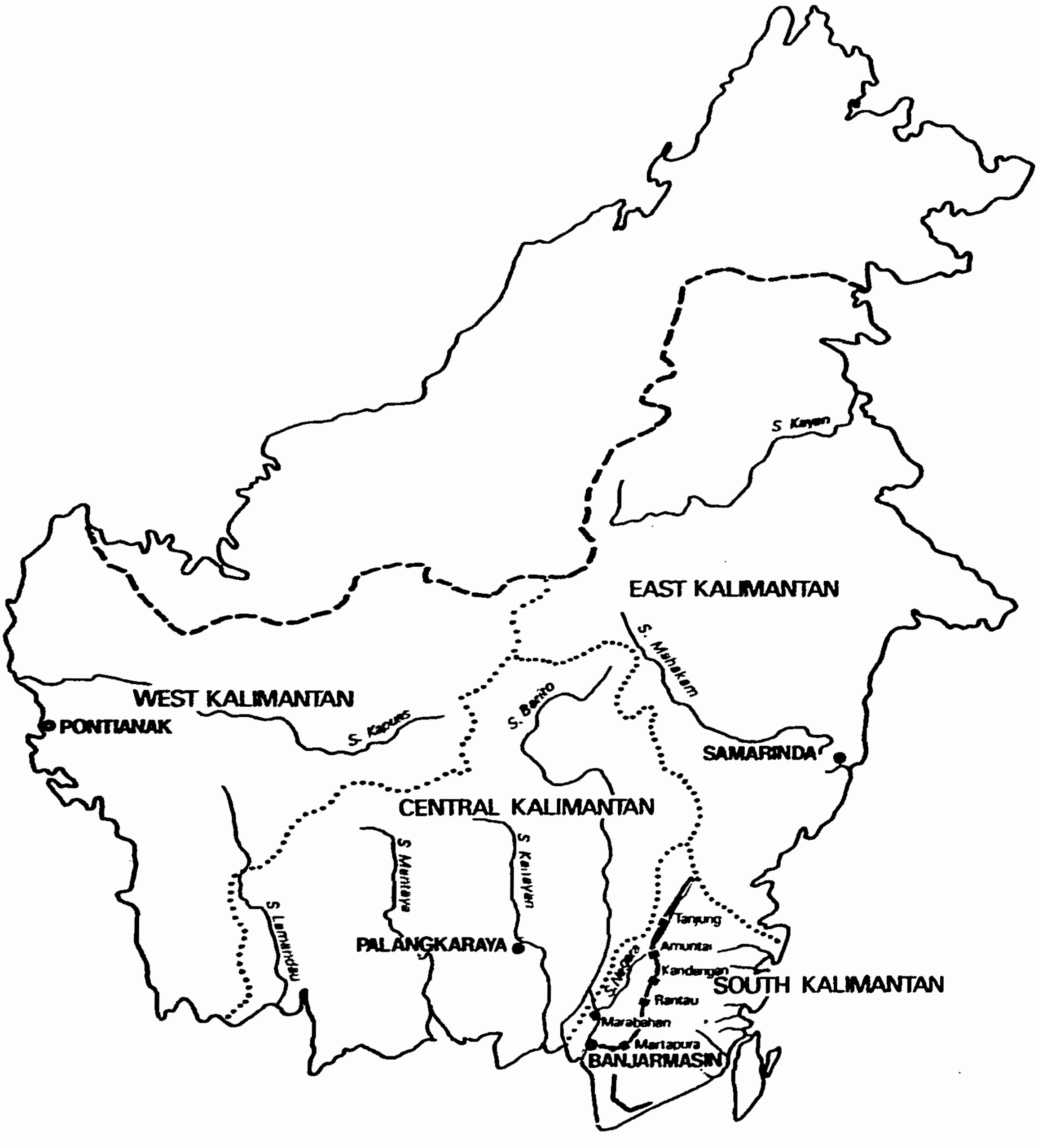
DEPARTEMEN TRANSMIGRASI
BIRO PERENCANAAN
(REPUBLIK INDONESIA)

ORSTOM
INSTITUT FRANCAIS DE RECHERCHE SCIENTIFIQUE
POUR LE DEVELOPPEMENT EN COOPERATION
(REPUBLIQUE FRANCAISE)

THEMATIC GEOGRAPHY
TO DEVELOP TRANSMIGRATION SETTLEMENTS



LOWLAND RICE AND WATER MANAGEMENT
IN THE SOUTHERN PART OF KALIMANTAN

INDONESIA ORSTOM TRANSMIGRATION PROJECT (PTA-44)
JAKARTA - 1985

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LOWLAND RICE AND WATER MANAGEMENT
IN THE SOUTHERN PART OF KALIMANTAN

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INDONESIA-ORTOM TRANSMIGRATION PROJECT PTA-44

JAKARTA, 1985

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FOREWORD

The following geographic report is a continuation of the five-year, multidisciplinary study carried out in view of installing Transmigration Centers in the province of Central Kalimantan and favorizing their development.

The first two phases of the study, based on a preliminary general reconnaissance survey of Central Kalimantan, consisted in selecting favorable upland sites[1] and then proposing a system of development for virgin land[2]. These projects were then followed by a regional analysis of the Mentaya valley which presently serves as a model for the implantation of the first Transmigration Centers in the interior of the island[3].

It was quickly seen from these studies that the upland projects - whose extension cannot continue indefinitely - could be resourcefully complemented by the development of the swampy lowland plains in the surrounding areas, which cover 1,720,000 hectares within the provinces of Central and South Kalimantan. This complementary development appears all the more interesting since the IVth 5-Year Plan has scheduled the installation of 126,000 families in the province of Central Kalimantan alone.

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[1] Reconnaissance Survey in Central Kalimantan. Indonesia -ORSTOM Transmigration project. PTA 44. Jakarta 1981.

[2] Tumbang Sangai Priority Area. Indonesia-ORSTOM Transmigration project. PTA 44. Jakarta, 1982.

[3] Regional Geography to Develop Transmigration Settlements in Central Kalimantan. "The Lower Mentaya Valley". Indonesia-ORSTOM Transmigration Project. PTA 44. Jakarta, 1984.

With this in mind, the analysis of the previously-existing projects in the province of South Kalimantan, where Transmigration appeared earlier, proved well-advised. The natural surroundings are indeed homogeneous from the 110th to 116th degree East longitude below the 2nd parallel South latitude, and there are a great many development methods based on a water control system that is more or less efficient. These systems were either set up by the local populations who have for centuries examined the possibilities and constraints of their environment, or result from the application of techniques developed by the transmigrants who settled in the area at an earlier date.

Concerning the local populations, a study was carried out in the villages of Pematang Panjang, Kayu Bawang, Pemakuan, and Gudang Hirang, in the Banjarmasin area; for the transmigrant population, a survey was made of the situation in the two centers of Sei Luang and Barambai, along the Barito. Meanwhile, the presentation of the Alabio polder answers the need for an analysis of an intensive development of the natural surroundings using modern methods[1].

The object of this report is thus to provide a response to the objectives of the Republic of Indonesia regarding Transmigration within the framework of the IVth 5-Year Plan[2], and in particular to paragraphs 2d, 2e, and 3 :

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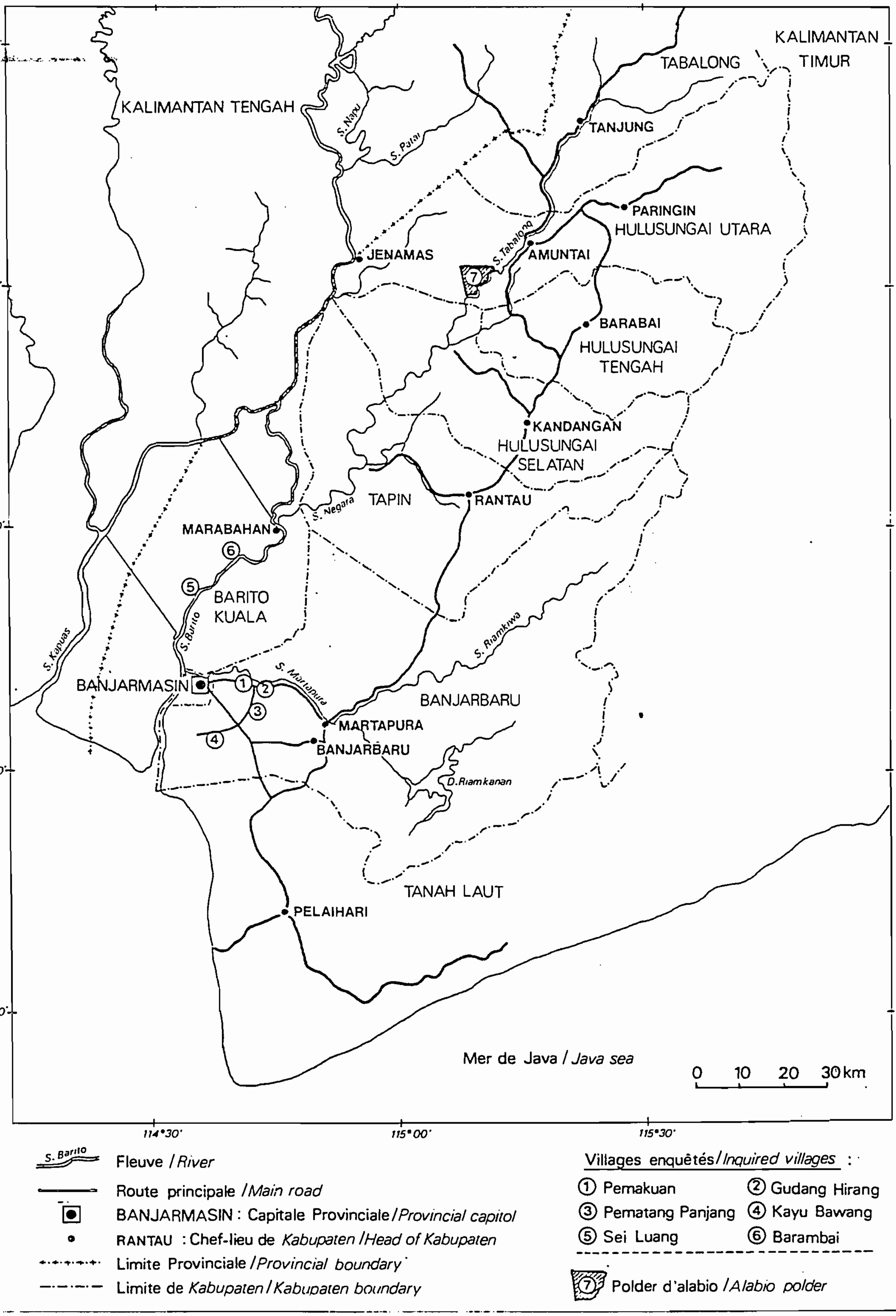
1 see Situation Map.

2 Transmigration Policies in Repelita IV. Department of Transmigration. Republic of Indonesia, Jakarta, March 1985.

1. CARTE DE LOCALISATION / *SITUATION MAP*



-"To guarantee the successful implementation of Transmigration (....) it is necessary to step up the coordination in implementation which covers among other things (....) production facilities and social infrastructure needed in the transmigration area and effort to integrate the transmigrants with the local population"[1].

-"The promotion of the undertakings of peasant transmigrants and the local population"[2].

-"... settlement planning has to take into account a range of factors that are relevant not only to transmigrant welfare but also to the specific needs of the regions. These factors include spatial, ecological, economical, and human aspects of the settlement"[3].

Thus, this report serves two purposes : to draw instruction, lessons, and recommendations for improving the function of the existing transmigration centers in keeping with the framework of the Second Stage Development studies, but also to propose a new model for rational development of the lower valleys.

Finally, I wish to express my thanks to the Services of the provincial government of South Kalimantan, particularly those of the Ministry of Transmigration and the Ministry of Public Works, for their precious aid. A special thanks must be made to Dr.Ir.H.J. Schophuys for the hospitality and precious counsel he so generously offered me.

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[1]ibid, p. 11.

[2]ibid, p. 11.

[3]ibid, p. 14.

INTRODUCTION

South-east Kalimantan is a doubly singular region. On a large scale, from the foot of the Meratus Mountains in the east to the Kahayan River in the west, and as far north as the Tanjung region, an orderly, even geometrical, landscape whose ridges are sometimes so clearly defined as to evoke the shape of some sort of fork, on a background of dikes and canals, contrasts just as sharply with the blurry indecision of the central part of the island as it does with the surrounding lowland plains. The latter - great, deserted, swampy areas cross-cut with mighty rivers that are scattered with oxbows and cut-offs - are reputed to be repulsive and malaria-infested and are generally devoid of human inhabitants.

On a small scale, however, the civilized appearance takes on a relative character. There is nothing comparable to the antiquity of the extraordinary densities of the continental Asian deltas (Tonkin delta) or the Indian sub-continent (Ganges delta). In the Java Sea periphery it is the mountains that are ripe with history and which shelter the densest populations. Naturally, Java is the best illustration of this phenomenon, but the imposing human burden of this island must not mask the importance of the Sumatranese range, nor the intensity of the Toraja region in South-Central Sulawesi. On the other hand, the amelioration of the lowland plains is a recent implementation as shown by the example of Lampung, on the extreme southeast tip of Sumatra.

Around Banjarmasin, its port, and its sultanate, an original civilization grew up, borrowing from the Javanese, Dayaks, Bugis, Malays, and even the Dutch; from this civilization emerged a new people, the Banjar. Due to these multiple cultural contributions, the Banjar were the first to succeed in perfecting an original type of development in an environment which others considered repulsive, so that today the region offers a variety of forms that are more or less finished depending on whether the water control is more or less perfect.

PART I

A Mesopotamia, of Sorts

Around Banjarmasin, a 10,000 to 15,000-km^2 amphibious plain was formed by the gigantic accumulation of alluvial deposits washed down by the Barito, Kapuas, and Kahayan rivers, as well as, to a lesser degree, the Negara. This intermediate zone between land and sea is for southern border an immense, more or less consolidated delta of highly varying shape, common to the three major rivers. The recent evolution of this delta was sufficiently perceptible to condition the history of the region's colonization. The political history of the area bears witness to the ambiguous relationship between man and water : the latter was first seen as a means of transportation, then as a method of agricultural development, and finally as a danger to be provided against. Such a relationship permits one to speak - albeit exaggeratedly - of a "Mesopotamia".

CHAPTER I

A lowland region overhung by water tanks.

Water is an ever-present subject, due to the existence of a mountainous amphitheater that surrounds a regularly-flooded lowland and functions as a natural reservoir.

1.1. The mountainous amphitheater

The south-southwest/north-northeast-oriented Schwaner range, whose altitudes range from 1700m to nearly 3000m, is joined at the latitude of the equator by the Meratus range of roughly north-south orientation that cumulates in 1892-meter Gunung Besar. The southern end of the Meratus Mountains gives rise to South Cape (Tg. Selatan), the extreme southern tip of Borneo in the Java Sea.

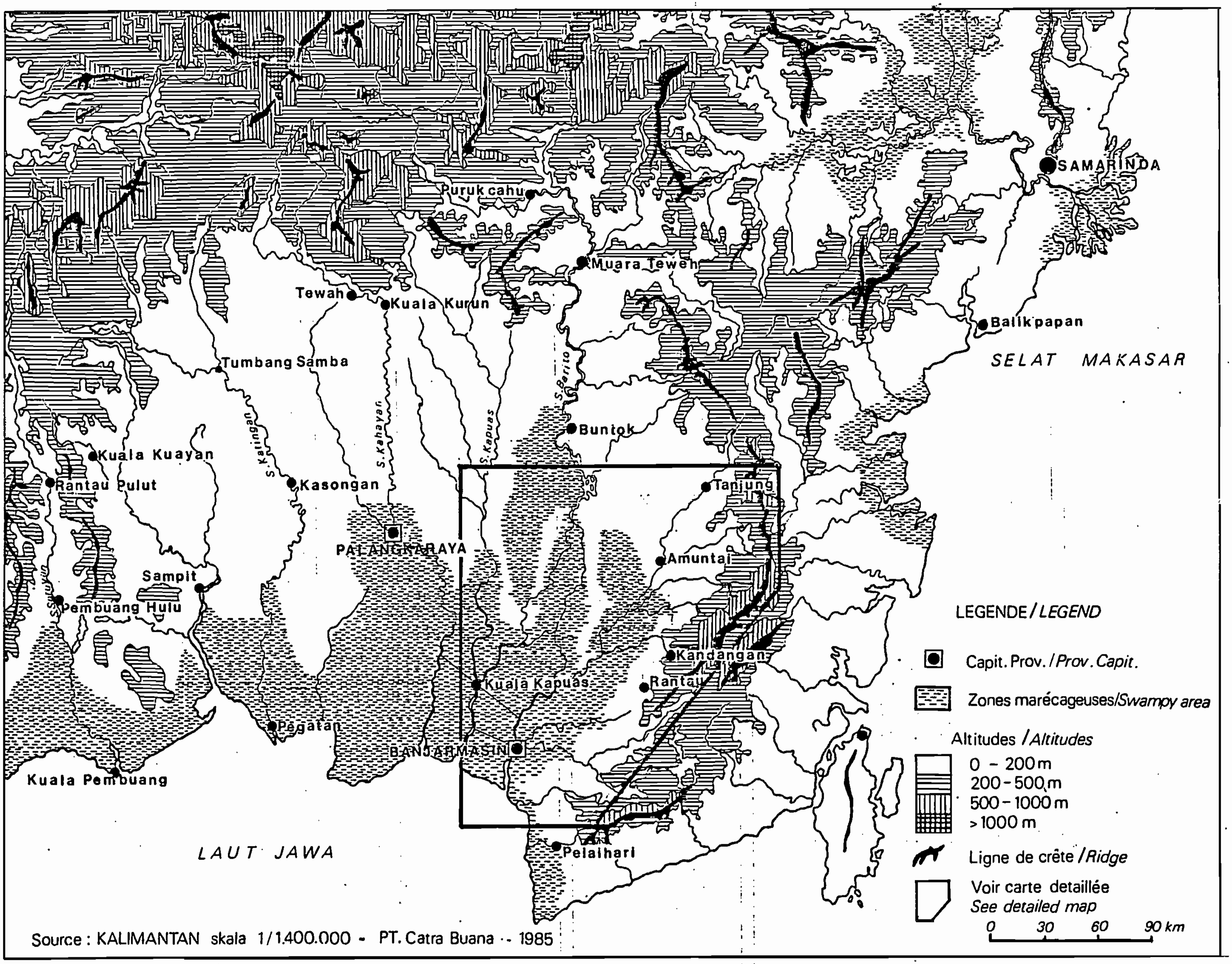
The Meratus range makes up a long axial zone that corresponds to the secondary base : pre-jurassic crystalline schists, jurassic sediments obtruded by peridotites - ultra-basic, monomineral rocks containing neither feldspar nor quartz - then by diorites. This axis is bordered by sedimentary bands, giving an overall presentation in the form of parallel ranges.

Thus, at Rantau, traveling straight east, one leaves the plain at an altitude of about 15 meters, and crosses a sloping piedmont that rises about 100m in 8 or 9 kilometers, before being confronted with a series of vigorous, bar-type reliefs that are always parallel, running in a north-south direction and rising in terraces (Pulungkapitu Mountains : 204m; Tanitimahar Mountains: 610m). Formed, respectively, from andesites and porphyries, then from undifferenciated granites, these relief lines are channeled with narrow ravines such as the Tapin River gorge.

Further south, near Martapura, the landscape is marked by a vigorous bar oriented, in this case, north-northeast/south-southwest. Here, Mounts Pemparun (426m), Tiwang (507m), Tiwaang (504m), Jilatang (329m), Cemara (428m) and Melati (621m) form

2.a CARTE PHYSIOGRAPHIQUE DU SUD-EST DE KALIMANTAN

PHYSIOGRAPHIC MAP OF THE SOUTH-EASTERN PART OF KALIMANTAN



a chain. This razorback ridge corresponds to the Alino formation[1] in which are grouped clays issued from a sedimentation process that occurred at deep-sea levels, and volcanic rocks which are often very closely related to ultrabasic rocks but are black and in this case totally crystallized, of the diabasic type, as well as tuffs and porphyries. This combination underwent metamorphosis and hydrothermic changes. The age of this Alino formation remains uncertain, though it is probably jurassic.

To the west, this line of peaks rises sharply (400m in one kilometer) over a sloping piedmont whose altitudes are around 100m in the Astambul district, as opposed to 25m further west in the Karangitan district. Near Martapura the transition occurs smoothly with the lower plain whose altitudes range from 3 to 6 meters.

1.2. The amphibious plain

1.2.1. The plain

The mountainous amphitheater surrounds a vast depression which is none other than a marine gulf that progressively filled in with sediment washed down by the Kahayan, the Kapuas, and the Barito rivers. The Java Sea coastline, nowadays oriented in a north-northwest/south-southeast direction, makes up the southern limit (on the 3rd and 4th parallels) of this recently-formed plain which is inclined on a north-south slope and deformed laterally from west to east by an anticlinorium then by a synclinorium.

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[1] R.W. Van Bemmelen. The Geology of Indonesia, Vol. 1 A, General Geology of Indonesia and Adjacent Archipelagoes. Martinus Nijhoff, The Hague, 1949, p. 341.

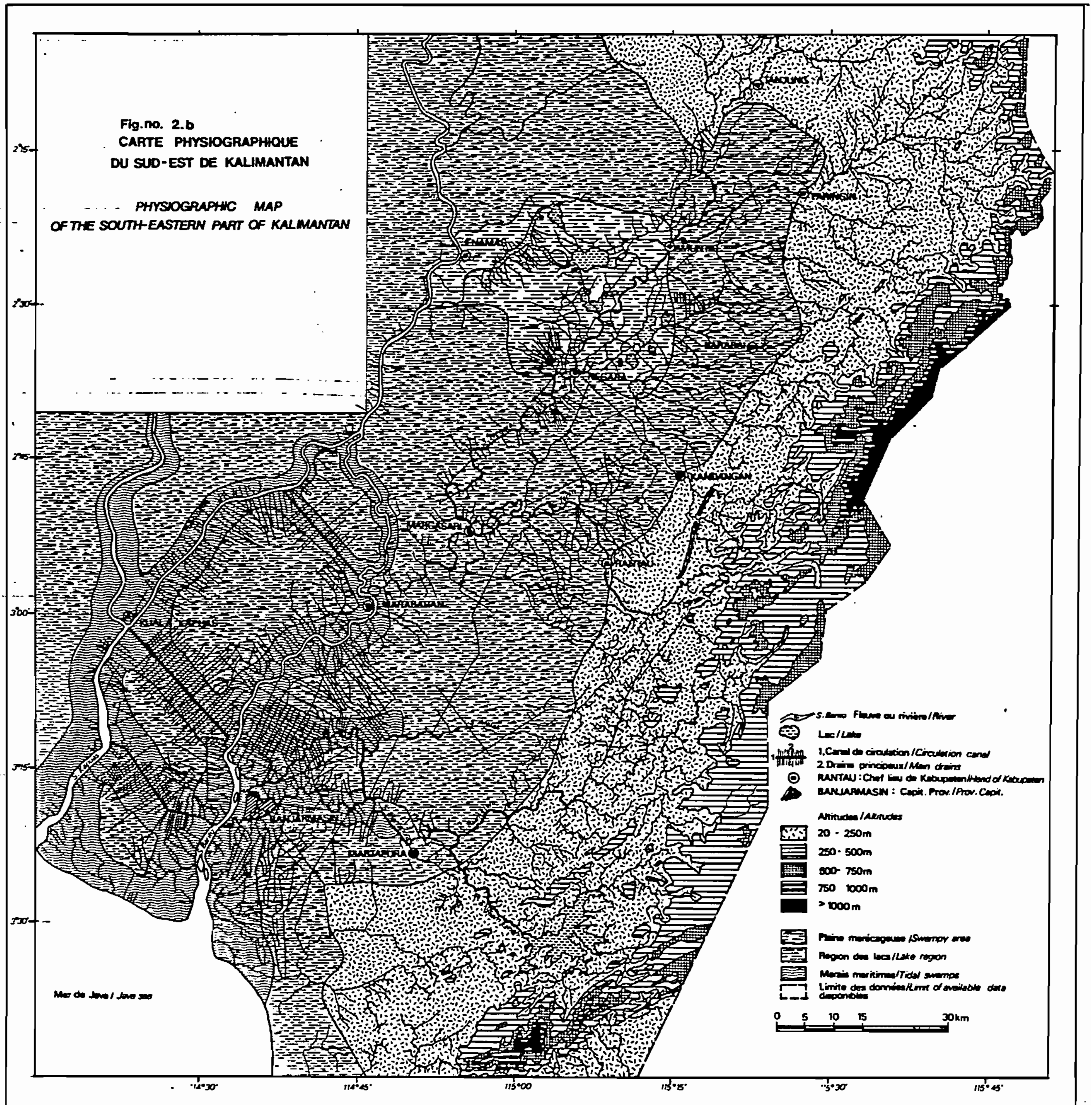
Thus, the northern part (for example, Tewah, in the province of Central Kalimantan) is situated at 300m of altitude; the central part (Palangkaraya, capital of the province of Central Kalimantan) is at 40m, while the town of Banjarmasin, on the coast, is built on the one-meter contour line. Laterally, the Mentaya-Katingan interfluve makes up a line of relatively high ground (Gunung Kaki, 2°45' South latitude, 113° East longitude, altitude 150m) which breaks the monotony of the low swampy plain whose altitude falls off to the east until it stops against the foot of the Meratus Mountains at only two meters above sea level.

It is the cradle stretching from Tanjung in the north (altitude 30 to 40 meters) to Banjarmasin in the south (alt. 1m), to Kuala Kapuas in the west and bordered on the east by the foothills of the Meratus Mountains, which makes up what can be called a "mesopotamia", a "mesopotamia" to which this study is limited.

Thus, while the entire watershed of the rivers Kahayan, Kapuas, Barito, and Negara, all of whom rise in the Müller or Meratus Mountains, represents 82,000 km^2, this study focuses on the amphibious lowland plain from Pulang Pisau and Maliku, in the west, to Amuntai in the north-northeast, and to Banjarmasin in the south, representing about 13,200 km^2.

In this barely-drained environment, slopes and altitudes are very slight (Table No. 1). The slopes are always inferior to 0,1 °/oo, to the extent that the altitudes, given in centimeters, should be considered according to two cases : high tide and low tide. A slight depression from Margasari to Marabahan even places these two localities below the high-water mark (-10, -24 cms). The highest points in the north (Tanjung, Kelua) are not 2m in altitude during the highest spring tides.

This lowland plain does not merge with the visible riverbeds of the Barito and its tributaries before reaching Buntok. The Barito rises further north in the Müller Mountains, almost on the equator,



Source : Peta Topograh skala 1/50.000 daerah pengairan S Barito di Kalimantan Selatan Departemen Pekerjaan Umum - OTCA Tokyo - 1974.

drawn by Bambang de

TABLE No. 1

Altitudes

Station	Altitude during highest tides (spring tides) -cms-	Altitude during lowest tides (neap tides) -cms-	Distance with respect to Barito's mouth: in direct line -kms-	following the river -kms-
Barito's mouth	0	280	0	0
Banjarmasin	16	296	30	40
Anjir Serapat	15	295	40	45
Marabahan	– 24	256	70	100
Margasari	– 10	270	95	135
Negara	46	326	125	185
Babirik	109	389	140	205
Alabio	325	605	150	215
Amuntai	361	641	160	225
Kelua	700	980	–	–
Tanjung	1402	1682	–	–

Slopes

°/oo

Stations	High tide		Low tide	
	in direct line	following river	in direct line	following river
Barito's mouth	0	0	0	0
Banjarmasin	0,005	0,004	0,1	0,075
Anjir Serapat	0,004	0,0033	0,074	0,0655
Marabahan	0,0035	0,0024	0,037	0,0256
Margasari	0,001	0,0008	0,027	0,021
Negara	0,0036	0,0025	0,023	0,018
Babirik	0,0078	0,005	0,028	0,011
Alabio	0,021	0,015	0,04	0,03
Amuntai	0,0225	0,016	0,04	0,03

Source : Prof. Dr. Ir. H.J.Schophuys. "Perspectives of lifting water for irrigation and drainage in Indonesia in general, in Sumatra and Kalimantan in particular". Bogor, March-September 1969.

and flows into the Java Sea. Its major tributaries are on the left bank : the Murung, the Busang, and the Tewah to the north of the 1st parallel. Here the river cuts narrow gorges in the bedrock before it reaches the piedmont at Purukcahu and the plain at Muarateweh. Then it begins to meander, at first as totally enclosed valley meanders, then as simply overflow meanders inscribed in gigantic spreads.

At Buntok (1°5' S. latitude), the river shifts become frequent. At flood period the water level rises with respect to the main bed, the overflow cuts channels in the banks; this can sometimes be a veritable defluviation. Fluvial islands, lakes formed from previously-filled-in meanders, and oxbows are particularly abundant. However, the Barito's specific feature is the large delta created conjointly with the Kahayan, the Kapuas, and the Negara. This delta covers 8000 km^2 (80 kms wide from east to west, 100 kms long from north to south).

1.2.2. The Barito delta

The delta is composed of three major branches, respectively, from east to west : the Barito itself; the Murung River, often called Batang Murung, issuing from water from one of the arms of the Barito (Pulaupetak River) and from water from the Kapuas; – and the Kahayan, often called "Dayak Besar"[1] (as opposed to Dayak Kecil, another name for the Kapuas).

Former digitations and erstwhile channels that have half filled in provide lateral access to the different branches of the delta. These are often called "terusan" or "anjir"[2] as they are often canalized (ex.: Anjir Serapat, Anjir Kelampan, ...).

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[1] "besar" = big; "kecil" = small.

[2] "terusan" : canal, in Indonesian; "anjir" : canal, in Banjar

The eastern branch is the deepest one, with depths of 15 to 20 meters around the Tatas fort at Banjarmasin. On the other hand, the western branch is relatively shallow; at Bahaur, the navigable channel is only 5 to 10 meters deep. However, the greatest difficulties in navigation appear at Batang Murung, where the channel is frequently not more than 3m deep.

In the absence of data concerning the turbidity, it is not possible either to calculate the specific degradation, which one can only suppose is considerable, or to evaluate the delta's progression other than through historical cross-cuts. However, it must be noted that the maximal depths are not recorded at the rivers' mouths, but at a distance of 30 to 35 kms from the sea. For example, the Barito is 40 m deep at the junction with Anjir Serapat; at Jambu, 130 kms. from the sea, the depth is 20 meters, while the marked channel that allows cargo ships to leave the Banjarmasin port is only 5 to 10 meters deep. The same phenomenon is found on the Kahayan : while the marked channel is only 6 meters deep, at Mintin, to wit 80 kms. from the mouth, the depths reach 10 meters. Furthermore, if one takes into account the numerous fluvial islands (Pulau Alalak, Pulau Kembang, Pulau Kaget, Pulau Temparung Besar and Kecil) that are scattered along the river, it is possible to affirm that the aggradation and the progression of the delta are considerable.

1.2.3. The ever-present subject of water

The very low altitude combined with the mountainous belt formed by the Müller and Meratus ranges, as well as the proximity of the Java Sea, make water an obsessive subject : sea water, flood waters or defluviations, rainwater!

1.2.3.1. The tides

When the dry season is pronounced, the tide flows upriver as far as Buntok on the Barito or Amuntai on the Negara, or, respectively, 300 kms. and 225 kms. from the coast.

The tidal amplitude of 2.80 m at the river's mouth remains very high (2.20 m and 1.88 m) at 100 and 135 kms inland due to the fact that the towns of Marabahan and Margasari are situated below sea level (Table No. 2). As far upriver as Amuntai, the amplitude is still 8 cms!

Should a spring tide occur at the same time as heavy rains on the mountainous counterforts, the water level can rise more than one meter aboveground and this at more than 200 kms from the coast. This is a capital information as far as both river traffic and development possibilities are concerned.

1.2.3.2. Hydrological data which, though fragmentary, permits a glimpse of an extreme irregularity and high risks of flooding.

There are no yearly hydrological statistics, but only at various stations, a few records spread from 1979 to 1984 with no evidence of any periodicity. Thus, some years 20 or so readings were made, as opposed to others in which only 6 or 7 were done. These data consist of a series of measurements ranging from the width of the riverbed to the flowspeed and wetted section. From these scattered data, two types of analyses were made. The first was the study of flow variations for all years combined, with the amount of water yielded being the basis of classification, and the second was the analysis of the monthly variations in flow. The choice of the rivers is not necessarily judicious; thus there are no data for the Barito, notably at the mouth. This is unfortunate, but then only existing data can be used.

TABLE No. 2

Tidal Amplitude

Stations	Maximal tidal amplitude (spring tides) -cms-	Maximal water level above ground -cms-
Barito's mouth	280	0
Banjarmasin	260	4
Anjir Serapat	260	5
Marabahan	220	82
Margasari	188	26
Negara	60	182
Babirik	40	-
Amuntai	8	93

Source : Prof. Dr. Ir. H.J.Schophuys "Perspectives of lifting water for irrigation and drainage in Indonesia in general, in Sumatra and Kalimantan in particular". Bogor, March-September 1969.

1.2.3.2.1. Monthly variations in flow

The rivers chosen for this analysis were those for which there are the longest series of data upon their entry into the plain. The monthly flow figures were obtained by seriating by months the data for the total number of annual series that was available. Of course, the figures obtained can only be relative ones, as on the one hand the original statistical material is very sparse and on the other hand it is impossible to know under what circumstances the data were recorded : did the technician move about during heavy flood periods, during low water periods, or else did he follow another sort of specific calender? In any case, these figures have an indicative value; the main thing is to remember that they are the only ones available and that they concern rivers on Borneo! It goes without saying that, in the absence of reliable topographical data, there is no point in calculating specific modules and other flow rate coefficients; the figures obtained are low ones (Negara River : 134 m^3/s, Tabalong River : 96 m^3/s, but they should not be taken for granted since it cannot be repeated often enough the mighty rivers Barito, Kahayan, and Kapuas are not included in the analysis!

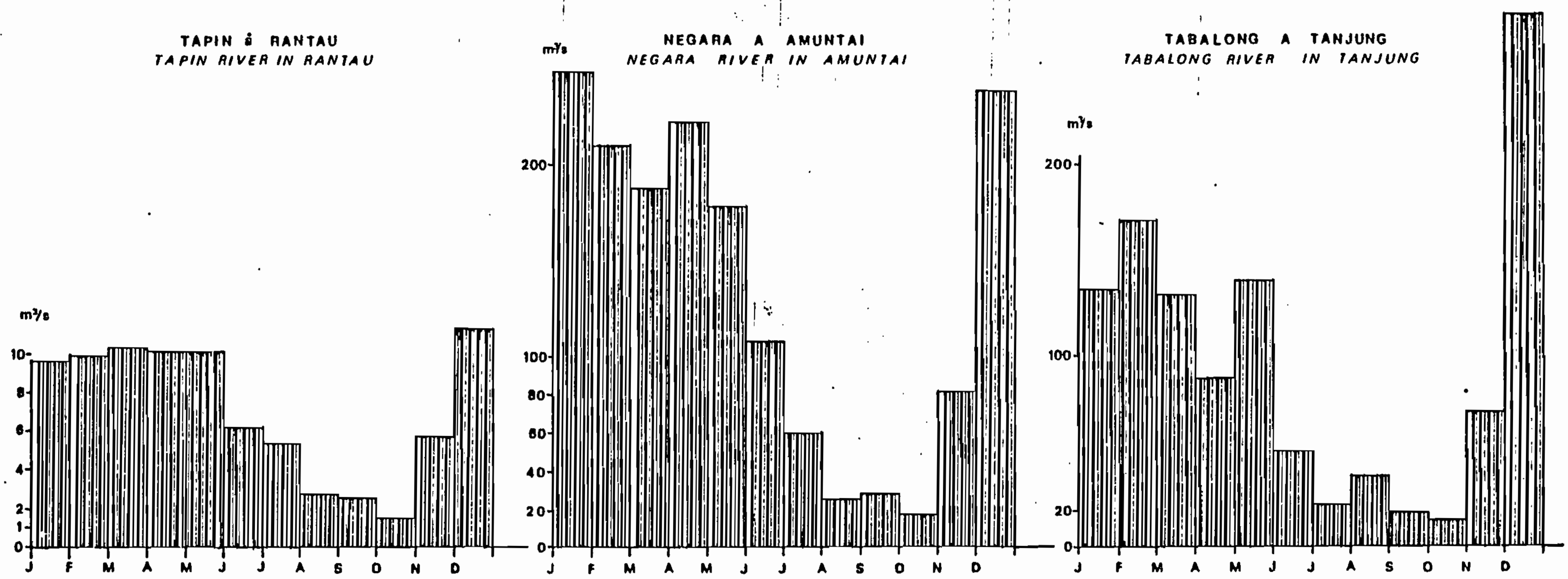
The monthly variation curve (Graph No. 3) presents the same characteristics for the three rivers that were studied, to wit : high water levels from December to June and low water levels from July to October with the occasional secondary minimum in April. It would hardly be prudent to make any further conclusions, given the quality of the available data.

