. Corn is again seeded in May, and harvested in August. Corn stalks are used for firewood. After three months' fallow during the high-water period, he starts to prepare the field again. The first operation is careful digging of corn roots in search for beetle larvae, which are local delicacies.

The soil texture of the labang fields varies from place to place. The barrangay captain reports that sandy soil is more suitable for peanuts, and finer soils for tobacco.

Since koman is located higher than the reach of normal floods, it is planted with crops continuously through the year. The typical cropping calendar of the koman field in Solana area is as follows: from May to August corn is intercropped with mung beans, cowpeas, peanuts and tobacco; from August to mid-October, mung beans are cropped; from November to February corn is cropped; and from March to May, mung beans are cropped again. The second crop of mung beans are often intercropped with dry rice, or even completely replaced by dry rice in rainy years when conditions are too wet for mung beans. The popular rice variety in the koman is galiyano, a sticky rice. This is harvested by rakem (hand knife).

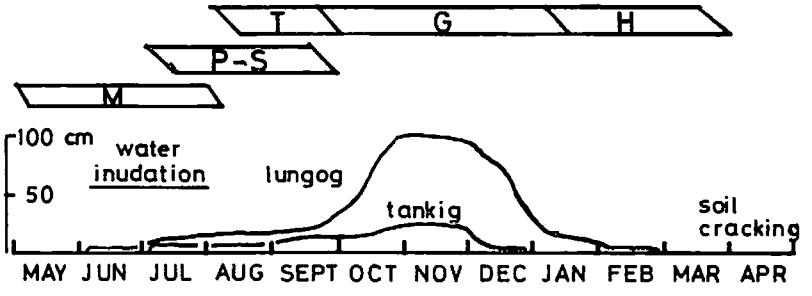
The koman fields interpenetrate with the lower tankig land and are in the process of conversion into wet-rice fields.

The combination of crops planted on bankag fields differs in different localities. Corn, mung beans, cowpeas, peanuts and tobacco feature in the bankag of Solana area. Tobacco, cotton, and corn are important in Santa to the

south of Cabagan. Cotton, corn, and sweet popato are popular in San Antonio on the opposite side of Tumawini. Dry rice intercropped with corn is very popular in Sipay on the northern bank of Pinacanuwan Ilagan river. The combination of dry rice and peanuts is extensively cultivated in the territory of the notorious Hacienda San Antonio to the east of Ilagan. Dry rice is also extensively cultivated on the Plio-Pleistocene hills to the east of Ilagan. This feature seems to be related with Kalinga people who sparsely inhabit these hills.

3.2.3.2. Tanap (wet-rice field)

The cropping calendar of rice as reported to me by Mr. Pamposo Tallud in Bangag, Solana is illustrated in Fig. 11. Nursery beds are prepared on the tankig in July. Dry grains are row-seeded (inyras) or broadcast (sabag) on dry soil which has been tilled by plough and harrow, and covered with soil by paragos. When the seedlings are uprooted, the nursery bed is already ponded. The transplanting season varies from year to year depending on the water conditions. Tall seedlings, usually two-month old, are uprooted from the mud, and cut down to 40 cm height before transplanting. Wagwag aga, wagwag tawatao, and wagwag fino are suited to tankig. Java and magkampul are planted in lungog. All are strongly seasonal varieties which are harvested in February, or March in the case of Java, whether they are planted in August or in December. If they are planted in January, however, they are harvested the following January. If planted at the normal times, wagwag aga is an early variety; Java and magkampul are late varieties; Java is the tallest and thickest. Other are intermediate varieties. They are all harvested by sickle.



M: Mung bean P-S: Ploughing and seedling
T: Transplanting G: Growing period H: Harvesting

Fig. 11. Cropping Calendar of Rice Fields in the Solana Area

Soils dry out in March, and coarse cracks develop in most of the backswamp. With the first rain in May, some farmers till their fields and

row-seed mung beans. This is harvested in 60 days.

Tilling implements, although simple, work well enough drawn by a water buffalo. The plough has a long sole and moldboard. The moldboard of the plough used for wet-rice fields is longer and narrower than that for dry fields. Paragos (bamboo-pegged harrow) is used for harrowing, levelling and for soil-covering.

The yield of wagwag varieties is about 70 to 80 cavan/ha (1 cavan = ca. 50 kg).

The flood is peculiar to the area. The normal flooding of the tanap is caused by the discharge from the Pangul creek, while the high floods are caused by the overflowing of the Cagayan river. Extraordinarily high floods occur when high waters of the Cagayan and Chico rivers coincide. At Bangag, the flood level in 1973 reached 2.2 m above house floors, and that in November 1980 reached 1.4 m above house floors.

Under these circumstances farmers follow the traditional rice cultivation, and emphasize the importance of drainage from lungog in order to modernize the technology. Others emphasize the importance of irrigation, for example, a big landowner in Baian, who has 100 ha of tanap. His rain-fed fields on the tankig were changed into irrigated fields in 1965 by pumping up water from Pangul creek. Since then the number of pumps in use has increased, and now amount to 21 in Bauan alone. He has a 6-inch tube-well from which 100 ha can be irrigated in the rainy season and 20 ha in the dry season. This sort of innovation is now taking place in many locations.

Meso-scale irrigation projects by NIA have also been successful. Examples include the Pinacanuwan river project at Tumawini, which has the target area of 6,100 ha, and the Dummon irrigation project, which started in 1977. These irrigation projects tap water from small tributaries upstream in the Sierra Madre moutains.

3.2.4. Brief account on the history of exploitaion

Most inhabitants of Solana are Ibanag people. When asked about the landscape in the past, they replied that there were more forest and shrubs on the low terrace and active floodplain. The trees included palen, baliti, aludig (Streblus spp.), and kamacere (Pithecolobium dulce). Many of the people over 50 have experience of clearing the forest and shrubs to make koman and tankig. For three years after clearing the forest, they used to broadcast dry rice grains on the tilled fields. Grains were coverd by soil with paragos. After three years, transplanting was employed instead of broadcasting. The acreage of wet-rice fields increased remarkably, and they estimate that it is now about three times what it was in the 1950s. The population has approxi-

mately doubled in the same period. Their main food in the 1950s was corn, with rice only in the three months from March to May. Now people can afford to eat rice six months of the year. This rapid expansion of rice fields must have drastically changed the landscape.

When asked which is more important of bankag and tanap, most farmers replied bankag. Some said that bankag is susceptible only to floods, while tanap is damaged by both floods and drought. The Ibanag people were formerly dry-field cultivators, wet-rice fields having been introduced a century ago or so by Ilocano migrants. To the Ibanag people, wet-rice culture is still something difficult to manage.

In this Ibanag country, the Pared and Dummun river valleys have exceptionally dense populations of Ilocano migrants. Both rivers have small intermontane basins upstream, which are sinkholes in the limestone hills. The area around the confluence of the Pared river has long been neglected by the Ibanag people because of the severity of the high floods. This area was inhabited by Ilocano migrants, for whom the small town of Baybayog became the center. In the floods of 1973, water rose to 5 m above the ground, overtopping the roofs of the houses, while in 1980 it reached 4 m. Many water buffaloes were drowned in these floods. One Ilocano migrant left his tractor grease-sealed, and recoverd it undameged after the flood receded. He came to Baybayog from Batak, Ilocos Norte in 1955. He found the labang coverd by shrubs and kept as grazing lands. He bought several tens ha of the idle land, cleared it, and planted tobacco until 1974 when the tobacco price fell drastically. Then he switched to corn and mung beans. He used to obtain irrigation water for wet-rice fields from Baybayog lake, which was dried up by NIA. In 1974 he constructed a dam for wet-rice fields which he had opend on the labang. Surprisingly, this dam can store up to 2 m of water. His case exemplifies drive and determination of Ilocano rice farmers.

Another group of Ilocano migrants moved further eastward along the Pared river and they engaged in adaptive subsistence agriculture. Some of them are engaged in shifting culture on the low hills to the east of Baggao. The hills are coverd by shrub, which is the fallow phase of the cycle, together with several stands of escaped banana and pioneer plants like Macaranga and Erythrina. The shifting cultivation of these very recent migrants from Ilocos Norte is as follows. The present patch on the steep hillslope was opened in 1980. Shrubs were cut in March as a group task and burnt in April. In May, dry rice seeds were dibbled into holes punched with a long digging stick(asad). Rice varieties planted were araramang, gabao, arimuran, and balkatan, which are bulu-type rice judging from the grain shape and phenol reaction. The latter

two are glutinous rice. Corn grains were similarly dibbled. Lima beans, garlic, and tobacco seedlings were also planted. Weeding was done frequently. They harvested the rice in October with a hand-knife (ani) ear by ear. The same plot was planted for three years, then planted with banana and coconut palm, and left fallow. Rice is milled with a pestle and round mortar. Their main foods are rice and glutionous corn which is crushed and boiled in a similar way to rice.

Another example is a sloping wet-rice field. This illustrates how Ilocano migrants adapt to the given environment in the process of opening rice fields. Sloping, ponded rice fields are located on the colluvial slopes between the hillslope and the valley bottom, which has already been converted into normal rice fields. These sloping fields retain the relief of the original landform, and none of the patches is level. Bunds are made at the lower end of a patch, and water ponds in the lower portion of the patch but not the higher portion. In July, farmers start ot plough and harrow this sloping patch. Surprisingly, the unponded, higher portion is also puddled with the harrow. Soils are moist enough to be puddled due to the abundant rainfall, which exceeds 300 mm in October and November.

Sloping wet fields are cultivated for a number of years, e.g., 10 years, then they are gradually converted into level terraces in the following years.