FIG NO:3

VARIATIONS MENSUELLES DU DEBIT DE QUELQUES COURS D'EAU

DU SUD KALIMANTAN

MONTHLY VARIATIONS OF SOME RIVER FLOWS IN SOUTH KALIMANTAN



Source : Departemen Pekerjaan Umum. Direktorat Penyelidikan Masalah Air - Kalimantan Selatan.

1.2.3.2.2. Extreme values

The calculation of the ratio between the extreme, observed (Table No. 3) is therefore the only possible processing. The high values represent the mountain torrents which swell after a heavy rain and then dwindle to a thin trickle a few hours later (for example, the Tabanio River, which covers only about 50 kms. and rushes into the Java Sea from the southern headlands of the Meratus Mountains). The middle figures (ranging from 100 to 120) concern the larger rivers analysed on their upstream sections (Tabalong Kiri, at Mahe), while the more moderate values represent the largest rivers at their entry into the plain (Negara, at Amuntai).

At any rate, the variations between the extremes are always considerable, as are, consequently, the flood risks. At Amuntai, the Negara River - a major economic artery in terms of both traffic and agriculture - has a rate of flow which oscillates between 5 m^3/s and more than 350 m^3/s, the average - which consequently has little significance - being 133.76 m^3/s!

1.2.3.3. More reliable pluviometric data which accounts in a large part for this flood risk

Precise data are available for 8 stations from 1975 to 1982 (Table No. 4). The annual values range from 2000 mm (Pelaihari) to 3250 mm (Barabai). The coastal towns have the lowest pluviometry: Pelaihari, 2018 mm; Teluk Dalam-Banjarmasin, 2030 mm; while further into Kalimantan in a south - North direction the figures increase: Amuntai, 2743 mm; Tanjung, 2169 mm).
However, it will be noted that this is not a lineary transition; at Tanjung the pluviometry is lower than at Amuntai, though the latter is 35 to 40 kms further south. Nevertheless, the towns located on the Meratus piedmont receive the most rain: Barabai, 3248 mm; Kandangan, 2405 mm (Table No. 4).

TABLE No. 3

Extreme Variations Observed in the Flow of Some Rivers on S. Kalimantan

River (Station)	S. Tabalong (Tanjung)	S. Tabalong Kiri (Mahe)	S. Negara (Amuntai)	S. Tapin (Rantau)	S. Baruh Batung Barabai)	S. Riam Kiwa (Sei Langsat)	S. Tabanio (Bajuin)
Flow at flood (x) / Flow at low water (xx)	101,49	114,25	65	25,30	28,09	128,05	1347

x Highest observed value, taken from a series of data recorded from 1979 to 1984.

xx Lowest observed value, taken from data recorded from 1979 to 1984.

Source: Departemen Pekerjaan Umum - Direktorat Penyelidikan Masalah Air Kalimantan Selatan.

TABLE No. 4

Yearly Average Rainfall at Some Stations in S. Kalimantan

Stations	Yearly Average -mm-
Kandangan	2405
Barabai	3248
Rantau	2292
Amuntai	2743
Tanjung	2169
Teluk Dalam (Banjarmasin)	2030
Pleihari	2018
Kota Baru	2253

Source: Direktorat Bina Program Pengairan
Sub P3SA Barito Kalimantan Selatan

The general appearance of the 8 curves is similar: there is a pluviometric maximum in November-December-January which sometimes continues on into February, and a very marked minimum from June to October. The months of August (Pelaihari, Rantau, Amuntai, Kota Baru, Teluk Dalam-Banjarmasin), or perhaps September, are the least rainy.

Yet some curves stand out due to a secondary maximum in July (Kota Baru, Pelaihari, Amuntai) which can only be explained by the general atmospheric circulation, in itself characterized by the I.T.F. (Inter-Tropical convergence Front).

During the northern winter (Fig. 5) the Indonesian archipelago is under the influence of maritime trade winds that are created by the central Asian anticyclone and which bring the rainfall. On the other hand, during the northern summer, the I.T.F. moves up as far as China. The continental trade winds, issuing from the mobile Australian anticyclone, which are dry at the outset, gradually become humid upon contact with the sea but bring only moderate precipitations.

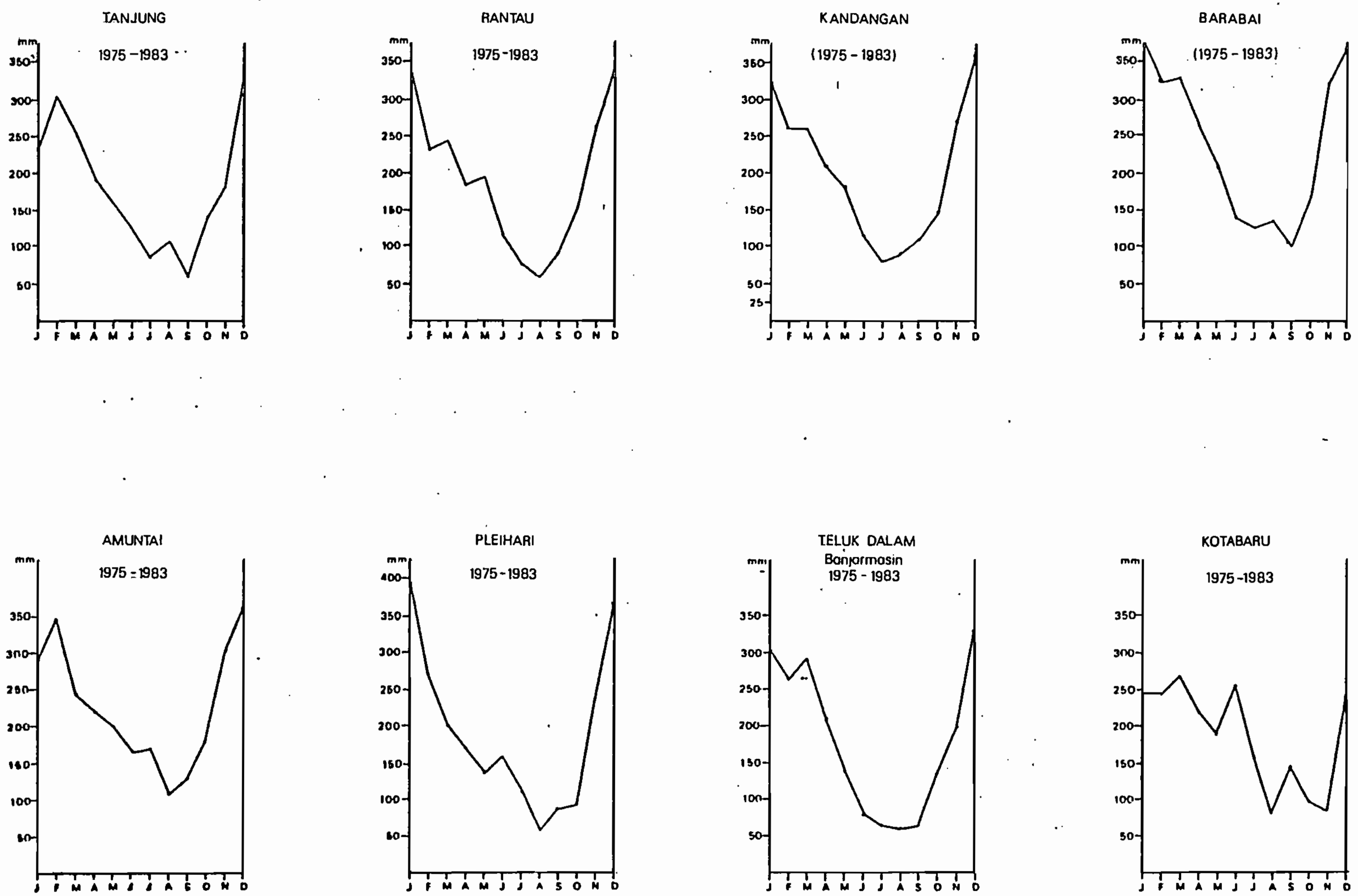
However, this general outline must not mask the very high inter-annual variability, which will be dealt with in greater detail in the presentation of the Alabio polder for which the most detailed data are available. The disposition of land and sea, within the entire archipelago that makes up the East Indies, as well as the extreme proximity of the equator, are responsible for considerable irregularities.

The analysis of the intensity of the precipitations at Amuntai, calculated from 1975 to 1983, shows that 66.64% of the total rainfall expressed in millimeters comes as heavy showers of more than 20 mm, whereas the light rains of less than 5 mm only represent 4% of the total (Table No. 5). Continuing the analysis in terms

FIG NO: 4

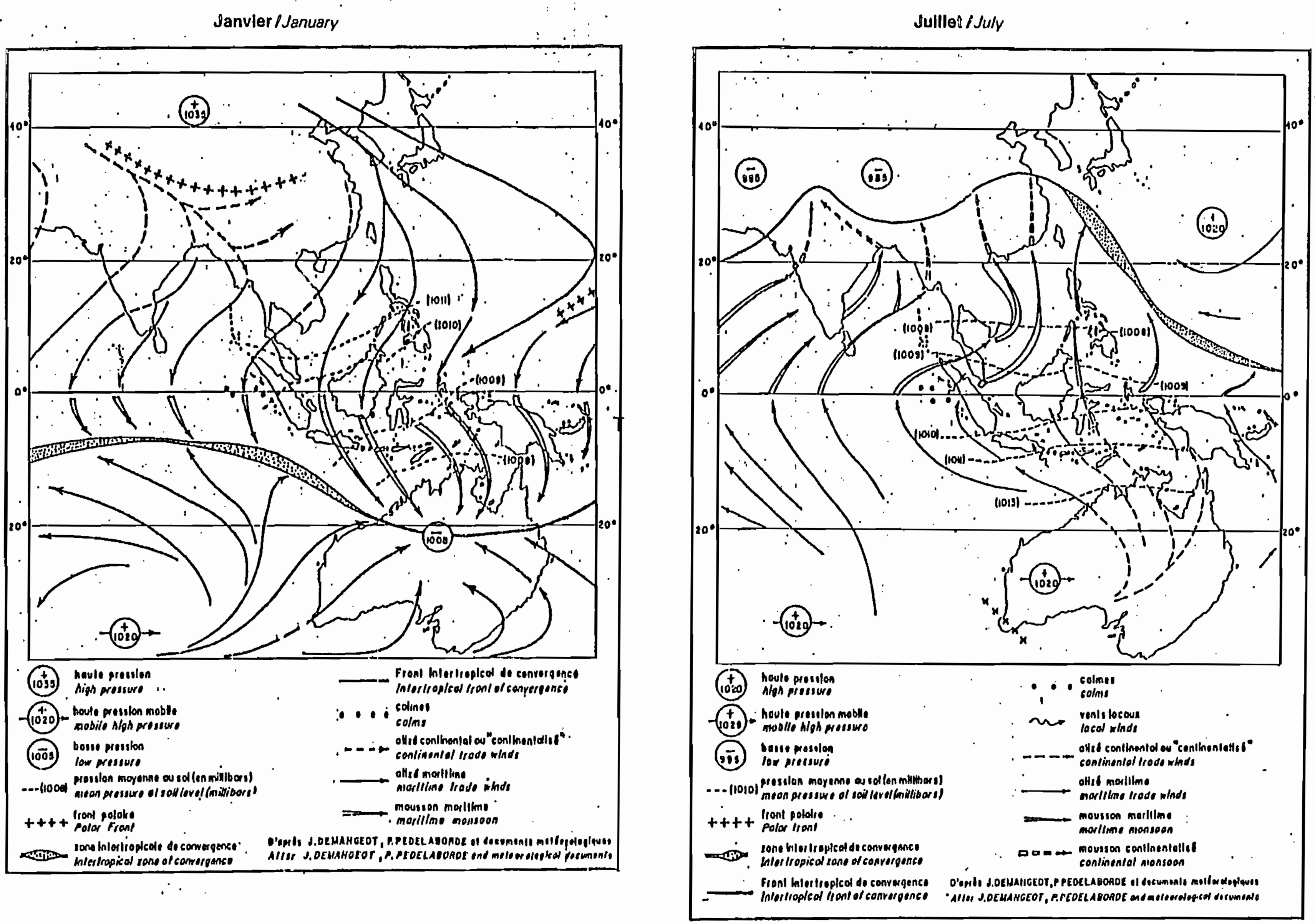
RYTHMES PLUVIOMETRIQUES DANS LE SUD KALIMANTAN

.MONTHLY RAINFALL VARIATION IN SOUTH KALIMANTAN



Source: Direktorat Bina Program Pengairan-Sub.P_3SA-Barito-Kalimantan Selatan.

Fig. no 5 CIRCULATION ATMOSPHERIQUE
ATMOSPHERIC CIRCULATION



Source : *J. Fontanel and A. Chantefort - Bioclimates of the Indonesian Archipelago.*
Institut Français de Pondichery - 1978 pp 14.15

of frequency shows that these 66.64% (or 1828 mm) represent in frequency only 30% of the total number of showers. Consequently, it is probable that the amount of run-off water, considering the ground's retention capacity, is quite large, superior even to 1300 mm[1].

P 2743 mm - PET 1300 mm - Ground retention capacity 100 mm = 1343 mm.

As paradoxal as it seems, however, the analysis of these same data also shows that, over an 8-year period, 35% of the months are dry; that is, in these months, the total amount of precipitation is less than the potential evapotranspiration. In this case, which represents one months out of three on the average, no rain drains off, given the ground absorption. It can be further added that 8% of the months are very dry (30 mm $<$ P $<$ 60 mm) and 9% are extremely dry (P$<$30 mm - Table No. 6).

Thus, this amphibious environment, frequently underwater be it due to the tides or to the very strong coefficient of the rise and fall of the rivers, also runs a non-negligeable risk of drought. It is obvious that this fact is of the utmost importance to agricultural development.

1.3. A lowland plain divided into three regional sub-sections, each with its own landscape.

Given the information - sparse though it be - provided by the data on climate, hydrology, and topography, it is possible to classify three regional sub-sections within which the conversion

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[1] In these regions, 1300 to 1400 mm are commonly accepted PET values, as well as 100 mm for the ground retention capacity.

TABLE No. 5

Rainfall Intensity
Amuntal – 1975-1983

Type of rainfall	January		February		March		April		M a y		J u n e		J u l y		August	
	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %
P < 5 mm	6,32	37,24	4,59	39,36	7,24	41,6	2,71	35,58	6,82	39,36	3,35	32,26	3,01	20,29	4,49	29,27
5 ≤ P < 9 mm	9,99	20,69	4,19	10,24	9,69	18,4	4,66	15,38	8,31	17,03	6,56	20,43	6,55	20,29	1,61	4,88
10 ≤ P < 19 mm	16,18	18,62	16,28	18,90	20,93	19,2	52,59	24,04	23,22	23,40	11,19	18,28	14,34	23,19	31,45	36,58
P > 20 mm	67,51	23,45	74,94	31,50	62,14	20,8	40,04	25	61,65	20,21	78,90	29,03	76,10	36,23	62,45	29,27
Total %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

September		October		November		December		% of annual total of precipi- tations	Freq. % in one year	Annual rainfall -mm-
% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %	% of monthly rainfall	Freq. %			
4,03	27,78	3,01	27,06	2,52	26,51	2,65	23,93	3,88	30,21	
4,55	12,96	10,48	28,23	24,05	16,67	7,86	19,63	9,18	18,24	
21,40	29,63	8,32	10,59	12,32	19,70	20,93	25,77	20,30	22	2743
70,02	29,63	78,18	34,12	61,11	37,12	68,56	30,67	66,64	29,55	
100	100	100	100	100	100	100	100	100	100	

Source : Direktorat Bina Program Pengairan SUB P3SA Barito – Ministry of Public Works Banjarmasin, South Kalimantan.

of the natural environment and the agricultural development have taken on specific characteristics: aside from the alluvial valleys upstream from Kelua in the north, there are, successively towards the south: the lake region, from Kelua to Negara: the swampy plain per se from Negara to Marabahan; and lastly the amphibious lowland plain under tidal influence from Marabahan to the sea.

I.3.1. The lake region

The lake region is well-represented only at some distance from the Negara, near the Barito. Its altitudes range between 2 m and 1 m; the rivers, rather shallow, run between two levees but defluviations occur frequently. Here and there lakes break the monotony of the landscape; their levels as well as their general shapes vary with the rainfall on the upper basin. These lakes function as flood regulators.

From north to south, the Danau[1] Maningiti and Bintin (1070 – ha.), Panggang (162.5 ha.) and Bengkau succeed each other, as well as a multitude of other lacustrian formations of smaller size. The primary condition for the development of this region is protection against the sudden floods and the construction of dykes at least 3 or 4 meters tall in the northern part and at least one to two meters in the southern part. The analysis of the variations in water level for the Negara River at Amuntai (Table No. 7) shows that for a series of 77 readings taken from 1976 to 1981, in more than 40% of cases the water level is higher than 3 meters. As it will be seen further on, this region is one that has been partially polderized.

[1]Danau = lake

TABLE No. 6

Amuntai 1976-1983

% of Dry Months

(Pmm < PET)

60 < P < 120mm % of months:	17.71%
30 < P < 60 mm % of months:	8.33%
P < 30 mm % of months:	9.37%
Recapitulation: % of months in which P < 120 mm:	35.42%

Note : PET value retained: 3.9 mm/day, to wit, 110 to 120 mm/month, or about 1400 mm/year

Source : Direktorat Bina Program Pengairan Sub P3SA Barito - Kalimantan Selatan.

However, water control cannot be perfectly obtained unless an irrigation method is included. In fact, it has already been shown that from May to October there is a risk of water shortage.

1.3.2. The swampy plain

The actual swampy plain is only a few centimeters above sea level. In this case the main constraint is drainage, even though the same risk of drought makes irrigation a mandatory result of this same drainage. Irrigation further allows one to limit the acidity of soils covered with a layer of peat that varies from 1 to 5 meters depending on the locality, underneath which is a clay horizon. In order to permit continuous cultivation on soils whose pH is less than 4, it is absolutely necessary to re-route part of the fresh water that flows out of the Meratus Mountains and irrigate the previously-drained parcels.

1.3.3. The region under tidal influence (tidal swamps)

It has been shown that the high tidal amplitude and very slight slopes, combined with the considerable depth of the rivers, results in a part of the swampy lowland plain being influenced by the tides. This section of the plain extends 30 to 50 kms. inland-from the coast and on either side of the rivers up to 5 kms. on the interfluve. Here, a tidal bore phenomenon is put to profitable use by the farmers. During the clearing and land development, a simple system of canals which serve both to drain the soil when the tide goes out and to irrigate it when the water rises, is sufficient[1].

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[1]This technical method is described in the report "Regional Geography to Develop Transmigration Settlement in Central Kalimantan - The Lower Mentaya Valley" - ORSTOM-Transmigration Project PTA.44-Jakarta, 1984, concerning the coconut plantations in the Samuda area.

Table No. 7

Water Levels - Negara River

Amuntai - 1976-1981

Water level	Frequency	% number of readings
< 0.5 m	6	7.79
0.5 - 0.99 m	8	10.39
1 - 1.99 m	17	22.08
2 - 2.99 m	14	18.18
3 - 3.99 m	16	20.78
≥ 4 m	16	20.78
TOTAL	77	100

Note : Above 0 on the scale

Source : Departemen Pekerjaan Umum - Direktorat Penyelidikan Masalah Air - Kalimantan Selatan.

However, the total area which can be developed in this way remains very limited, on the order of 500,000 ha. Flood protection is less necessary given the width of the floodplain. In this area, the primary agricultural necessity is to reduce the soil's acidity and to prevent capillary infiltration during the dry season.

However, all these regional differences are not based on anything very ancient. This intermediate lowland between land and sea, this former marine gulf filled in by sediments from the Müller, Meratus, and Schwaner mountains carried down by the Barito and its tributaries, is of sufficiently recent construction to have affected the politics of the different Kraton[1] which succeeded each other in the history of South Kalimantan.

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[1]Kraton : palace, seat of political authority

CHAPTER II

A political history closely linked to the morphological development

The history of the first human settlements in southeast Borneo bears witness to diverse cultural influences and emphazises the obsession of the political authorities who, to control circulation and resist the growing Western pressure, had to change places often, thus underligning the aggradation of the delta and the progression of land.

The main information on the history of the Banjarmasin sultanate is the "Hikajat Bandjar", a chronicle that retraces the lives of the various political leaders as well as the mythical origins of their rules. J.J. Ras[1] devoted himself to deciphering this chronicle, and to comparing the different versions, their origin and their evolution, in order to differentiate between the realistic notations, historical information per se, and mythological reconstructions on the other hand. The comparison of this information with the data concerning the morphology of the delta will henceforth provide an outline for the rest of this study.

II.1. The phenomenon of aggradation and the progression of the deltas in the Java Sea periphery

The progression of the deltas in the Java Sea periphery is surprising. A few examples taken from J.J. Ras[2] will help shed

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[1] J.J. Ras, "Hikajat Bandjar". Martinus Nijhoff, The Hague. 1968.

[2] Ras, op.cit., pp. 192-196.

light on the phenomenon.

Demak, to the north-east of Semarang, was located on the coast in the XVIth century and is today 12 kms. inland. The average aggradation has been 30m/year. Occasionally, it can reach 108 meters, as it has near Indramayu, in West Java, or even 200m/year west of Semarang in the Bodri delta.

However, the most famous example is still that of Palembang. Palembang, which is now located 50 kms. inland, was a seaport 400 years ago. In 100 years, the coastline at the mouth of the Jambi River has advanced by 7.5 kilometers!

II.2. Birth of a new people

It seems, notably according to J.J. Ras[1], that at the origin of the Banjar people is a nucleus of Malay populations who came from the western part of the archipelago in the first century A.D. Those who arrived first probably settled in the Tabalong region, that is to say, at the foot of the Meratus Mountains, which were at the time bordered, if not by the sea, at least by a vast marine gulf.

These Malays progressively intermixed with the Maanyaan and Bukit Dayaks, forming an initial Banjar group. In this context was founded the Tanjung Pura kingdom whose capitol, Tanjung Puri, was very probably located in the area of present-day Tanjung. This is a port at the junction of the Tabalong (sometimes called Tobalong) and Balangan Rivers, but it is also the name of a promontory![2]

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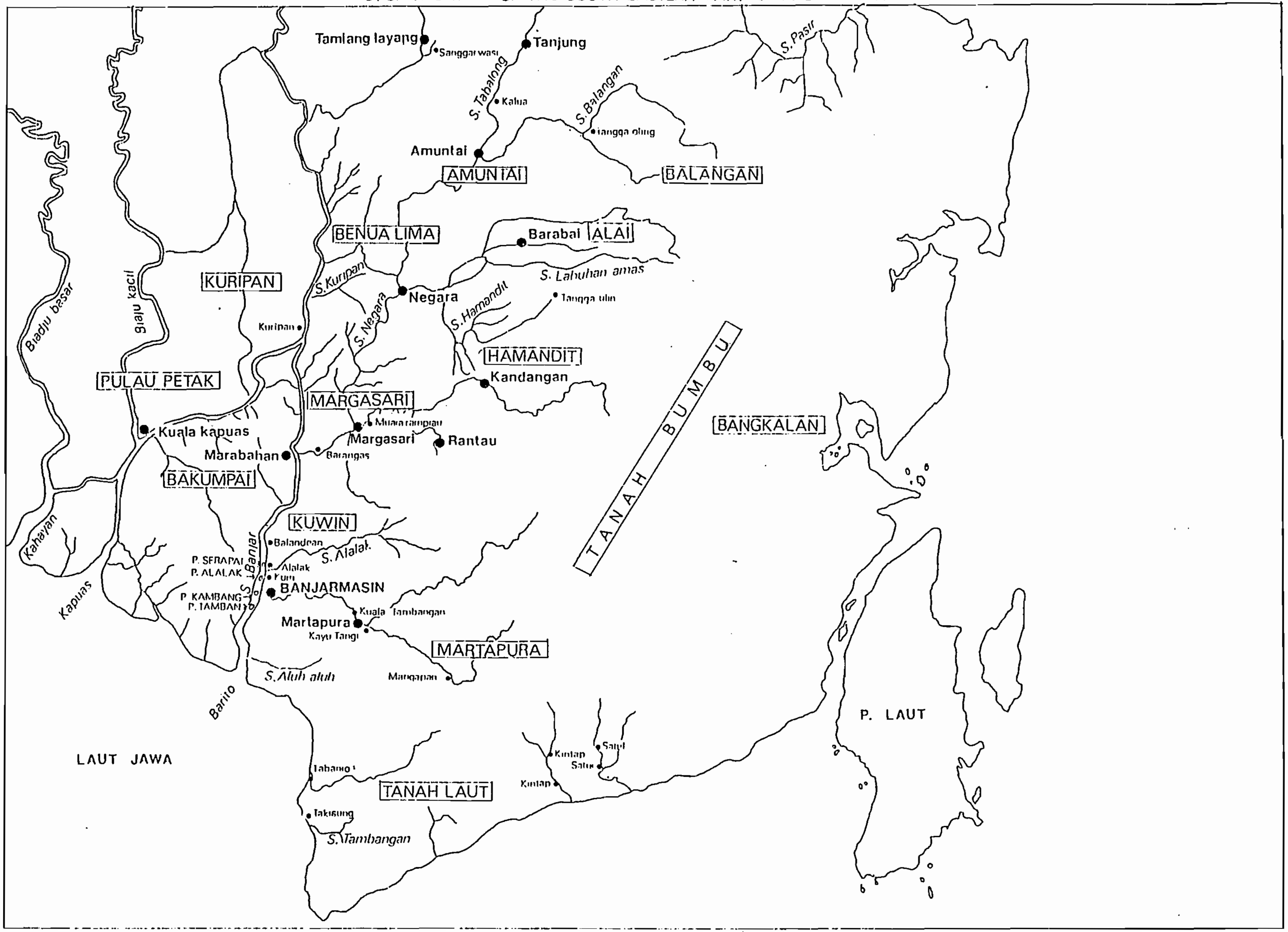
[1] J.J. Ras, op.cit.

[2] Tanjung = cape, point

6. CARTE HISTORIQUE DU SUD-EST DE KALIMANTAN
HISTORICAL MAP OF THE SOUTH-EASTERN PART OF KALIMANTAN



Notes 1. Source : W.A. VAN REES, *DE BANDJEMASINSCHE KRIJG VAN 1859-1863*. Arnhem 1865 - 1867 repris dans J.J. RAS, *HIKAYAT BANDJAR*. MARINUS NIJHOFF - THE HAGUE 1968.

Progressively, though much later, other ethnic groups joined this first nucleus. In the XIIth century, Ampu Djatmaka, arriving from Keling, stopped on the island of Hudjung Tanah and founded Nagara Dipa, a feudal state of Tanjungpuri. Keling can be interpreted as the name of a South Indian town, and according to tradition, the people from Keling came from Coromandel. "The state of Banjarmasin (...) was founded by a certain Ampu Djatmaka, son of a merchant from the coast of Coromandel named Mankoe Boemi (...). He left his homeland, settled in Borneo, and called the country Nagara Dipa."[1] Further reinforcing this theory, it has been found that a large group of Indians were once settled in Banjarmasin. This group was large enough that in 1635, the office of Sjahbandar (port authority) was held by a Gujerati. The Gujerati are also mentioned in Chapter 9, Part V, of the "Hikajat Bandjar[2]" along with people from Keling.

However, J.J. Ras echoes the opinion of those for whom there is, on Java near Kediri, a village called Kling. In connection with this, he points out that the name "Ampu Djatmaka" sounds indo-javanese, further emphasizes that in the text of the "Hikajat Bandjar", many notes evoke a Javanese influence, and finds a disturbing coincidence. The gong Rabut Paradah upon which the mythical hero Surjanarta emerges from the waters at Pandaraman[3] has the same name as the sacred gong in Lodaja, near Blitar, in eastern Java in the Kediri area (Mbah Pradeh). Therefore, this could have been a faulty translation of a term whose origins had been forgotten at the time the "Hikajat Bandjar" was written. Given this possibility,

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[1] T. Van Capellen, Notice historique du royaume de Banjarmasin (Borneo) le Moniteur des Indes Orientales et Occidentales no.8 - 1846-p 164

[2] Ras, op.cit., p. 371.

[3] J.J. Ras, op.cit., p. 186.

Ras comes to the conclusion that it was a group of Javanese, and not of Indians, led by a man from Kediri, who came to South Kalimantan and founded the kingdom of Nagara Dipa, bringing with them, among other things, a gong which was part of the regalia.

It is not necessary to subscribe to one or the other theory, but the multiplicity and variety of ethnic influences must be stressed, for, as will be seen, these influences left permanent marks on the present-day landscape.

II.3. Controlling the traffic in the delta: the obsession of the political authority

Progressively, as the marine gulf silted up, it perturbed the economy by forcing port activity further and further south, thus regularly weakening the governments in power who, as the distance increased, lost control of both river and maritime traffic. This same occurrence repeated itself many times.

Following diverse vicissitudes with which we are not very familiar, the political power first passed over from Kuripan (Tanjungpuri) to Nagara Dipa whereas the port was moved further south to Nagara-Daha at the junction of the Nagara Dipa, Alai, and Hamandit rivers in the Parit Basar region. It is all the more difficult to point out, precisely, this relocation on a map, since the present-day hydrographic network did not exist, or at least not in its present form.

Nor can we hardly hope to trace the troubled history of Nagara Dipa, though it can nevertheless be noted that during the reign of the Maharajah Sari Kaburangan the kraton was very rapidly relocated from Nagara Dipa to Nagara Daha, near the new port.

From this point on, history speeded up; the political power and the port were continually relocated further south, thus following the progression of the silting-up. Muara Rampiau harbored a port, then Muara Bahan, the present-day Marabahan at the junction of the Barito and the Nagara, before the Pangeran[1] Samudra finally convinced the merchants in Marabahan to move down to Banjarmasin in the Kuin region. From then on the port has remained in Banjarmasin, even when the capitol moved inland temporarily (Kuala Tambangan, Kayu Tangi, ...).

II.4. Offering resistance to Western pressure

All these shifts must be reconsidered in the context of the adoption of the Moslem religion as a reaction against the arrival of the Portugese Christians in the seas of the archipelago, which hindered and finally ruined Islamic trade in Asia. In 1511, the Portugese took Malacca. Aceh, Demak, and Ternate remained resistant to Portugese attempts at hegemony. Concious of the danger the Portugese represented, Demak took control of Modjopahit in 1521 and appropriated its treasure; henceforth the remaining Hindou kingdoms were rapidly seized. In 1524, Banten came under the influence of Demak, then, in 1527, Selat Sunda. Thus in all probability Banjarmasin became a garrison town in 1526 and united with the population of Nagara Daha, and afterwards with Marabahan. It was in these same circumstances that the Pangeran Samudra adopted Islam and became the Sultan Suriansyah in order to obtain Demak's assistance and thus transform the Banten-Demak-Banjarmasin triangle into a dangerous zone for Christian trade.

Thus, everything coincides progressively: silting-up, progression of the delta, grouping together of populations who wished to trade easily and to units against the Christian foreigners. Morphological development mixes with history. When the Malays arrived from Sumatra at the beginning of our era, they settled in the

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[1] Pangeran = Prince

only inhabitable place, Hudjung Tanah, on the coast of a gulf that had not yet filled in. Progressively, Tanjungpuri became an inland town separated by new lands that were occupied by newcomers, thus forcing the political authority to relocate. This phenomenon repeated itself many times, whereas due to the considerable accumulation of souls, the first settlements spread to the west and south. From this permanent confrontation between man and water were born original agricultural development techniques, while at the same time a truly Banjar culture grew up little by little.

PART II

A Veritable Palimpseste of Diverse Cultural Contributions and Successive Impressions

After integrating with the native elements around Banjarmasin, Martapura, and Pleihari - the Malays from Sriwijaya, the Sundanese and Javanese from Modjopahit, the Bugis, then to a lesser degree, the Indians, Arabs, and Chinese - the Banjar people assimilated the Dayaks of the Hulu Sungai region[1]. From these multiple borrowings, a unique culture sprang up whose mark can be clearly seen in the landscape. However, the original Banjar landscape was obliterated by later Dutch and Indonesian installations, which the following chapters will attempt to describe.

[1]Hulu Sungai = literally, "up the river". This area of the Negara River and its tributaries above Marabahan was occupied by Dayak populations who were pushed back by the end of the XVIIIth century by the extension of pepper cultivation. Main source of wealth for the Banjarmasin sultanate.

CHAPTER III

Banjar solutions to the land development problem

III.1. The Banjars

The Banjars make up a totally Moslem population that speaks a dialect of Malay origin within which there are many local dialects, at Amuntai, Kadangan, Tanjung, Kelua, ...

The population of the Province of South Kalimantan counted about 2,200,000 inhabitants in 1983 (Table No.8). The greater part is composed of Banjars, but also of large Bugis and Dayak minorities. The national census only consider Indonesians and does not include any ethnic reference; under these conditions it is not possible to determine the exact number of strictly Banjar population other than in an approximative manner.

The number of Bugis is estimated at about 140,000 to 150,000 people, mainly in the eastern Kabupaten[1], to wit: half of the population of Kabupaten Kota Baru and about 15% of the population of Kabupaten Tanah Laut.

The Dayaks of the Maanyan group make up most of the population of Kecamatan[2] Loksado (Kabupaten Hulu Sungai Selatan) and about 70% of Kecamatan Haruai and Kecamatan Muara Uyu (Kabupaten Tabalong), for a total of 34,000 to 35,000 people. To this must be added 14,000 to 15,000 Bakumpai, who are related to the Ngaju Dayaks but whose adoption of Islam dates back to the XVIIIth century. These Bakumpai live at Marabahan, at the

[1] Kabupaten: administrative circumscription corresponding to a department

[2] Kecamatan: administrative circumscription corresponding to a canton

Table No. 8

Population of the Province of South Kalimantan by Kecamatan

Kabupaten	Kecamatan	Population inhab	Area km^2	Densities inhab/km^2
Banjar	Aluh Aluh	32447	143,90	225,48
	Kertak Hanyar	24975	81,30	307,19
	Gambut	23478	129,30	181,57
	Sei Tabuk	31370	147,30	212,97
	Martapura	70907	221,40	320,27
	Banjar Baru	25545	46,40	550,54
	Karang Intan	26825	1381,70	19,41
	Astambul	43927	364,90	120,38
	Simpang Empat	18429	611,30	30,15
	Pangaron	16884	567,90	29,73
	Sei Pinang	7726	1019,50	7,57
	T o t a l	322513	4714,9	68,40
Kota Administrasi Banjar	Banjar Baru	25545	46,40	550,54
	Landasan Ulin	17540	178,20	98,43
	Cempaka	15216	146,70	103,72
	T o t a l	58301	371,3	157
Barito Kuala	Tabunganen	12840	240	53,5
	Tamban	40894	307,80	132,86
	Anjir Pasar	13933	126	110,58
	Anjir Muara	13701	117,25	116,85
	A l a l a k	20311	106,85	190,09
	Sei Puntik/Mandast	14497	399	36,33
	Rantau Baduah	20831	445,81	46,73
	Belawang	20205	117,75	171,59
	G e r b o n	5370	206	26,07
	Bakumpai	14608	482	30,31
	Kuripan	3630	343,50	10,57
	Tabukan	6564	166	39,54
	T o t a l	187384	3057,96	61,28

Kabupaten	Kecamatan	Population inhab	Area km^2	Densities inhab/km^2
Tanah Laut	Takisung	16910	490	34,51
	Jorong	18204	1149,10	15,84
	Pleihari	34812	593,50	58,65
	Kurau	18962	236	66,30
	Bati Bati	20445	325,11	62,88
	Panyipatan	14675	336	43,68
	Kintap	16445	537	30,62
	T o t a l	140453	3716,73	37,79
Kota Baru	P. Sembilan	6485	119	54,50
	P. Laut Barat	10388	621	16,73
	P. Laut Selatan	12824	492,87	26,02
	P. Laut Timur	5407	263,75	20,50
	P. Sebuku	3508	172	20,39
	P. Laut Utara	48031	485,33	98,97
	Kusan Hilir	49500	506,20	97,79
	S a t u i	22933	850	26,98
	Kusan Hulu	7020	1315,91	5,33
	Batu Licin	34408	406,15	84,72
	Kelump Selatan	6759	440	15,36
	Kelump Hulu	5634	290	19,43
	Kelump Tengah	7397	142	52,09
	Kelump Utara	4894	306	15,99
	Pamukan Selatan	5195	380,70	13,65
	Sampanahan	5919	590,93	10,02
	Pamukan Utara	6320	980	6,45
	Hampang	4162	610	6,82
	Sungai Durian	4091	582	7,03
	T o t a l	250875	9553,84	26,66

Kabupaten	Kecamatan	Population inhab	Area km^2	Densities inhab/km^2
Tapin	B i n u a n g	21630	342,08	63,23
	Tapin Selatan	16878	366	46,11
	Tapin Tengah	15271	342,20	44,63
	Tapin Utara	27582	338,43	81,50
	Candi Laras Selatan	9900	327,85	30,20
	Candi Laras Utara	12192	730,48	16,69
	Bakarangan	8038	115,54	69,57
	P i a n i	3204	131,24	24,41
	T o t a l	114695	2693,82	42,58
Hulu Sungai Selatan	Sungai Raya	15154	87	174
	Padang Batung	15631	194	80,57
	Telaga Langsat	8545	100	85,45
	Angkinang	14789	68	217,48
	Kandangan	37645	145	259,62
	S i m p u r	15077	87	173,29
	Daha Selatan	34518	396	87,17
	Daha Utara	24952	368	66,83
	Kalumpang	7237	35	206,77
	L o k s a d o	6340	228	27,81
	T o t a l	179528	1708	105,11
Hulu Sungai Tengah	H a r u y a n	17884	148,63	120,33
	Batu Benawa	25701	290,98	88,33
	Labuhan Emas Selatan	13074	86,54	226,63
	Labuhan Emas Utara	23586	161,81	145,76
	Pandawan	24791	144,74	171,28
	Barabai	38755	54,57	710,19
	Batang Alai Selatan	26569	437,74	60,69
	Batang Alai Utara	24900	147,49	168,82
	T o t a l	205260	1472,5	139,39

Kabupaten	Kecamatan	Population inhab	Area km^2	Densities inhab/km^2
Hulu Sungai Utara	Danau Panggang	19939	267,12	74,64
	B a b i r i k	16458	182,22	90,32
	Sungai Pandan	37466	242,50	154,50
	Amuntai Selatan	19615	76,76	255,54
	Amuntai Tengah	44750	137,44	325,60
	Amuntai Utara	30464	108,10	281,31
	Lampihong	13223	168	78,71
	Batu Mandi	11713	167	70,14
	A w a y a n	14489	394,10	36,76
	Paringin	17122	388,37	44,09
	J u a i	9851	212,53	46,35
	H a l o n g	10822	426,86	25,35
	T o t a l	245912	2771	88,74
Tabalong	Benua Lawas	14059	161,60	87
	K e l u a	27648	285,06	96,99
	T a n t a	11080	172,10	64,38
	Tanjung	19799	323,34	61,23
	Haruai	20734	184,27	112,52
	Muara Uya	19283	700,84	27,51
	Murung Pudak	15374	118,72	129,50
	T o t a l	127977	1945,93	65,77
Banjarmasin	Banjar Selatan	102744	31,55	3256,54
	Banjar Timur	120915	11,59	10441,71
	Banjar Barat	118234	7,89	14985
	Banjar Utara	58404	20,98	2783,79
	T o t a l	400297	72	5559,68

Source : Kantor Sensus dan Statistik - Banjarmasin junction of the Barito and Negara rivers.