3.3. Magat Region

3.3.1. Landform

The Magat region includes the terrace area of Isabella, which was formed by the main stream of the Cagayan river, the Magat river and the Siffu river. High floods are rare in this part of the Cagayan valley since the terrain is high and far from the constricting narrows at Alcala-Nassiping. Although the main stream of the Cagayan river cuts the terrain deeply at the eastern margin, the Magat and Siffu rivers have shallow beds. The Magat river has its apex near Oscariz. The discharge of sediments from this outlet in various directions must have contributed to the aggradation on this terrace and the formation of the ridge which divides the area into two triangular sub-terrains. The northern sub-terrain is bounded by Oscariz, Cauayan and Alicia, the southern one by Oscariz, Santiago and Alicia. The former slopes down to northeast, the latter to southeast.

Another important factor contributing to the terrace formation and the present landform is the counterclockwise tilting of the bedrock, which seems to have caused the splitting of terrace surfaces and the shifting of Magat river from the east to west. This hypothesis is based on the general landform and

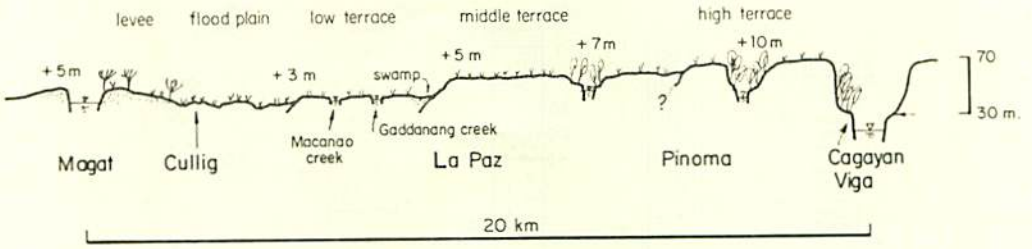


Fig. 12. Schematic Cross Section in Cabatuan-Cauayan Transect, Magat Region

the soil form. The eastern margin of the terrain has higher elevation and more weatherd soils. Fig. 12 illustrates the cross section of the northern sub-terrain, from Cabatuan via Pinoma to Angadanan, and this supports the hypothesis. Oxbows left by the former meandering of the Magat river are seen on the floodplain, and the Gaddanan and Macanao creeks lie on the low terrace. To the west of the La Paz there is a low, sharp escarpment approximately 3 m high. This delineates the middle terrace, on which the Marabulig and Minante creeks lie. The Minante creek cuts the terrace rather deeply. To the east of Pinoma, the land surface becomes considerably undulating. Creeks incise ca. 10 m deep valley. Pinoma itself lies on high terrace, although the escarpment is not clear. Further eastward, toward Viga, the ground surface rises gradually and has gently rolling topography. This eastern high terrace is mostly used for grazing and upland crops. At Viga, the terrace is cut by the Cagayan river in a sharp, high escarpment. Beneath this, a floodplain and low terrace have developed along the river course.

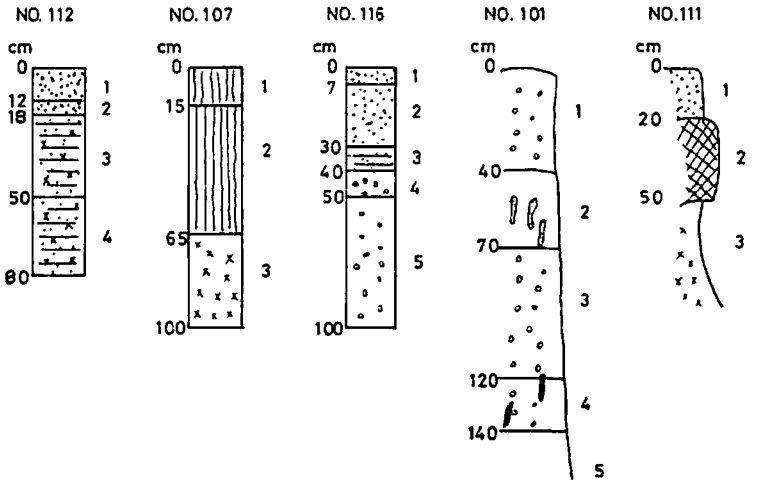
3.3.2. Soil

Soils on each terrace surface are distinctly different. The following is a brief description of soil stratigraphy.

The active floodplain along the Magat river is again subdivided into koman and labang. The soil texture in the active floodplain is much finer than in the middle reaches. Along the Siffu river, it is particularly fine: brown silty clay soil are dominant. It becomes coarser along the Magat river, where loam and fine sandy loam soil predominate. These soils are suited to tobacco cultivation.

The variation of soil forms on successive terrace is illustrated in Fig. 13. From the observation of these outcrops, an idealized stratigraphy of the middle and high terrace formation can be synthesized as shown in Fig. 14.

In brief, the low terrace soils have no iron and manganiferous pisoliths but only the soft, spherical concentrations. The middle terrace soils are



No. 112 low terrace between Cullig and La Paz
1 dark brown SiCL;
2 gray SiC, cutan on ped faces;
3 brown SiC with common yellowish brown mottles, strong medium blocky, cutan on ped faces, compact;
4 yellowish brown SiC with many manganiferous mottles and concentration, compact.

No. 107 depression on low terrace at Caliguian
1 black HC, strong medium blocky;
2 dull yellowish brown HC, strong medium angular blocky, cutan on ped faces;
3 gray HC, many iron and manganiferous concentrations and mottles.

No. 116 middle terrace to the west of Alicia
1 dull yellowish brown L.
2 grayish yellow brown SiL, common fine iron and manganiferous pisoliths;
3 yellowish brown SiC, many fine iron and manganiferous pisoliths;
4 pisolith layer composed of rounded iron pisoliths (5 mm);
5 light gray HC, prismatic, many very fine (1 mm) iron and manganiferous pisoliths.

No. 101 middle terrace at Union, Gamu
1 dark gray HC, with developed cutan along the prismatic ped faces, many iron and manganiferous pisoliths;
2 brownish gray HC, many very fine iron and manganiferous pisoliths, many coarse calcareous pipes in vertical position (10 cm long);
3 gray HC, many manganiferous pisoliths (2 mm);
4 light yellow LiC, many manganiferous pisoliths (2 mm), many dark soil pipes, tuffaceous in its origin;
5 light yellow LiC, soil clod is light, tuffaceous in its origin.

No. 111 high terrace 3.5 km east of Viga
1 dull brown SL, loose;
2 botryoidal laterite pan;
3 light gray HC, many iron concentrations, tuffaceous in its origin.

Fig. 13. Variation of Soils in the Magat Region

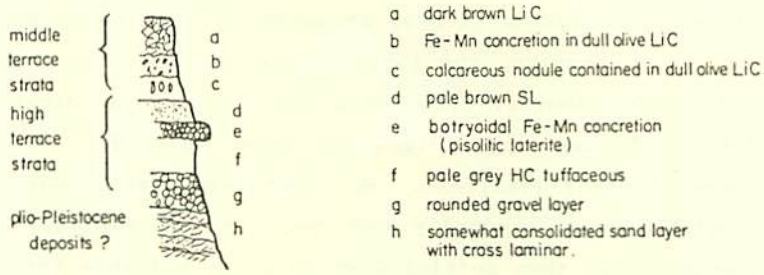


Fig. 14. Idealized Stratigraphy of Middle and High Terrace in the Magat Region

usually overlain by local alluvium in gentle depressions where rice fields are extensive. Otherwise, upper layers have hard, spherical pisoliths which are mostly of manganiferous composition with an thin iron crust. The subsoils often contain pebble-sized lime nodules embedded in an olive-yellow clay matrix. This clay seems to have been calcareous in nature although it no longer retains free lime.

The high terrace soils feature white gray sandy topsoil and a botryoidal laterite pan. In some cases, this laterite pan is disintegrated into slag earth, but some amount of botryoidal crust remains. Gravel beds are not as strongly weatherd as those corresponding gravel beds in Japan, but remain rather fresh. At most the gravel surface is bleached white. The hard sand layer with cross laminae, which is cut unconformably by the gravel bed, is a Plio-Pleistocene Ilagan formation.

3.3.3. Land use

Land use and the history of exploitation strongly depend on landform. The largest distribution of active floodplain is found along Magat river from Oscasiz via Cabatuan, San Mateo, to Gamu. Although less extensive, it is also found along the Cagayan river, particularly to the east of Cauayan, and along the Mallig and Siffu rivers. High terrace is distributed along the periphery of the area: the gently rolling area around Cordon and Santiago, the undulating area from Echague via Alicia to Cauayan, and another patch in Oscariz. Low and middle terraces occupy the major part of the remainder. Land use in active floodplain centers on the cultivation of upland crops, above all, tobacco and corn. Since the low and middle terraces in this area are easily irrigable by gravity from rivers, these were transformed into irrigated fields early on by Ilocano migrants. The high terrace, on the other hand, because of the difficulty in tapping the irrigation water, mostly remains as grazing ground or is planted with dry rice and corn.

The oldest settlement in the Magat region is Gamu. Located at the junction of the Magat and Cagayan rivers, it seems to have been an important ferry port. According to Keesing, the 1591 encomienda list of the population gives the number as "500 tributes, 2,000 souls" in the Cagayan-Magat junction area. The population of Gamu in a 1746 survey was reported to belong to a tribe called Gadanes [Keesing 1962:261]. No other large settlements existed. This sparsely populated area gradually received Ilocano farmers who first visited the area seasonally, then settled down on sites suitable for dwelling. The tobacco monopoly begun in 1781 accelerated the immigration. Keesing writes, "from 1850 to 1897, Ilocanos were given free passages, advances of money, to settle as tobacco growers" [Keesing 1962:181].