Thus, on the whole, the Banjar population counts about 2,000,000 inhabitants of which nearly 640,000 live in the Hulu Sungai region.

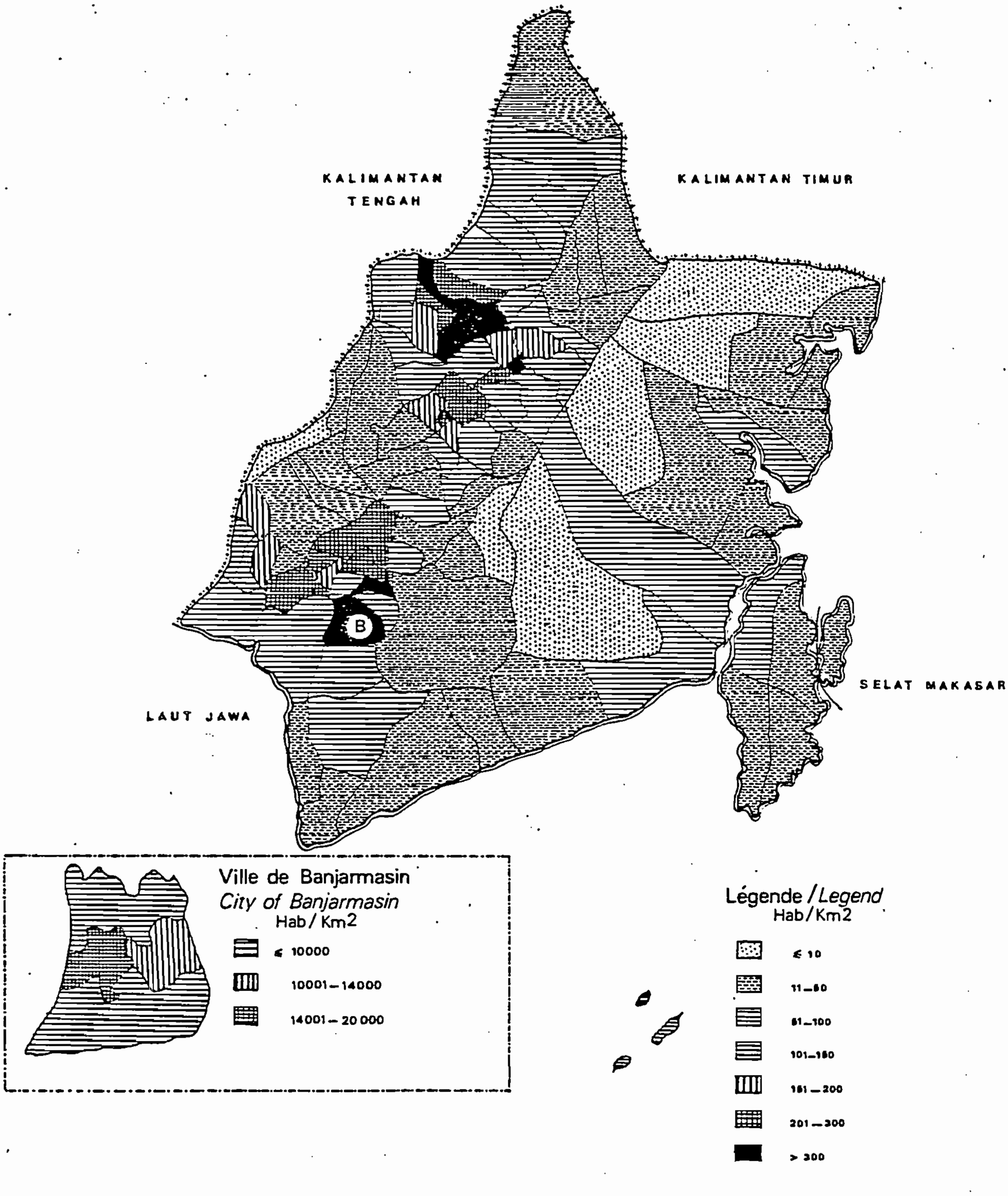
III.2. An uneven population distribution

The population is not homogeneously distributed, with density ranging from less than 10 inhabitants per km^2 (Kecamatan Pamukan Utara, 6.45; Kecamatan Hampang, 6.82, in Kabupaten Tanah Laut) to more than 300 inhab/km^2 (Kecamatan Amuntai Tengah, 325, in Kabupaten Hulu Sungai Utara), this excluding the town of Banjarmasin (Map No.7). The average density for the province as a whole is 69.62 inhab/km^2.

As a general rule, the eastern kabupaten are underpopulated (Tanah Laut and Kota Baru). These are either dryland agriculture regions bordering the Makassar straits that have recently been developed by the Bugis and by transmigrants re-settled by the government (Sebamban Center, for example), or mountainous regions inhabited by Dayak populations scattered throughout the Meratus range (Kecamatan Loksado, 27.81 inhab/km^2, Kabupaten Hulu Sungai Selatan). However, it must be noted that in no case do the densities drop below 5 inhab/km^2, which is on the contrary frequently the case in the neighboring province of Central Kalimantan.

However, still without including Banjarmasin, the densities are very much higher than average in Kabupaten Hulu Sungai Selatan (105.11 inhab/km^2) and Hulu Sungai Tengah (139.39 inhab/km^2) and even in Hulu Sungai Utara (88.74 inhab/km^2). These districts cover the Negara watershed that borders the western slope of the Meratus Mountains from Marabahan to Amuntai. It will be seen in the next chapter that this historical melting-pot, cradle of Banjar civilisation, has, since the beginning of the century, been

7. CARTE DES DENSITES/*DENSITY MAP*
KALIMANTAN SUD/*SOUTH KALIMANTAN*



Source : Kantor Statistik Propinsi Kalimantan Selatan - 1983

DRAWN BY WIYONO

the object of considerable agricultural development that has permitted intensified agricultural practices and favorised an influx of population

Finally, the town of Banjarmasin and the surrounding area (Kotamadya Banjarmasin, or "Greater Banjarmasin") make up a third unit. The density exceeds 10000 inhab/km^2 in Kecamatan Banjar Timur and 14000 inhab/km^2 in Kecamatan Banjar Barat, which make up the downtown area, while the surrounding villages, grouped into Kecamatans Banjar Utara and Banjar Selatan have densities comprised between 2700 and 3500 inhab/km^2. Agricultural life is relatively intensive, as will be shown by the examples of the orchards in Pemakuan and Gudang Hirang.

III.3. Original land development techniques

Following the Bugis example the Banjar have become masters in the art of drainage and the development of lowlands flooded by the tides. In addition to the choice of appropriate varieties of rice and of original cultivation methods, notably concerning the transplantation of the rice, they shape the landscape and leave a lasting imprint on it with their methods of ridging and building up lands.

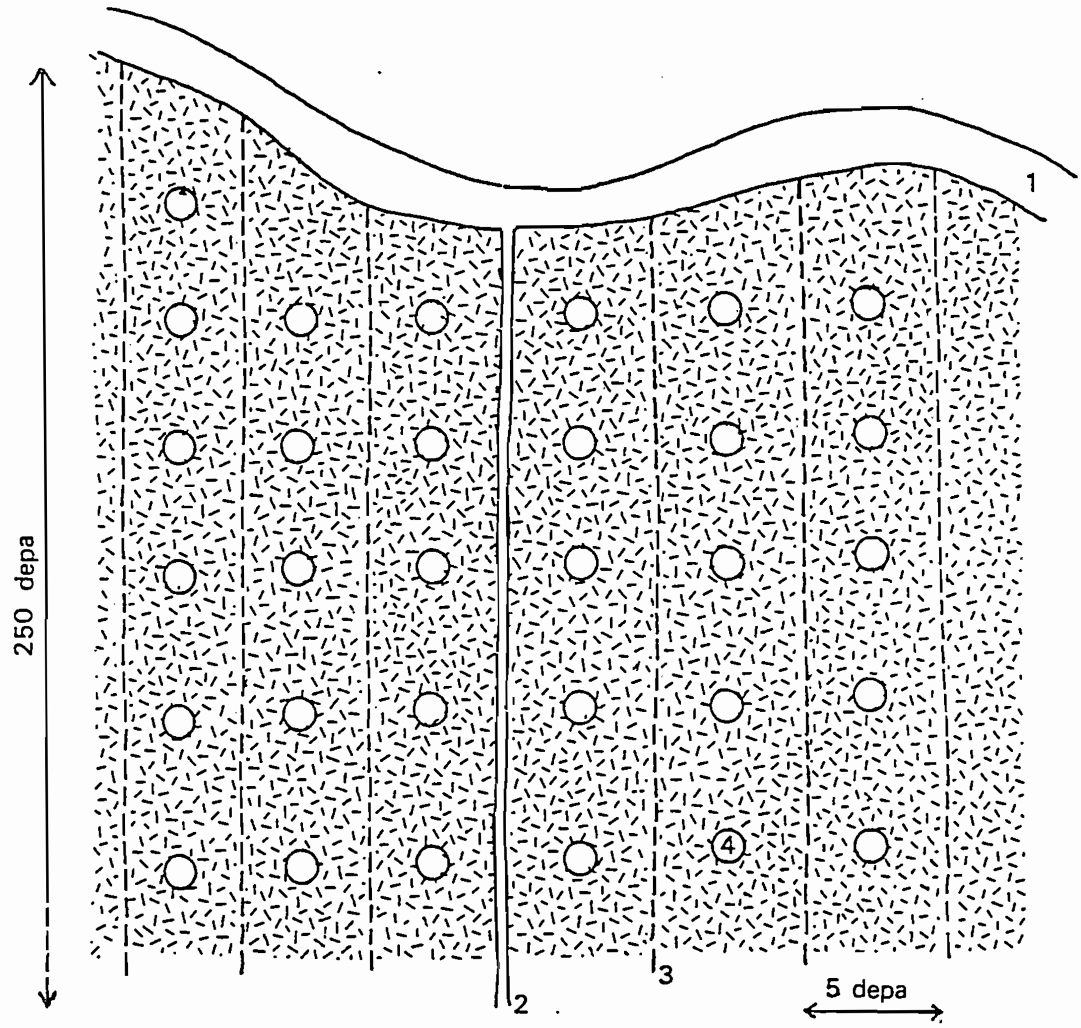
III.3.1. Ridging techniques

As they have to develop an amphibious environment that is flooded twice a day by the tides and more irregularly when the rivers are at flood stage, the Banjars have come up with a large variety of forms in order to drain the crops and work with differences in level of a few dozen centimeters.

III.3.1.1. The "Tukungan"

This is the most summary form of development. After the swampy lowland plain has been cleared, simple hillocks of earth of some 30 to 50 cms in height and 1 to 1.5 meters in diameter

8. EXEMPLE DE MISE EN VALEUR PAR LE BIAIS DE *TUKUNGAN*
TUKUNGAN LAND-USE PATTERN



1. Cours d'eau / *River stream*
2. Fossé / *Ditch*
3. Drain / *Drain*
4. Butte exondée / *Rising ground*

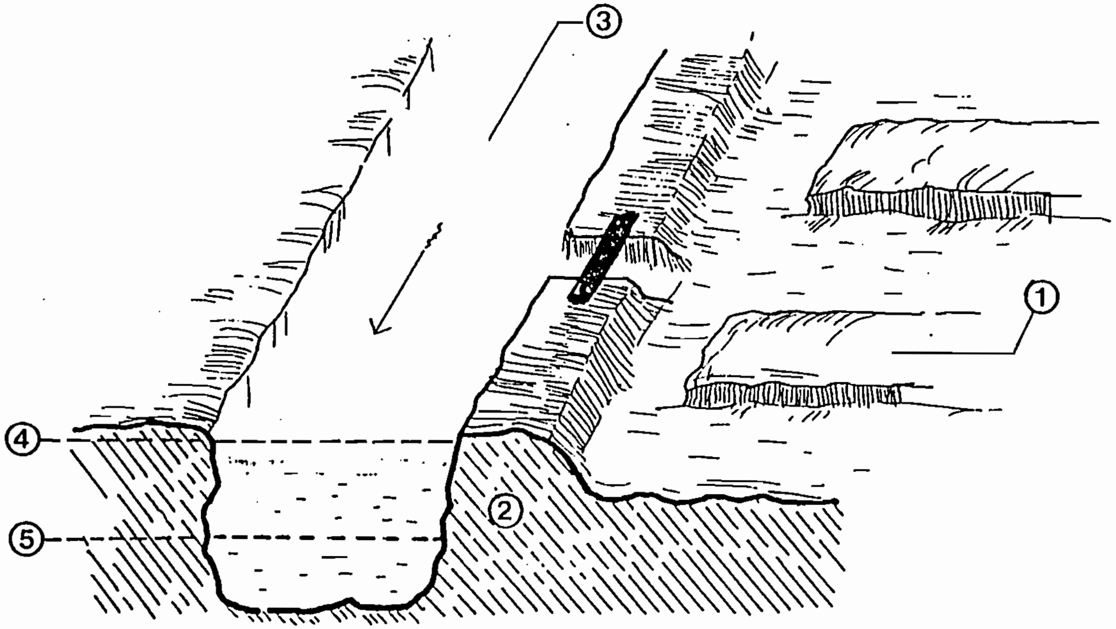
1 depa (brasse / *armspan*) : 1,50 à 1,70 m

Source : D'après W.L. COLLIER. "Limapuluh Tahun Transmigrasi spontan dan Transmigrasi-Pemerintah di tanah berawa Kalimantan.
Prisma no.5 - LP3AS.

Fig. nº 9

UTILISATION DE L' ONDE DE MAREE POUR LA MISE EN VALEUR

.TIDAL EFFECT TO IMPROVE LAND



LEGENDE / *LEGEND*

1. Planche / *Ridge*
2. Bourrelet alluvial / *Levee*
3. Cours d'eau / *Watercourse*
4. Niveau de l'eau à marée haute / *Water level at high tide*
5. Niveau de l'eau à marée basse / *Water level at low tide*

⊢——⊣ 30 m

are built up, surrounded by the water that remains stagnant despite the efforts made to drain it off towards the nearest stream in roughly-made ditches.

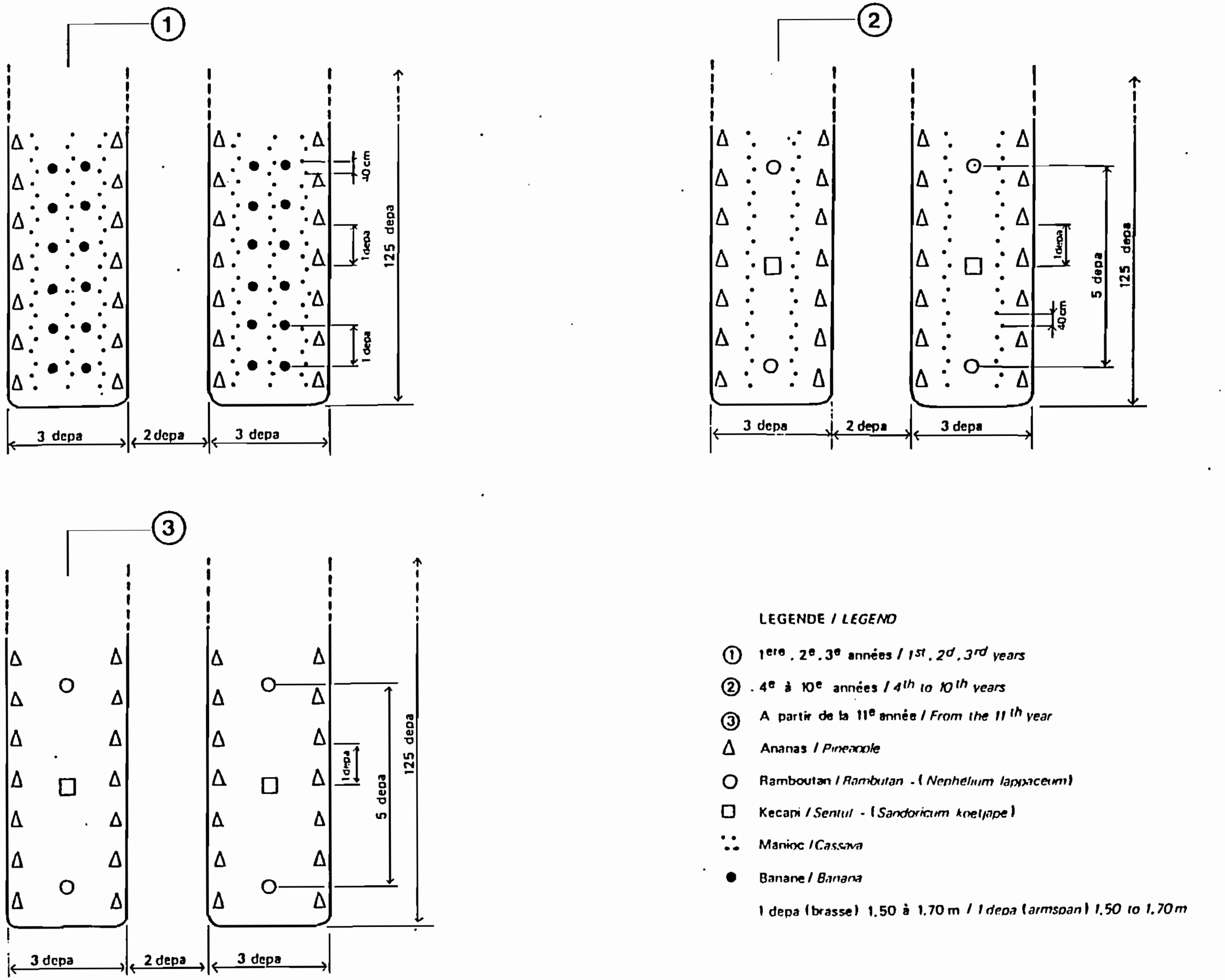
On top of these hillocks, the Banjars usually plant a coconut tree, (Bahaur, lower Mentaya Valley, Central Kalimantan) or else, though less successfully, a rubber tree (Anjir Serapat, Province of South Kalimantan). As a rule, there are usually 130 to 140 "tukungan" limed up per hectare (sketch No. 8).

III.3.1.2. The "balur" and the use of the tidal bore

The "balur" are built-up lands constructed either by connecting "tukungan" or else from scratch in the same manner as the "tukungans" by piling up earth from ditches dug out on either side. The "balur" are thus always raised and surrounded by ditches that have been deepened, or "parit". The Banjar art consists in building ridges that are higher than the level of the highest waters so that they will be permanently above the water level whereas the ditches have a depth that is always between the levels of the lowest and highest waters.

The role of the ridges and the ditches is to allow a minimum of water control in the tidal zones, draining and irrigating using the force of the tidal bore. Thus, they are always built perpendicular to the river or stream. When the tide goes out, the water level drops in the stream, and the water that flows between the ridges is drained by gravity. Conversely, when the tide comes in, it blocks the river water, reversing the current and producing a tidal bore phenomenon: the water level rises, and the fresh water from the river, blocked by the tide, can run into the ditches. A few wooden planks at the end of the ditches permit either to retain the water when the tide goes out and thus limit the drainage or else to limit the flooding during high tide according to the need (graph No.9).

10. TYPES DE PLANCHES ET UTILISATION DU SOL (Antar Baru) / *TYPES OF RIDGES AND LAND-USE (Antar Baru)*



Using these empirical techniques of water control, the Banjar create a particular, very ordered, landscape perpendicular to the river. Progressively, an entire network of canals is set up via the junction of different ditches, or even by enlarging the largest ones, and a veritable gridwork is thus created (see the example of the village of Pemakuan, Fig No.16).

There is a large variety in the ridges according to the geographic location, the use that is made of it, the type of crop to be grown as well as its evolution with time. In this way, when the ridges are to be planted in citrus fruits, their width is only 1.5 depa[1] as opposed to 2 depa for coconut palms or 3 depa, to wit almost 5 meters, whenever rambutan (Nephelium lappaceum) are to be planted.

The ridges are generally complanted, but the crops that are associated change with time. Thus, when the ground has just been recently drained, only pineapple, banana, and manioc are planted. Only progressively, after 3 or 4 years when the soil has stabilized, are set out fruit trees such as rambutan, or kecapi, while the banana trees disappear, followed by the manioc as soon as the fruit trees have reached a respectable size (figure No.10).

III.3.2. Specific rice cultivation techniques

The Banjar have selected several varieties of rice that can endure flooding and have developed agricultural techniques that are adapted to the sudden variations in the water levels, although curiously enough, they have no floating rice. Their main worry is to be able to work within the curve of the water level so that the rice will neither suffer from drought nor be submerged.

III.3.2.1. The varieties of rice

The Banjars differentiate between two types of rice: the selected varieties, or unggul, sold at the cooperatives or else

[1] depa = armspan. 1.5 to 1.7 meters.

distributed by the Agricultural Services, of which the Banjars are familiar with only two or three varieties whose properties are rather specific; and the traditional varieties of rice (umbang) which the Banjar themselves have selected in function of their needs.

Our intention is noot to go into detail on each variety of rice. Suffice it to say that the selected varieties provided for the farmers in South Kalimantan all have as common essential characteristics a short growth cycle of about 90 days and short stems (0.50 to 0.60 m). Whenever the water control is not perfectly assured, these varieties have a double inconvenient, in the Banjar's eyes. First, the rice, due to its short stems, is easily swamped and thus if the flood period lasts longer than a week, any hope for a harvest is annihilated. Second, the regularity of the growth cycle makes it absolutely imperative that this rice be transplanted before the tillering stage; that is, between the 22nd to 26th days.

On the other hand, the Banjar appreciate those varieties with long stems (of about 1.4 m). When the risk of submersion is particularly high, the Kencana Putih variety is chosen, as its stem can reach two meters in height. But if the risk of drought seems most proabale, the Kencana Kuning variety is chosen for its ability to arrive at the earing stage even during a severe dry spell provided this occurs after the rice is two months old.

Other varieties that are favored are those which have a long tillering stage, which permits the farmers to stagger, or even to multiply the transplantations and thus to work in function of the length of the growth cycle, which generally runs from 6 to 8 months. In this way the growth of the rice can be retarded by one or two months should the high-water period be longer than usual.

III.3.2.2. Floating nurseries and multiple transplantations bear witness to this same wish to follow the curve of the water levels

The sudden rise in the river levels, the low river banks, and the vastness of the floodplain cause the ricefields to be frequently covered by one or even several meters of water. High ground is rare and reserved to the houses. In these cases the Banjars live in boats and watch avidly for the least sign of a drop in the water level. In order to be ready for when the water will have dropped and to make use of the lapse of time in which the fields are partially drained and ready to be planted, the Banjar set up floating nurseries called "kotongan" that evolve with the variations in the water level.

Floating plants are used; a few sacred lotus grouped in such a way as to form a sort of raft, are covered with a very thin layer of mud. The rice seeds, which have been placed in a small basket to soak for several days so that they will germinate, are spread over this muddy film and then the whole thing is covered with ganggang or floating hornwort (Ceratophyllum demusum). After about twenty days, the paddy can be transplanted.

When the water level drops and part of the ricefield has emerged, the Banjar carry out a double transplantation: "ampakan", then "lacakan". The "ampakan", or first transplantation, consists of slicing through the mud underneath the rice plants, cutting part of the roots, and transplanting clumps of 70 to 80 plants. These clumps are then simply placed directly on the muddy ground in the part of the field which is draining. The plants remain thus for about one month while the roots take hold again.

At this point comes the "lacakan" or second transplantation. By this time a larger portion of the paddy field is above water; the plants are pulled up, the tillers are separated, part of the leafy section is cut off to compensate for the reduction of the root system, and then the plants are again laid in the mud, over an area much larger than during the "ampakan". The plants remain thus for 30 to 50 days.

At this time it is possible to carry out the actual planting out, in rows using a seed-lip about 30 cms long, or "tuja", this time covering the entire field. The plants are spaced about 25 to 30 cms apart, two to three plants being set out each time.

There are four reasons behind this multiple transplantation system. First, it allows the farmers to follow the evolution in the water level: as the rice field progressively drains, it is used to the best advantage. The second convenience is that there is a close relationship between the growth cycle of the rice and the water level. Should the water drop drastically, the "lacakan" is frequently omitted, while on the other hand, should the water remain high it is always possible to lengthen the stage of one or the other transplantation and thus delay the growth of the rice by one or two months and wait for a more favorable situation.

The third advantage in this procedure is that the Banjar obtain plants that are more mature, thus more resistent, at the time of planting out. The paddy can therefore bear if necessary a sudden rise in the water level.

Lastly, it is largely tillers that are planted out, and not central stalks, which constitutes a considerable saving in seed. This economy is all the more interesting as the floating nurseries built when the parcels are under water are from necessity of limited size while in fact one should dispose of a nursery whose size equals about $^{1}/10$th of the total area of the field.

These rice cultivation techniques adapted to an amphibious environment have some variants. Thus when the high ground is of larger area, it is not necessary to build floating nurseries. The nursery is still of the same conception but is set up on a river bank; the "kotongan" becomes a "taradakan". Also, it very often happens that when the drop in the water level is difficult to evaluate, the field is sectioned off in such a way as to set out plants of different ages and therefore be prepared for every situation.

Obviously, there is an entire tradition of adaptation to the variations in the water levels. It is because of this deep knowledge of their amphibious environment that the Banjar have been able to understand and integrate the benefits of the Dutch hydraulic methods.

CHAPTER IV

Development of a flat-land which from the Dutch point of view, could only be polderized

All kidding aside, it must be remembered that the Dutch felt quite at home in South Kalimantan. They found themselves in a familiar landscape which they shaped to a considerable extent. Other than the historical traces that mark the landscape, the effects of this influence are still in evidence in spite of Indonesia's independance, because a veritable "school of hydraulics" had been created and continues even today to influence the development models that are proposed.

IV.1. The premises

Between 1880 and 1890, the first canals were dug connecting the Barito and the Kapuas. The Anjir[1] Serapat which makes travel possible from Banjarmasin to Kuala Kapuas without having to go by sea, by linking two arms of the delta (the Pulau Petak River and the Barito itself) was dug by hand over 28 kms in 1889 under the direction of the Controller Aernout. The major objective of the time was to favorize penetration into the interior of the island, and so the traffic aspect was priviledged. On the whole, 5 major canals were dug during this period.

However, development of the south coast did not receive any decisive influence until the early XXth century (1914-1922).

[1] Anjir = canal

At this time, the colonial government became aware of the shortage of rice on Java and decided to develop the "Outer Provinces" in order to overcome this deficit. Henceforth, the canals were not only traffic routes but also functioned as drains. A multitude of small secondary canals were dug perpendicular to the major axes, more often than not as continuations of the canalization of small rivers. When the tide went out, the acid water from the peat bogs was thus evacuated and the land was progressively improved. Spontaneously, the Banjars built ridges and, more or less successfully, planted heveas, since natural rubber was in high demand at that time; in the ditches between each ridge, they grew rice. The amount of land improved in this manner came to 100 ha. in 1930 and 35,000 ha. in 1970, for the Pulau Petak region alone!

During this same period, in 1922, a new road was opened linking Banjarmasin and Martapura, towards the Hulu Sungai. In contrast to the preceding route, which ran closely along the Martapura River via Gudang Hirang, Pemakuan,...[1] the new road crossed the swamp. Thus the roadbed had to be bordered by two drainage ditches, and there were spontaneous migrations of Banjars from Hulu Sungai, who developed the land on either side.

However, this frenzied colonization was severely hindered by the Great Depression, which hit hard in the Dutch East Indies, and such public works did not begin again until the 1930's.

In 1937, the manually-dug Serapat canal was rehabilitated and dredged. At the same time, feasability studies and a pedological survey were carried out in order to re-settle Javanese farmers who were too closely-packed on their native island and to transform

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[1]See Situation Map

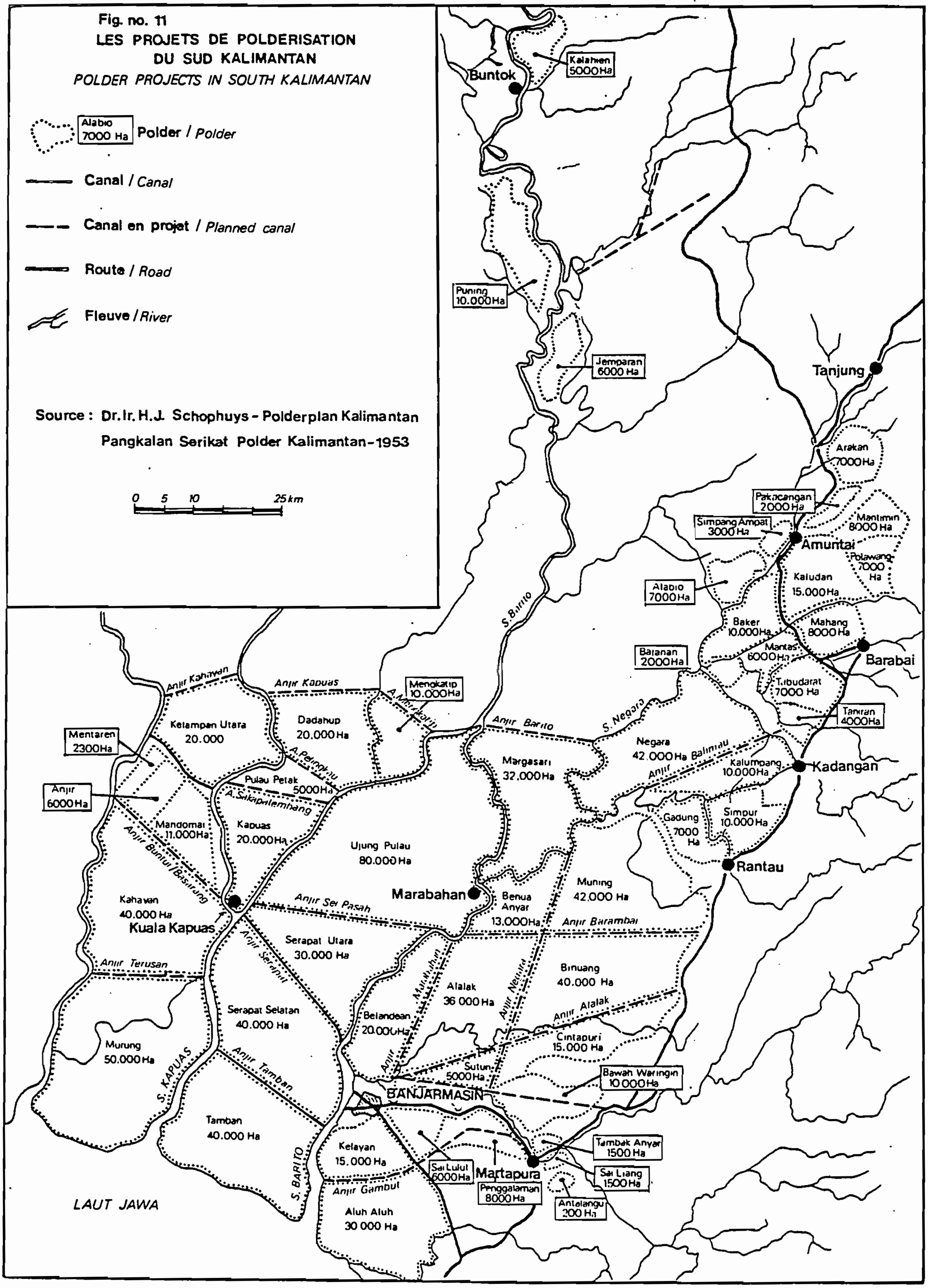

Fig. no. 11
LES PROJETS DE POLDERISATION DU SUD KALIMANTAN
POLDER PROJECTS IN SOUTH KALIMANTAN

Source : Dr. Ir. H.J. Schophuys - Polderplan Kalimantan
Pangkalan Serikat Polder Kalimantan - 1953

South Kalimantan into a rice granary. This was the first appearance in South Kalimantan of the governmental transmigration program to balance the populations of the various islands of the archipelago. This project was directed by the engineer Wehburg, a member of the "Kolonisatie Commissie Kuhneman".

IV.2. The "polder-plan"

From 1948 to 1952, in spite of the incertitude that reigned in the country and the departure of most of the Dutch, Dr.Ir.H.J.Schophuys, head of the Agricultural Services of South Kalimantan, directed studies in order to lay out the basis for a regional development of the Barito, Kapuas, and Kahayan valleys through the development of the poorly-consolidated lands. In 1953, these studies led to the formulation of a "polder-plan" devised to cover 840,000 ha. in 18 years. Three principal canals were manually dug as part of this project: the Basarang canal (24.7 kms. long), the Sakapalembang canal (16 kms.) and the Palingkau canal (9 kms.). Their construction took from 1951 to 1963. To these major axes were added numerous secondary canals, notably in the Pulau Petak region.

In 1950, 40,000 ha. were tested. Four perimeters were surrounded with dikes as protection against the floods, and drainage and irrigation were combined through a single system of pumps, so that two successive rice harvests could be made on the same plot.

This "polder-plan" was short-lived, however, and in 1958 it was abandoned. Only two veritable polders were finally set up, at Mantaren and at Alabio[1], while the others remained at the planning stage (the Kaludan, Baker, and Mantimin polders in the Amuntai area; the Alalak polder near Banjarmasin - Fig.No. 11).

[1]The latter will be studied in Chapter 8.

The "polder-plan" was replaced by a gigantic project called "pasang-surut" which, instead of pumps, uses the tidal force to drain and irrigate. This project was originally conceived to improve 1,500,000 ha. on Kalimantan and Sumatra. It was planned to transform the coastal swamplands into ricefields in five years, but this time within the framework of the vast national Transmigration program of independant Indonesia.

CHAPTER V

Transmigration and the improvement of the South coast of Kalimantan

It has already been mentioned that the overpopulation on the island of Java (690 inhabitants/km^2 on the average but with local densities that exceed 1500 inhab./km^2) has, since the beginning of the century, led the different authorities in power to undertake a large transmigration program: the transferral of the populations of Java, Madura, and Bali to the outer islands. In South Kalimantan, though the first transmigrants arrived about 30 years ago, the greatest part of the settlers have only much more recently arrived! These "pioneer" villages, whose characteristic shape is immediately recognizable, have given the landscape its latest look.