Lewis [1971] described the history of a small village named Manbabanga located near Luna. The village was founded around 1915 by Ilocano farmers who bought land that the government had purchased from the Catholic Church from 1905 on and was selling to settlers. Each family could buy up to 24 ha of land, although a family labor could not normally manage to cultivate more than 3 ha. One ha was planted with Ilocano rice, one ha with garden crops like corn, beans, and banana, and one ha with tobacco. Lewis writes as follows: "tobacco had long been commercially importan along the main rivers, but a rice economy did not develop until the forest and savannah lands were opened up by Ilocano settlers" [ibid: 34]. Gradually a few farmers emerged as larger landowners, and in 1939 one of them opened an irrigation network with a small weir built at Macanao creek.

These descriptions convey an idea of the rapid changes that took place in the landscape and agriculture of Cagayan valley in earlier times. The following paragraphs describe the recent trends observed in my survey.

Land use in the Siffu area as related by the barrangay captain of San Juan, Quirino, is as follows. His father sailed to Aparri from Laoag in about 1900, and by smaller boat reached Andarayan (Cauayan). There was boat transport shuttling between Echague and Lallo. The boat carried, besides passengers, tobacco and corn on the down trip, and salted fish on the return trip. Gamu is the oldest town in this area. Other towns like Mallig, Roxas, Queson, Burgos, San Manuel, and Quirino, emerged in the 1940s as small barrio under Gamu. Land use on koman along the Siffu river still follows the traditional pattern. In the rainy season, Ilocano awned rice is dibbled on koman. After the harvest, for which the rakem is used, tobacco, corn, cotton, and mung beans are planted in January and February. Level terrain, which is now converted to rice fields, was formerly a grass plain covered by talahib (Saccharum spontaneum) and cogon (Imperata cylindrica), where Kalinga people

practiced shifting cultivation. Ilocano migrants prepared dry nurseries on hills (actually the high terrace), and transplanted seedling by asad (digging stick) in July and August on the cleared and tilled level terrain. Within a few years, they built simple dikes on the fields. This change took place on the low and middle terraces. The land was not leveled, however. Popular rice vaieties were wagwag and raminad. Harvesting was done in February and March with the rakem. Harvested ears were threshed by trampling, by people or sometimes by water buffaloes. Now, modernization has advanced to some extent. Irrigation of rain-fed rice fields started in the 1960s using pumps to raise water from the Siffu river. The NIA started irrigation in 1972 through the construction of Siffu dam and canals. This enabled two rice crops to be harvested. Thanks to the short-term IR varieties and his own private deep well (28 m), the barrangay captain can harvest three crops of rice in a year. The rice yield in the past with old varieties was about 70 cavan/ha (1 cavan = 56 kg here). The present IR varieties give a maximum yield of 120 cavan/ha/crop and a mean yield of 80-90 cavan/ha/crop.

The Luna and Cabatuan area have many communal irrigation systems (CIS). Organized in the 1930s and 1940s, these systems utilize small creeks which flow on the low and middle terraces. The Gaddanan dam, which I saw in 1982, was claimed by a farmer to have been constructed in 1935. The irrigation netwerk is still working.

These innovations, however, were not completed immediately. In earlier stages, Ilocano farmers, beside the usual transplanting method, employed simpler methods adapted to the harsh conditions. For example, the middle terrace has some amount of undulation. The swampy depressions located between Caliguian and Sandiat used to be talahib plain and were opened by an Ilocano farmer in 1950. Field preparation started with cutting down the talahib with a long knife (tebas) and burning it. For the first several years no tillage was done, but seedlings were planted with a digging stick (asad) by placing them obliquely on the ground and pushing the root neck into the muddy soils with the stick. An informant claimed that this method is intended to protect the hands from injury by the harsh grass roots remaining in the soil. It seems to me, however, to be related to the non-tillage culture found extensively in the marshes under tropical rain forest of Southeast Asia.

Wet broadcasting was also popular. An old farmer in Nagrumbuan who came from Tarlac about 50 years ago said that the talahib plain was opened from the depressions (lungog). Pre-germinated rice was broadcast on the wet soil, which was tilled by plough and harrow. Planting was done in August and September, and harvesting in January. Ilocano rice was harvested with the rakem, and

other indica-type rice, wagwag, raminad and rinamai, was harvested with the sickle.

Dry broadcasting seems to have been practised extensively. Indeed, it remains on the high terrace. I observed one example along the way to Viga. The field is tilled several times. The first ploughing is done in July, and harrowing one month after in August. Then ploughing and harrowing are repeated twice. This elaborate tillage is needed for weed control. Dry rice mixed with bat guano is broadcast in September. Ten days after broadcasting, the plough is passed once to form ridges and furrows, and plants come to stand in rows on the ridges. After the plants are established, a small paragos is passed through between ridges repeatedly to remove weeds. Harvesting is done in January with a sickle. The rice variety planted is called bensir (an indica-type rice). The seeding rate is 1 cavan/ha and the yield is 30 cavan/ha. This field, formerly grazing ground, was converted into a dry rice field 10 years ago. In the near future this area will also come under the Magat river irrigation project. Transformation of grazing ground into irrigated wet-rice fields characterizes the recent history of land use in Isabella.

Thus, the Magat region has recently received a combination of modernized farming systems: HYVs (high yielding varieties) and successful irrigation projects like MARIS and SIFRIS. This area will be able to become an important rice granary. The community, however, has lost control of irrigation water, which has been transferred to the hands of the governmental agency. This tends to destabilize the community organization which Ilocano migrants fostered. It seems to me that control of irrigation systems should be returned to the hands of farmers again in order that self-supporting and stable farm communities can be established.

3.4. Chico Region

3.4.1. Landform and soil

The Chico region is separated from the main stream of the Cagayan by a range of hills about 400 m high. The rock comprises interbedded strata of sand, sometimes calcareous sand, and rounded gravel beds consisting of various kinds of sandstone, chert and dacite. This Pliocene formation is strongly tilted, dipping toward the east. The Chico region is pinched by this hill range into two basins, namely, the Tabuk basin and Tuao-Chico east.

3.4.1.1. Tabuk basin

The Tabuk basin has distinctly developed terraces with a sharp escarpment. The higher terraces are called the Tabuk plateau; the floodplain and low terrace form the lowland of the Tabuk basin. The tendencey for the river

course to shift westward is observed in this basin, as in the Magat river basin. The present river bed lies at the western extremity of the valley. The escarpment between the floodplain and the low terrace is clear and about 3 m high near the town of Tabuk, becoming obscure in the northern part at Laya. The escarpment of the middle terrace is as high as 10 to 15 m. The Tabuk plateau rises toward the east, and its height above the floodplain reaches 40 to 60 m. The middle terrace remains largely a flat surface, while the high terrace shows considerable undulation (Fig. 15).

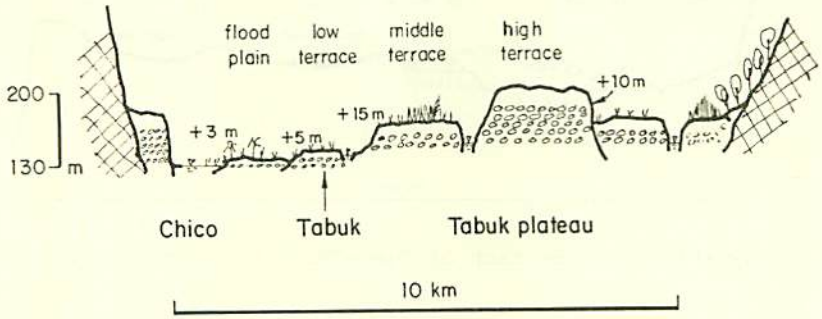


Fig. 15. Schematic Cross Section of Tabuk Basin, Chico Region

The soil of the floodplain is gray-brown lowland soils (Fluvisol), with a friable dark brown loam subsoil. The low terrace has dark brown light clay subsoil, which is very compact and rests on round gravel beds. The stratigraphy of the middle terrace is illustrated in Fig. 16. Soil of high terrace has similar features, but subsoil mottles are reddish brown, and the gravel beds are more weathered. The parent material of these soils is strongly influenced by acid tuff, as evidenced by abundant quartz grains of euhedral form. Judged from the parent material and the weathering degree, the soils on higher terraces are infertile.

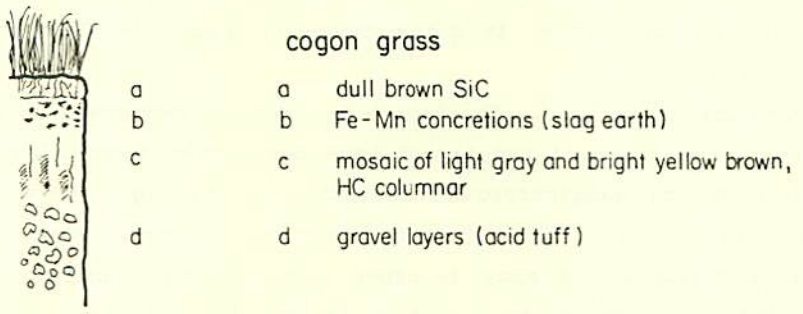


Fig. 16. Soil Stratigraphy of Middle Terrace of Tabuk Plateau

3.4.1.2. Tuao-Chico east

Tuao-Chico east has two components: a floodplain at Tuao, and an undulating plain to the east of Tuao (Fig. 17). The undulating plain, which is a Pliocene formation, is trough-shaped and split into two parts: the Gadu-Liwan trough and the Lakambini-San Vicente trough. The lower depressions of the troughs have local alluvium of heavy dark clay which is slightly calcareous, while the upper erosive slopes have senile soils with pisolith layers.