V.1. Transmigration on the south coast of Kalimantan: a relatively recent history

The first transmigration center in South Kalimantan opened in 1953 at Takisung, near Pelaihari (724 Javanese families were settled by the government). The second opened in 1957, near Tamban, and was soon followed by two other projects: in 1959 at Marabahan and in 1961 at Balandean. On the whole, from 1953 to 1982, slightly less than 107,000 people have been re-settled in this way (Table No.9).

This is a relatively small number compared to the 500,000 people sent to Lampung, South Sumatra, from 1905 to 1982, but above all these are recent movements. Whereas at Lampung 67% of the transmigrants arrived before 1968, in South Kalimantan the

TABLE No. 9

Transmigration in South Kalimantan

Installation period	Transmigrants	
	Number	% total
Pra Pelita[x] (1953-1968)	13,617	12.75
Pelita I (1969-1974)	10,145	9.50
Pelita II (1974-1979)	27,089	25.35
Pelita III[xx] (1979-1982)	55,973	52.40
T o t a l	106,824	100

Notes: [x]Pelita = 5-Year Plan
[xx]Only the data for the first three years of the plan are available.

Source: Buku Data Transmigrasi - Proyek Bimbingan Tehnis Operasionil Proyek-Proyek Dalam Lingkungan Dit.Jen. Transmigrasi Jakarta March 1983.

majority of the settlers (52%) arrived after 1979. Transmigration had already been structured around two types of projects: dry-land projects and "pasang-surut"[1] projects based on Banjar land development methods. The former are located on the east coast which borders the Makassar strait while the latter have essentially allowed for the colonization of the Barito delta (Map No.12). This study will be limited to the latter.

V.2. The "sistim garpu" and the settlement villages

Transmigration has permitted the improvement of 140,000 hectares of which 130,000 are irrigated in the lowland plain from Marabahan in the north to the south coast of the island on the Java Sea (Map No.13). All of the "pasang-surut" projects have been conceived on the same line which, seen from an airplane, resembles a fork, from which the name "sistem garpu" comes, "garpu" being Indonesian for "fork". This type of settlement village was developed in 1969 by Professor Soenarjo with the assistance of the Agricultural Faculty of the Gadjah Madah University in Yogyakarta. It was first experimented downriver from Marabahan at Barambai, then south of Kuala Kapuas on the Murung before being developed in the Pulau Petak area.

The general layout of the various projects always includes a primary canal perpendicular to the river. This canal, 8 to 9 meters wide and 2 to 3 m deep, is divided into two secondary branches at 2.5 to 3 kms. from the riverbank. Each secondary branch, which is 6 to 7 kms. long, ends in a reservoir, actually an artificial lake of rectangular shape of about 12 ha. in area and 2.5 m in depth. These main canals are used for traffic, drainage, and irrigation.

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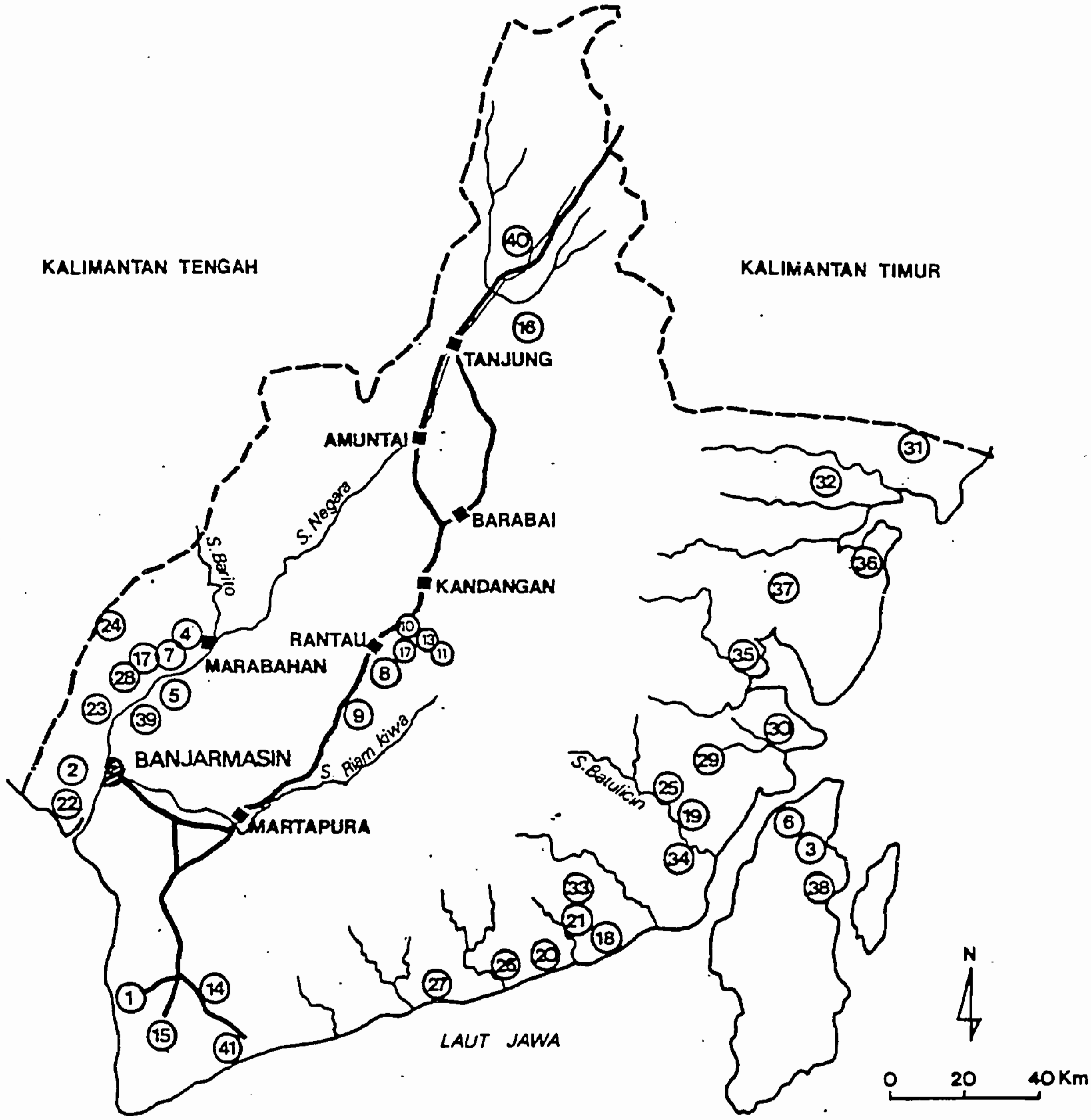
[1] pasang-surut = tide

12. LES CENTRES DE TRANSMIGRATION DANS LA PROVINCE DE KALIMANTAN SUD
TRANSMIGRATION CENTRES IN SOUTH KALIMANTAN PROVINCE



PRA PELITA	PELITA I (1969-1973)	PELITA II (1974-1979)	PELITA III (1980-1984)	
1. TAKISUNG	7. BARAMBAI	14. TAJAU PECAH	19. BATULICIN I	31. PAMUKAN I
2. TAMBAN	8. TAMBARANGAN	15. BATUTUNGKU	20. SEBAMBAN II	32. PAMUKAN II
3. BERANGAS	9. HATUNGUN	16. MASINGAI	21. SEBAMBAN III	33. SEBAMBAN VI
4. MARABAHAN	10. PARANDAKAN	17. BELAWANG	22. TABUNGANON II	34. PIR (BATULICIN)
5. BELANDEAN	11. MIAWA	18. SEBAMBAN I	23. SEI MUHUR	35. KELUMPANG I
6. SEBELIMBING	12. SIDODADI		24. SAKALAGUN I	36. KELUMPANG II
	13. AYUNAN PAPAN		25. BATULICIN II	37. KELUMPANG III
			26. SEBAMBAN IV	38. BERANGAS II
			27. SEBAMBAN V	39. SEI PUNTIK
			28. SEI SELUANG	40. HAYUP
			29. BATULICIN III	41. JORONG
			30. SEI KUPANG	

PELITA I : Plan / *Plan*

Source : Kantor Wilayah Transmigrasi Kalimantan Selatan - 1982

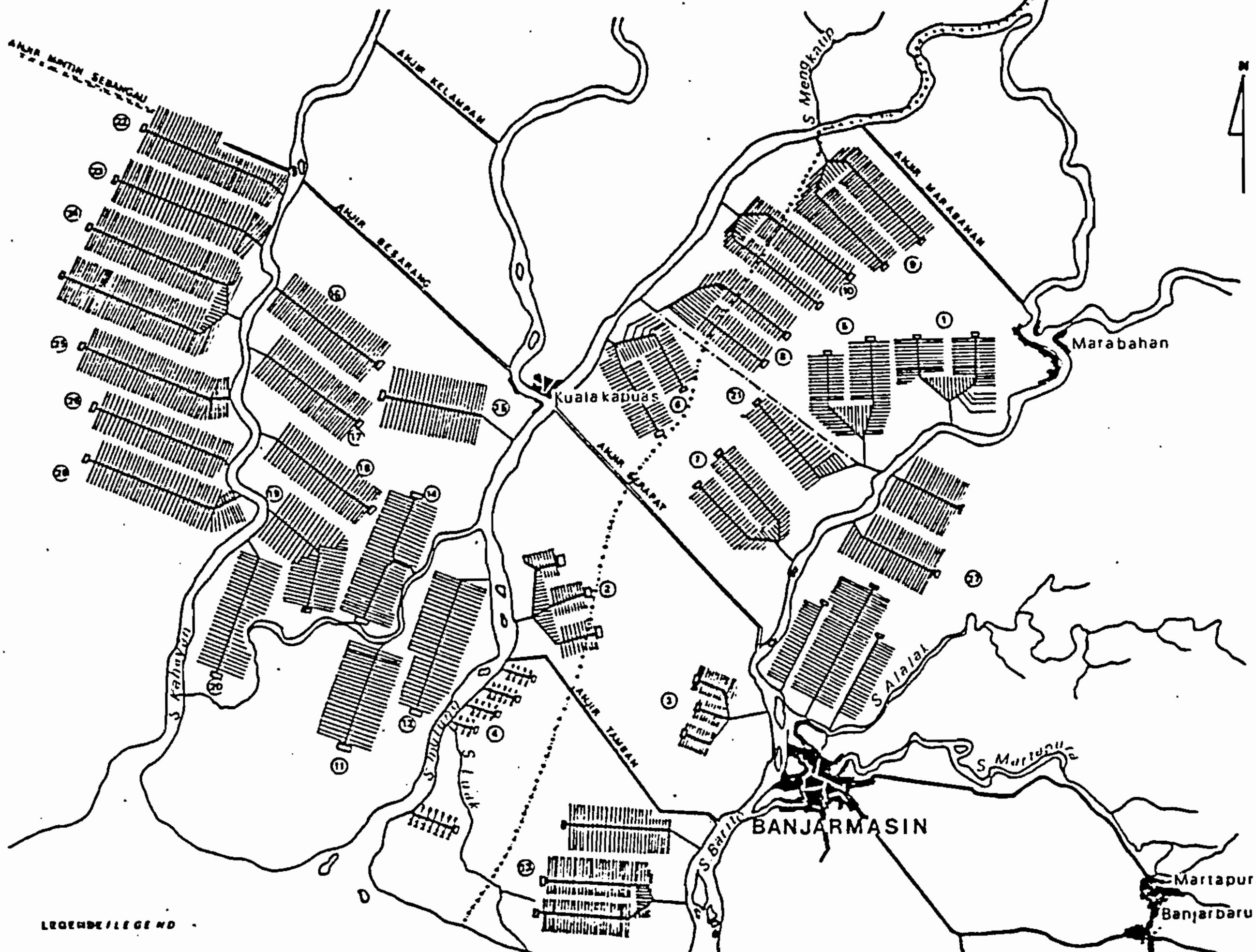
From the secondary canals, 3 kms. from the junction with the primary canal, tertiary and quaternary canals branch off, serving the rice plots and used in this case only for drainage and irrigation, traffic being absent from here on.

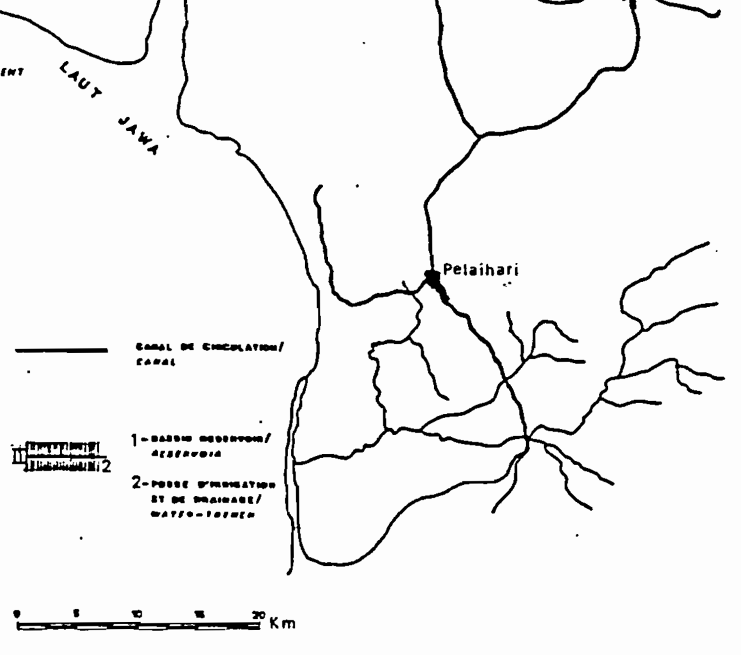
This usage method is taken from the Banjar water control system. When the tide comes in, the water level rises while a tidal bore phenomenon allows the water to mechanically flow into the canals and to reach the rice fields; this is the irrigation process. Conversely, when the tide ebbs, the river flows faster, the water level drops, and the rice fields are drained. This system makes it then possible for the farmer to drain off any excess water, after a heavy rain, for example. A simple set of boards placed across the tertiary and quaternary canals provides rudimentary water control while the reservoirs, as a rule, permit a regularisation between the tides.

Thus, only the conjunction, the superposition even, of the different cultural influences - Banjar, Dutch, Indonesian - allows one to understand the multiplicity of the development methods that are found in the "Mesopotamia" which is South Borneo.

13. CENTRES DE TRANSMIGRATION DE TYPE "PASANG-SURUT" DANS LE SUD KALIMANTAN

TIDAL TRANSMIGRATION SETTLEMENTS IN SOUTH KALIMANTAN.





LEGENDE / *LEGEND*

KALIMANTAN SUD / *SOUTH KALIMANTAN*	SUPERFICIE IRRIGUEE / *IRRIGATED AREA*	SUPERFICIE DU CENTRE DE TRANSMIGRATION / *SURFACE AREA OF THE TRANSMIGRATION SETLEMENT*
KALIMANTAN SELATAN :	IRIGASI :	UNIT
1. UNIT BARAMBAI	: 5.241 HA.	: 5.511 HA.
3. UNIT JELAPAT	: 4.106 HA.	: 4.293 HA
5. UNIT BELAWANG	: 5.040 HA.	: 5.732 HA.
7. UNIT SIDO MUNUR	: 2.507 HA.	: 2.608 HA.
9. UNIT PALINGKAU	: 4.750 HA.	: 5.098 HA.
13. UNIT TABUNGANEN I	: 2,909 HA.	: 3.052 HA.
21. UNIT TABUNGANEN II	: 5.013 HA.	: 5.237 HA.
21. UNIT SEI.SELUANG	: 3.323 HA.	: 3.539 HA.
27. UNIT SEI PUNTIK I,II,III	: 12. 200 HA.	:
KALIMANTAN CENTRE / *CENTRAL KALIMANTAN*		
KALIMANTAN TENGAH :		
2. UNIT TAMBAN LUAR	: 3.350 HA.	: 3.691 HA.
4. UNIT TAMBAN LUPAK	: 1.972 HA.	: 2.055 HA.
6. UNIT TATAS.	: 5.443 HA.	: 5.000 HA.
8. UNIT SAKALAGUN I.	: 5.490 HA.	: 5.800 HA.
10. UNIT SAKALAGUN II.	: 5.805 HA.	: 7.585 HA.
11. UNIT SEI TERUSAN TENGAH	: 4.452 HA.	: 4.652 HA.
12. UNIT SEI MUNING SELATAN	: 5.767 HA.	: 5.067 HA.
14. UNIT SEI TERUSAN UTARA	: 4.919 HA.	: 5.081 HA.
15. UNIT MUNING UTARA	: 4.167 HA.	: 4.341 HA.
16. UNIT SEI PAMALI	: 4.027 HA.	: 4.131 HA.
17. UNIT SEI. TAHAI.	: 3.619 HA.	: 3.742 HA.
18. UNIT SEI BELANTI I	: 3.631 HA.	: 3.735 HA.
19. UNIT SEI BELANTI II	: 4.794 HA.	: 4.945 HA.
20. UNIT SEI BERANGAS	: 2.798 HA.	: 3.009 HA.
22. UNIT K I N T I K	: 4.258 HA.	: 4.372 HA.
23. UNIT K A K A H I T	: 6.957 HA.	: 5.062 HA.
24. UNIT M A L I K U	: 8.644 HA.	: 9.075 HA.
25. UNIT K A R T A N.	: 4.812 HA.	: 4.977 HA.
26. UNIT P A N G K O H	: 4.450 HA.	: 4.548 HA.
28. UNIT T A L I O.	: 4.901 HA.	: 5.026 HA.

CANAL DE CIRCULATION / *CANAL*

1 - BASSIN RESERVOIR / *RESERVOIR*

2 - FOSSE D'IRRIGATION ET DE DRAINAGE / *WATER-TRENCH*

PART III

Analysis of the Rice-farming Landscape in South Kalimantan

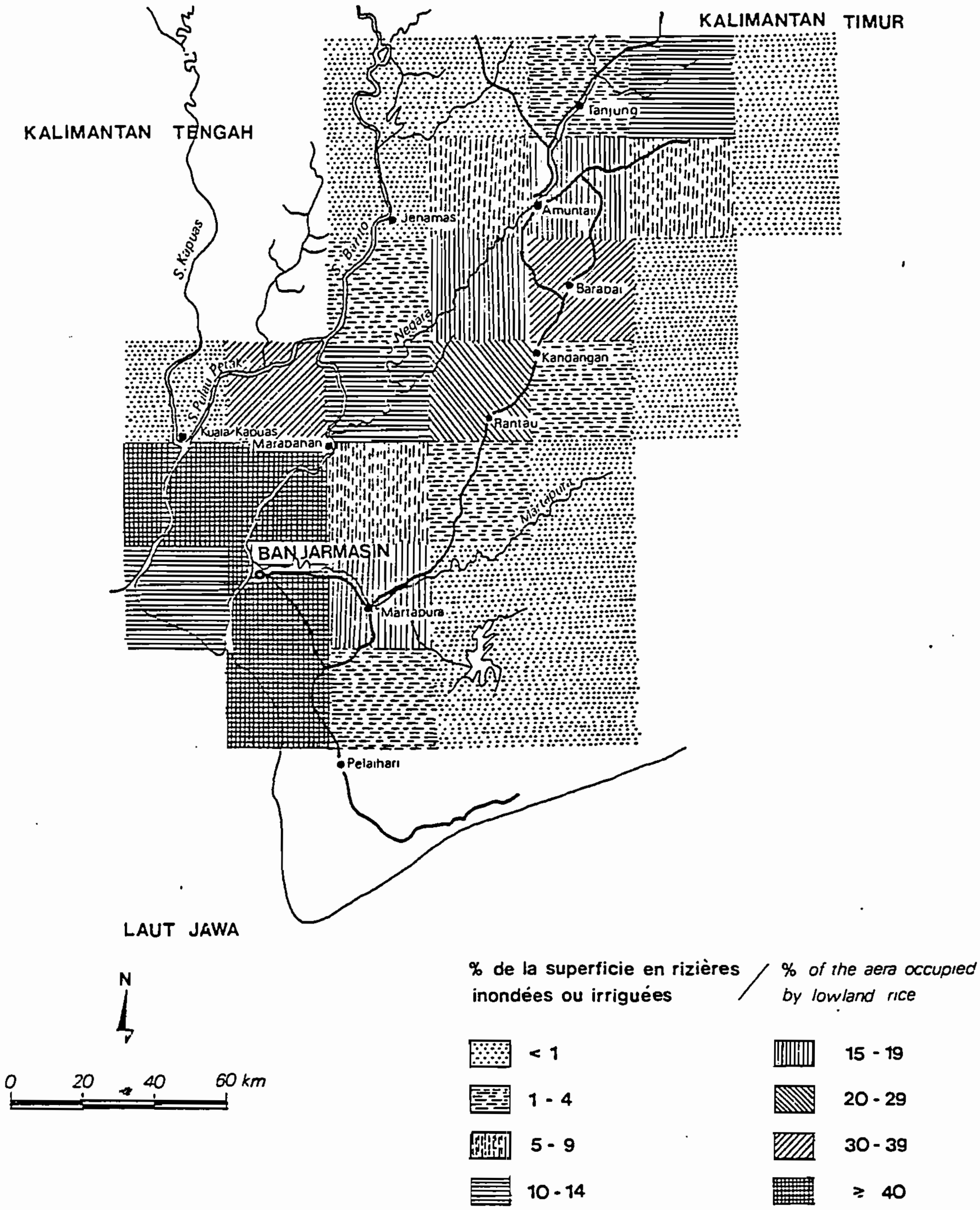
In order to make an estimation of the area consecrated to rice paddies in South Kalimantan, a series of maps drawn up in 1974 by the Japanese firm OTCA together with the Indonesian Ministry of Public Works has been plotted. For each map, the ratio of area in rice fields to mapped area was calculated. The figures obtained in this way made it possible to establish Synthetic Map No.14, which is a composite showing the series as a whole. Only flooded or irrigated rice fields, whatever the level or water control obtained, have been included, with the exception of the rain-fed upland rice of the ladang type.

One will therefore see that the Barito delta from Kuala Kapuas to the south coast, and including the Banjarmasin area, has the greatest proportion of rice fields, with more than 40% of the surface area under rice. The second largest rice-growing area is the Hulu Sungai region above the Negara River in the west to the Meratus foothills (from Rantau and Barabai as far as Amuntai and Babirik), though the development of rice cultivation does not reach the Barito. In fact, the areas around Kualasirah or Paminggir are only swamplands, as a general rule.

On the contrary, the mountainous zones are deserted of human populations and not very developed. The lowest percentage of ricefields (less than one percent of the surface area under rice) are the areas around Belimbing, Haraan, Mia, or else Aranio to the south.

14. LES RIZIERES DU SUD KALIMANTAN

LOWLAND RICE IN SOUTH KALIMANTAN



Source : Planimétrage des cartes topographiques OTCA (Tokyo 1974. 1/50.000)
Planimetry of OTCA topograpical maps (Tokyo 1974. 1/50.000)

This brief analysis must be made more precise, however, The figures thus obtained cover diverse realities that vary in function of the characteristics of the environment under development (swampy plain, lake region, etc.), but above all in function of the amount of human intervention. From here on, the combination of these two parameters will be the focal point of the report. Simple drainage methods will be examined first, then the type of landscape created from the use of the tidal bore phenomenon and controlled flooding, and finally, a polder - the most sophisticated form of water control - will be analysed.

CHAPTER VI

Elementary methods, or how to get rid of peat

The simplest development technique consist in draining and reducing the thickness of the peat, especially along the coast. Efforts have been made to this end since the beginning of the century in the Banjarmasin area as the town gradually spread and newcomers came to settle.

VI.1. That ever-present peat

Fifteen kilometers east of Banjarmasin, present-day Kecamatan Gambut offers a lush rice-growing area bordered some kms. further east by a swamp forest that is barely penetrated. The term "gambut" itself, meaning "peat", is quite significant.

Up to about 1920, the region was deserted and covered in swamp forest growing on peat. Development was considered difficult if not impossible, and the Banjar populations preferred to concentrate on the banks of the Martapura River while the Dayaks remained withdrawn to the north (Tamiang Layang) and the north-west (Kuala Kapuas). In 1922, a new road from Banjarmasin to Martapura was opened, favorizing the installation of Banjars who moved spontaneously from the Hulu Sungai, mainly from Kandangan.

This raised road was first bordered on either side with drainage ditches before, under the direction of the Dutch authorities, a network of perpendicular canals was dug, first towards the southwest and the Barito via Aluh Aluh, then later towards the Martapura around the village of Sungai Tabuk. Finally, a criss-crossing of secondary canals and bunds was progressively added to the larger network.

Between WWI and WWII, the peat was about one meter thick; the farmers progressively burned it off during the dry season. They estimate that it takes from 10 to 15 years to reach the underlying clay layer. During this time, the ditches allow the acid water from the peat bogs to run off while at the same time the soil improves little by little through the "washing" it gets during floods and heavy rains.

VI.2. Pematang Panjang and Kayu Bawang: two villages that are characteristic of the agricultural colonization of the Banjarmasin area between WWI and WWII.

In July 1984, a 1/10 survey was made of the farms in the villages of Pematang Panjang and Kayu Bawang. These two villages are 15 kms. apart, with the older being Kayu Bawang, founded in 1928. Kayu Bawang is a one-street village that lines the drainage canal which goes to Aluh Aluh. Pematang Panjang was founded later, in the 1940's. "Pematang" signifies "levee", "embankment", "causeway", and in fact the village lies to either side of a road built on a sandy bar during the Japanese occupation as a cross road between the old and new Martapura roads.

This historical gap makes it easier to understand the differences that were noted at the level of land tenure (Table No.10). At Kayu Bawang, the exploitations are on the average 1.5 hectares (54 borongan[1]) large as compared to 0.8 ha. at Pematang Panjang. The same is true for the properties which are three to four times larger in the former village than in the latter one (nearly one hectare as opposed to 0.25 ha.). Since Kayu Bawang was founded earlier, more land has been cleared.

[1]borongan : surface unit corresponding to 10 armspans X 10 armspans
1 hectare = 35 borongan.

TABLE No. 10

Pematang Panjang and Kayu Bawang: Structure of Land Tenure

Villages	Average areas of exploitations (borongan)	Average areas of properties (borongan)	% of areas		Method of obtention of owner-farm lands		Social origins of proprietor of sharecropped lands (% areas)			
			Owner-farms	sharecropped	inheritance % areas	purchase % areas	Farmer	Merchant	Civil servant	Other
Pematang Panjang	29.53	9.67	32.73	67.27	34.48	65.52	39.02	0	50.30	10.68
Kayu Bawang	54[x]	31	46.97	53.03	38.71	61.29	57.97	42.03	0	0

[x] Not including sharecropped lands.

Source : Field surveys. July 1984. Sample : Pematang Panjang, 15 exploitations; Kayu Bawang, 15 exploitations.

1 hectare = 35 borongan.

Yet the proximity of Banjarmasin and the urban influence can be felt intensely in both villages. There is a very high percentage of share-cropped land (53% to 67% or the surface areas) while 60 to 65% of the land cultivated as owner farms was purchased. Lastly, for the record, though no satisfactory explanation can be offered, one notes that the civil servants have preferred to invest in Pematang Panjang and the merchants in Kayu Bawang: the percentages of sharecropped land, given with respect to social origin, are diametrically opposed.

VI.3. Methods of cultivation that indicate the most rudimentary form of water control

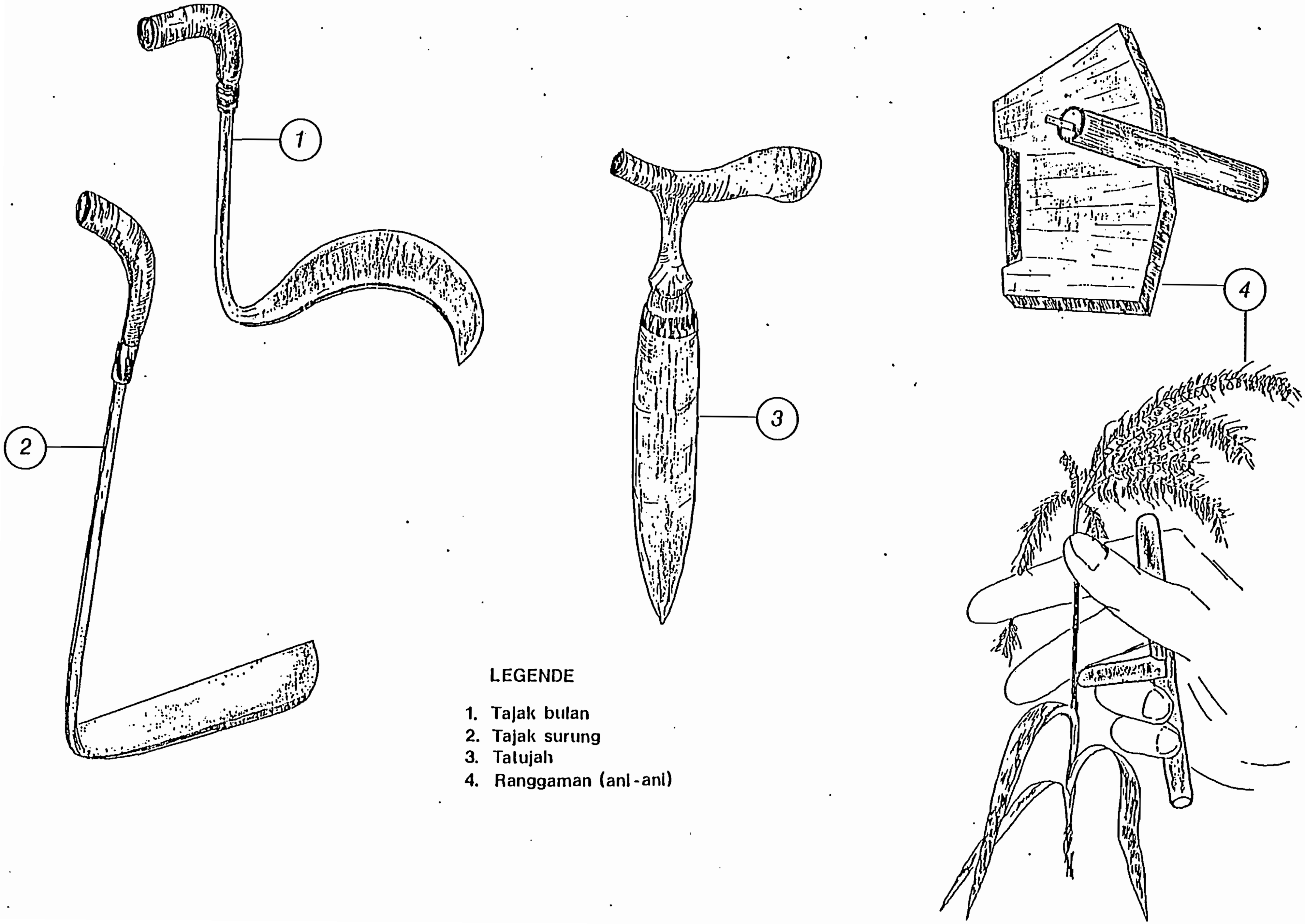
The considerable tidal bore in the Aluh Aluh region does not carry as far as Kecamatan Gambut. Supplying water to the rice fields in the absence of flooding from the Martapura and irrigation by gravity can only be done through lateral supplies of rainwater, from which comes the name "tadah hujan"[1] rice fields. Under these conditions, only one rice harvest per year is possible.

At the end of October or the beginning of November, the rains begin. The seed-bed is set up on a high piece of land, usually behind the houses. This seed-bed is always very simply built; the soil is not really broken up, but a few holes are made with a seed-lip and a handful of seeds that have been first set to germinate in a basket full of wet soil is then placed in each hole. With this method, one needs 5 to 6 kgs of seed per hectare.

About 1/10th of the rice field is then scythed, and the grasses placed on the bund to form a compost pile; should the grasses remain in the rice field, they would not decompose and would make the peat thicker.

[1] Tadah hujan: non-irrigated rice field which, literally, "gathers rainwater".

Fig.nº. 15.
INSTRUMENTS ARATOIRES / *AGRICULTURAL IMPLEMENTS.*



LEGENDE

1. Tajak bulan
2. Tajak surung
3. Talujah
4. Ranggaman (ani-ani)

In mid-December, when it is certain that the rainy season has completely arrived, which is to say, 1.5 to 2 months after the seed-beds have been set out, the field is transplanted for the first time. This is the "ampakan" operation, followed one month later by the "lacakan", or second transplantation, described in the preceding chapters.

In between times the entire plot has been cleaned; the grasses piled on the bund and aired once or twice have decomposed and have been strewn over the plot as fertilisers.

Finally, in early April - five months after the seed-bed was set out - the rice is definitively planted out using a seed-lip. Depending on the place, the year, and the water level, one or two rapid weedings (or none at all) will be needed before the harvest, which is done with a panicle knife (Fig.No.15), at the end of August or in early September.

The rice is thus 9 to 10 months old when it is harvested. The growth rate had to be slowed so that it would coincide with the pluviometric rythm, since almost no water control is possible. The drainage canals only permit the excess water to run off, and any dry spell could be fatal to the paddy. It is therefore in the farmer's highest interest to estimate whether or not the rainy season has indeed set in before planting out the rice, and in order to do this, to play on multiple transplantations, as any error means disaster.

The harvest date is of little importance and at any rate varies one to two months from one year to the next depending upon whether the growth cycle has been retarded a little or a lot. The harvest usually takes place during the pluviometric minimum, but this is not an important factor.

The main thing is to obtain an honorable rice harvest with a very average amount of work, despite the aleatory water control and the presence of the peat.

TABLE No. 11

Amount of Time Spent in Labor for a Rice Field in Pematang Panjang and in Kayu Bawang

Agricultural operations		No. of work-days/ha.
Seed-bed (Taradakan)		21
Preparation of the parcel	weeding	16
	making compost	12
	spreading compost	8
1st transplantation (ampakan)		3
2nd transplantation (lacakan)		8
Planting out (seed-lip/dibbling stick)		29
Weeding and other minor upkeep		10
H a r v e s t		42
T O T A L		130

TABLE No. 12

Yields in Paddy in Pamatang Panjang and Kayu Bawang (unhusked rice)

Yields t/ha	% parcels
< 1.5	23.68
<1.5 - 1.99	26.32
2 - 2.49	13.16
2.5 - 2.99	23.68
≥3	13.16

VI.4. Honorable yields for a modest amount of labor

Cultivating rice under these conditions only demands 120 to 130 work-days per hectare (Table No.11). The multiple transplanting does not create a great deal more work since it requires around 3 work-days per hectare for the "ampakan" and 8 for the "lacakan". These two operations are very rapid because they are very simple. The same is true of the weeding which is only necessary when the water level is low.

Harvest and planting out require the greatest amount of labor, with respectively 42 and 29 work-day per hectare. The harvest must be done panicle by panicle since the maturation of the paddy is not homogeneous and continues for over more than a month. This is due to the many alterations made in the growth cycle. Moreover, the stems are of very different lengths.

Planting out is the second largest effort, with 29 work-days per hectare. The reason for this length of time is the use of the seed-lip. There is no previous breaking-up of the soil, and it is impossible to hand-transplant directly into the mud..

Given the unfavorable environment, the few improvements, and the absence of fertilisers and pesticides, the yields are honorable ones (Table No.12), since half the parcels produce a harvest of more than 2 tons of unhusked paddy per hectare.

CHAPTER VII

Controlled-flooded croplands created from the use of the tidal bore phenomenon (pasang-surut)

The more complex forms created by the use of the tidal bore phenomenon lead to more highly-elaborated and more intensive cultivation methods. Whereas in the simpler types (tadah hujan) only the excess water can be evacuated, whether it comes from the acid peat bogs or from lateral supplies of rainwater, in the following types complementary water supplies are possible in function of the paddy's growth requirements.

The use of the tidal force has produced a whole range of landscapes varying from the combination of rice fields and orchards in the Banjarmasin area to the directed colonization forms within the framework of the national Transmigration program.

VII.1. Traditional development and the combination of rice fields and orchards

This subject can be illustrated by the study of Pemakuan and Gudang Hirang, two villages located 12 kms. east of Banjarmasin on a tributary of the Martapura River. Both are inhabited by Banjars; Gudang Hirang had 2711 inhabitants, and Pemakuan 2142, as of January 1984. Densities are high, respectively 339 and 612 inhabitants per square kilometer.

VII.1.1. A cellular landscape

The basic idea behind this development is to build the "tukungan" described in Chapter III, which are about 2 m^2 in

TABLE No. 13

Distribution of rice and of fruit trees on the plots cultivated at Gudang Hirang and Pemakuan

Villages	Rice fields: % area	Orchards: % area
Gudang Hirang	80.16	19.84
Pemakuan	68.51	31.49

% of area of plot occupied by fruit trees	Frequency
< 15	16
15 - 24	4
25 - 34	7
≥ 35	12

area and about 0.50 m above the highest water level. One year later, during the dry season, the tukungan are planted at a rate of one tree per hummock, while rice is cultivated between the mounds using traditional methods. After four or five years the hummocks are connected using earth from either side and gradually a very orderly, very cellular landscape takes shape, alternating raised screens of trees and trenched rice fields (Fig. No.16), patterned here and there by ditches that join the main waterway.

VII.1.2. The complanted parcels

VII.1.2.1. The rice fields

Within this association of rice fields and orchards, the paddy takes up 2/3 if not 3/4 of the area of the plots (Table No.13)

One harvest can be made each year with varieties whose cycle stretches over 5 to 6 months. The cultivation methods are the same as those previously described, which is to say that they include a double transplantation before the seedlings are finally set out, and that the soil is not previously broken up. In these conditions it is not surprising that the amounts of labor needed are very similar to those calculated for the villages of Pematang Panjang and Kayu Bawang (Table No.14).

However, the yields are visibly higher (Table No.15). Nearly 55% of the parcels have a yield greater than 2.5 t/ha. as opposed to 37% in the former example. Water control, though not perfect, is better ensured and the dependance on rainfall less considerable. During the dry spells, it is at least possible to change the water level in function of the paddy's growth requirements. The complementary water supply is obtained when the river level rises; a set of rudimentary sluice gates allows one to then block the water reserves before the river level drops.

TABLE NO. 14

Amount of labor on the rice fields at Gudang Hirang and Pemakuan (local varieties of rice)

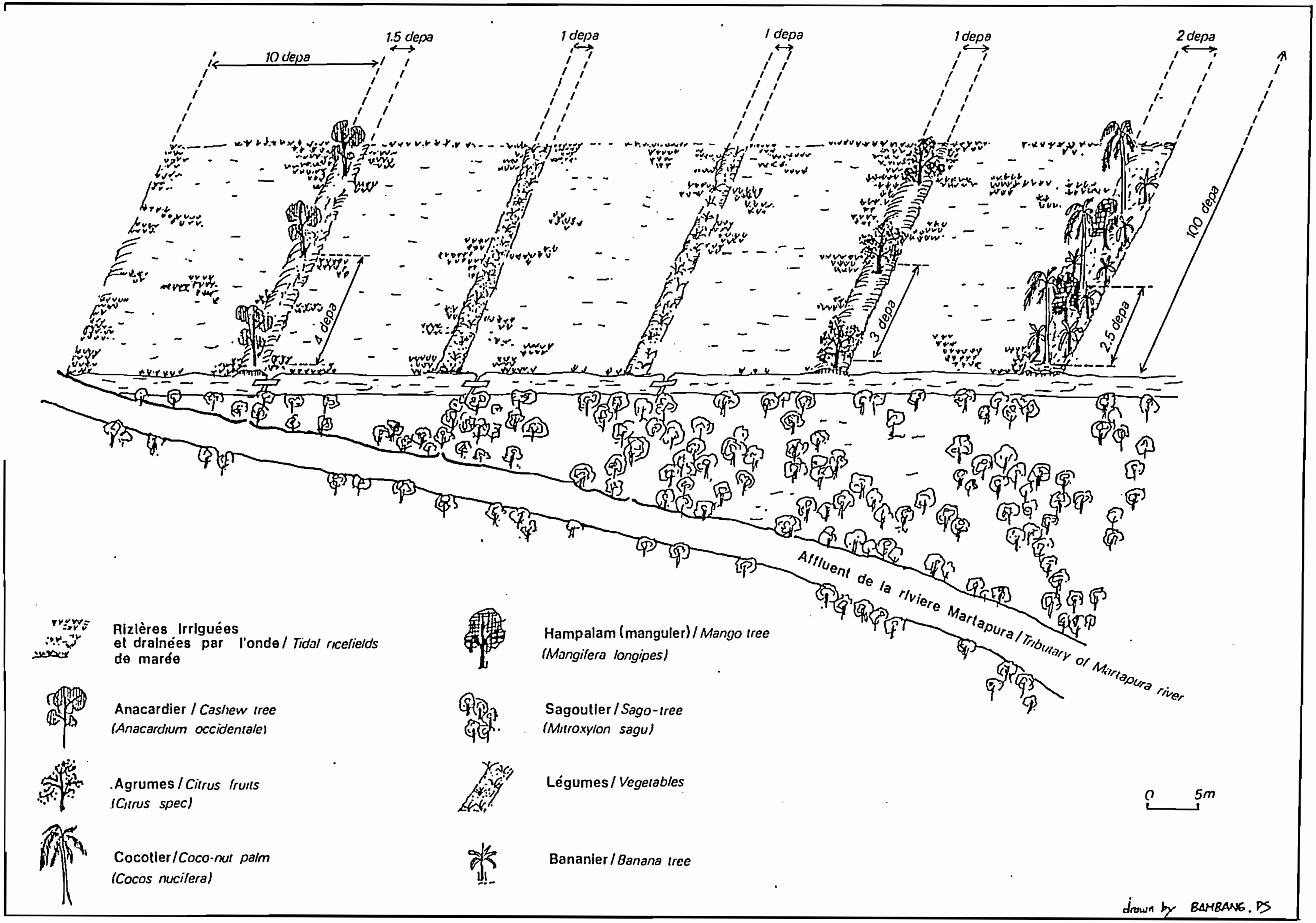
Agricultural operations		No. of work-days/ha.
Seed-bed (taradakan)		2
Preparation of the parcel	weeding	19
	making compost	12
	spreading compost	7
1st transplantation (ampakan)		3
2nd transplantation (lacakan)		8
Planting out using seed-lip		33
Weeding and other minor upkeep		16
H a r v e s t		50
T O T A L		150

TABLE No. 15

Yields in paddy at Gudang Hirang and Pemakuan (unhusked rice)

Yields in t/ha.	% of parcels
< 1.5	14.58
1.5 - 1.99	8.33
2 - 2.49	22.92
2.5 - 2.99	22.92
3 - 3.49	14.58
⩾ 3.5	16.67

16. TYPE D'OCCUPATION DU SOL DANS LES ENVIRONS DE BANJARMASIN (Village de Pemakuan)
TYPE OF LAND USE IN THE SURROUNDINGS OF BANJARMASIN (Village of Pemakuan)



VII.1.2.2. Orchards whose confirmed citrus-growing orientation bears witness to an adaptation of the techniques to an amphibious environment

On the ridges, the trees are set out in a very precise order. Thus, the coconut palms are more and more frequently planted only at the ends of the ridges. The Banjars have realized that the coconut palms provide so much shade that the other fruit trees cannot grow properly, especially the citrus. Along this same line, the banana trees are set out only on the eastern side of the ridges so that they filter the sun's rays in the afternoon yet do not shade the citrus in the morning.

Once again, several types of ridges are possible (Fig. No.17). The rambutans are always 5 armspans apart, that is, about 7 to 8 meters, and set out on the widest ridges (3 armspans). Due to the considerable shade they provide, they make up homogeneous stands, whereas it is possible to set out banana trees and coffee shrubs between the coconut palms, in which case the ridge is only 2 armspans wide.

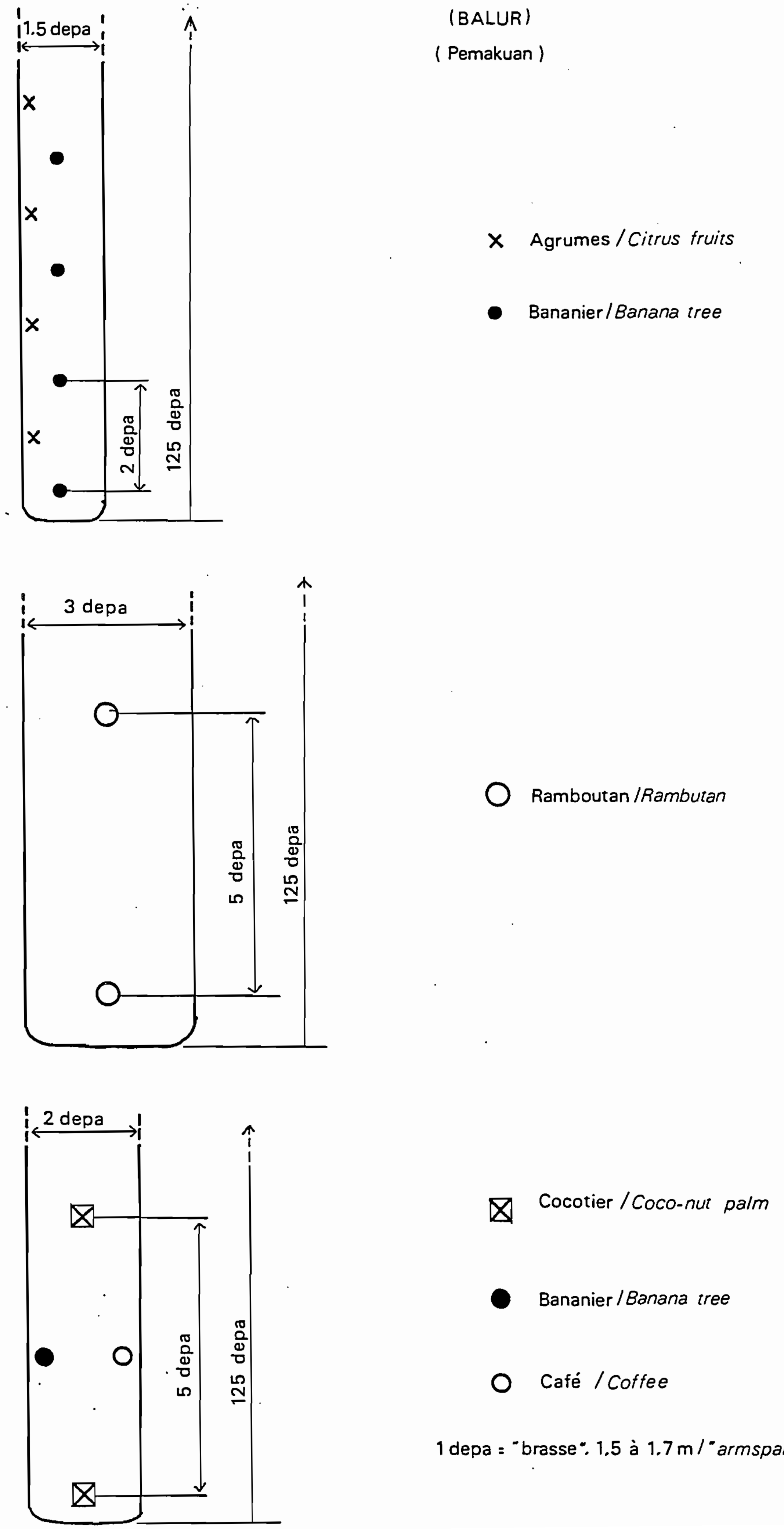
Between WWI and WWII, and during the years following Indonesia's independance, coconut palms dominated the landscape. However, progressively over the last 15 years, the coconut palms have been replaced by citrus trees (Table No.16). This tendancy has been reinforced since 1981 by financial advantages provided by the Ministry of Agriculture (BIMAS).

Citrus trees have been present in the Banjarmasin area since the beginning of the century. Three species are most often found: the "jeruk purut" or "limau sayur" (Citrus hystrix) also called citrus combara and used as a vegetable; the "jeruk siam", or green tangerines; and the "limau irisan", a type of large, juicy orange. On the other hand, grapefruit ("jeruk bali" and the small green limes are few in number.

Fig No. 17 TYPES DE PLANCHES / *TYPES OF RIDGES*

(BALUR)

(Pemakuan)



1 depa = "brasse", 1,5 à 1,7 m / "*armspan*", 1,5m to 1,7m

TABLE No. 16

Composition of the orchards at Pemakuan and Gudang Hirang

T r e e s	Frequency in %	
	Pemakuan	Gudang Hirang
Coconut palms[1]	37.70	8.12
Banana trees	16.89	54.79
Diverse citrus trees	26.50	30
Mango trees		1
Ampalam[2]	4.75	0.03
Kastouri[3]		0.04
Cashew trees[4]	8.33	
Custard-apple trees (sirsak)[5]	2.09	
Ramboutan[6]		1.03
D u k u h[7]		0.11
S a l a k[8]		0.09
Melinjau[9]		0.09
Sapodilla trees (sawo)[10]		0.09
Mangosteens (manggis)[11]		0.13
K e c a p i[12]		0.13
Sago palms[13]	3.75	1.29
Coffee shrubs (robusta)		3.06
T O T A L	100	100

1) Cocus nucifera 2) Mangifera longipes 3) Mangifera similis 4) Anacardium occidentale 5) Annona muricata 6) Nephelium lappaceum 7) Lancium domesticum 8) Salacca edulis 9) Gnetum gnemon 10) Manilkara achras 11) Garcinia mangostana 12) Sandoricum koetjape 13) Metroxylon sagu

Just as the distribution of the trees on the plots is proof of a judicious analysis of the potentials of the environment, the methods of plant reproduction developed by the Banjars are perfectly adapted to the amphibious surroundings. Despite the exhortations of the Agricultural Services, who are trying to distribute grafted plants from nurseries, the farmers prefer the marcottage technique. The trees obtained in this way, of small stature, conserve forever superficial roots that will never rot as they scarcely penetrate more than 20 cms into the ground, as opposed to almost one meter for the nursery-raised trees which can only thrive on high ground.

The marcottage technique is quite perfected (Fig. No.18). An existing branch from which a few centimeters of bark has been stripped is wrapped with a little earth, then with a banana leaf, and finally with a sheet of PVC. After 45 days the roots emerge from the stripped portion; when they have reached a length of one centimeter, the branch is cut from the tree and the whole thing placed in a plastic bag filled with soil. Three to five months later the young tree is ready to be planted.

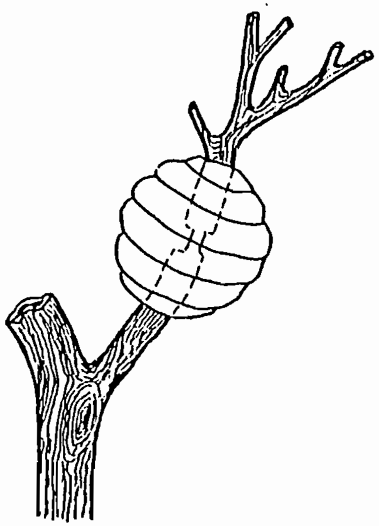
A 5-year-old "jeruk siam" tree yields about 250 fruits; if need be the surplus young fruits are pulled off. For a 10-year-old or older tree, the Banjars expect an average 700 fruits. Certain orange trees obtained from marcottage are still producing after 60 years! The harvest usually takes place in June and July, but in some years, if the rains have been neither too abundant nor too scarce, a secondary harvest is possible in March-April.

VII.2. Transmigration and the "sistem garpu"[1]: a Javanese analysis of a Banjar landscape

The Banjar methods of water control reinterpreted by the Javanese at Gadjah Madah University in Yogyakarta produce syncretic

[1] sistim garpu: from sistim, system, and garpu, fork, refers to the shape of the Transmigration Centers created in this manner.

18. MARCOTTAGE DES AGRUMES/*MARCOTTAGE OF CITRUS*



Source : Batchelor, L.D. and Webber, H.J. *The Citrus Industry*
California 1948. Repris dans C.N. WILLIAMS
THE AGRONOMY OF THE MAJOR TROPICAL CROPS
OXFORD IN ASIA COLLEGE TEXTS. OXFORD UNIVERSITY PRESS

KUALA LUMPUR • LONDON • NEW YORK • MELBOURNE - 1982 forms. The Javanese option in favor of a greater intensiveness leads to the practice of two crops a year on the same parcel and the introduction of team traction whereas the Banjar set-up is characterized by the use of local rice varieties cultivated according to traditional methods that have been proven over centuries on the southern Kalimantan coast.

VII.2.1. Javanese in Banjar country

The analysis of two Transmigration centers of different ages, at Barambai (Kolam Kiri) and at Sei Luang, will not only specify the originality of these two settlement projects with respect to the traditional Banjar development system; but will also show how their agricultural situation evolves over a period of time. Both projects are located on the right bank of the Barito; Barambai is 50 kms., and Sei Luang 80 kms., south of Marabahan via the river. The Barambai center dates back to 1969-1973 while Sei Luang is more recent: the families arrived in 1980 and 1981. All the families that were transmigrated are Javanese or Soundanese with the exception of 10% of the group who came from South Kalimantan as part of the politics of assimilation between the different peoples of the archipelago (Table No.17). On the whole, the village of Barambai-Kolam Kiri had 3410 inhabitants in 1984 and Sei Luang 2239 in 1981.

The natural surroundings are still the same: a layer of peat 0.70 to 1 meter thick underneath which are yellowish kaolinitic clays. Aeration of the lower soil horizons (of the alluvial gleysol type) is difficult.

Each family received a land allocation of 2 ha. at Barambai and 2.25 ha. at Sei Luang. At Barambai the 2 ha. consist of 0.25 ha. of garden around the house and a 1.75-ha. plot of rice field, while at Sei Luang 2 one-hectare plots are added to the 0.25 ha. of garden. After 15 years at Barambai, the land situation has evolved considerably, since the land allotted by Transmigration

TABLE No. 17

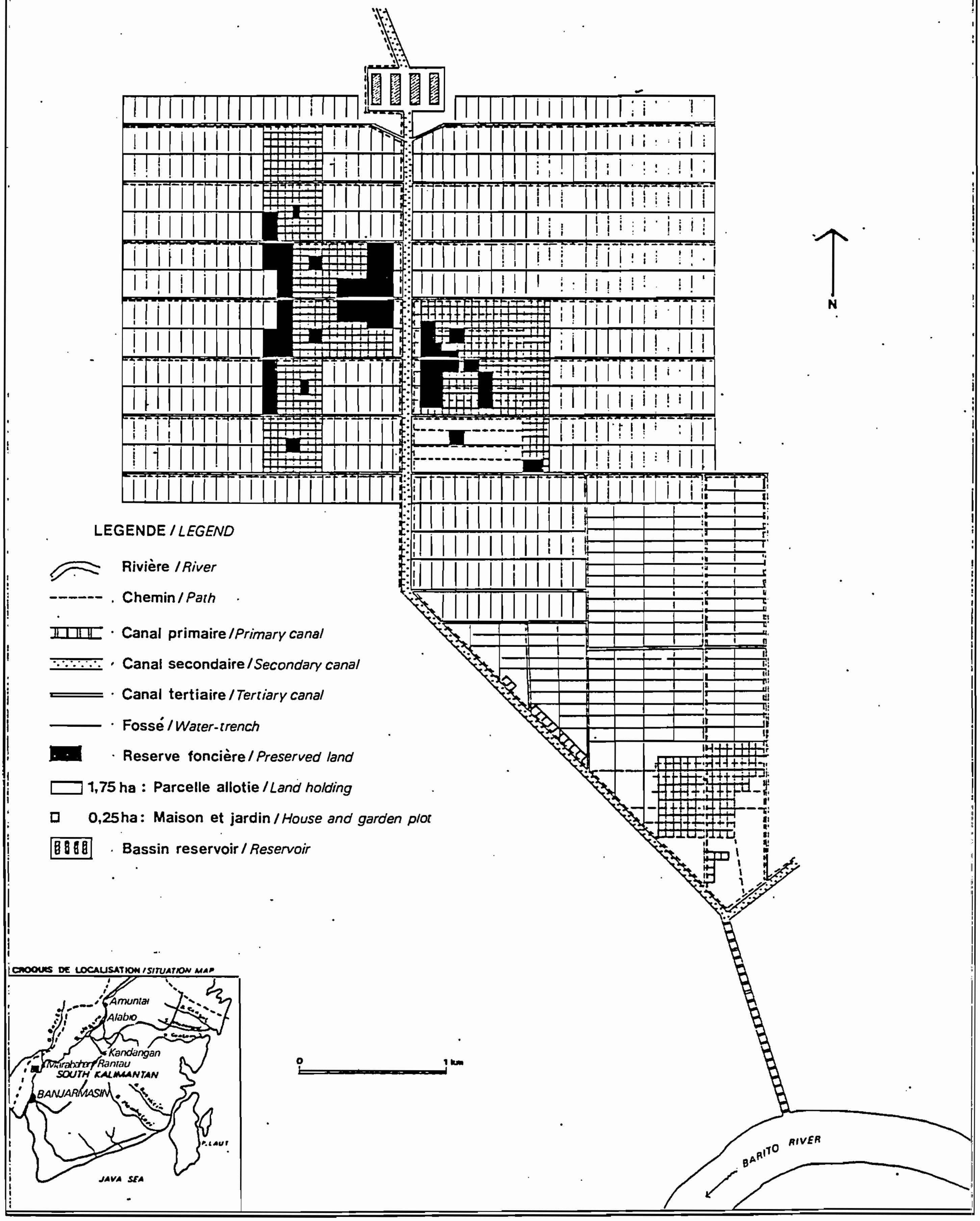
Origins of the transmigrants
Barambai - Kolam Kiri - August 1984

Province of origin	No. of families
West Java	26
Central Java	262
D.I. Yogyakarta	76
East Java	195
South Kalimantan	83
O t h e r	1
T O T A L	643

Sei Luang 1980-1981

Province of origin	No. of Families
West Java	100
Central Java	200
D.I. Yogyakarta	50
East Java	100
Local area	50
T O T A L	500

Fig. n°.19
LE CENTRE DE TRANSMIGRATION DE BARAMBAI (KOLAM KIRI)
BARAMBAI (KOLAM KIRI) TRANSMIGRATION SETTLEMENT



in the beginning only represents about 44% of the cultivated areas today (Table No.18). New rice fields have been acquired, a few of which came from the project's land reserve, but most of which were cleared around the Center (37 to 38% of the land presently under crops comes from such clearings. 50% of the families own more than 4 ha. of land, and the average per exploitation comes to 4.55 hectares.

The situation is very different at Sei Luang, the recent project, as only 90.55% of the allotted land is actually cultivated. 30% of the families cannot manage to cultivate their 2.25 ha.!

VII.2.2. A first step towards intensification

Intensiveness is greater here than in the two Banjar villages, Pemakuan and Gudang Hirang. 90% of the families at Barambai, and 75% in Sei Luang, obtain two harvests per year on the same plot.

The first crop is selected rice (unggul of the IR36 type). The rice field is prepared in November; the soil is either turned over with a plow pulled by buffalo or oxen[1], or labored with a hoe. Only the surface horizon of the soil is labored (as deep as 5 cms. when the labor is done with a hoe, or 10 cms. using a plow). The underlying clayey soil remains compact in order to avoid the seepage of acid sulfates[2]. At the end of November or in early December, the plot is harrowed, if the farmer has a team, otherwise the sod is simply broken up.

In early December the seed-bed is set up in a conventional manner, by broadcasting germinated seed on soil that has been previously broken up.

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[1]The farmers at Barambai have 80 buffalo and 40 oxen.

[2]from sulfates contained in sea water.

TABLE No. 18

BARAMBAI

Distribution of cultivated lands

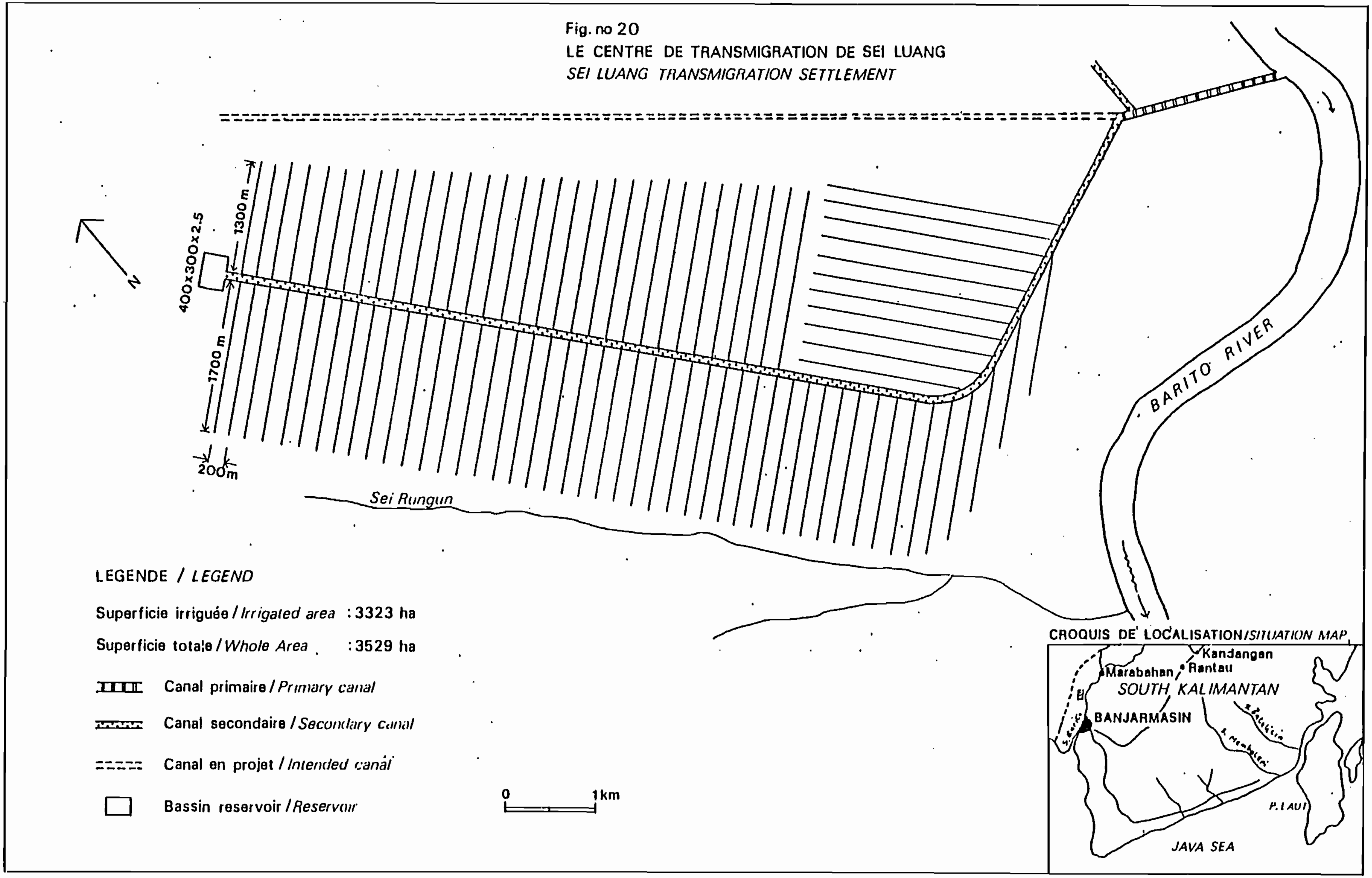
a) Percentage of total area cultivated

Land allotted by Transmigration		Supplementary garden	Supplementary rice field cleared within the project	Supplementary rice field outside the project
gardens	rice fields			
5.50	38.46	4.03	14.34	37.67

b) By class of exploitation

Surface cultivated per family -ha-	% families
2	9.52
2 - 2.99	4.76
3 - 3.99	33.33
4 - 4.99	9.52
⩾ 5	42.87
Average area per exploitation: 4.55ha	

Fig. no 20
LE CENTRE DE TRANSMIGRATION DE SEI LUANG
SEI LUANG TRANSMIGRATION SETTLEMENT



The originality lies in the transplanting method, as neither the Javanese system of hand-transplanting nor the Banjar system of multiple transplantations is used. The seedlings are simply pulled up and planted out with a seed-lip. The rice is about 20 days old and has not yet tillered, so in this case it is really central stalks that are planted out, at a rate of 3 per hole every 20 cms. This is a compromise between the Banjar techniques (tillers planted out using a seed-lip with no previous soil preparation) and the Javanese methods which consist of planting out young central stalks, but by hand and in mud. This compromise is made absolutely necessary by the limited depth at which the soil is labored, but requires a greater number of work-days per hectare (40 days/ha., Table No.19).

The fertilisers, urea and TSP[1], are spread twice, 20 and 50 days after planting out, while the insecticides, Diazinon and Sumithion, are sprayed three times, 70, 80 and 90 days after the rice has been set out. Weeding remains manual, however, and two passages are necessary, the first after one month and the second at 50 days; these require together 40 to 45 work-days/ha., which are high amounts for irrigated rice cultivation.

The harvest takes place 100 to 150 days after the planting out. When it is done with a sickle, it only takes a small amount of labor (6 days/ha.), as does the use of a simple threshing machine using a drum and a pedal.

The second crop is a traditional one which is closely drawn from Banjar methods using local varieties of rice. The seed-bed is set up 30 to 40 days after the selected rice has been planted out. On a hummock, a small plot is simply scythed; the soil is not even broken up and the seeds are planted using a simple dibbling stick, about 10 seeds to every 20 cms.

[1] TSP: Tri Super Phosphate.

TABLE No. 19

Amount of labor on the rice field

Barambai

Agricultural operations		No. of work-days/ha. Selected varieties	Local varieties
Seed-bed		1	2
Preparing the soil or the parcel	laboring	8	
	harrowing	3	
	weeding		17
	making compost		20
1st transplantation (lacakan)			8
Planting out (with seed-lip)		40	17
1st weeding		23	8
2nd weeding		23	
Fertilising (2 passages)		4	4
Pesticides (2 passages)		3	3
Harvest[x] - with sickle		6	
- with panicle knife			12
Other: upkeep, bunds, canals		20	20
T O T A L		131	111

[x]Figure very low as yields small

Only a few days after the selected rice has been harvested, the field is scythed; the stubble is collected and is either piled on the edges of the parcel or spread in rows in the middle (Fig.No.21). The stubble is periodically aired but decomposition is nevertheless very slow. However, this operation must be done in order to avoid the formation of peat. The transmigrants estimate that it takes 6 to 7 months for the stubble to turn into a compost which is therefore not spread over the entire ricefield until only a few days before the planting out of the selected rice one year later.

In this case, before the local varieties are definitively planted out, only one previous transplantation (lacakan) takes place, when the plants are about 40 days old. The plants are placed on the edges of the yet-unharvested rice field, over about 1/3 of the total plot, which reduces the area under selected rice by as much. The rice is planted out when the plants are 50 days old. It has already tillered, and it is no longer central stalks that are planted out with a seed-lip between the rows of decomposing stubble. The transmigrants use about 2 to 3 tillers per hole, spaced 30 cms. apart.

These plants are already adult and resistent when planted out. Such plants do not suffer from flooding, and the transmigrants do not hesitate to let water flood the field in order to limit weeding to its simplest form (8 work-days/ha.).

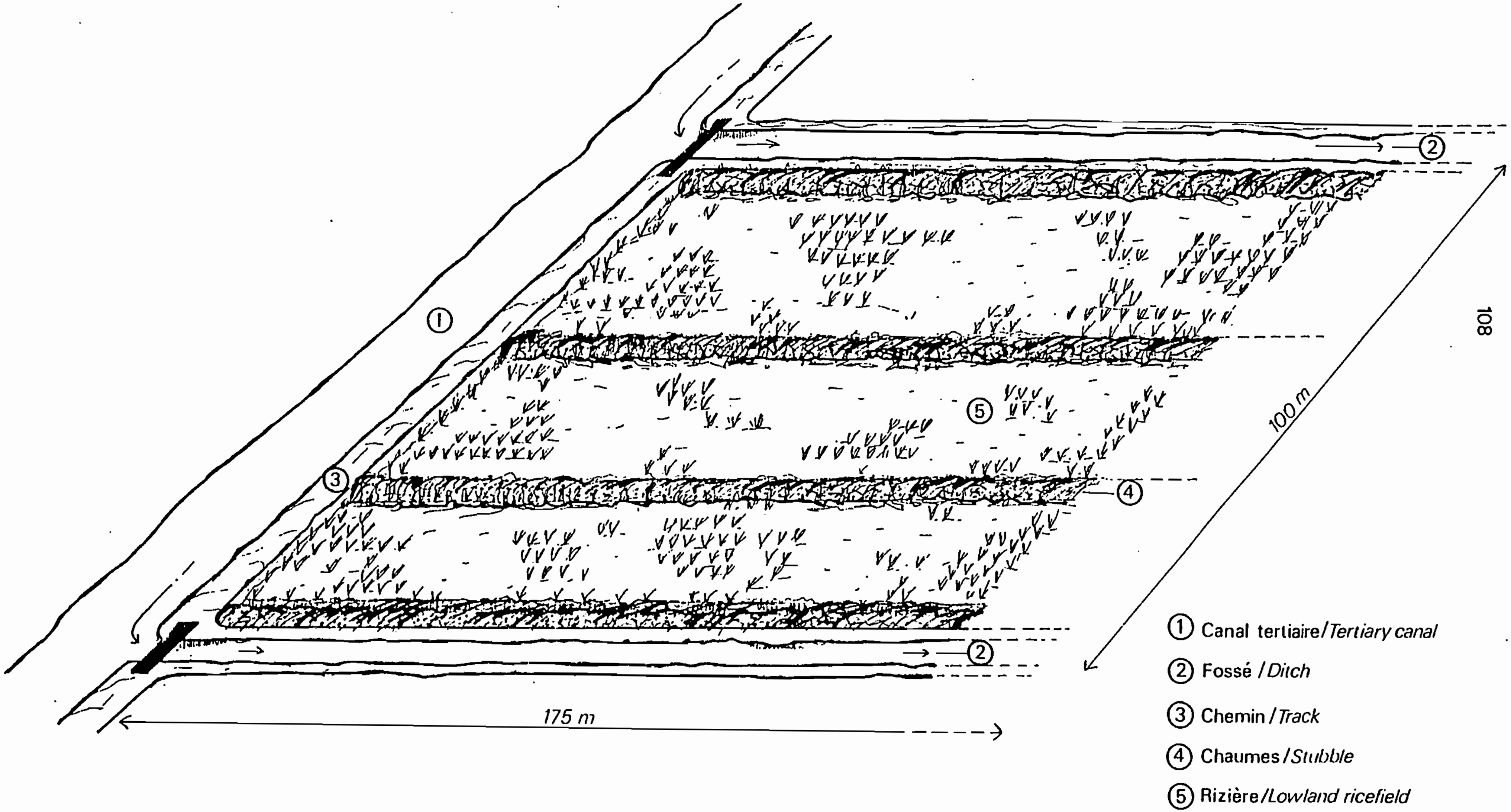
After using the same fertilisers and pesticides as on the selected varieties, the farmers expect a harvest at the end of September or the beginning of October, to wit 5 months after planting out. The dates vary in function of the climatic conditions and the variety of rice used. The paddy is not homogeneous in size, so to avoid losses the harvest is done panicle by panicle this time. For the same reasons, the rice is trod out on a mat (graph No.22).[1]

[1] Graph No.22 does not represent the association of traditional and selected lowland rice on the same plot at Barambai but as it does exist at Sei Luang.

21. REPARTITION DES CHAUMES SUR UNE RIZIERE

HEAP OF STUBBLE REPARTITION ON A LOWLAND RICEFIELD

- BARAMBAI -



The amount of time devoted to the cultivation of one hectare of local paddy is considerably less than that needed for the selected varieties. Weeding makes the difference, as does the planting out which is much less carefully done than in the first case.

VII.2.3. Limitations and problems

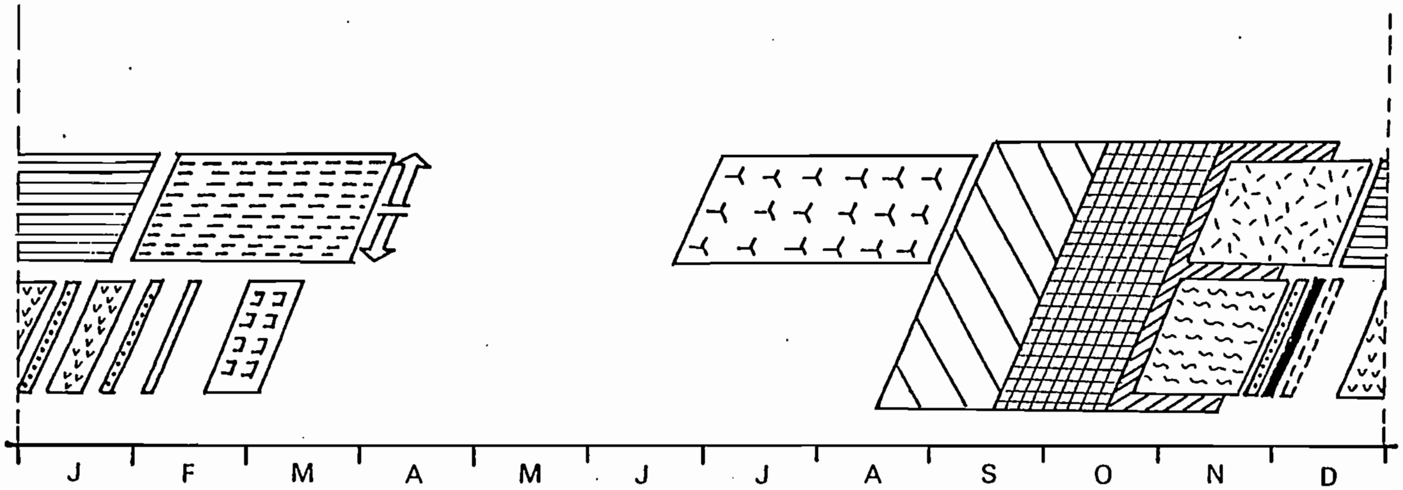
All told, the yields are rather disappointing (Table No.20), as 66% of the plots at Barambai, cultivated successively in selected rice and in local varieties, do not manage to produce more than 1.5t to 2.5t, which is considerably less than at Pemakuan and Gudang Hirang where rice is only cultivated once a year on the same parcel. Moreover, at Sei Luang the results are positively catastrophical: out of 2 harvests, 53% of the parcels only yielded between one and two tons. There are many reasons for this failure.