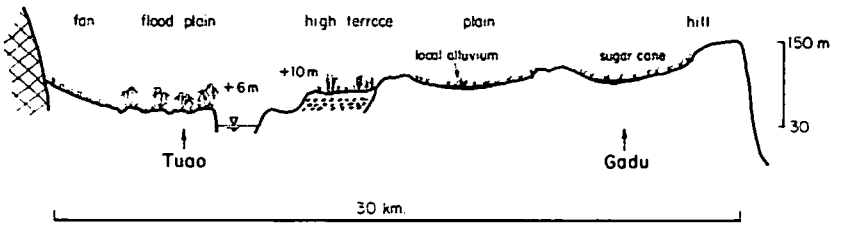


Fig. 17. Schematic Cross Section of Tuao-Chico East Transect, Chico Region

The hydrology of trough is also characteristic. The bottom part is blessed with a good aquifer which collects interflow water coming down from the sideslope of the trough. This situation provides abundant ground water to springs and wells. Many wells are even free-flowing.

The western margin of the plain is cut by the Chico river. A high terrace runs in a long strip along the river. The aquifer is poor on this terrace and pumps are rarely installed.

Tuao is located on the floodplain of the Chico river. The area is low-lying and has no remarkable highs. The eastern side of the town has several rows of former levees and river beds. The specific height difference does not exceed one meter. NIA constructed an inlet gate at the southern end of the floodplain in 1967, and started to provide irrigation water to the levee area, which was planted with upland crops. The active floodplain, which even now is planted with dry crops, is quite extensive along the Chico river from Tuao to Santo Nino.

Soil forms are as follows. The trough has two end members. Soils located on the upper erosive slope of the trough have dark brown sandy clay with many fine (2 mm) iron and manganiferous pisoliths in the top layers, and dark olive-yellow heavy clay with streaky mottles, common fine iron and manganiferous pisoliths, and many feldspar spots in the subsoil. The soil fabric very closely resembles the top three layers of No. 57 found on the Tabuk plateau. The implication is that the formation of the upper trough ground

surface is equivalent to the middle terrace formation having a Ferralsol.

Soils on the depression of the trough, on the other hand, belong to the Vertisol group. The upper layers are dark olive-yellow heavy clay with common fine manganiferous pisoliths. Although free lime is absent, the fabric shows the calcareous nature of the parent material.

Soils of high terrace have brownish sandy clay top layers of gritty appearance due to abundant fine iron and manganiferous pisoliths (1 mm) and coarse quartz grains. The subsoil has a coarse mosaic of white-gray matrices with reddish brown and yellowish brown mottles. It also appears gritty due to abundant fine pisoliths (2 mm). The lowermost layer is a sand and gravel bed. Tuffaceous gravels are strongly weathered.

Soils of Tuao floodplain are Regosols of brown sandy loam.

3.4.2 Land use

Chico region was for a long time sparsely populated, and the inflow of migrants is very recent. A few big landowners controlled huge areas which were mostly used for grazing. Tuao, however, seems to have attracted inhabitants from earlier times. It was a fort town in the middle of the 18th century [Keesing 1962; 234]. The trough area of Tuao-Chico east is also a new frontier, where, by virtue of its rich aquifer, irrigated rice fields are rapidly expanding.

3.4.2.1. Tabuk basin

The history of the migration to the Tabuk basin is summarized in the following paragraphs. This account is based on an interview with Mrs. Belandres of Laya, Tabuk.

Mrs. Belandres came from Manila to Tabuk in 1944. One of her relatives was working as a superintendent at Tuga colony. At that time, the marshes were more extensive and many laborers from Bontoc suffered from malaria and hepatitis. There were many herds of wild water buffalo, hog, and deer. In 1930s there were no wet rice fields in the Tabuk basin. The main crops were dry rice and corn, which were planted on levees. Wild buffaloes often damaged crops at night.

The native people were Kalingas, who planted dry rice in swiddens on the lowland and the plateau. Fires often spread over the whole basin, burning the talahib plain in a day. In the 1940s more Ilocano migrants arrived and in the 1950s migrants from Mountain Province. Rain-fed rice fields increased on the floodplain and the low terrace. In the 1950s, communal irrigation systems were organized. Free-flowing water inlets were constructed at Apas, Laya, Balong, Dilag, Sokubut, and Tuga. One of the main inlets still remains, close to the Calana bridge. Canals were excavated, extended and maintained by the farmers.

In the 1950s irrigation coverage reached 1,500 ha. In the 1960s, NIA expanded the coverage to 3,000 ha.

Rice varieties formerly planted were bensir, wagwag, wagwag tawatao, raminad, and intan. Only one rice crop was raised annually. At present, the floodplain is planted with three rice crops of IR varieties. Wet-rice cultivation is predominant there. The low terrace has different land use: even in the rainy season, upland crops are planted to some extent. Water is tapped from the Barigatan creek using simple brush dams made of stone, bamboo and log. The low terrace seems to be more stable and established as arable land.

The Tabuk plateau, on the other hand, has no water resources, and no inhabitants except Kalinga people accommodated in a settlement camp. They cut cogon grass, burn it in May, dibble dry rice grains with an osok (asad, digging stick) in June, and harvest in December-January by hands. Rice varieties planted include unoi, walai, bulik and ifuyan. These appear to be bulu-type rice judged from the grain shape and negative phenol reaction. In the dry season, they plant beans and some vegetables. Corn, however, is rarely planted. After a few years, before moving to other plots, they plant banana.

A few Ilocano migrants living in two small huts cultivate rain-fed rice with long-term varieties like raminad and miragurosa. They depend much on a coffee garden located on hillslopes to the west of Tabuk.

3.4.2.2. Tuao-Chico east

The implementation of irrigation projects by NIA has caused a remarkable change of the land use in the Tuao floodplain. Before 1967, the western half of the floodplain was a rain-fed rice area, while the eastern half was planted with upland crops: corn, tobacco, mung beans, and peanuts. Now, irrigated rice cultivation is expanding even in the levee area of the eastern half.

Cultivation in the active floodplain is similar to that elsewhere. In addition to tobacco, corn and mung beans, cotton is an important crop in this area.

Land use on the high terrace and plain along the Chico river remains primitive. This area is owned by Hacienda Vilecette, which has no interest in improving agricultural technologies for its laborers. It is indicative of the situation that Mr. Vin Vilecette, a member of the family in charge of farming management, does not know about IR varieties. The family is more interested in sugarcane production, and the hacienda's design restricts the land use. Laborers, however, secretly plant rice, mostly on the high terrace since this poor land is more neglected by the landowner. Laborers till the soil in July by plough and harrow, and transplant about two-month-old seedlings which were prepared on dry beds. Rice varieties planted in this enclosed territory are

traditional one like bensir, raminad, wagwag fino, zerop, Burma, and so on.

The upper slopes of the trough were first planted with sugarcane in 1976, when the CASUCO (Cagayan Sugar Company) factory began operation. Formerly these slopes were mainly used for raising beef cattle.

The bottom of Gadu trough is owned by Hacienda Bautista. Bautista moved to Gadu in 1928 from Pampanga. The land, originally a talahib plain, is wet and often submerged, and thus he chose to plant rice. In the early stage he had to be content with one crop a year of wagwag varieties. No weeding was done after transplanting in September until harvesting in February. The yield was 30 to 60 cavan/ha. In 1965, he introduced pumps driven by diesel engines. This enabled him to raise two crops a year. Now, using IR varieties, three crops per year are possible. Yields have also risen remarkably to 80 to 120 cavan/ha/crop.

The southern part of Gadu-Liwan trough remained idle much longer. It was later obtained by the present Mayor of Tabuk, who lives in west Liwan. He moved from Tabuk in 1949, when he found large herds of wild water buffalo in this savannah-like plain. The major trees were bulalan in the marsh, and guava and tamarind on the dry slopes. Liwan was suitable for rice cultivation since a large area was naturally submerged in the rainy season. Pre-germinated seed was broadcast on wet beds in June. Two-month-old seedlings were transplanted by hand in August and September. Deep water was maintained in order to depress weeds. Harvesting was done in January and February. Popular rice varieties were wagwag tawatao, raminad, bensir, and macapunu. Dry broadcasting was employed on the higher portion. Dry rice was broadcast in August and September on dry soil tilled with the plough, and covered immediately by use of the bamboo-pegged harrow. Harvesting was done in February.

Irrigation with deep-well pumps became popular in the 1960s, and wet-rice cultivation expanded dramatically. To maximize the irrigation coverage, farmers sometimes construct canals on elevated dikes which lead water to upper slopes far from the well.

3.5. Upper Cagayan Valley

3.5.1. Landform and irrigation

The upper Cagayan valley includes the small intermontane basins of Nueva Vizcaya, which are located along the upper Magat. Wet-rice fields have been opened in the narrow strip of backswmp along the river. The height difference between the floodplain and the river bed does not exceed 2.5 m. The relatively steep gradient of the basin, the shallow river course, and the abundant water volume make irrigation systems by gravity rather simple. Because of this

situation, communal irrigation systems have been developed from earlier times, probably even before the arrival of the Spanish. The largest and the oldest one centers on the San Vicente Colocol dam, which diverts the water of the Magat river at Bayombong and distributes it to rice fields in Bayombong, Solano and Bagabag. The following brief account of the system is based on an interview with Mr. Lannu, vice president of the San Vicente Gaddang Farmers' Irrigation System, Bayombong-Solano-Bagabag Federation.

The association that runs this system, like other communal irrigation associations, has officers, a president, vice-president, secretary, treasurer, business manager, auditors, a board of directors, and an ordinance which defines its aims, its organization, conditions of membership, and so on. The ordinance was originally written in the Gaddang language and later rewritten in Ilocano and Spanish. The rewritten ordinance is dated 1889.

The inlet is installed at the southern end of the town of Bayombong. Formerly it consisted simply of a brush dam of boulders piled obliquely across the stream, which diverted water to an inlet gate consisting of ducts made of coconut trunks with planks and bamboo as controlling panels. In 1956 the gate was rebuilt of concrete. Its water right is 12 ton/sec for irrigating 10,000 ha. There are 25 dams which diverted water from the main canal of San Vicente Colocol. Each dam and its laterals compose a primary unit of CIS. The total number of CIS units in Nueva Vizcaya was 232 in 1981.