First of all, one notes that those regions that were developed the earliest produce the best yields. Thus, the yields are greater at Gudang Hirang and Pemakuan, two villages founded at the beginning of the century, than at Barambai, created 15 years ago; and Barambai produces greater yields than at Sei Luang, which is only 3 to 4 years old. Placing the land under crops, drainage and irrigation with the resulting water circulation, "washing" the soil with fresh water from the river and rainwater, all progressively improve the land.

Furthermore, though Gudang Hirang, Pemakuan, Barambai, and Sei Luang are all villages surrounded by the same amphibious plain, and profit from the same tidal bore phenomenon, the geographic positions vary a great deal from one example to the next. Thus, Gudang Hirang and Pemakuan are located about 30 kms. from the sea, in an area where the tidal amplitude is still very strong, while the Transmigration centers are 70 kms. from the river's mouth. Considering the length of the canals which branch off from the right bank of the Barito, the irrigated parcels are located at least 8 or 9 kms. from the river. It goes without saying that

22. CALENDRIER AGRICOLE ASSOCIANT VARIETES DE RIZ TRADITIONNELLES ET VARIETES SELECTIONEES

TRADITIONAL AND SELECTED LOWLAND RICE AGRICULTURAL TIME-TABLE



Varietés traditionnelles/*Local varieties*

- Pépinière / *Nursery*
- 1ere Transplantation / *1st Transplanting (ampak)*
- 2e Transplantation / *2nd Transplanting (lacak)*
- Repiquage / *Last transplanting*
- Récolte au couteau à panicules *Capping knife reaping*

Varietés sélectionnees/*Selected varieties*

- Pépinière / *Nursery*
- Epandage des engrais / *Fertilizer spreading*
- Repiquage / *Transplanting*
- Repiquage complémentaire / *Complementary transplanting*
- Désherbage / *Weeding*
- Pesticide / *Pest-control*
- Récolte à la faucille / *Sickle reaping*

- Fauchage et préparation du sol / *Mowing and soil preparation*
- Fabrication de compost / *Compost making*
- Epandage du compost / *Compost spreading*

TABLE No. 20

Yields at Barambai - Kolam Kiri

Yields: t/ha.	Selected varieties: % parcels	Local varieties: % parcels	Annual yield: 2 crops/ year, selected + local varieties, % parcels
0.5	5.56	15	0
0.5 - 0.99	16.66	30	0
1 - 1.49	27.78	45	5.56
1.5 - 1.99	38.88	10	22.22
2 - 2.49	5.56	0	44.44
2.5 - 2.99	5.56	0	5.56
⩾3	0	0	22.22
T O T A L	100	100	100
Average yield: t/ha.	1.41	1.05	

Yields at Sei Luang

Yields: t/ha.	Selected varieties: % parcels	Local varieties: %parcels	Annual yield: 2 crops/ year, selected + local varieties. % parcels
0	22.22	0	0
0.1 - 0.49	16.66	35	0
0.5 - 0.99	44.44	30	20
1 - 1.49	5.56	15	46.66
1.5 - 1.99	5.56	5	6.67
2 - 2.49	5.56	10	6.67
2.5 - 2.99	0	0	6.67
⩾ 3	0	5	13.33
T O T A L	100	100	100
Average yield: t/ha.	0.61	0.94	

by this time the tidal amplitude cannot be measured in meters, but in centimeters. The drainage is relatively well-ensured, but irrigation is somewhat aleatory, when the dry season is pronounced and the river is low, which is to say exactly when the paddy needs water. The problem is even more serious at Sei Luang where the rice-growing areas are 10 to 14 kms. from the river. In other words, there is no real irrigation.

To rectify these insufficiencies in water control, the transmigrants are combining, on the same plot, selected rice from December to March, when the rainfall is at its maximum, with the idea that it will always be easy to drain off the surplus water during the ebb, and the more resistent local varieties from April to October. The latter are capable of bearing both a possible flood if the river is at flood stage, due to their long stems, and in most cases a dry spell due to the double-transplanting technique.

CHAPTER VIII

Alabio, or the misfortunes of a polder in the tropics

With the polder, we leave the coastal swamps and the lowland plain and its twice-daily tidal submersion for what we have decided to call the lake region. Here, the farmers must deal with a double challenge: not only flooding but also drought.

It has previously been shown that the relationship between the lowest and highest flow rates on the Negara River at Amuntai is around 1 to 65. Further south, at Alabio, the irregularity is such that the level of the water table varies from 0.5 m to 4.5 meters (Table No.21); thus, the average monthly variations must be considered with caution (Fig.No.23).

Drought risks are, paradoxally, high. It was noted that at Amuntai, out of 96 months from 1976 to 1983, 34 are dry from an agricultural point of view[1]. A closer analysis at Alabio shows that even though the average yearly pluviometry (2499 mm; with a maximum from December to March and a minimum from June to September) is high in frequency[2], in nearly 80% of cases, the month of August receives less than 100 mm and in 66% of cases, less than 50 mm (Graph No.24). Once again, the averages are misleading and uncertainly remains high, especially from November to March: rainfall for the month of November varies from 290 mm to 0 mm according to the year, and for February from 850 mm to 150 mm (Graphs No.25 and 26).

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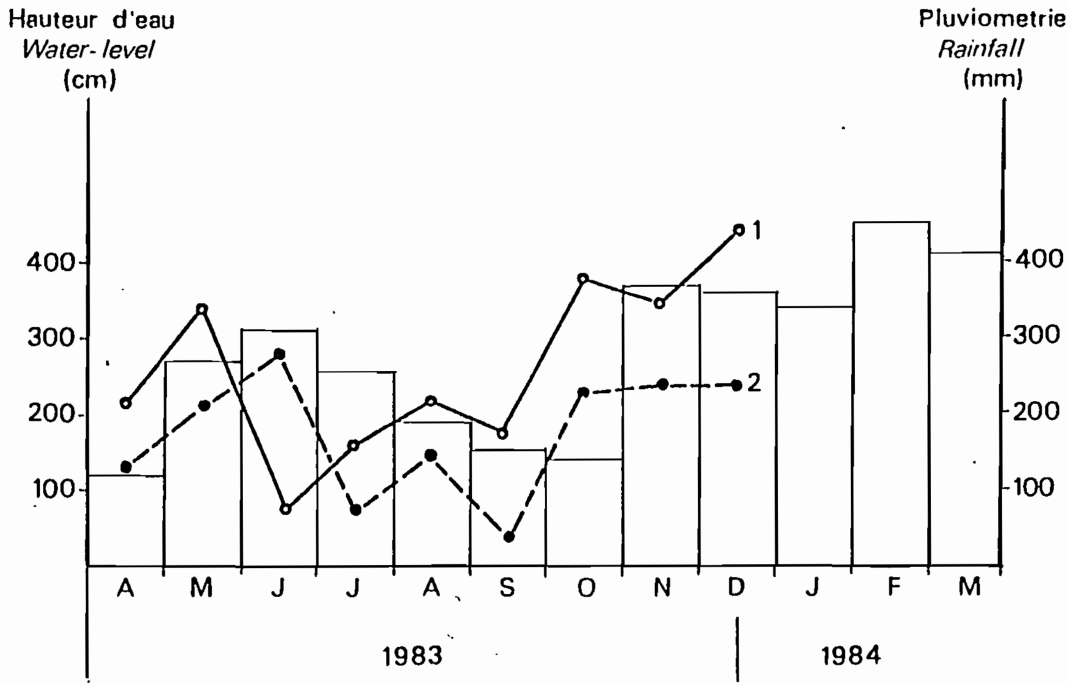
[1] p < PET of 120 mm.

[2] Over a twelve-year period: 1971-1982.

23. HAUTEURS D'EAU DE LA RIVIERE NEGARA A ALABIO ET PLUVIOMETRIE
WATER-LEVEL OF THE NEGARA RIVER IN ALABIO CORRELATED WITH RAINFALL



Pluviometrie / *Rainfall*
1. TANJUNG
2. AMUNTAI

TABLE No. 21

Variations in Water Level of the Negara River
Alabio - 1983-1984

Water level -m-	Frequency in %, on one daily reading												General Total
	January	February	March	April	May	June	July	August	September	October	November	December	
< 0.5	0	0	0	0	0	0	0	0	0	0	0	0	0
0.5 - 0.99	0	0	0	0	0	0	0	0	0	48.40	0	0	4.18
1 - 1.49	0	0	0	96.66	0	0	0	12.90	43.33	16.13	0	0	14.21
1.5 - 1.99	0	0	0	3.34	6.45	0	0	35.48	40	19.35	0	0	8.91
2 - 2.49	0	0	0	0	38.71	0	38.71	51.62	16.67	3.22	0	0	12.81
2.5 - 2.99	0	0	0	0	25.81	43.34	61.29	0	0	3.22	0	0	12.26
3 - 3.49	28	0	0	0	16.13	36.36	0	0	0	9.68	33.33	35.48	11.98
3.5 - 3.99	48	3.45	12.90	0	12.90	20	0	0	0	0	33.33	45.17	14.20
4 - 4.49	24	27.59	87.10	0	0	0	0	0	0	0	33.34	19.35	15.88
4.5 - 4.99	0	68.96	0	0	0	0	0	0	0	0	0	0	5.57
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

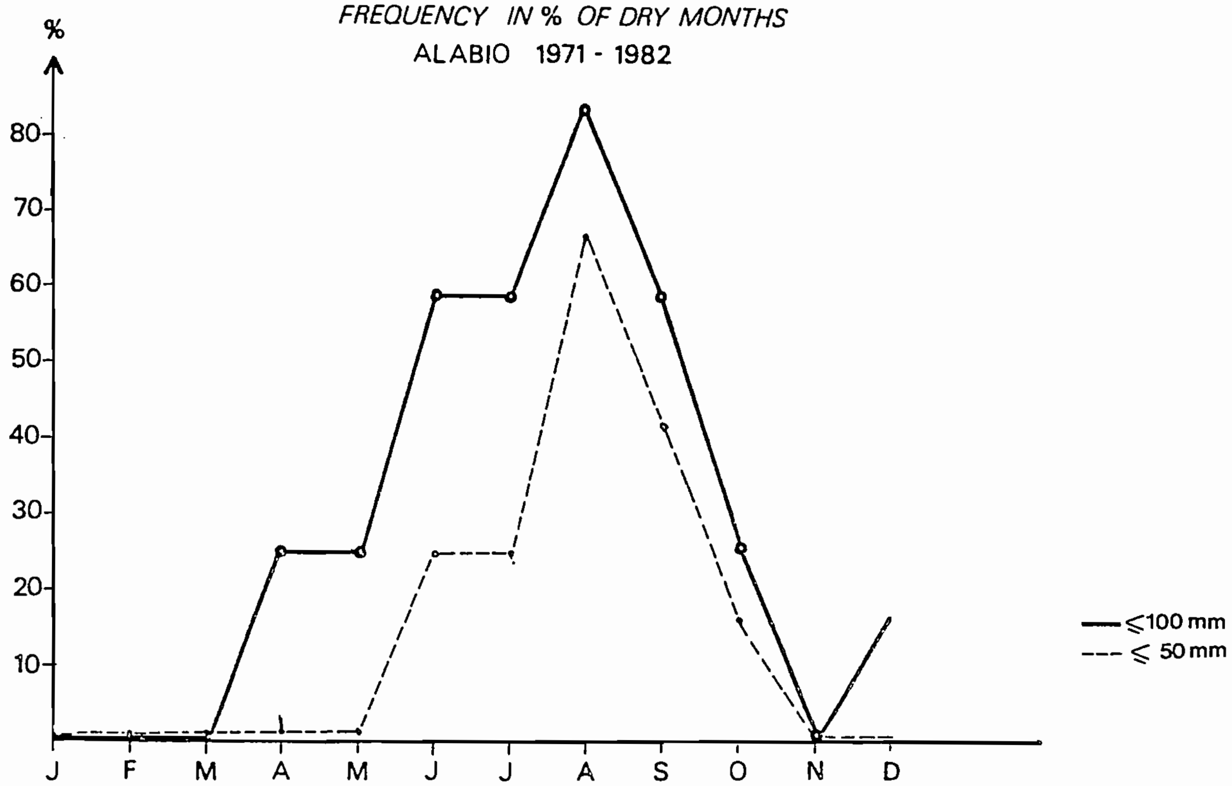
Note : Above 0 on the scale

Source : Departemen Pekerjaan Umum - Direktorat Penyelidikan Masalah Air - Kalimantan Selatan

24. FREQUENCE EN% DES MOIS SECS

FREQUENCY IN % OF DRY MONTHS

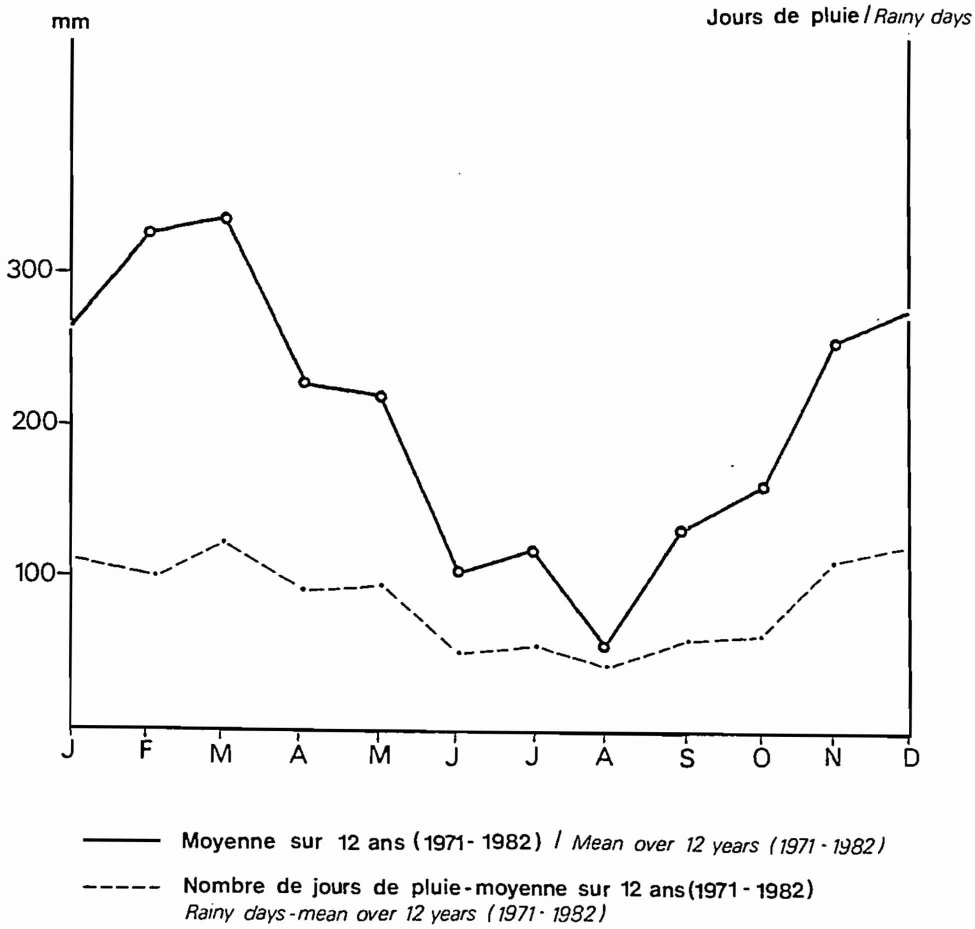
ALABIO 1971 - 1982



25. PLUVIOMETRIE MENSUELLE ET NOMBRE DE JOURS DE PLUIE

MONTHLY RAINFALL AND RAINY DAYS

ALABIO



Thus, the Alabio polder was built within the large lake and swamp region which, at an average altitude of 3.25 m above sea level, is nothing more than the floodplain of the Negara, Alabio, and Tabalong rivers. Over 38,000 ha., a tangle of changeable, mobile defluviation canals worm their way towards the lower Barito 35 kms. further west. The polder is the human answer to the paradox of flood risks and drought possibilities.

It has been mentioned that the "polder-plan" was dropped in 1958, after only two zones had been developed[1]; this is why the Alabio polder is surrounded by other unfinished ones: Simpang Empat, Kaludan, Baker, ... for which only part of the embankments and a few sluice gates were set up. Thus, the Negara River from Alabio to Babirik is completely canalized and runs between two embankments: that of the Alabio polder and that of the Baker polder.

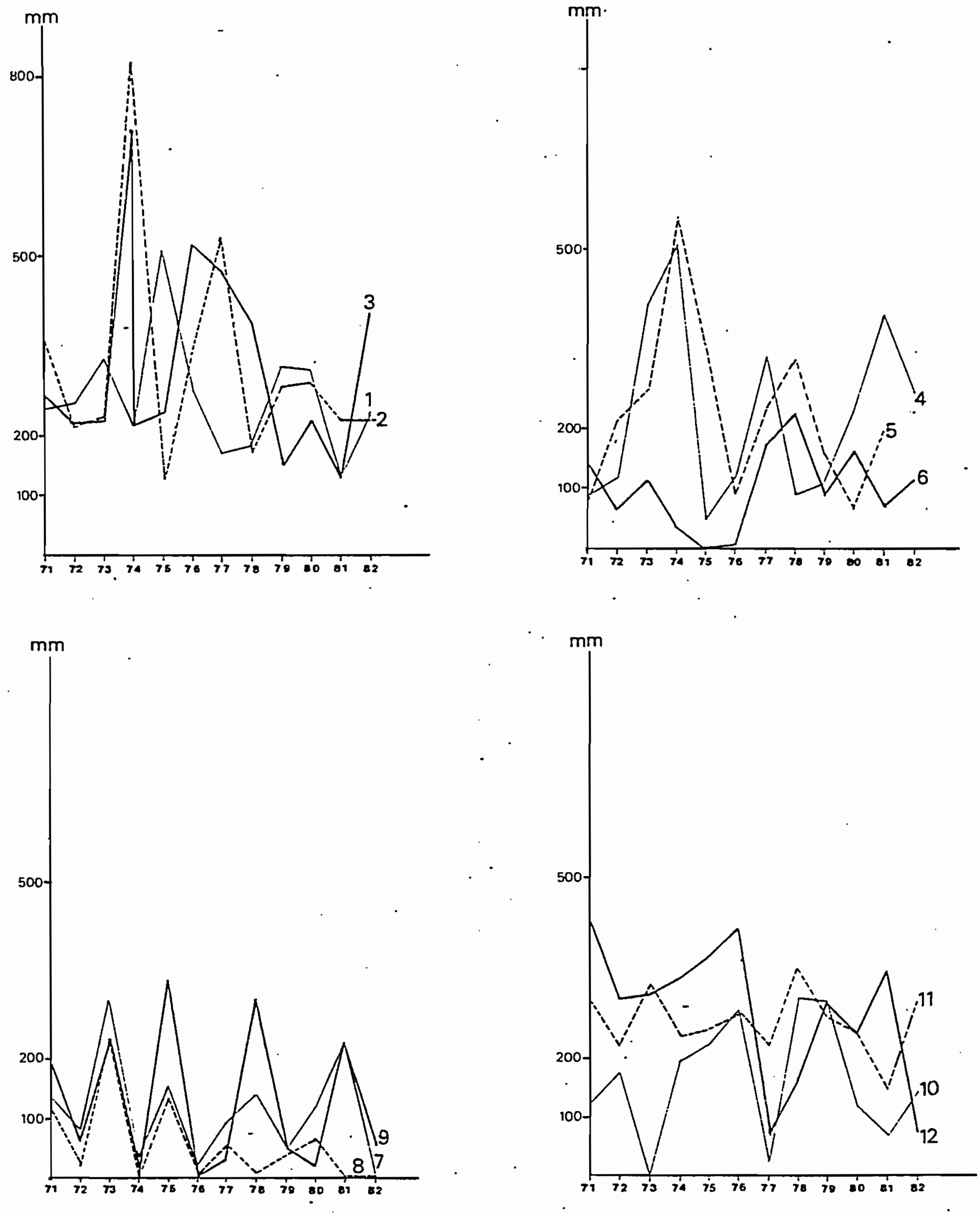
VIII.1. A Dutch polder in Banjar country

The Alabio polder consists of an embankment 43.6 kms. long and 5 m high which surrounds a 6350-ha. zone between the Negara, Alabio, and Tabalong rivers. The project was elaborated in 1929 by Dr.Ir.H.J.Schophuys,director of Agricultural Services for the province of South Kalimantan. The construction began with a simple circular dike which was intended to protect the rice-growing areas from the flooding from the Negara River. Then, from 1933 to 1936, through the application of a tax on the farmers' plantations and the sales of rubber, the dike was raised and ironwood sluice gates were installed on concrete supports.

WWII stopped the construction, but as early as 1948 the new Indonesian government recalled Dr. Schophuys from a research

[1] At Mantaren and at Alabio.

26. VARIATIONS INTERANNUELLES DE LA PLUVIOMETRIE
INTERANNUAL RAINFALL VARIATIONS
- ALABIO -



1. Janvier / *January*
2. Fevrier / *February*
3. Mars / *March*
4. Avril / *April*
5. Mai / *May*
6. Juin / *June*
7. Juillet / *July*
8. Aôut / *August*
9. Septembre / *September*
10. Octobre / *October*
11. Novembre / *November*
12. Décembre / *December*

trip in Holland and in the Camargue region of France, to have him set up a system of drainage canals. In 1952, a pump station was installed at Babirik consisting of 5 pumps of 200 c.u. each and a capacity of 150 m^3/minute, that was intended to lower the water level during flood periods.

A decisive step was taken in 1963 with the construction of a network of irrigation canals, followed in 1965 by an irrigation station capable of pumping 53 m^3/minute, on the Negara River. Finally, in 1982-1983, a central embankment 7.75 kms. long was built in order to create two distinct zones within the polder (Fig. No.27).

The cross-section (Fig. No.28) resembles that of a classical Dutch polder on an incline plane, except that the problems which must be dealt with are more complex. Whereas in the Netherlands the main constraint is the evacuation if water which enters the zone either through infiltration or through precipitation, in Kalimantan there is the added problem of supplying water for irrigation during the dry season. The rainwater or floodwater is thus trapped in a conventional manner by drains through which the water flows toward the lowest section of the polder, while these same ditches are over-hung with irrigation canals fed by the pumps in the north section of the polder.

VIII.2. Despite considerable investment, an imperfect water control, for minimal agricultural progress and big disillusions

Considerable investments were made in the polder, since on the whole, other than the two pump stations[1] and 16 sluice gates of which ten are main ones, there are 56 kms. of drainage

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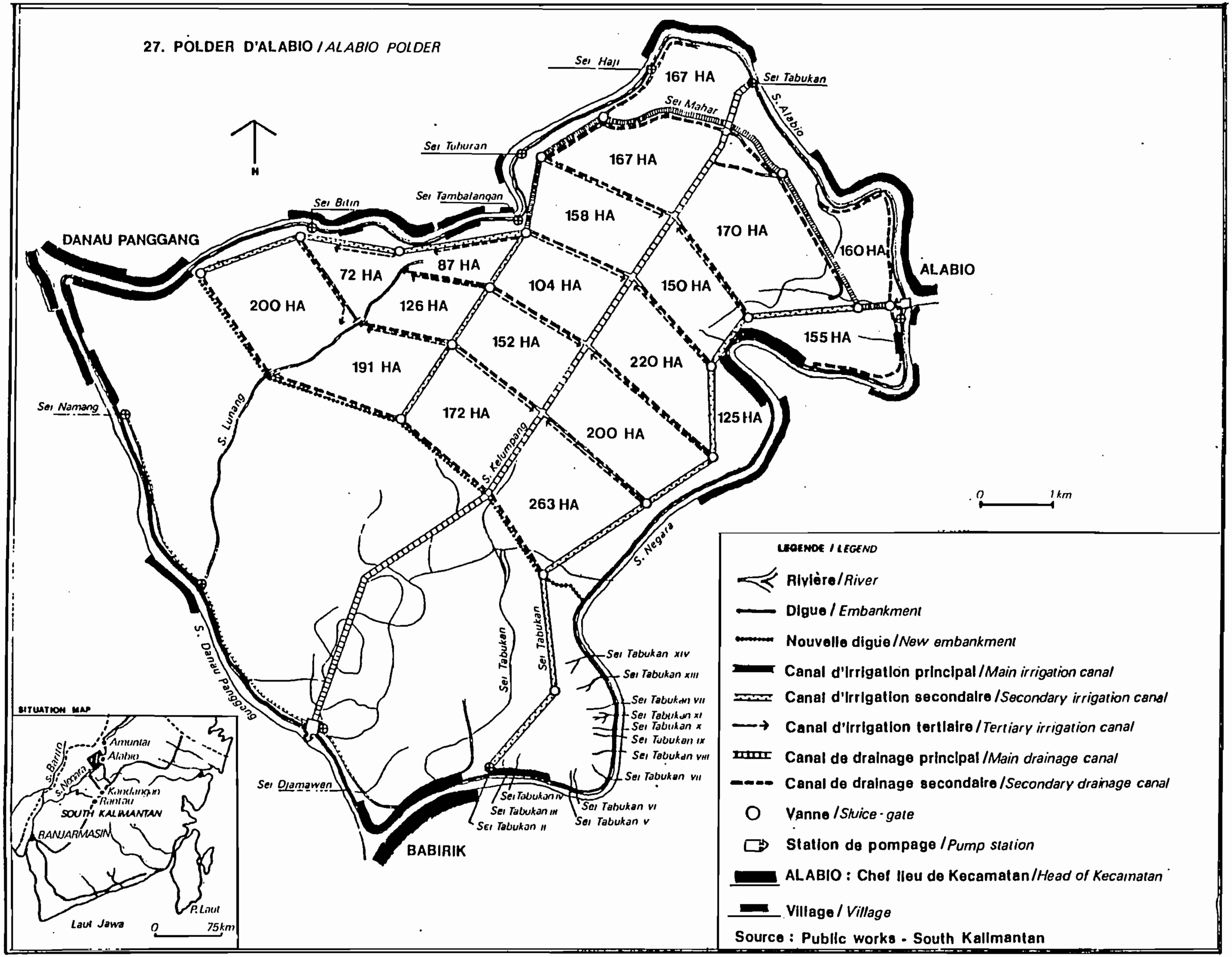
[1]Two 80-c.u. pumps and five 200-c.u. ones



27. POLDER D'ALABIO / *ALABIO POLDER*

ditches and 47 of irrigation canals. Yet water control is still not perfect. The pumps only run from 08:00 to 19:00, and do not manage to lower the water level more than 2 cms. per day, which has 4 major consequences on the agriculture: only one rice harvest per year can be considered; only traditional cultivation methods can be used; yields remain mediocre; and finally, only half of the zone is actually put to use.

<u>VIII.2.1. A paradoxal discovery: the polder designed to intensify rice cultivation only permits one harvest of paddy per year!</u>

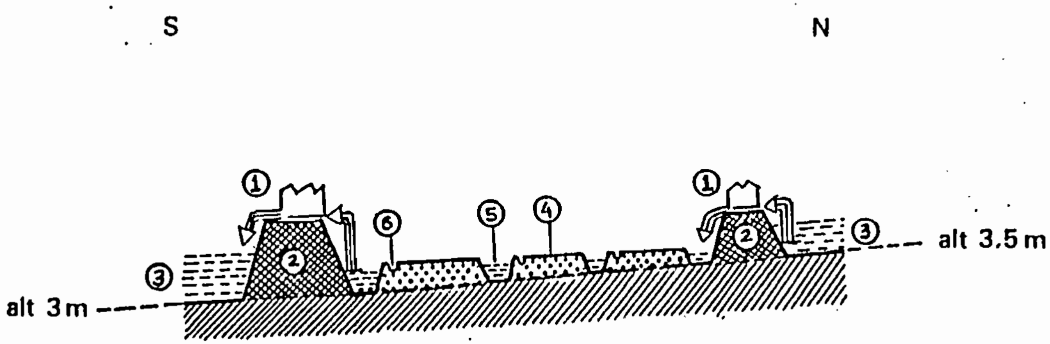
Water control is so uncertain that any attempt at it can only be made during the dry season from June to October-November. In the absence of any human intervention the level of the water table within the polder varies from 1.8 to 1.5 m from January to May, then falls off progressively beginning in June, reaching its lowest point (0.35 to 0.40 m) in October before rising again in November. Under these conditions, it is very difficult to grow rice. Pumping out 1.5 m of water at a rate of 2 cms. per day is almost senseless, especially since any rainfall of more than 20 mm (75.64% of the total rainfall and 31.50% of the number of showers in January) would ruin an entire day's work.

Using the pumps only hastens the mid-March to mid-June ebb. Three months of pumping therefore allows for a 7-month cropping season using appropriate cultivation methods.

<u>VIII.2.2. Combining Banjar methods of water control and Dutch hydraulics</u>

The rice cannot be planted out as long as the water level is above 10 to 15 cms., a level which is not attained through

28. Coupe du Nord au Sud du POLDER D'ALABIO
North to South cross-section of ALABIO POLDER



① Station de pompage / *Pump station*
② Digue / *Embankment*
③ Rivière Negara / *Negara river*
④ Riziéres / *Low land ricefields*
⑤ Drains / *Ditches*
⑥ Canaux d'irrigation / *Irrigation canals*

pumping until early June. After that, there is no longer any serious problem either of submersion or of drought as the pumps can answer the farmers' needs. Thus the traditional Banjar cultivation methods can be used, while at the same time simplified and reinterpreted.

The floating nurseries which are only used for local varieties of rice are set up in early April when the water is still waist-high, while in May a single intermediate transplantation (ampakan) before the actual planting out is needed. A second transplantation (lacakan) intended to favorize the plants' resistence as well as the lengthening of the stems is unnecessary. The water level has stabilised and any possible drought can be dealt with by complementary water supplies, should this be required, in July-August (graph No.29).

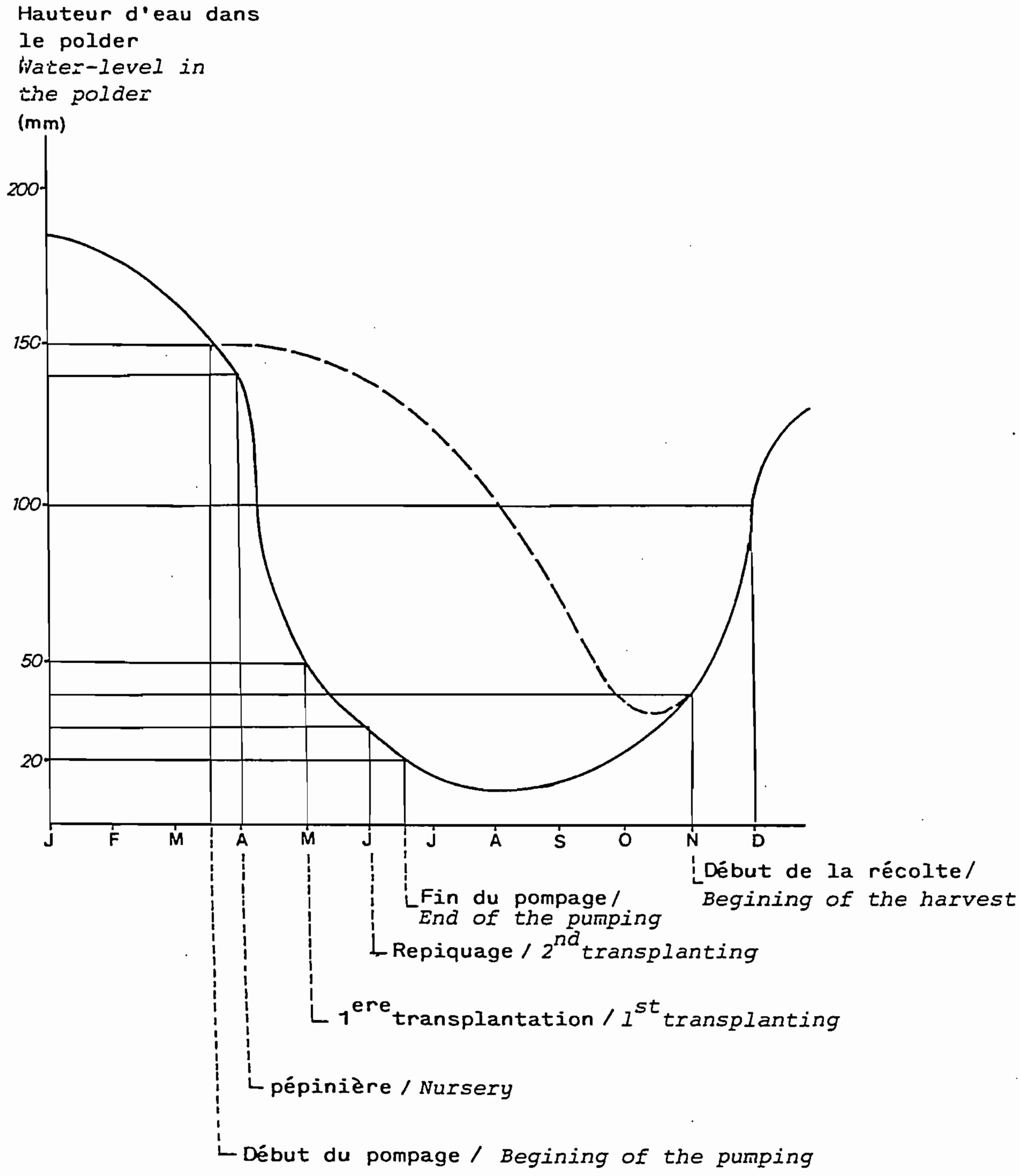
VIII.2.3. Big disappointments

In spite of the hopes that were placed in an intensive development of the environment, in spite of the combination of varying cultural contributions, the results in terms of yields are very disappointing (Table No.22/graph No.30). Nearly 50% of the parcels only produced between 0.5t and 1.5 t/ha. in 1983, which is infinitely less than the results obtained in the Banjarmasin area using simple, traditional methods. Moreover, for 17% of the parcels, there was no harvest at all: these rice fields had been submerged following heavy rains and a considerable runoff; the pumps were immediately activated but after several days under water the paddy drowned.

During the 1982-1983 agricultural season, and for the first time, attempts were made under the direction of the Agricultural Services to obtain two consecutive harvests on a single parcel using short-cycle varieties, in the northern part of the polder at the village of Teluk Betung. This village is located only a few kilometers from the irrigation station. 74 farmers participated in this operation which covered a 25-ha. zone. The satisfactory

ALABIO

CALENDRIER AGRICOLE ET MAITRISE DE L'EAU
AGRICULTURAL TIME-TABLE AND WATER-CONTROL



——— Niveau de l'eau dans le polder sans pompage/*Water-level in the polder without pumping*

——— Niveau de l'eau dans le polder après pompage/*Water-level in the polder without pumping* yields barely exceeded 2 t/ha. at each harvest despite the great care with which the operation was carried out: distribution of selected seed, fertilizers, pesticides .... During the 1983-1984 season the failure was complete despite the choice of the experimental zone, which had been reduced to only 12 ha.!

VIII.2.4. An overly-ambitious project?

Nearly 37,000 ha. are actually cultivated as irrigated rice fields, but this is never more than 57 to 58% of the total area of the polder; high ground which includes the villages and some diverse smallholdings of fruit trees and sago palms makes up 523 ha. or a bit more than 8% of the total area while the remaining 34% are distributed between the open water and the floating vegetation (Table No.23). A 430-ha. artificial lake was created to regulate the water level but it only represents 6 to 7% of the polder's area. Yet 1734 ha., to wit more than 27% of the total area, are covered in floating vegetation only; depths are often more than 3 meters and agricultural life is compromised. (Map No.31).

The development of the polder is not at all uniform; the rice-growing zones are concentrated in the northern section - (80 to 85% of the area of the villages in Kecamatan Sungai Pandan and Danau Panggang) while almost 65% of the land in the villages located in Kecamatan Babirik are unfit for agricultural use.

VIII.3. The polder's mishaps

After such costly development, the reasons for disappointment are varied and revolve around two large types of problems. The first concerns technical problems that can be solved without too much difficulty, while the second, of a cultural nature, is much more delicate.

VIII.3.1. Insufficient technical mastery

The main technical problems are those caused by a poor topographical development which is compounded by deficient water use.

TABLE No. 22

ALABIO
- Yields in 1983 -
(unhusked rice)

Yields in t/ha	S.Namang No.	S.Namang %	Darusalam No.	Darusalam %	Putat Atas No.	Putat Atas %	Total No.	Total %
0	6	30	3	9,68	6	16,23	15	17,05
0 - 0,49	5	25	2	6,45	8	21,62	15	17,05
0,5 - 0,99	5	25	4	12,91	9	24,32	18	20,45
1 - 1,49	2	10	6	19,35	2	5,40	10	11,36
1,5 - 1,99	1	5	4	12,90	2	5,40	7	7,95
2 - 2,49	-	-	2	6,45	1	2,70	3	3,41
2,5 - 2,99	1	5	2	6,45	6	16,23	9	10,23
3 - 3,49	-	-	2	6,45	2	5,40	4	4,55
3,5 - 3,99	-	-	4	12,91	1	2,70	5	5,68
4 - 4,49	-	-	-	-	-	-	-	-
4,5 - 4,99	-	-	-	-	-	-	-	-
≥ 5	-	-	2	6,45	-	-	2	2,27
Total	20	100	31	100	37	100	88	100

Source : Field surveys

Parcels left uncultivated
due to flooding

Villages	% of parcels left follow because of flooding
Sungai Namang	20
Darusalam	8,82
Putat Atas	0
Murung Panti	95,65
Kalumpang Luar	100

Source : Field surveys

30. LES RENDEMENTS EN PADDY / *PADDY YIELDS*

POLDER D'ALABIO / *ALABIO POLDER*

— 1983 —

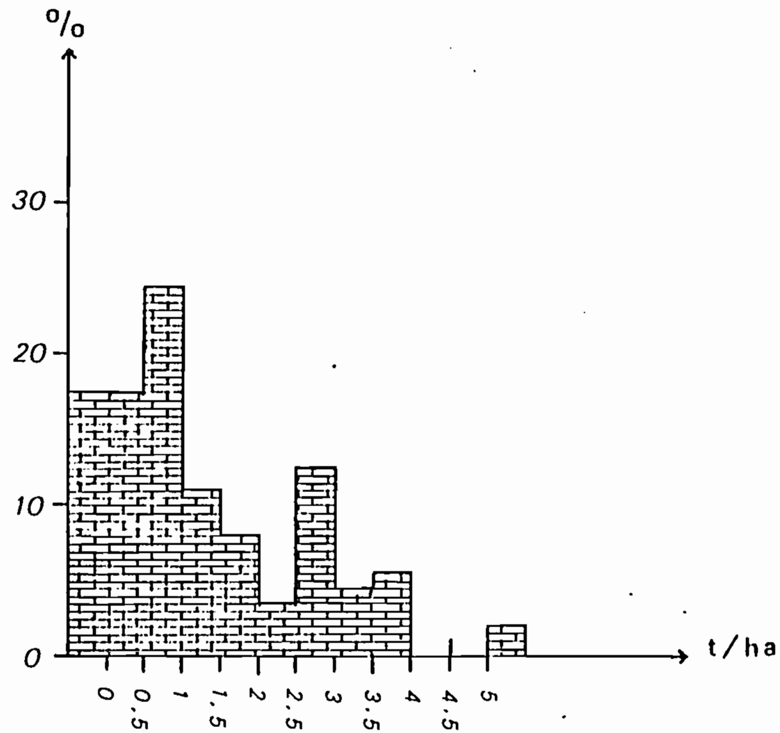


TABLE No. 23

Land-use

Land-use	Kec. S. Pandan Ha.	Kec. S. Pandan % area	Kec. D. Panggang Ha.	Kec. D. Panggang % area	Kec. Babirik Ha.	Kec. Babirik % area	Total Polder Ha.	Total Polder % area
Irrigated rice fields	1837,5	80,67	756,25	85,91	1075	33,60	3668,75	57,71
Floating vegetation	0	0	99,25	11,28	1634,75	51,09	1734	27,27
Open water	0	0	0	0	431,25	13,48	431,25	6,78
High ground	440,25	19,33	24,75	2,81	58,5	1,83	523,5	8,24
Area of Kecamatan	2277,75	100	880,25	100	3199,5	100	6357,5	100

Source : Plotting of topographic maps on the 1/50,000 scale. No. 14/IXi and 14/IXs. OTCA (Japan) and Departemen Pekerjaan Umum dan Tenaga Listrik, Direktorat Jenderal Pengairan. 1974 (based on 1972 aerial photographs)

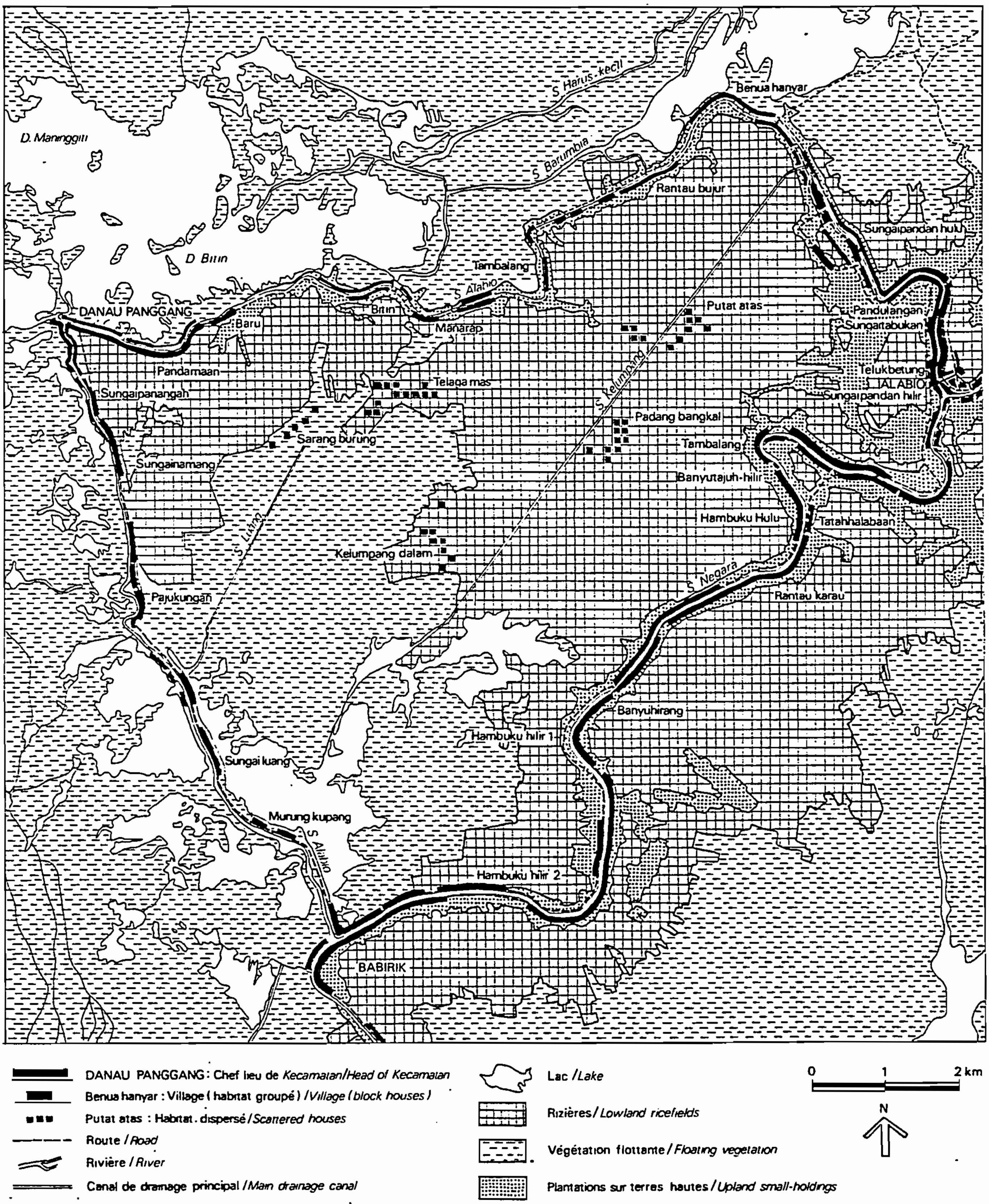
The zone's topography is far from being level. Absolutely no peneplanation, no leveling, was carried out during the separation of the lots and the distribution of the parcels. The result is a lumpy collection of depressions and hummocks scattered in a haphazard manner. Naturally, in these conditions, the set of pumps dries out some ricefields while others are still flooded, and, vice, versa, submerges some parcels as it irrigates others. This is a permanent source of conflict between the farmers.

To this is added the main incline of the polder which turns north to south. To the north at Teluk Betung the average altitude is from 3.25 to 3.5 m while at Babirik in the south it is only 3 meters. A slight slope was intended in the initial project so that water circulation would be easier, but from slight, the slope of the perimeter has become such that the entire southern section of the polder has become a lake: at Babirik and in the surrounding villages 70 to 90% of the parcels are now unfit for agricultural use. Not only are the pumps incapable of draining the zone but they also help make the problem worse.

Indeed, the polder's main drainage canal is 11.5 kms. long whereas the Negara River from Alabio to Babirik covers 16 kilometers. Obviously, in these conditions, pumping diverts water from the Negara and modifies its profile in length, while the current accelerates and the erosive power of the river increases. Progressively, the average level of the southern section of the polder is lowered while the waterways which meander without the dikes silt up, become clogged, and rise. This has become a vicious circle: the more the water accumulates at Babirik, the more one must pump; the more one pumps, the more the level of the polder drops and the deeper the southern lake becomes. The central drainage canal has practically become the main bed of the Negara River, whose former bed now only serves as a defluviation canal! In the end, due to the lack of lateral drains outside the embankments, the negative results on rice cultivation can become catastrophical for

31. L' OCCUPATION DU SOL DANS LE POLDER D'ALABIO

LAND-USE IN ALABIO POLDER



Source : Cartes Topographiques 1/50.000e Nos. 14/IX-i et 14/IX-s
DEPARTEMEN PEKERJAAN UMUM et OTCA - Tokyo 1974

the entire polder: the difference between the level of the backed-up Negara and the top of the dike is in some places so small that a heavy flood will end up washing everything away.

VIII.3.2. Misunderstandings born of different ethnic experiences

Problems of a cultural nature are the most delicate ones to solve, as they explain the rivalry between the various economic actors. The ethnic experiences of the different human groups and the perception each has of the landscape, are so diverse that the way the land is used can only be incoherent. The polderized zone is therefore divided between rice farmers, fishermen, itenerant merchants, and duck breeders. The interests of each are rarely convergent, and conflicts are frequent.

VIII.3.2.1. Differences in population densities that are too pronounced, and an aberrant distribution of the habitat

In 1984, the total population of the 44 villages that make up the polder was 37,097 inhabitants, which represents 50.22% of the population of the three kecamatans[1] that cover the diked-in perimeter. The densities range from about 50 inhab/km^2 to more than 400, which does not fail to provoke differences in opinion between those who favor intensive agriculture and those who prefer an extensive economy (Table No.24). The northern part of the polder, especially Kecamatan Sungai Pandan, is on the average the most densely populated (163 inhab/km^2, with agricultural densities that sometimes reach 470 inhab/km^2). On the other hand, in the southern part of the polder, the average densities drop to 106 inhab/km^2, or even, in places, to 55 inhab/km^2 (Fig. No.32).

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[1]"Kecamatans" Sungai Pandan, Danau Panggang, and Babirik.

TABLE No. 24

Population and Densities in the Alabio Polder

- 1984 -

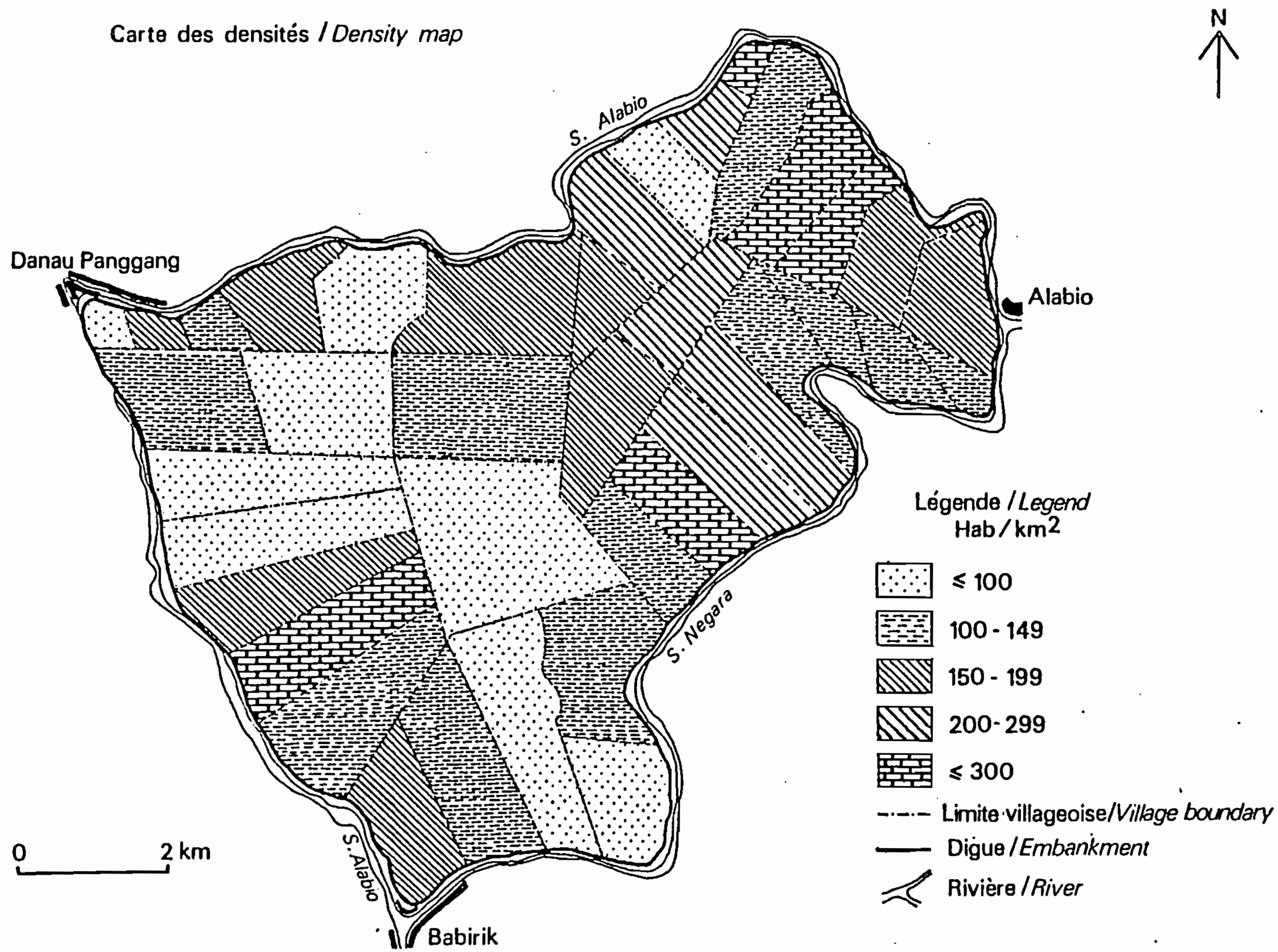
Kecamatan ˣ	Villages	Hab	Densities Hab / Km^2
Sungai Pandan	Banua Hanyar	705	470
	Teluk Betung	1324	189
	Pandulangan	957	101
	Teluk Cati	1142	104
	Galagah	624	312
	Nelayan	845	422
	Sungai Tabukan	2145	153
	Rantau Bujur Hulu	774	258
	Sungai Haji	557	223
	Rantau Bujur Tengah	541	54
	Rantau Bujur Hilir	830	259
	Tambalang Raya	674	204
	Tambalang Kecil	879	146
	Tambalang	570	139
	Tambalang Tengah	477	140
	Hambuku Hulu	1076	120
	Hambuku Raya	561	224
	Putat Atas	600	240
	Hambuku Tengah	542	361
	Teluk Sinar	501	143
	Pandang Bangkal	617	176
	Hambuku Pasar	586	234
	T o t a l	17527	163
Danau Panggang	Danau Panggang	1653	92
	Sungai Namang	663	124
	Pandamaan	1422	151
	Darusalam	1410	114
	B a r u	617	152
	Sarang Burung	516	99
	B i t i n	1624	65
	Manarap	1422	288
	Manarap Hulu	778	158
	Telaga Mas	975	102
	T o t al	11080	112
Babirik	Murung Panti Hilir	1054	170
	Murung Panti	1180	105
	Hambuku Hilir	438	70
	Sei Luang Hilir	974	433
	Sei Luang Hulu	562	173
	Sungai Dalam	952	90
	Pajukungan Hilir	496	55
	Kalumpang Dalam	664	72
	Kalumpang Luar	488	130
	Pajukungan Hulu	664	89
	Hambuku Baru	425	80
	Hambuku Lima	593	112
	T o t a l	8490	106
	General total	37097	129,63

Note : ˣThe total number of villages in each Kecamatan is not an integral part of the polder.

Source: Offices of the different Kecamatan concerned.

32. POLDER D'ALABIO / *ALABIO POLDER*

Carte des densités / *Density map*



Note : Le nombre de villages ne correspond pas à celui du tableau de population, certains villages ont fait l'objet d'un dédoublement administratif.
The number of villages is not the same as in the population table because of a new administrative division

Sources : Recensement / *Census* - 1984

TABLE No. 25

Distribution by area of the smallholdings
(Alabio - June 1984)

Area (borongan)	Teluk Betung		Galagah		Tambalang		Putat Atas		Darussalam		S. Namang		Total sample	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
< 5	0	0	0	0	0	0	0	0	0	0	2	15,38	2	2,44
5 - 9	0	0	1	7,69	2	10,53	0	0	0	0	4	30,78	7	8,54
10 - 14	3	33,33	7	53,86	5	26,31	1	7,14	5	35,70	3	23,08	24	29,26
15 - 19	3	33,33	2	15,38	4	21,05	2	14,29	0	0	1	7,69	12	14,64
20 - 24	1	11,11	1	7,69	2	10,53	1	7,14	2	14,29	0	0	7	8,54
25 - 29	1	11,11	2	15,38	3	15,79	1	7,14	2	14,29	1	7,69	10	12,19
30 - 34	0	0	0	0	3	15,79	2	14,29	2	14,29	0	0	7	8,54
35 - 39	0	0	0	0	0	0	2	14,29	0	0	0	0	2	2,44
40 - 44	0	0	0	0	0	0	0	0	0	0	1	7,69	1	1,22
45 - 49	0	0	0	0	0	0	1	7,14	0	0	1	7,69	2	2,44
≥ 50	1	11,12	0	0	0	0	4	28,57	3	21,43	0	0	8	9,75
Total	9	100	13	100	19	100	14	100	14	100	13	100	82	100

Source : Field surveys, June 1984. 1 ha. = 35 borongan
Average area of the exploitations: Teluk Betung: 21.11 b (0.60 ha.); Galagah: 14.66 b (0.42 ha.); Tambalang: 18.37 b (0.52 ha.); Putat Atas: 36.79 b (1.05 ha.); Darussalam: 27.79 b (0.79 ha.); Sungai Namang: 14.65 b (0.42 ha.).

Notes : 1. Sharecropped land that is not cultivated by the owners in the sample is not taken into account.
2. Land located outside the polder, in other villages, ..., is not included (see Table No.29).

The habitats are grouped together; the villages all have a single street and are scattered along the embankment, except for five recently-installed villages in the center of the polder[1] (Map No.31). This is absolute heresy as far as water management goes, for these villages, which make up a solid 9% of the population of the polder, or 3300 inhabitants can only be reached by boat, and, obviously, to get supplies to them one must cross the dike, thus open the sluice gates, and therefore ruin all the efforts the Public Works Services have made to dry out the zone!

VIII.3.2.2. The rice-growing North: small landholdings intensification, and demands

There is a correlation between high densities and amount of rice cultivation. Thus, 80 to 85% of the highly populated kecamatans, Sungai Pandan and Danau Panggang, is covered in rice fields (Table No.23).

The study of the three villages of Teluk Betung, Galagah, and Tambalang makes the analysis more precise. The small-holdings are not very extensive: 67% of the smallholdings at Teluk Betung, 77% of those at Galagah, and 58% of those at Tambalang are no more than 19 borongan[2] in size, which is about half a hectare. This is a striking contrast with the polder's central villages; for example, in Putat Atas 50% of the smallholdings are more than one hectare in size (Table No.25).

In terms of exploited parcels, (Table No.26) the contrast is even more significant. For the entire polder, more than 64%

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[1] A few temporary set-ups have received the status of "village"; Kalumpang Dalam and Sarang Burung in the late 1970's; Padang Bangkal, in 1979, and Putat Atas, in 1981.

[2] "Borongan" = surface unit corresponding to 10 armspans X 10 armspans; 1 ha. = 35 borongan.

TABLE No. 26

Distribution by Area of Cultivated Parcels

(Alabio – June 1984)

Size of parcels (borongan)	Putat Atas		Tambalang		Teluk Betung		Galagah		Darussalam		S. Namang		Kalumpang Luar		Murung Panti		Recapitulation	
	Freq.	% total	Freq.	% total	Freq.	% total	Freq.	% total	Freq.	% total	Freq.	% total	Freq.	% total	Freq.	% total	Freq.	% total
< 5	2	5	0	0	6	17,14	3	8,82	0	0	2	7,14	3	5,88	1	4,35	17	5,82
5 - 9	15	37,5	24	54,54	21	60	13	38,24	10	27,03	10	35,71	9	17,65	4	17,39	106	36,30
10 - 14	9	22,5	18	40,90	6	17,14	14	41,18	10	27,03	8	28,58	15	29,41	2	8,70	82	28,08
15 - 19	5	12,5	1	2,28	1	2,86	1	2,94	7	18,92	2	7,14	7	13,73	6	26,08	30	10,27
20 - 24	4	10	1	2,28	0	0	2	5,88	3	8,11	4	14,29	4	7,84	2	8,70	20	6,85
25 - 29	0	0	0	0	0	0	0	0	2	5,40	2	7,14	0	0	0	0	4	1,38
30 - 34	1	2,5	0	0	0	0	1	2,94	0	0	0	0	9	17,65	2	8,70	13	4,45
≥ 35	4	10	0	0	1	2,86	0	0	5	13,51	0	0	4	7,84	6	26,08	20	6,85
Total	40	100	44	100	35	100	34	100	37	100	28	100	51	100	23	100	292	100

Source : Field surveys, June 1984. 1 borongan = 10 armspans x 10 armspans 1 ha. = 35 borongan
No. of exploitations surveyed per village: Putat Atas: 15; Tambalang: 20; Teluk Betung: 10; Galagah: 16; Darussalam: 16; Sungai Namang: 16; Kelumpang Luar: 22; Murung Panti: 8.

TABLE No. 27

Land-use Methods

(Alabio - June 1984)

Villages	Owner Farms			Sharecropping			% of exploit in mixed use (owner farms + share cropping (3)	Mortaged land % of area	Non farming owners % of area
	% area of sample in owner-farms	% of no.of T exploit in sample in owner-farms (1)	Average area of properties farmed by the owner (borongan)	% area in sample share-cropped	% of no.of exploit share-cropped (2)	Average area of land in share-cropped (borongan)			
Putat Atas	34,19	66,67	12,4	65,81	80	23,87	53,33	0	0
Tambalang	52,18	75	10,15	43,96	65	8,55	45	0	3,86
Teluk Betung	30,06	60	8,65	23,05	60	14,3	20	0	46,89
Galagah	64,78	56,25	13,22	35,22	43,75	7,19	6,25	0	0
Darussalam	91,46	93,75	35,5	7,57	18,75	2,94	12,5	0,97	0
Sungai Namang	63,69	75	12,5	36,31	56,25	7,12	37,5	0	0
Kalumpang Luar	94,60	81,81	43,84	3,93	13,63	1,82	0	1,47	0
Murung Panti	96,99	87,5	60,41	0	0	0	0	3,01	0

(1), (2), (3), Sum of percentage is greater than 100 due to the possibility of multiple answers.

1 borongan = 10 armspans X 10 armspans; 1 ha. = 35 borongan.

Number of exploitations surveyed per village: Putat Atas, 15; Tambalang, 20; Teluk Betung, 10; Galagah, 16; Darussalam, 16; Sungai Namang, 16; Kalumpang Luar, 22; Murung Panti, 8.

Source : Field Surveys.

TABLE No. 28

Distribution by surface area of parcels exploited as owner-farms

(borongan)	Tambalang		Teluk Belung		Galagah		Darussalam		S. Namang		Kalumpang		Murung Panti		Putat Atas	
	Freq.	% total	Freq.	% total	Freq.	% total	Freq.	% total	Freq.	% Ttotal	Freq.	% total	Freq.	% total	Freq.	% total
< 5	1	6,67													1	10
5 - 9	5	33,33			1	11,11	1	6,67	6	50	1	5,55			1	10
10 - 14	3	20	1	16,67	5	55,56	4	26,65			3	16,67	2	28,58	1	10
15 - 19	2	13,33	3	50			1	6,67	1	8,33	3	16,67			2	20
20 - 24	1	6,67					1	6,67	3	25	1	5,55			2	20
25 - 29	2	13,33	1	16,67	2	22,22	1	6,67							1	10
30 - 34	1	6,67					1	6,67							1	10
35 - 39													1	14,28	1	10
40 - 49									2	16,67	5	27,78				
50 - 59							3	20								
60 - 69							1	6,67			2	11,11	1	14,28		
≥ 70			1	16,66	1	11,11	2	13,33			3	16,67	3	42,86		
Total	15	100	6	100	9	100	15	100	12	100	18	100	7	100	10	100

Source : Field Surveys.

of the parcels have an area of between 5 and 14 "borongan" (0.14 to 0.4 ha.) but in the northern part at Teluk Betung 77% of the rice fields are less than 0.25 ha. (9 "borongan") in area, while on the contrary, to the south at Murung Panti, 43% of the parcels easily surpass half a hectare (20 "borongan").

If the analysis is narrowed down to the level of the land-use methods (Table No.27), one notes that the northern and western parts of the polder are exploited by small farmers who own their land (nearly 65% of the areas and more than 56% of the exploitations at Galagah; more than 90% of areas and exploitations at Darussalam) whereas sharecropping is widespread in the central part of the polder only (65 to 66% of the areas and 80% of the number of parcels at the village of Putat Atas).

The analysis in frequency of the distribution by surface area of the parcels exploited as owner farms (Table No.28) only corroborates the general impression of a small-scale, owner-operated though rather hard put for room, farming which has no other possibility than to intensify its rice cultivation, which has notably attempted to obtain two annual harvests on the same plot, but which as a result is very demanding in terms of water management.

As a result, it is impossible for such farmers to accept the southern inhabitants' demand that the polder be placed under several meters of water at least once a year. One group sees flooding as a means to fertilize the rice fields and drown the small rodents that cause so much damage to the harvests during the period of reproduction, while the other, who use fertilizers and protect their crops from predators with plastic screens around the parcels or poisons, see flooding as the ruin of their efforts to obtain a second yearly harvest.

Along this same line, the rice farmers in the north insist that their parcels be irrigated if need be and refuse to consider the demands of the inhabitants of Babirik for whom drainage is the only solution.

The sources of conflict are so frequent that the Public Works and Agricultural Services, for whom agricultural progress is a by-product of intensification, have decided to favorize the northern part of the polder: at the level of Kecamatan Danau Panggang, the central embankment divides the polder into two distinct zones. Actually, it is the level of the water in the north of the polder where development is intensive that determines whether or not the water regulation services intervene; the southern and south-central zones, thus sacrificed, turn to other speculations.

VIII.3.2.3. Devastating competition: fishermen and duck breeders

Immediately to the west of the northern kecamatan of Sungai Pandan, there is a greater proportion of lakes and areas of either open water or, here and there, floating vegetation, of the water lily or duckweed sort. Lake Maningiti-Bintin and Lake Panggang respectively cover 1070 and 162 ha. To the west, Kecamatan Danau Panggang alone has more than half the lacustrian surfaces, and Kecamatan Babirik has more than a third. However, only the latter has lakes both outside and inside the diked-in perimeter.

The calculation of the ratio of the number of hectares under rice in the polder to the number of inhabitants in the same polder gives figures that are extremely low in Kecamatan Danau Panggang (0.07 ha. under rice per inhabitant), though it is true that these figures are still very average in the other kecamatans (0.10 and 0.13 ha. per inhabitant). However, a qualifying factor must be added: outside of the polder below the surrounding dike, 1305 ha. and 575 ha. have been made into rice fields beyond the flood level of the Negara, in Kecamatans Sungai Pandan and Babirik (Table No.29 and Map No.31). This is the framework of the Baker polder that was never realized. In terms of the above-mentioned ratio, the divergence is consequently very clearly marked between Kecamatan Danau Panggang, where rice cultivation is minimal, and the two other kecamatans where nearly 0.20 ha. of rice field is available per inhabitant.

TABLE No. 29

Distribution of lakes

Kecamatan	Area in open water Outside polder ha.	Inside polder ha.	% total area of lakes
Sungai Pandan	332,5	0	13,97
Danau Panggang	1232,5	0	51,79
Babirik	383,75	431,25	34,24
T o t a l	1948,75	431,25	100
General total	2380		

Source : plotting of Map No. 31 "Land Use in the Alabio Polder"

Areas under rice per inhabitant

Kecamatan	Population of villages in polder -inhab-	Area under rice in polder ha.	Area under rice outside polder ha.	Ratio Ha. rice in polder / inhabitants	Ratio Whole area under rice / inhabitants
Sungai Pandan	17527	1837,5	1305	0,10	0,18
Danau Panggang	11080	756,25	0	0,07	0,07
Babirik	8490	1075	575	0,13	0,19
T o t a l	37097	3668,75	1880	0,10	0,15

Source : plotting of Map No. 31, "Land Use in the Alabio Polder"

It is thus easier to understand how the proportion of farmers with respect to the total working population drops to 23% in Kecamatan Danau Panggang while that of fishermen is nearly 45% (Table No.30). This contrast in the structure of the activities does not exist without causing problems between neighbors. The fishermen stretch their nets across the defluviation canals outside the polder, but they also block the drainage ditches inside the polder with fish traps made of rattan. Furthermore, the very best places to fish are former rice fields that have been flooded after the harvest, and it is very tempting to fish in such places from a boat in December and January while the polder is under water. Yet a great deal of damage is done to the bunds whenever they must be crossed by boat-

The conflicts get even worse as the villages located in the center of the polder decide to complement their fishing with duck breeding. Actually, the association of ducks and ricefields is excellent as a rule, since as the ducks dabble about, they clean the parcels. However, their numbers, estimated at nearly 30,000 ducks in Kecamatan Babirik alone, are something of a problem. A weekly supply of food for a 160-duck farm comes to: two 20-odd kilo bags of feed, 40 kgs. of dried fish, and in the range of five sago palm trunks which will be cut up and shredded! The manufactured feed comes from Amuntai via Alabio, the dried fish from Danau Panggang, and the sago from the north-northwestern part of the polder. All is carried by boat, which means that for each trip, the sluice gates must be opened which naturally results in at least a momentary flooding; the boats circulate in the drainage ditches and, to make the trips shorter, the heavy barges are pushed or pulled using ropes over the top of the irrigation canals that overhang the drainage ditches! In fact, the installation of the polder upset the whole traditional circulation network.

TABLE No. 30

Activities in the southern part of the polder

Type of activity	% of working population Kecamatan Babirik	% of working population Kecamatan Danau Panggang
Farmers	58.65	22.96
Agricultural workers	6.20	-
Fishermen	27.13	44.70
Small-scale merchants	2.28	3.85
Owners of rice mills	0.16	-
Carriers (Klotok)	0.50	-
Civil Servants	3.28	1.41
Retired civil servants	0.27	-
Other (craftsmen ...)	1.53	27.08
TOTAL	100%	100%

Source : Kecamatan offices, Babirik and Danau Panggang June 1984.

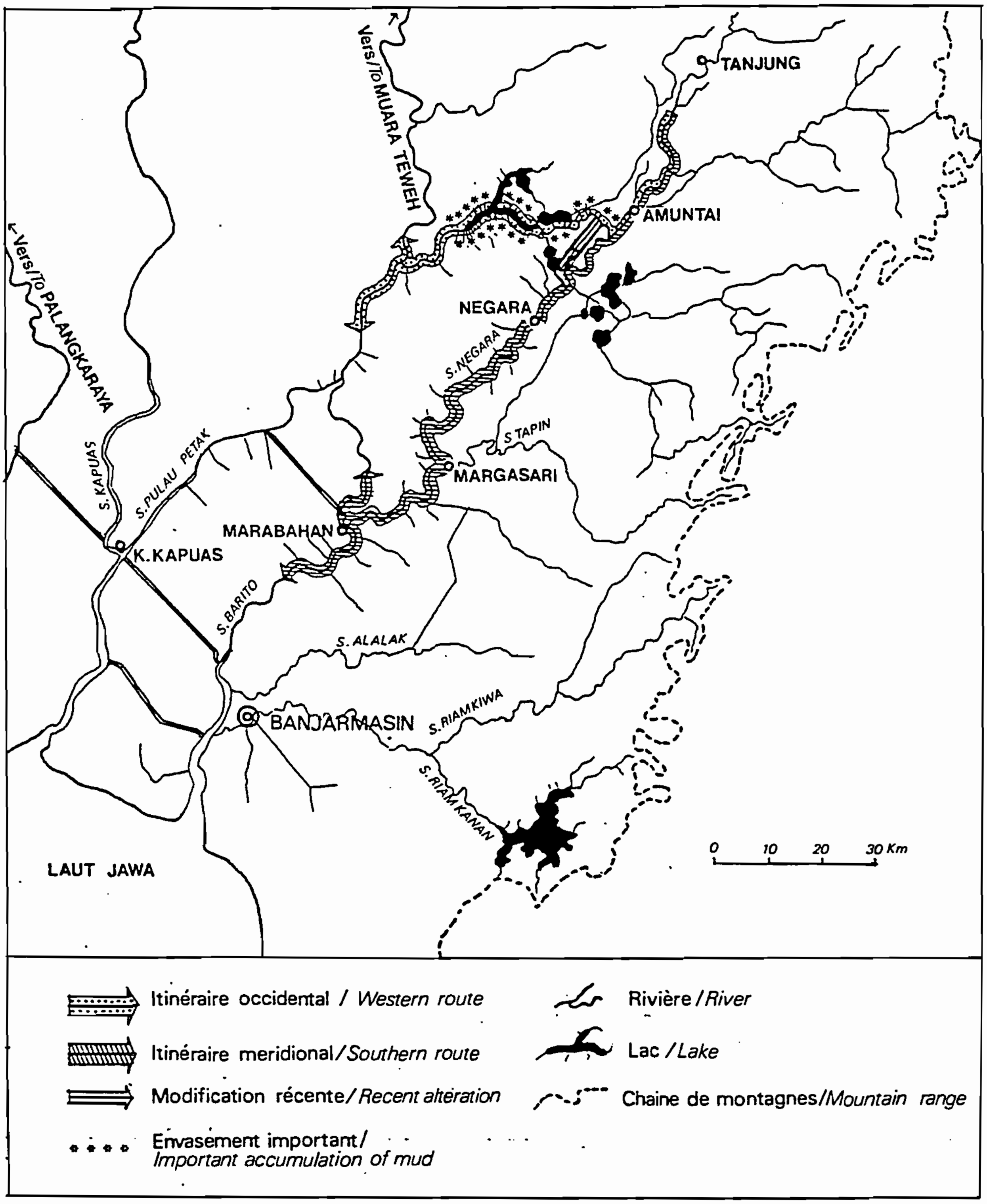
VIII.3.2.4. The disorganization of the traffic routes (Map No.33)

Traditionally, and up to the early 1950's, river traffic from Tanjung and the northern part of the Hulu Sungai region circulated towards the Barito along two main routes. The southern route meant going to Banjarmasin in the south by taking the Negara River at Amuntai, finally reaching Marabahan and the Barito via Babirik, Negara, and Margasari. The western route began on the Alabio River at Amuntai, crossed the Danau Panggang before moving straight west via the Utar River, to enter the Paminggir and finally the Barito below Jeramas. This itenerary offered the advantage of either a short cut back up the Barito to Muara Teweh, or going down the Barito to Marabahan, or else cutting west to Kuala Kapuas via the Pulaupetak River. From Kuala Kapuas it was possible to reach the Kapuas and the Kahayan rivers, thus to travel in Dayak country as far as Palangkaraya, Kuala Kurun, and Tewah via Pulang Pisau and the Basarang canal.

The construction of the polder had two effects whose consequences are fundamental for river traffic. The main bed of the Negara River moved west insofar as the drainage canal with its two pumping stations captured it, and the construction of the embankments and the modifications that were brought about in the flow caused the silting-up and blockage of the Alabio River which winds its way to the north and west of the polder. With such conditions the western route via Danau Panggang is more and more difficult to follow, especially during the dry season, when the southern route is preferred. To get from Tanjung to Muara Teweh during the dry season, one must now go through Marabahan!