3.5.2. Land use

The active floodplain is not cultivable in the upper Cagayan, since it is nothing more than a pile of cobbles and boulders. The floodplain, however, has long been of primary importance for wet-rice cultivation. The following account of rice cultivation is representative of the situation in Solano-Bayombong area. The rice fields are ponded first and prepared by ploughing and harrowing twice in June and July. Seedlings are prepared in wet nurseries located in easily drainable sites in the fields. Pre-germinated seeds are broadcast on the mud.

Popular varieties in the past were Ilocano rice: sagamanteka (oily when cooked), guyud (awned rice), malarisa (soft rice), canal (awned rice) and so on. It was customary to prepare seedlings by laying ears on the puddled mud. This practice is still popular in the Ifugao area. Seedlings were transplanted by hand in August and harvested in February with the gamulang (rakem, hand knife). Ilocano varieties were later replaced by wagwag and raminad, which remain popular. These are planted in August and September, and harvested in January and February by sickle.

On higher ground like levees and colluvial fans, other planting methods,

such as dry inyras (row-seeding) and dibbling with asad (digging stick) were done on dry soils.

Some rice fields in the backswamp are too muddy to be ploughed. These fields are just trampled (sipsip) by men. Dominant weeds are badang-badang (a leguminous water grass) which are mixed up together with mud. Ilocano rice is still cultivated in these fields.

Elsewhere with the introduction of IR varieties, two crops of rice per year are usual. Even three crops of rice are not rare.

In the low terrace area in Bagabag, many rice fields are planted with upland crops like corn, sugarcane, cassava, mung bean and so on.

On the talus slopes in the foothills of the Cordillera Central, there are beautiful rice terraces, their stone walls reminiscent of but less high than those in the Ifugao and Bontoc areas of Mountain Province. An example is found at barrangay Uddiawang to the west of Solano. Inhabitants of this village are mostly descendants of Ilocano migrants. They have exploited two different sites for cultivation: the limestone hills and the talus slope. Corn is dibbled on the dark soils of limestone hills after tilling the slopes with plough and bamboo-pegged harrow. The first crop is cultivated from October or November to February, the second crop from May to September.

Rice terraces on a smaller scale have been opened on gentle slopes with gradients of about 10 %. Streams issuing from the limestone hills are diverted by small brush dams made of stones, and further divided into several channels at small diversion gates located in the village. Rice fields are neatly surrounded by dikes on which taro and string beans are planted for home consumption. Irrigation channels run through the rice terrace in a grid pattern. The lateral channels are separated by two rice terraces. They collect water from the upper fields and feed it to the lower fields. This irrigation system is different from that in the Ifugao area, where farmers lead water to the uppermost fields, from where it overflows to successively lower fields.

4. Concluding Remarks

Various aspects of adaptive localization in the natural environment have been described in the foregoing account. Ethnic preferences in the choice of environment, however, needs further remarks. The ethnic groups mentioned in this article are the Ibanag-Itawis, Kalinga, Gaddang and Ilocano. Some

elements of the Ifugao culture are also perceptible in the landscape of the upper Cagayan valley.

The Ibanag-Itawis people are dry-field cultivators. They do not regard rice so highly, and accept crops like corn as a substitute for rice. Therefore, dry fields on the active floodplain offer a rather stable base for cultivating dry crops, while the backswamps are unstable and difficult sites to manage because of the unpredictable flooding.

On the other hand, the Kalingas, who are assumed formerly to have inhabited the Cagayan valley extensively, regard rice highly and rarely depend on corn. They are still engaged mostly in shifting cultivation on high terraces and rolling hills, and plant banana before moving to new plots.

The Gaddang people who have settled in the upper Cagayan valley appear to be wet-rice cultivators. Their habitats, at least, are those which admit early conversion to irrigated rice fields through simple devices. This assumption is supported by the testimony that ordinance of an irrigation association was written in the Gaddang language before being rewritten in Spanish and Ilocano. How old the irrigation system is and how extensive it was, however, are not known.

Ilocano farmers are wet-rice cultivators. There are several indications that irrigation association (zanjera) in Ilocos states started in the 17th century. It is also possible that irrigation systems had been present even before their contact with the Spanish. On migrating to the Cagayan valley most of them settled in the Magat region and the upper Cagayan valley. They converted grasslands into irrigated fields. This implies that major part of these regions were formerly occupied by Kalingas who planted dry rice in swiddens.

Although there are no groups of Ifugao people, Ifugao elements are present in the upper Cagayan valley. Their agriculture in their core area in Mountain Province is characterized by soil tillage by paddle-shaped spade, bulu rice, elaborate irrigation technologies, hydrodynamic construction of rice terraces, and the presence of tuber crops with rice. Although it is not possible to date the rice terraces in the Mountain Province exactly, their appearance suggests that a stable Ifugao community must have practiced irrigated rice culture for several hundred years.

Ethnic elements in the agriculture of the Cagayan valley is summarized as shown in Table 2.

Table 2. Ethnic Features of Rice Agriculture in the Cagayan Valley

	Itawis-Ibanag	Kalinga	Ilocano migrants	Gaddang	Ifugao
Settlement area	Middle Cagayan	Chico region, Eastern hill of Middle Cagayan, Magat region	Lower Cagayan, Magat region, Upper Cagayan, Chico region	Upper Cagayan	Mountain Province
Main habitat	active flood plain and low terrace	hill, high terrace	coastal plain, aggraded terrace, floodplain, trough	floodplain, talus	mountain slope
Main food crop	corn and rice	dry rice, banana	wet rice	wet rice, some tubers	wet rice, many tubers
Tillage	plough, harrow, paragos (bamboo-pegged harrow)	long knife asad (stick)	plough, harrow, paragos	plough, harrow human trampling	paddle spade (kahud)
Nursery	dry bed (wet when uprooted)	none	wet bed	wet bed (sometimes laying ears)	wet bed (laying ears)
Dry rice planting	row-seeding	dibbling	broadcasting-harrowing	none	none
Irrigation	little	none	gravity, tube well	gravity	gravity
Harvesting	sickle	hand-picking	ani (hand-knife), sickle	gamulang (hand-knife)	gamulang
Rice type	indica	bulu	bulu, HYV	bulu, indica	bulu
Shifting cultivation	none	main	few	few	significant

ACKNOWLEDGEMENT

My field survey was done from September 1981 to January 1982, when I was affiliated as a senior research fellow at the Multiple Cropping Department of the International Rice Research Institute (IRRI). Sincere thanks are due to IRRI for giving me substantial support to make the survey.

REFERENCES

Climatological Division of the Philippines. 1975. Monthly Rainfall, Normal Rainfall and Standard Deviation of Synoptic Stations. Quezon.

Furukawa, H. 1982. Luson-to no Rikuto-saibai to sono Kankyo (Dry Rice Cultivation and its Environment in the Luzon Island). Noko no Gijutsu (Agriculture and Technology) 5: 53-72.

Keesing, F. M. 1962. The Ethnohistory of Northern Luzon. Stanford: Stanford Univ. Press.

Lewis, H. T. 1971. Ilocano Rice Farmers: A Comparative Study of Two Philippine Barrios. Honolulu: Univ. Hawaii Press.

Wernstedt, F. L. & Spencer, J. E. 1967. The Philippine Island World: A Physical, Cultural, and Regional Geography. Berkeley: Univ. California Press.

A NOTE ON AGRICULTURAL LANDUSE IN RELATION TO SMALLHOLDERS' COCONUT PLANTATIONS IN ISIMU, GORONTALO

Aris Poniman KERTOPERMONO

1. Introduction

This paper aims at describing agricultural landuse with special reference to coconut plantations run by smallholders in Isimu village, Tibawa District, Gorontalo Regency, North Sulawesi. The province of North Sulawesi is famous in Indonesia for its tremendous coconut production. According to Estate Service of North Sulawesi, the average coconut production of the province amounted to 217,766 tons per year during the four years from 1980 to 1983, the largest of any province in Indonesia. Coconut palms are grown both in large plantations such as government estates or on small farms run by peasant farmers. Isimu village is an area predominated by smallholders.

Through a survey conducted in the village from September to October 1984, landuse based on conventional coconut cultivation was investigated by interviewing farmers and observing the field condition. To supplement the data obtained in field studies and to complete the landuse map of the village, available aerial photographs were used.