But moreover - and the consequences are hard on agriculture - one must take the Kalumpang River and thus cross the entire polder! This means that the sluice gates are constantly besieged, opened and closed no longer at the rice farmers' request but at the demands of the traveling salesmen!

33. LES MODIFICATION APPORTEES AU RESEAU DE CIRCULATION PAR LE POLDER
CIRCULATION NETWORK ALTERATIONS DUE TO THE POLDER



These merchants carry even more weight if they have invested in rice-growing land. Thus, at Teluk Betung, a village of extremely meticulous rice farmers who are very concerned with water control 23% of the fields are sharecropped, and of these 23%, 31% are owned by merchants. At Putat Atas, 65% of the fields are sharecropped, and of these fields, more than 51% belong to merchants (Table No.31). Under such conditions how could one refuse the latter the possibility of circulating within the developed zone, despite the farmers' complaints? In fact, the real problem is the organization of the strong, structured farming community.

VIII.4. Cultural data that have been poorly considered

Though it is true that many of the polder's misfortunes are due to poor technical mastery, it is nonetheless true that these deficiencies cover for the most part misunderstandings between people: the weak bonds within the farming community, but also the Dutch planning that naively neglected to take into account the amount of historical and ethnic tradition and that formed Indonesian engineers who, nowadays, are completely lost.

VIII.4.1. A farming community whose cohesion is far too weak

Faced with the pressure group made up by the merchants, the farmers are far too poorly organized. When a decision that is vital to agriculture must be made, such as the choice between irrigating or draining or else when a dike must be repaired, the farmers cannot manage to make their wishes respected, and if need be punish those who go against them.

At any rate, water management is beyond them. This function is the exclusive domaine of the Public Works Services who maintain and run the pump stations and open and close the sluice gates according to the case. The farmers' requests are made through the intervention of a few HIPPA (Himpunan Petani Pemakai Air,

TABLE No. 31

Distribution of surface areas that are Sharecropped in function of the Social Origin of the Owners

Villages	% areas Sharecropped	Distribution of sharecropped fields in function of proprietor's social origin			
		Merchants %	Farmers %	Diverse civil servants %	Teachers %
Teluk Betung	23,05	31,30	46,64	0	22,06
Galagah	35,22	17,89	65,26	16,85	0
Tambalang	46,96	0	90,27	9,73	0
Putat Atas	65,81	51,12	36,87	0	12,01
Darussalam	7,57	21,28	78,72	0	0
Sungai Namang	36,31	31,17	68,83	0	0
Kalumpang Luar	3,93	34,29	65,71	0	0
Murung Panti	0	0	0	0	0
Recapitulation for the total sample		32,46	56,52	3,03	7,99

Source : Field Surveys - June 1984.

or "Water-Using Farmers' Association"). The speakers for these associations communicate the farmers' wishes to the Public Works Services, who act in consequence.

However, such associations are far too few in number, with only 5 or 6 for the entire zone, and furthermore, they are not very structured. Many farmers do not belong to any association, or do not even know they exist or what they stand for. Therefore, it is sometimes the village headman, encouraged by the villagers, who goes to the pump station and tries to make his point ... In short, there is a weakness in the farmers' organization, a weakness which might be called "consubstantial" since it is part of a continuing historical tradition.

VIII.4.2. The colonization of the Hulu Sungai region: a history of peopling which is not comparable to that of organized rice farmers

It has been seen that the constitution of the Banjar people happened over a long period of time through the massing together and assimilation of diverse peoples: Malays, Javanese, Bugis, and especially Dayaks. The result is a sort of heterogeneity which is particularly evident in the Hulu Sungai region where the amount of Dayak ancestry is still very great. In the XVIIIth century, the Dayaks of the Maanyan group lived in this area; the Banjars who came to grow pepper pushed many of these people further back, especially around Tamiang Layang, but they also assimilated a large part of the original group. It was therefore an "intermediate" Dayak-Banjar people who developed the Hulu Sungai. This colonization was carried out by small groups of individuals who never formed a true State like those of the coastal sultanates and whose tradition of individualism has always been very marked.

The colonization was done by following the rivers, and even today this can be seen in the dwellings that are almost always on the river banks and the houses built on piles in the purest Dayak tradition. The waterways are and always have been the favorite traffic routes, whereas the network of roads added by the Dutch between WWI and WWII is still not really a principal for organization.

VIII.4.3. Diverse analyses of the landscape

This multiplicity of cultural influences explains many of the misunderstandings. The Dutch only saw this landscape as a lowland to be polderized. They completely forgot that a polderized zone is not only a developed landscape but also a highly-structured farm community that is capable of affirming itself, of establishing its own rules and which feels the need to intensify its agriculture. The Dutch wanted to recreate a landscape with which they were familiar, and while the natural environment answered their wishes, the local populations have still not understood.

The majority of the population, which calls itself Banjar but which is in reality of Dayak ancestry, sees the landscape in another way. The inhabitants of the five villages in the central part of the perimeter have not yet "caught on" that this is a polder. The main drainage canal is still, in their eyes, the Kalumpang River. These people are recent immigrants who set up house along the canal, on piles as they would have done on any other river in Borneo. They fish, they travel by boat, and they supremely ignore the dike! And as paradoxal as it may seem, this is in short the revenge of the pushed-out Dayaks who are reclaiming their territory!

The Indonesian engineers who are in charge of the polder's upkeep are themselves prone to these various analyses of the landscape Trained in the Dutch school of hydraulics, they try to control the flooding and the movements of the water table, bu they see with Javanese eyes. For them, agricultural progress is made through "perfect" cultivation methods. Two transplantations of the paddy before it is finally set out is, to the engineers, absurd, even wasteful. They have not assimilated the cultural addition of the Banjar for whom these transplantations are above all a security, a sort of insurance against the brutality of the river. The introduction of the short-cycle, selected varieties, even to allow for two harvests a year, is not necessarily progress if water control is not perfect. In fact, it is no progress at all, and can even be a disaster: selected varieties are ruined if they are under water for more than eight days. The farmers have fully understood this, for every year the areas of the zones cultivated in this manner get smaller.

CONCLUSIONS AND RECOMMENDATIONS

Throughout this report, we have made a general survey of the problems of water control in South Kalimantan and examined the solutions elaborated by the various groups: Dutch, Banjars, and Indonesian. Diverse instructions must be taken from these experiences, be it in order to strengthen the potentialities of the existing Transmigration Centers or to facilitate the installation of new projects in the neighboring province of Central Kalimantan, especially in the low coastal plains which offer the same constraints but also the same possibilities.

With this in mind, the following recommendations have been organized around two themes:

- Evaluation and instruction
- Concrete proposals for the development of the lowland valleys.

I. Evaluation and instruction

At first glance, the most obvious findings are very disappointing: the greater the amount of development, the less convincing the results. Thus the yields in paddy drop off from Pemakuan and Gudang Hirang in the Banjarmasin area (traditional development), to Barambai and Sei Luang (Transmigration of the "garpu" type), as well as from Barambai to Alabio (polder)!

Henceforth, one can deduce that progress is not necessarily the outcome of large, haphazardly-made investments whose profitability is not always certain. What should be sought are harmonious relationships between the natural surroundings, knowhow, the populations' technical level, and the chosen speculation. These themes will guide the following remarks.

I.1. Analysing the potentialities and constraints of the environment

Before developing an area and opening large works sites, it is absolutely necessary to be throughly familiar with the natural surroundings and to have analysed them in detail.

A concrete example will provide a clearer idea of the stakes. Simply stating that southern Kalimantan is made up of a mountain range, a piedmont, and a lowland plain does not suffice; one must also pinpoint and map the different regions on one hand and acquire more knowledge about them on the other. Only after intensive studies have been done does one realize that the lowland plain is far from homogeneous and that it is actually divided into three sub-regions which each have their own specific characteristics which require different development methods in each case (coastal swamplands, lake region, peaty plain - Chapter 1). A greater understanding of the lowland plain and the amphibious phenomena would have prevented the installation at Sei Luang of a Transmigration Center of the "garpu" type which is supposed to use the tidal bore force, in an area where there is none (Chap. 7).

Besides a soil map, the nature of which we shall leave to the pedologist to determine, it is essential that one obtain information in the areas of hydrology, climatology, and topography.

I.1.1. Topography

The low coastal plains of southern Kalimantan, be they in the province of South Kalimantan or in the Province of Central Kalimantan, give a deceptive impression of homogeneity. Differences in altitude of about one meter, which are inconsequential in a mountainous piedmont zone, are in this case extremely important as far as hydraulic development is concerned. We have seen the catastrophical results that an uneven topography made up of the juxtaposition of hummocks and depressions can have on water management through the example of the Alabio polder (Chap. 8). One could also add the example of projects of the "garpu" type for whom irrigation is uncertain due to a slightly sloping terrain that makes drainage simpler but slows the progression of the tidal bore.

To avoid such problems, it would be preferable to have a set of precise topographic maps on various scales at one's disposal before setting up a project. To find the favorable sites, the best map is the topographic map on the 1/50,000 scale, or "Survey Map" under the condition that the spacing of the contour lines be about five meters[1]. For the actual installation of the development zones, one must have a 1/10,000 or even 1/5,000 -scale map. In this case, the amphibious nature of the mapped zone requires a spacing of the contour lines of about 10 centimeters, so that a water circulation map can be included.

1.1.2. Hydrography

The rivers that built the low coastal plains of Kalimantan are so great that today they condition both the traffic of men and goods and the development of the rice-growing perimeters (controlled-flooded fields - Chap. 8). To use them, it is indispensable to be very familiar with them, thus to plan for a series of hydraulogical stations.

The choice of these stations must be a judicious one. It is inconceiveable that such important rivers as the Barito or the Kapuas be left unstudied. Data must be available for at least three points on their courses (one station upstream, one at the entry to the plain, and one downstream).

The nature of the data must be revised. One cannot be satisfied with the rough standards, the flowspeed and area under

[1] Spacing the contour lines at 25m is not justified except in mountainous regions and is senseless in a swampy lowland plain. A 10-meter spacing is adapted to the topography of a midland composed of of plateaus and valleys that are not very deep.

water. There is a desperate need for data on the water quality and notably the turbidity. These figures are necessary to calculate the delta's progression, the evolution of the improved lowlands, as well as to evaluate the amount of fertilising limons that can be spread over the rice field.

Finally, the quality of the data must be above reproach. One must see to it that readings are taken daily and not just be satisfied with a few scattered data without ever knowing what prompted the technician to go in the first place (ebb tide, sharp rise in the water level, or whatever).

The "garpu"-type Transmigration Centers should be equipped with small, complementary stations that would help to better apprehend both movement and quality of the water. These small stations should in no way be substituted for the main water stations, whose purpose is to give a greater understanding of the flow of the major rivers, but they should act as complements and specialize in water management (daily oscillations in water level, turbidity, clinical quality of the water).

I.1.3. Climatology

The situation is more satisfactory as far as climatology is concerned, especially the reading of pluviometric data, though the series are not long enough, covering only 15 years or so.

What is mainly lacking are reliable data concerning temperature, windspeed, duration of daylight and cloud cover. Here again, a small weather station would be very profitably installed (especially if maintained), not in every Transmigration Center, but in each project that is representative of a type of development.

I.2. Evaluating the populations' "know-how"

This evaluation should have two aspects: that of considering both the techniques and the solutions used by the populations in the host province, and that of analysing the experiences, the capacities, and the "know-how" of the settlers.

1.2.1. Instructions provided by the Banjars' experience

The Banjars' experience provides three principal lessons: the use of the tides, the techniques of multiple transplantation, and the association of rice and orchards.

1.2.1.1. The use of the tide

The Banjar's greatest skill is to manage to judiciously use the tidal force by playing upon very slight differences in ground level, of about 10 cms. (Chapters 3 and 7). No plans are laid out beforehand; the landscape takes shape progressively with the connection of the different plots and the network of drainage ditches. This highly empirical method allows the Banjars to adapt to the least topographical differences, to estimate the tidal force at each point, and to avoid errors in implantation.

It would be most preferable to take heed of such pragmatism whenever the installation of a Transmigration Center is concerned. Instead of digging kilometers of canals with machinery - canals that are often too deep, ensuring drainage but much less often irrigation - why not simply dig the primary and secondary canals and leave the installation of the parcels to the Transmigrants? The important thing is to simplify the penetration of the interfluves, and to do this, to open canals that allow for the passage of small boats. Once this infrastructure is set up, the best thing is to let the Transmigrants carry out the development themselves. They will best use the environment's potentialities in function of their own crops.

1.2.1.2. The techniques of multiple transplantation

The Banjars have devised a technique of double transplantation of the paddy before it is planted out, which allows them not only to multiply the seed but also to obtain more resistant plants and above all to follow the variations in the waterlevel and base themselves on the rainfall cycle (Chapters 3 and 6).

Experience has proven that the distribution of selected seed, adapted to the intensive Javanese rice cultivation that benefits from a perfect method of water control (Chapters 7 and 8), is not a factor of progress on Kalimantan, at least for the moment. The paddy's too-short stems, the constraints of the growth cycle, and the considerable fragility of the selected varieties in general lead to catastrophes in a pioneer environment where hydro-agricultural development is still rudimentary.

This is why we must recommend, especially during the first years of the Transmigrants' installation, the distribution of local varieties of paddy that must be grown according to empirical techniques that have been perfected by the natives of the region (and not on Java!) and that have proven themselves reliable. The introduction of floating varieties of rice, perfectly adapted to delta environments, would be a positive measure.

Any intensification of rice cultivation can only be considered progressively, when water control is perfected. It is better at first to obtain modest but almost certain harvests than to risk a disaster in hopes of getting a prodigious yield. In the present state of affairs, it is foolhardy to count on a 5 to 6-ton/hectare harvest at the "garpu"-type centers.

1.2.1.3. The association of rice fields and orchards

Like in the lower Mentaya valley[1], the Banjars have succeeded in the combination both spatial and temporal, of food crops and

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[1] Regional Geography to Develop Transmigration Settlements: "The Lower Mentaya Valley". ORSTOM. Transmigration Project. PTA 44. Jakarta 1984. Chapter 7.

cash crops. In Central Kalimantan, they have come up with an original type of coconut grove, and in the zone around Banjarmasin they have created complanted areas that combine rice fields and orchards (Chapter 7).

This development model is very interesting to Transmigration for it allows the settlers to obtain stable rice supplies from the very first years while at the same time progressively entering the channel of commercial agriculture. After about 10 years, when the time comes to intensify the pioneer forms of agriculture and boost the center's economy, this system gives the transmigrants available cash to invest in agriculture.

The problems is to find an adequate speculation to combine with the rice-growing zones. This speculation must be able to thrive in an amphibious environment, must not require a great deal of labor, at least in the first years, and must have a ready market.

For this reason, citrus is the recommended crop (using the marcottage technique described in Chapter 7) for the areas around the large towns where there are large markets that can be reached without much difficulty, as such crops have high returns but are perishable. On the other hand, in the remoted valleys, products that pose no problem in terms of consumption and storage must be favored. Coconut palms seem the most appropriate in this case, even more so since the groves can, with time, lead to a small-scale industrialization (coprah fabrication, oil factories,...).

1.2.2. The Transmigrants' experiences and know-how

The experiences and the know-how of the migrant populations are two aspects that are at least as important to consider as the benefits that can be had from the experience of the host populations. It was seen in Chapter 8 that one of the polder's major problems is that it was conceived to permit intensive rice farming while the populations it is concerned with have made more extensive economic decisions.

Consequently, it is highly recommendable to reserve the intensive development projects of the polder type for those populations who are capable of grasping the sophistication of such projects. Only the Balinese, who practice meticulous rice cultivation, whose social ties are very strong, and who, more-over, are used to managing water through the organization called "subak", seem the most capable of benefitting from such infrastructures.

II. Development propositions

Two basic types of propositions can be made in light of the instructions taken from the link between water control and development: those that concern the rehabilitation and improvement of already-existing Transmigration Centers, and those that make up a list of new development proposals.

II.1. Improving the efficiency of existing centers

It was seen in Chapter 7 that in the "garpu"-type centers, though drainage is generally correct enough, the same cannot be said of irrigation. To improve the functioning of this type of project and be able to hope for better harvests, this second point must thus be ameliorated.

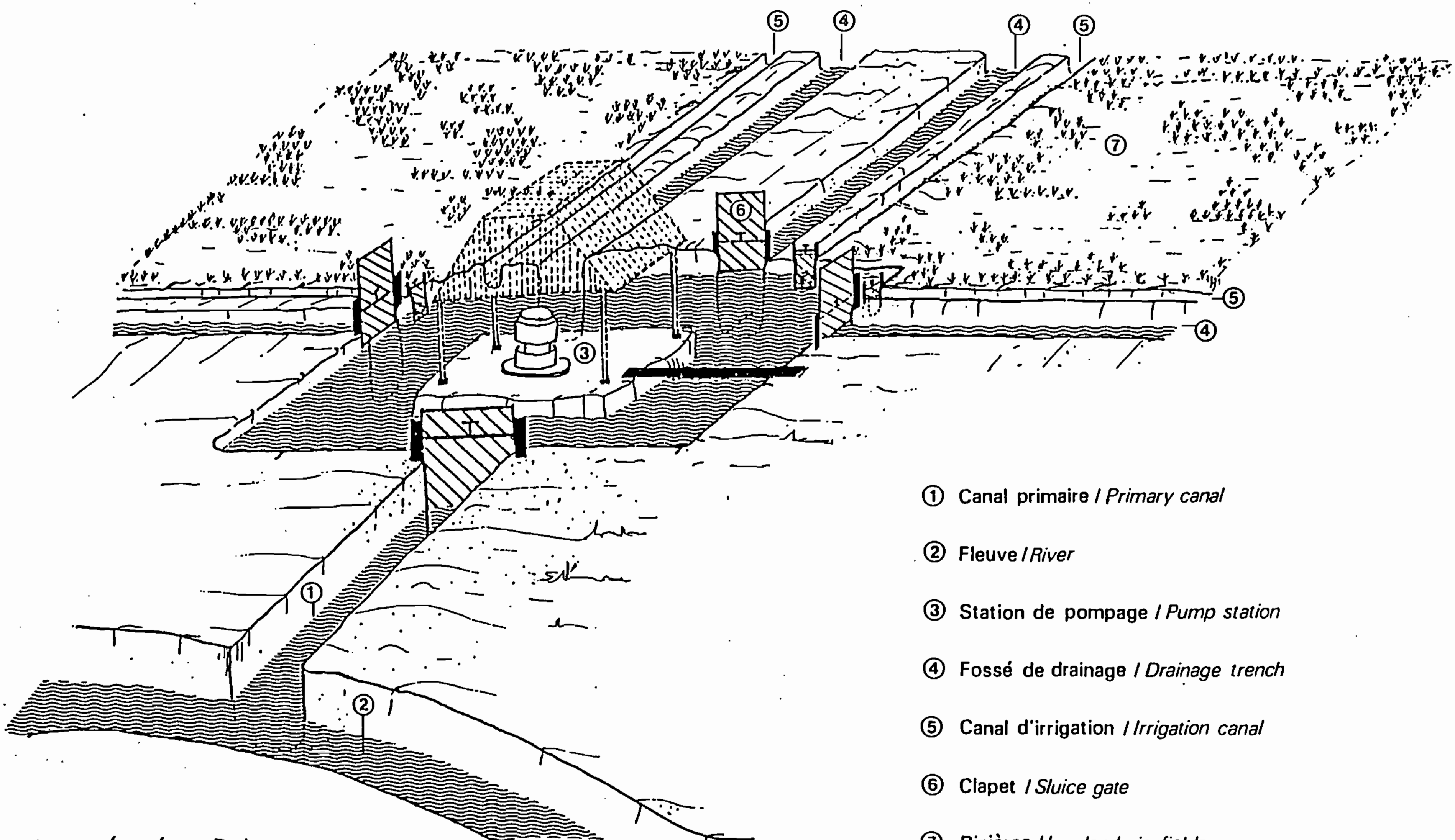
II.1.1. The first step

The best solution seems to be the installation of a double system of drainage ditches and irrigation canals along the same lines as that in use at Alabio. In this respect the primary and secondary canals that already exist retain their functions of circulation, drainage, and even irrigation while the tertiary and quaternary trenches remain simply for drainage. These ditches must be overhung with irrigation canals that supply the rice field by gravity.

To compensate the insufficient tidal force, the water is evacuated from the irrigation canals or sucked out of the drainage ditches with a system of pumps set up on both networks of drainage

34. PROJET DE STATION DE POMPAGE MIXTE : DRAINAGE ET IRRIGATION

DRAINAGE AND IRRIGATION PUMP STATION PROJECT



① Canal primaire / *Primary canal*

② Fleuve / *River*

③ Station de pompage / *Pump station*

④ Fossé de drainage / *Drainage trench*

⑤ Canal d'irrigation / *Irrigation canal*

⑥ Clapet / *Sluice gate*

⑦ Rizières / *Lowland ricefields*

Situation représentée : Drainage
A marée basse, l'eau des fossés de drainage est aspirée, les vannes des canaux d'irrigation sont fermées.

Depicted position : Drainage
At low tide, irrigation canals sluice-gates are closed, water-trenches are exhausted

drawn by BAMBANG.DS.

and irrigation as well as on the present primary or secondary canal (sketch No.34). A simple set of sluice gates makes it possible to use the same pumps for both drainage and irrigation.

When there is a need for irrigation, the pumps suck fresh water from the river beginning at the primary canal. To economize fuel and increase the pumping power, the pumps should be turned on at flow tide, when the water level rises naturally. The water is then pushed out of the irrigation canals and flows into the parcels due to gravity.

Conversely, when the rice fields are flooded the pumps must be turned on at ebb tide. The water is thus sucked out of the drainage ditches and flows into the river, again via the primary canal.

The pumps always function in the same manner; it suffices to work with the tides and use a system of sluice gates that open or close the irrigation and drainage canals according to the need.

II.1.2. The second step

Once these modifications in the canal networks have been made, the system can be further improved by building a circular dike around the project, in order to limit flood risks and economize the amount of pumping during the rainy season.

II.2. Development of the lower Katingan valley

The lower Katingan valley below Tumbang Samba could lend itself to an agricultural intensification through Transmigration[1].

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[1] For maps, consult the Atlas "Reconaissance Survey in Central Kalimantan". ORSTOM. Transmigration Project. PTA 44. Jakarta,,1981.

Development resembling the techniques used for polderization would be highly adapted.

There is a double advantage to such a solution. First, it would be virtually the only opportunity for Javanese or Balinese transmigrants to practise an intensive type of rice cultivation on Kalimantan. Second, from the point of view of regional development, it offers the possibility of beginning construction in the hinterland of the provincial capitol of Palangkaraya. The newly-opened road that links Kasongan to Palangkaraya would permit one to export the crops and to supply with rice a capitol that up to now has had to import all of its food from Java or else from Sulawesi via Banjarmasin.

The natural conditions are favorable. Below Tumbang Samba, the river winds; these are bed meanders. The river, which is not deply-cut, runs between two embankments, but defluviations are frequent, as are oxbows, and cut-offs. The floodplain, well-developed over three to four kilometers on either side of the banks though difficult to reclaim due to the risk of sudden submersion, could be profitably developed. The soils, though not exceptionally fertile, are of the alluvial gleysol type and are classed as "moderately suitable" by the pedologists[1].

The only constraint is the considerable amount of human occupation: 80% of the land has been cleared and appropriated. In view of organized migrations, one would have to provide reimbursement for the squeezed-out populations. However, this inconvenient aspect could be made into an advantage once the advantages of agricultural intensification have been explained to the local inhabitants who are hard-put for room. Such a movement towards intensifica-

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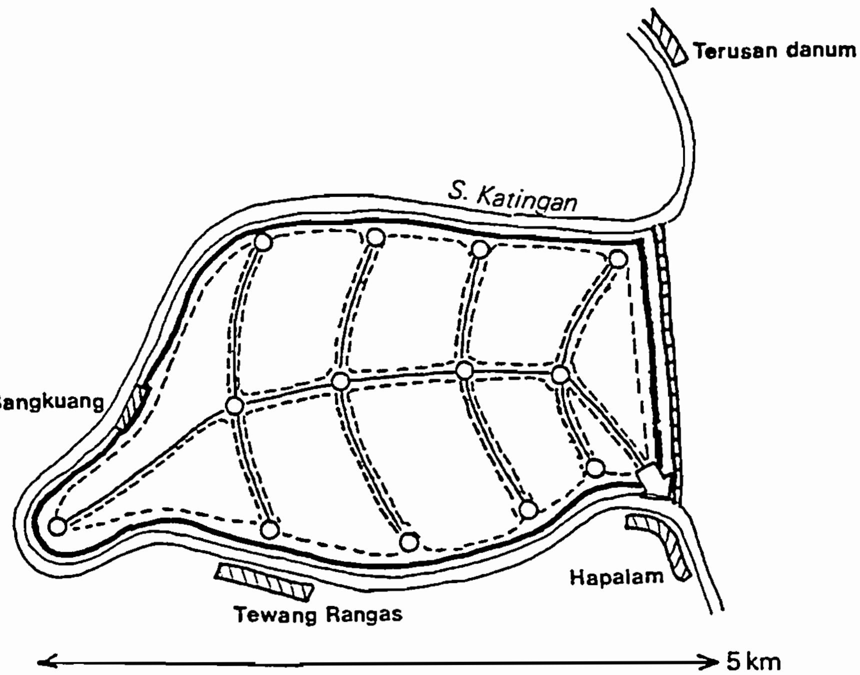
[1]Atlas op.cit., Map. No. 11 B.

35. AMENAGEMENT TYPE D'UN MEANDRE SUR LA MOYENNE KATINGAN
POLDER PATTERN ON THE MIDDLE KATINGAN VALLEY



- Fleuve / *River*
- Digue / *Embankment*
- Village / *Village*
- Canalisation d'un recoupement naturel / *Canalization of a natural cross-check*
- Fossé de drainage / *Drainage trench*
- Canal d'irrigation / *Irrigation canal*
- Station de pompage / *Pump station*

Note :

Il s'agit là d'un aménagement type, non d'un projet définitif. Une reconnaissance approfondie préalable est indispensable avant d'élaborer un plan definitif.

This is only a proposal pattern, not a ready-to-make project. A one more detailed reconnaissance study is necessaryto make it definitive.

tion crops up spontaneously at any rate. It is hardly possible any more to set up new rubber or rattan smallholdings, and increasingly difficult to clear new ladangs every year, which leads the Dayaks to develop the lowlands that were once disdained and which have nowadays become rudimentary rice fields.

Two types of development inspired by the polderization techniques can be proposed. The first concerns the middle valley and the second the actual lower valley wherever it benefits from the tidal bore phenomenon that has not yet been put to use.

II.2.1. In the middle valley

The standard development consists in cutting through a meander and building a circular embankment on the inside bank. The soil that is used to build the dike must come from the central part of the perimeter so that the zone will be situated below the level of the river. In this way, irrigation through gravity is possible.

Within the polder thus defined, a double network of drainage and irrigation canals linked to a single pumping station must be built according to the model previously described (Fig. No.35). In this way it should be possible to drain the fields after a heavy rain and irrigate them in the dry season.

As an example, a drawing has been made of a standard system (Fig. No.34). This is not a final project which only requires construction, but it is, based on a concrete situation, a proposition intended to help understand the development system that is adapted to the middle Katingan valley. Before undertaking any construction, a detailed study of the hydrology and the topography is necessary, as well as an estimation of construction costs and of the land available to Transmigration after relocation and indemnisation of part of the local inhabitants of the perimeter.

At any rate, it is only necessary to construct small zones of a thousand hectares or so. One of the biggest problems of the

Alabio polder is the surface area which is far too large (Chapter 8). Small perimeters are easier to develop and above all simpler to manage.

11.2.2. Downriver

Further downstream, the development method is more complex since to the risks of defluviation are added the chances of submersion caused by the twice-daily tides. Therefore, it is wiser to plan upon two pumping stations that provide more power than in the preceding example, one upstream from the perimeter and responsible for irrigation, the other downstream whose unique function is to evacuate the water at ebb tide. Moreover, the embankments have to be strengthened and raised.

In this case, it is possible to combine the technique of the polder and the Banjar method using the tidal bore to develop the coastal swampland. In this manner, though it is preferable that the rice fields benefit from a water control that is as perfect as possible, one could consider opening a second, more summarily-developed, zone with a simple network of canals used for both drainage and irrigation that would allow one to set up limited smallholdings of coconut palms or citrus cultivated on ridges in the traditional manner (Chapters 3 and 7) (Fig. No.36).

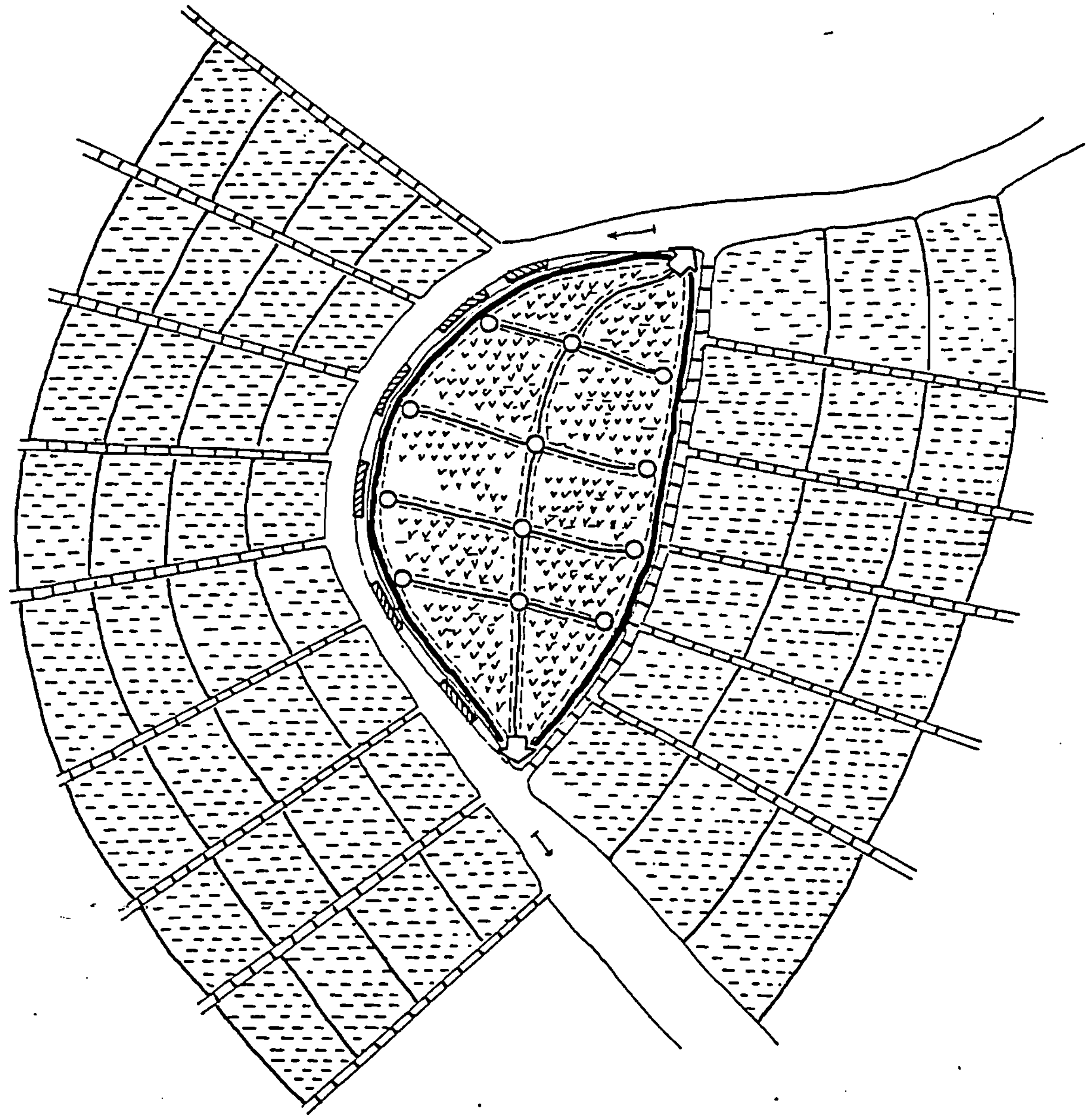
Combining both types of zones should allow each family to receive a plot composed of 1 ha. of prepared rice filed and 1 ha. of land to be made into a smallholding which after a few years would provide cash income.

Naturally, here again this is only the general outline of a development project which, given the available information on the environment, seems to be the best adapted. Before actually setting up a project, we cannot stress enough that a detailed reconnaissance survey of the entire lower Katingan valley must be made.

At first, the reconnaissance studies must be based on obtaining the most precise information possible on the constraints of the

36. MODE DE MISE EN VALEUR DES MARAIS MARITIMES SUR LES BASSES VALLEES

TIDAL SWAMPS RECLAMATION PATTERN ON THE LOWER VALLEY



- Fleuve / *River*
- Digue / *Embankment*
- Habitations / *Dwelling-houses*
- Canal / *Canal*
- Fossé de drainage / *Drainage trench*
- Canal d'irrigation / *Irrigation canal*
- Station de pompage / *Pump station*
- Rizières / *Lowland ricefields*
- Plantations villageoises sur billons / *Ridge-planted small-holdings*

<u>Note</u>: Il s'agit là d'un amenagement type, non d'un projet precis. Une reconnaissance approfondie préalable est indispensable avant d'élaborer un plan definitif.

This is only a proposal pattern, not a ready-to-make project. A one more detailed reconnaisance study is necessary to make it definitive area: hydrological data and a soil map are absolutely necessary.

The next step is to make a detailed economic analysis:

- Estimation of the total cost of investments and possibilities of amortization.
- Evaluation of the labor force available for a single transmigrant family so that the plots of rice fields and the lots destined for perennial crops can be distributed in adapted dimensions. One must not forget that this type of development is useless unless it permits the farmer to obtain two yearly harvests of paddy, which is already a workload of at least 250 work-days per hectare per year.
- A study of the profitability of such projects in consideration of the costs of operation and maintenance. As an example, one can analyse the operational costs for the Alabio polder.

11.3. Give particular attention to the operating costs of the large projects: the example of the Alabio polder

The analysis of the operating costs of the Alabio polder is only an example whose finality is a dual one: to illustrate the type of reasoning that must be imperatively carried out, and to estimate the cost of water per hectare.

11.3.1. Irrigation costs

There are five pumps at the Sei Mahar station, two to pull water from the Negara River, with a power of 80 c.v. each and a total capacity of 1.93 m^3/s; three other pumps of 30 c.v. each raise the water table. At 0.48 lt/s/ha, 4000 hectares can therefore be irrigated.

Supposing that for one season the pumps run day and night[1] for 2.5 months, or 1800 hours, and given their fuel con-

[1] Actually, they only operate during the day.

sumption[1], one would have to provide for 126,000 liters of fuel, which at Rp.240/lt. comes to about Rp.30,000,000.

To this sum, one must add the salary - in this case, yearly-- for 4 technicians who are responsible for maintenance, to wit, some Rp.4,000,000, plus about Rp.1,000,000 for spare parts and various other costs. Thus the total cost of 80 days of irrigation comes to Rp.35,000,000.

II.3.2. Drainage costs

The Sei Kalumpang station has five 200-c.v. pumps with a total capacity of 12.5 m^3/s. Lowering the water level by one meter means sucking out 63,570,000 m^3, given it does not rain during the operations. Taking infiltration into account, one has to add an extra 25%, which brings the total amount to be evacuated to 79,460,000 m^3.

The pumps' capacity is 12.5 m^3/s; or 45,000 m^3/hour, thus it takes 1766 hours, or 70 days, to carry out this operation, which represents a consumption of about 495,000 liters of fuel for a cost of Rp. 118,000,000.

To this cost is added the annual salary of the four employees, Rp. 4,000,000, and a sum we fix contractually at Rp. 1,000,000 for small maintenance. Total cost of drainage: Rp. 124,000,000.

Thus, for one year, the polder's operating costs come to about Rp. 160,000,000. If this is compared to the total area of the zone, it represents a cost of Rp. 25,170/ha, but if it is compared to the area that is actually used, 3669 ha., the expenses come to between Rp. 43,000 and Rp. 44,000/ha.

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[1] 0.28 lt per c.v. and per hectare.

All in all, this is not an enormous amount of money. It represents the equivalent of about 440 kgs of unhusked rice, but this means that, under the present conditions, if the farmers paid for the water, it would take 1/3 of their income!

The intention of all this is not to make hasty conclusions and imply that such development methods are not justified; rather, we wish to draw the attention of the persons responsible for these projects to the fact that they are meaningless unless the type of agriculture practiced is very intensive.

List of Maps, Charts, Figures and Sketches

TABLES

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