2. Location and History of Isimu Village

2-1. Location of Isimu Village

Isimu Village is located in Tibawa District of Gorontalo Regency, Province of North Sulawesi, at coordinates of 0°35'- 0°45' N and 122°45'-122°55' E (Fig. 1). Administratively the village has been divided into two, Isimu Utara (North Isimu) and Isimu Selatan (South Isimu), since 1950, both of which are included

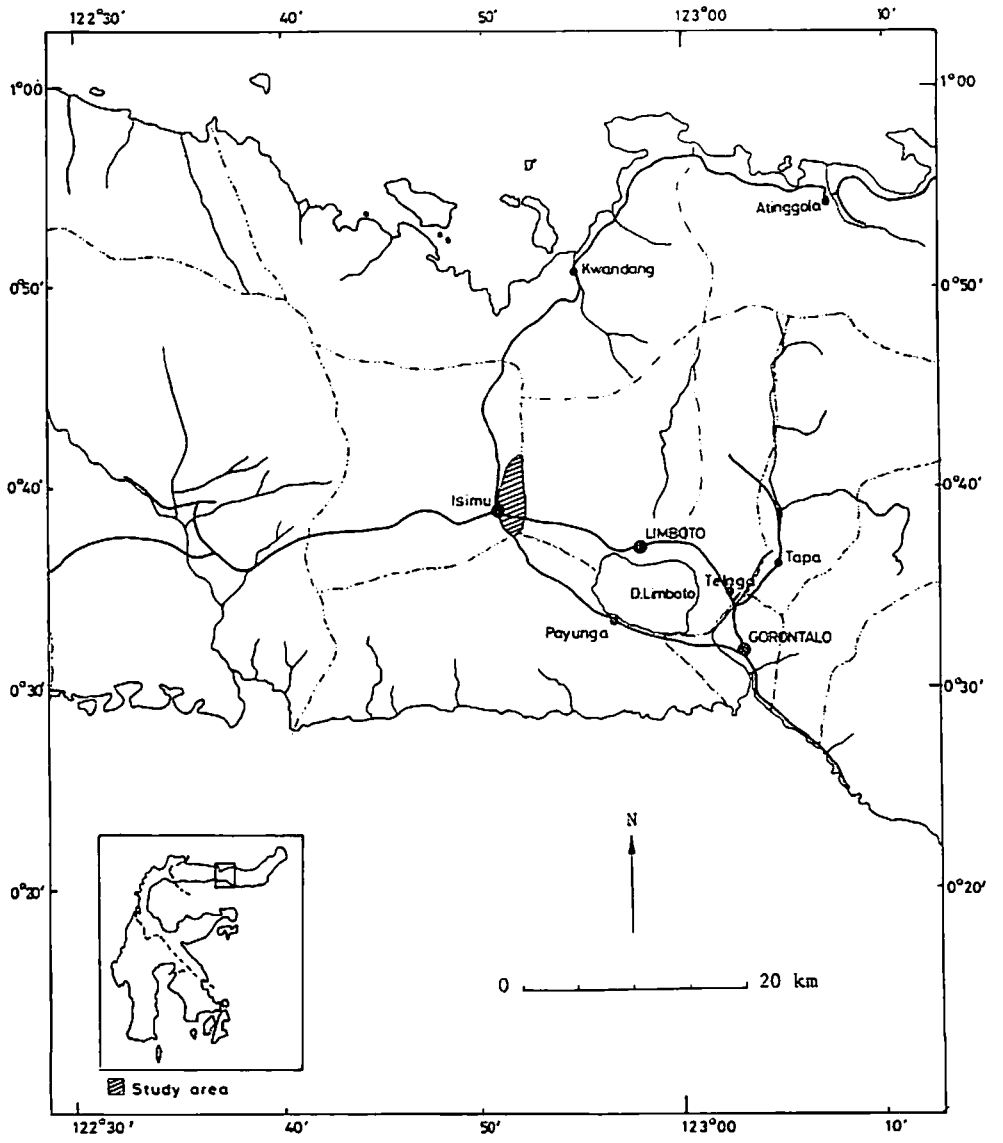


Fig. 1. Location of Isimu

in references to Isimu herein. According to the village office, the total population of Isimu as of August in 1984 was 7,185.

2-2. History of Isimu Village

According to the village head of Isimu Utara, who is usually called ayahanda, the king of Boalemo was the first pioneer to come to the Isimu area and open the forest. The Boalemo people came from Boalemo in Central Sulawesi [Haga 1931: 15]. The people in the Gorontalo area led by olongia (king), lived in groups on the mountain slopes when the king of Boalemo arrived. The Isimu area was subsequently attacked by the king of Limboto, since the area was considered to be under Limboto sovereignty. As a result, the king of Boalemo was forced to retreat to the hinterland. In 1806, however, he launched a counterattack from the present Tilamuta area through Bongomeme. Forewarned of the attack, the king of Limboto ordered a stronghold to be built at Petahu, where the elementary school of North Isimu is now situated, and gave his commanders the order: "isimui mota ti mongolia" ('chant the magic words toward them'). This magic formula prevented the attack of the king of Boalemo and his troops retreated without fighting. Since this conflict the area came to be called Isimu after the magic words.

From 1873 the Dutch colonial powers had strengthened their dominion over the Gorontalo area, which was handed over to Verenidge Oost-Indische Compagnie (VOC) by the kingdom of Ternate in 1877 [Tacco 1956]. In 1885, under the control of VOC, the petty kingdoms of Gorontalo, Limboto, Bone, Boalemo and Atinggola drew up joint regulations on their boundaries, lands, justice, labour, and taxes, including articles dealing with coconut cultivation. One article stipulated that every able-bodied male with his own house and land should plant and manage 50 coconut palms in his holding. In addition, they were forced to plant commercial crops like cacao, cotton and coffee wherever lands suitable for these crops were available [Haga 1931]. It was following this regulation that coconut cultivation became extensive in the Gorontalo area.

At that time only a footpath or horse track connecting Kwandang and Limboto passed through the Isimu area. In 1915 the path was upgraded to a main road by Dutch colonial government, which recruiting native labor through village heads. People occupying the mountain slopes were ordered to move down and settle along this road. Since around 1930, when the price of copra began to rise sharply, coconut became more important in the village economy than wet rice. The foundation of the present settlement and village economy of Isimu was thus established in the 1930's.

3. Landcover and Landuse in Isimu.

3-1. Landcover and Landuse Based on Physiographical Units

Physiographically, the Isimu area can be divided into two units: the plain and the hills and mountains.

The plain has been fully exploited as delom bongo (coconut fields), ilengi (upland fields), kintali (homestead gardens) and pangimba (wet-rice fields). It is bisected by the main road running west to east through the village, and this division corresponds with the division of agricultural landuse: the northern part is used for upland fields, the southern part for wet-rice fields. The southern part was originally the bed of Lake Limboto, which was raised by sedimentation, and is still subject to flooding in the rainy season. The northern part is utilized for ilengi and delom bongo.

The hilly or mountainous unit is located in the north of the village and consists of forest, bini (bush and scrub) and ilengi. The forest is now protected as a conservation area, and its agricultural use is prohibited. The shifting cultivation that was formerly widespread has been restricted spatially by regulations for reforestation. Some of the former shifting cultivators have moved away and others have been resettled in lower areas, for example, in the flat lowland in Atinggola. The hilly areas are used as upland fields cultivated mainly with maize. Coconuts are also grown on the hilly slopes, but only on sufficient scale for daily consumption.

Fig. 2 shows the present landuse in Isimu Village. This map was prepared from color infrared aerial photomaps on a scale of 1:60,000 and field observations. Fig. 3 is a north-south cross section showing schematically the landuse pattern in Isimu Village.

3-2. Agricultural Landuse

3-2-1. Ilengi (Upland fields)

Upland fields were formerly swiddens; there was no sedentary cultivation. According to Mr. Musa Ismail, a farmer with long experince of the traditional cultivation, shifting cultivation was first introduced into Isimu by the Boalemo people, who grew upland rice and maize. When the Dutch came and ordered all the forest-dwelling people to resettle down in the road-side areas, the Boalemo people instead moved away to more remote forest areas. Subsequently, Telaga people came to the mountainous areas and practiced shifting cultivation, but they also moved away.

The pioneer settlement of Isimu was established in 1915 by six families

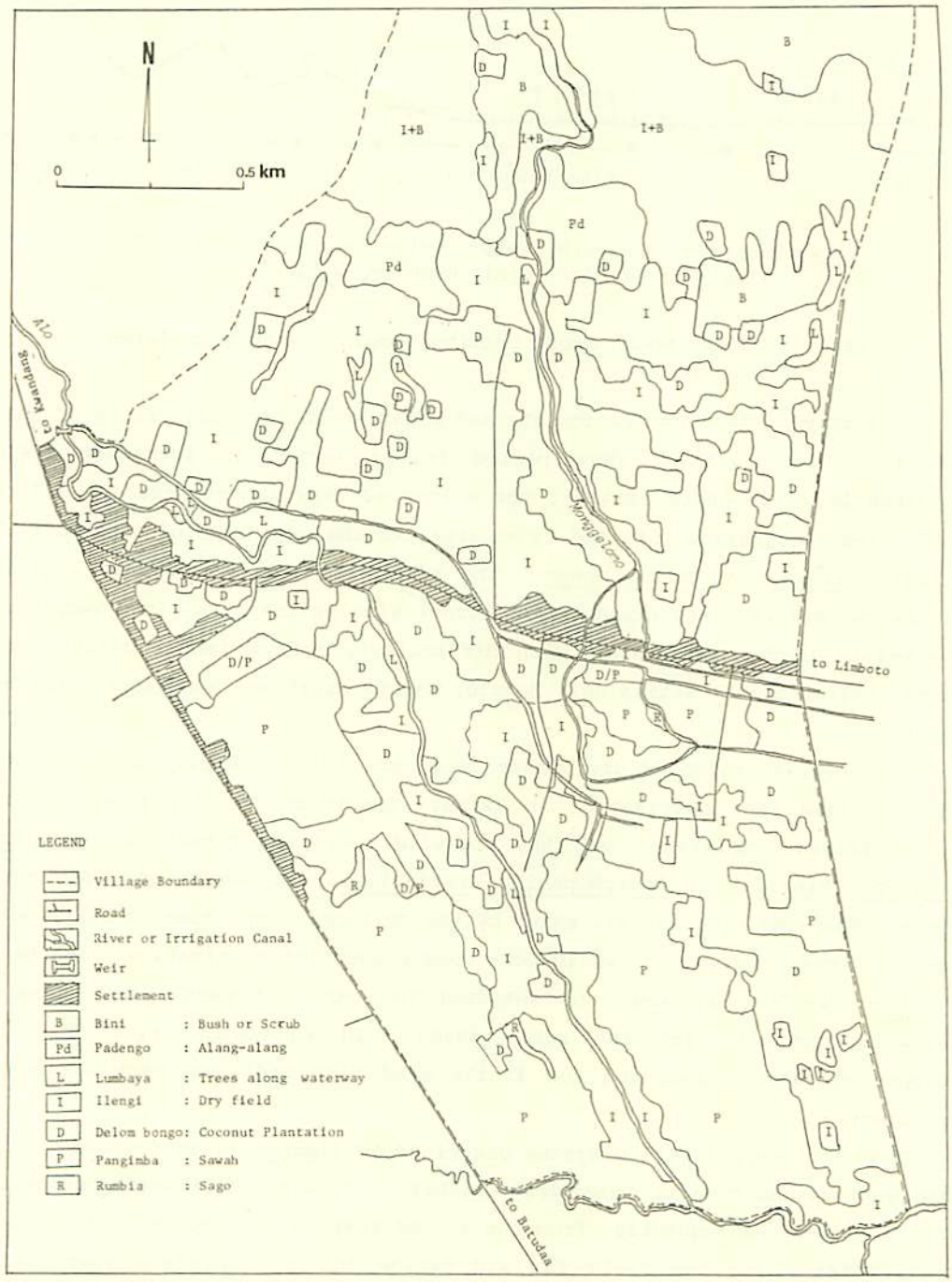
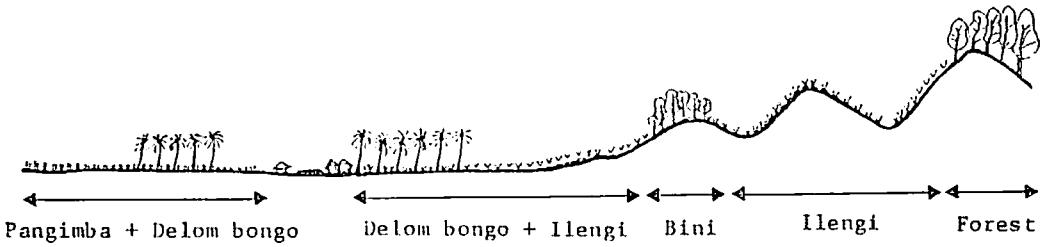


Fig. 2. Landuse Map of Isimu



Notes Pangimba: wet-rice field; delom bongo: coconut field
ilengi: dry field; bini: bush or scrub.

Fig. 3. North-South Cross Section Showing Landuse in Isimu

led by Najihiru. They opened forests and began sedentary cultivation of upland rice and maize with a short-period fallow system in permanent fields. Concurrently with their arrival, the main-road improvement started, and this accelerated immigration into the Isimu area and the expansion of upland fields including ilengi and delom bongo. The rice varieties then grown included; Pale Patahu Wadala (long grain, white kernel with yellow husk, long awn, hardly attacked by birds, and sheds with difficulty), Maraya (small grain), Bruna Kuning (yellow husk), Sanihalagi, Bohulo, Maraya Minahasa, Munggiango, Kartuna, and Sibagu.

Recently, a prolonged dry season from June 1982 to April 1983 brought an end to upland rice cultivation in Isimu. According to villagers, the rice harvest failed completely, and they ate wild roots and tubers such as bitule (Dioscorea hispida) or Amorphophallus variabilis, and sometimes young banana shoots. The seed rice was all eaten by the children. Mr. Musa Ismail expected that the coming year, 1986, would be a good season for cultivation. and he had therefore visited Paguyaman and Kwandang in search of seed rice. None was available, however, for the same reason. In Paguyaman, rice had also disappeared, and in Kwandang too little seed rice had been kept for him to borrow any.

The short-period fallow system practiced in ilengi is as follows. In the first year upland rice is grown from October to January, followed by maize from March to June. Subsequently, from the second year to the fourth only maize is grown, after which the field is laid fallow for two or three years. Some villagers say that if a field could be used for one year of cultivation, then fallowed for three to four years, it would provide the best harvest. However, this cycle is not possible because of the limitated field area. In the flat

lands located between the slopes, continuous cultivation for about ten years is possible.

The fields are prepared with a plow drawn by two bullocks where slopes are not too steep for the bullocks to operate. Recently a green manure plant called lamtoro has been introduced in the fallow period to maintain soil fertility. However, as lamtoro grows very fast and spreads very vigorously, its root system hampers the first plowing after the fallowing. Although its introduction seems to be effective in terms of field rehabilitation, it has raised a new problem to land preparation.

Besides upland rice, maize is the main crop in ilengi. The hilly and mountainous land unit produces a large amount of maize, with better unit yield and production than the northern part of the plain, where maize is usually grown under coconut palms in delom bongo.

3-2-2. Delom bongo (Coconut fields)

Delom bongo are mainly distributed in the plain as shown in Figs. 2 and 3. They are further classified according to location and utilization:

a. delom bongo: field planted only with coconut,
b. mohelungo: field planted with a mixture of coconut and upland crops,
c. bongo to pangimba: wet-rice field mixed-planted with coconut,
d. bongo to kintali: homestead garden mixed-planted with coconut,
e. bongo to hundu: ridge in wet-rice field planted with coconut, and
f. bongo to huidu: coconut field in mountainous area.

Delom bongo is a field given over exclusively or almost exclusively to coconut palms. The planting pattern and density are not fixed; some fields are planted in a regular arrangement, others are not. The palms are usually planted at intervals of 8 to 12 meters. Delom bongo are fenced by living trees or woods.

Mohelungo is a field mixed-planted with catch crops like sweet potatoes, cassava, pulses, or maize underneath the coconut palms. The cropping pattern in mohelungo differs according to the age of the coconut palms. When the palms are still young, from 0 to 4 years, for example, maize is grown as the catch crop. When the coconuts reach the 4 to 10 years stage, maize no longer grows well because of the shade of the coconut-palm canopy. People then grow cassava or sweet potatoes, which are more tolerant to lower irradiation. At this stage mohelungo are also called limehu. After this stage, once the coconut reaches a certain height, maize again gives yields comparable to those in the first stage. Some mohelungo are used solely as delom bongo until the coconuts reach a sufficient height to allow cultivation underneath in better conditions. Once the coconuts reach around 25 years old, every mohelungo is used for catch

crops.

Bongo to pangimba means literally coconut palm grown in a wet-rice field. But it also indicates a wet-rice field which is planted with coconuts. When coconuts are planted, soil is piled in mounds and a seedling is planted in each mound to prevent damage by flooding.

Bongo to hundu and bongo to huidu are minor cropping patterns in the village. Bongo to huidu are especially limited by their distance and isolation from the village, and crops are not grown underneath. The harvest of bongo to huidu is transported by kokoyonga, a sledge-like carrier pulled by a bullock, because of its distance from the village.

3-2-3. Pangimba (Wet-rice fields)

Wet-rice fields are distributed in the southern part of the plain, where irrigation water is available by virtue of a weir constructed on the Alo river at the western end of the village (see Fig. 2). Another irrigation system draws on a smaller discharge from the Monggelomo river.

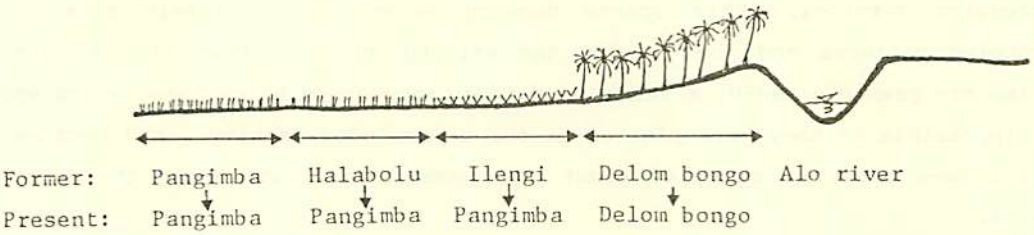
Before the irrigation system was improved, the area of pangimba in the village was smaller and only one crop of rice was grown a year. With the improvement of irrigation system, the pangimba was expanded and the double, sometimes triple cropping of rice, became possible. Double cropping is said to have first been introduced in the early 1950s, but it was not extensively developed until after PB-5 was introduced in 1970. Villagers consider that rice culture is now more profitable than coconut because of the fall of copra price and the improvement of the cropping patterns of rice, even though rice yields are still susceptible to unexpected insect and disease damage.

The fields are tilled by plow pulled by a pair of bullocks. According to one old farmer, in his childhood rice fields were prepared by a method of buffalo-trampling called paruda in the Limboto area, but when he moved to Isimu more than 50 years ago, the plow was already in use there.

Double cropping was fully established around ten years ago with the introduction of new high-yielding varieties like PB-36, PB-38, PB-42, Cisadane and Citarum. The rice was formerly harvested by cutting ears with an ani-ani (reaping knife), and the stubble was left in the fields for animals to graze. With the introduction of new varieties, however, the sickle replaced the ani-ani and rice stalks were piled in mounds after threshing, then burnt in the fields. According to some farmers, burning is necessary in order to prepare the fields for the second crop of rice, because they cannot wait for the stalks to decompose in the fields.

The pangimba area has gradually expanded since the Alo irrigation system was constructed. Fig. 4 shows a schematic cross section indicating the changes

in landuse in Southern Isimu. From the bank of the Alo river, delom bongo, ilengi, halabolu, and pangimba appear in the order. Halabolu are fields used for upland crops or, if rainfall is sufficient, for wet rice. With the deve-



Notes Pangimba: wet-rice field; halabolu: field being converted to pangimba; ilengi: dry field; delom bongo: coconut field.

Fig. 4. Cross Section of Landuse in Southern Isimu.

lopment of the irrigation system, halabolu have been converted to permanent wet-rice fields, and some ilengi are also being converted into wet-rice fields. In the near future, it seems that the entire area of halabolu and ilengi will be converted into pangimba.

In Isimu Selatan, wet-rice culture is sometimes practiced in delom bongo if water is available from the irrigation channels and the palms have reached sufficient height to allow the growth of rice underneath. Usually, the rice cultivator is not the owner of the field, but cultivates under a contract with the owner. Because coconut palms are susceptible to inundation, particularly if it is of long term, they are protected by mounds of earth around the bottom of the trunks and the restriction of rice-growing to one crop a year.

4. Coconut Cultivation by Smallholders

4-1. The Role of Coconuts in the Village

Coconut palms play an important role in the lives and economy of the Isimu villagers. They provide not only nuts for home consumption but also cash income from the sale of fresh nuts, copra and oil, which villagers traditionally process themselves. And when funds are needed for a funeral, medical expenses, or other emergencies, or for a wedding ceremony, schooling, or the pilgrimage to Mecca, a remarkable system operates in the Isimu area by which coconut palms, but not the fields in which they stand, are pawned or

sold.

4-2. Planting Density of Coconuts

Traditionally, coconut palms are not planted in a regular arrangement, and the distance between palms is usually greater than that recommended by the extension services. This sparse density seems to be closely related to cropping patterns and the pawning and selling system. Even if his coconut palms are pawned or sold, a farmer can grow catch crops below them, which would be impossible if they were planted at the recommended density. And because he still owns land, he can also plant new coconut seedlings among the existing palms.

4-3. Rejuvenation

Rejuvenation or replanting of coconuts has recently begun to be recommended in the village. Many coconut palms have already passed the maximum production stage and become senescent, being more than 40 years old. Two methods of rejuvenation are practiced by villagers: gradual replacement, and complete clearing. Either new seedlings are first underplanted and old palms gradually removed, or all palms are felled before new seedlings are planted. Complete clearing of the old plantation is almost impossible for a smallholder, unless special credit is available to tide him over a period of several years without income from his coconuts. Thus, the gradual replacement method is usually practiced in this village, and complete clearing is limited to those farmers granted credit under the government project for coconut rejuvenation.

Although every farmer understood the need for replanting, few were actually doing so. Some informants who grew coconuts in the southern part of the plain reported that coconut cultivation was now less profitable than rice culture because irrigation water had become available for rice and the price of coconut products had dropped. In the northern part, rejuvnenation entails hard work to protect seedlings from damage by wild pigs. Farmers, therefore, would not follow the recommendation to replant while prices remained low. In Isimu area rejuvenation has been carried out over only a limited area, and the introduction of new hybrid varieties is also restricted to small areas.

4-4. Harvesting

Coconuts are usually harvested every three months. Two or three bunches are harvested by a climber (tamopiata bongo), giving around 10 to 40 nuts per palm. The number of nuts harvested depends on the age of the palm, soil

fertility and rainfall. The climber uses a bamboo ladder to climb halfway up the palm, and cloth ankle rings to prevent him slipping down its smooth trunk. Besides removing the bunches, he cuts down old leaves. Climbing is hard work requiring considerable skill, and the younger generation are turning to other jobs giving better remuneration for the same effort. The number of climbers in the village, therefore, is gradually declining.

According to one climber, he does not work in the afternoon because the palm trunk becomes slipper then. This working time is followed by all cimbers. A climber can climb as many as 30 palms of medium height per day, and the payment is 100 rupiah or 4 nuts per palm.

4-5. Processing and Marketing

Three coconut products are marketed; fresh nuts, copra, and coconut oil. People process smoked copra when the market price of copra is enough high to cover the processing cost, while they sell fresh nuts when the price falls. The oil is processed by individual farmers in their kitchens, as there is no processing factory in the village . The market price of the farm-made oil is usually higher than that of factory-made oil: 650-750 rupiah per bottle compared with 600-650 rupiah for the factory-made.

Copra is processed as follows. Coconuts are dehusked with a spear-like tool called a pasombi. The dehusked nut (bongo hiluluta) is split into halves (bongo ngoa), and these are dried by direct heating in a kiln (porono) to make copra. The kilns in the village are small, consisting of a grill made of wooden or bamboo slats and a pit for fuel. The grill is roofed over, and the pit is enclosed with side walls. Coconut halves are dried and smoked for five hours in the kiln, then the copra is removed from the shells and further dried for three hours in the same way. After a final sun-drying for one day the copra is sold.

According to some informants, a kiln can generally process 500 nuts in one operation, yielding 100 kilograms of copra. A farmer growing two hectares of palms can harvest on average 8,000 nuts per year. This harvest provides 1,600 kilograms of copra, which can be sold for about half a million rupiah.

4-6. Pawning Systems; Papajaki and Pajak Buah

When a coconut grower needs a cash urgently, he can borrow it by pawning his coconut palms. This pawning is called papajaki. In this system the grower can borrow, for instance, 50,000 rupiah, if he pawns ten palms for a period of two years. In most cases, the contract is two years. The money lender receives as interest the harvest of the pawned palms for the contract period,

and the borrower needs repay only the amount borrowed. If the borrower cannot repay after the period of contract, ownership of the palms is forfeit to the lender.

The papajaki systems has reportedly been gradually replaced by the pajak buah system, and will eventually disappear from the village. In the pajak buah system, repayment of the loan is not necessary. A contract, usually verbal, is made between a grower and a lender, who decide the amount of money involved according to the number of palms and the estimated yields from them for a contract period. It is said that 2,500 rupiah can be usually borrowed by pawning one palm for a period of two years. The lender secures all the harvest from the contracted palms for this period. The pajak buah system is, therefore, a sort of advance sale of the harvest or a temporary transfer of ownership of coconut palms.

These systems create big owners of coconut palms who do not own the fields where their possessions grow. They also often lead to the palms in a field being owned by several persons. Ownership is indicated by scratching or painting the owner's mark on the trunk. This diversification of ownership is another factor militating against rejuvenation in the village.

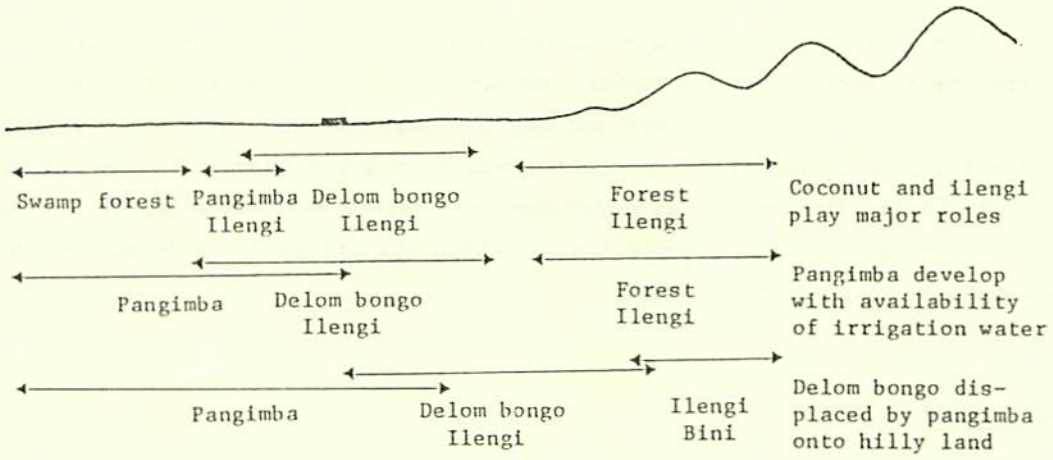
5. Transformation of Agricultural Landuse in Isimu

Coconut and wet rice have played important roles in transforming agricultural landuse in Isimu. The transformation is shown schematically in Fig. 5.

The Isimu area was uninhabited until the decade of this century, when exploitation started with the penetration of the colonial powers into the Gorontalo area. Before the first pioneers arrived in the Isimu area, native people seem to have practiced shifting cultivation on mountain slopes. The pioneer settlers opened the forest in the plain and began to develop sedentary cultivation with wet rice on the lower terrain and upland crops in higher ground.

When the coconut price rose in the 1930's, delom bongo expanded into the ilengi, where upland rice and maize were main crops. Most of the delom bongo and mohelungo in the northern part of the plain seem to have been developed in this period. Wet-rice culture at that time was still limited, and people depended greatly on coconut cultivation.

During the Japanese occupation, coconut cultivation suffered from a fall



Notes Pangimba: wet-rice field; ilengi: dry field; delom bongo: coconut field; bini: bush or scrub.

Fig. 5. Transformation of Landuse in Isimu.

in the price of coconut products. Villagers reportedly abandoned coconut cultivation beyond what they needed for home consumption. During this period, however, the Japanese military powers forced them to construct irrigation channels from the Alo river to enhance the production of rice in the wet-rice fields, and recommended them to grow cotton and various food crops in upland fields. The construction of the irrigation system provided the means to expand the pangimba, and the process of expansion started after the Second World War.

With the end of the war the price of coconut products recovered and remained high until the 1960s. This stimulated coconut cultivation in the village, and villagers began to take care of old palms and expand new delom bongo into the hills and mountains unit in the north of the village. In this period, some ilengi and bini were converted into delom bongo. However, the expansion of delom bongo seems to have decelerated since the 1970s. It was in the 1970s that wet-rice culture became more profitable, and the pangimba began to expand into the delom bongo and ilengi in the southern plain. Today villagers consider a holding of delom bongo and pangimba to be ideal for their livelihood because of the stability of production and income.

ACKNOWLEDGEMENT

I am grateful to the Japan Society for Promotion of Science (JSPS), the Directorate General for Higher Education of Indonesia, and National Coordination Agency for Surveys and Mapping (BAKOSURTANAL) for their supports and assistance in realizing my field research in North Sulawesi. I would like to acknowledge the provincial government and estate service of North Sulawesi at all levels. Finally I would like to thank the villagers of Isimu for their warmest and most efficient help.

REFERENCES

Haga, B. J. 1931. Lima Pahala: Susunan Masyarakat, Hukum adat dan Kebijaksanaan Pemerintah di Gorontalo.

Tacco, R. 1956. Kebudayaan Suku Bangsa Gorontalo. Gorontalo: Lolipu