DIREKTORAT JENDERAL TRANSMIGRASI
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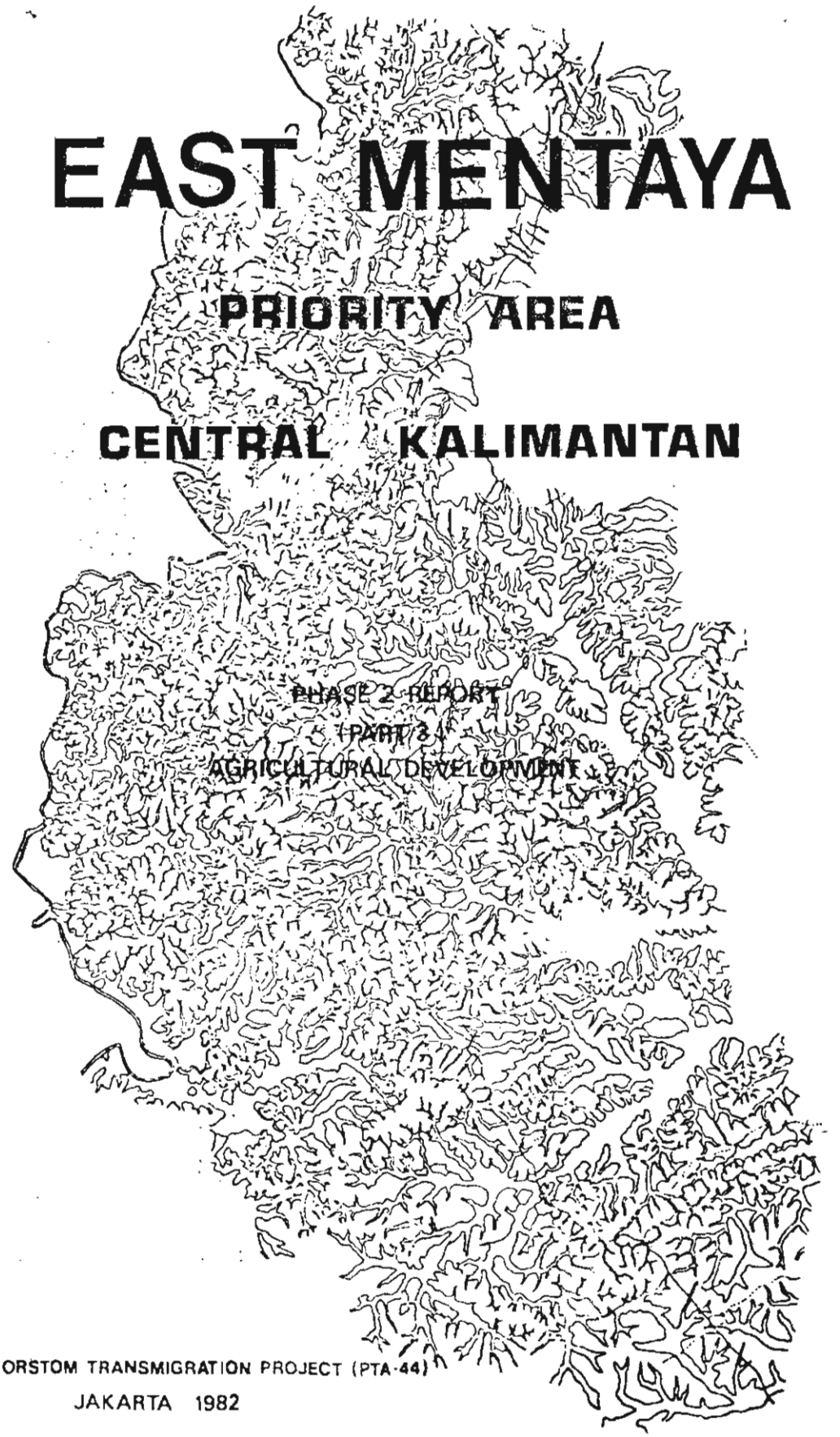
OFFICE DE LA RECHERCHE
SCIENTIFIQUE ET TECHNIQUE OUTRE - MER
(REPUBLIQUE FRANCAISE)

EAST MENTAYA

PRIORITY AREA

CENTRAL KALIMANTAN



PHASE 2 REPORT

(PART 3)

AGRICULTURAL DEVELOPMENT

INDONESIA - ORSTOM TRANSMIGRATION PROJECT (PTA-44)

JAKARTA 1982

Departemen Tenaga Kerja dan Transmigrasi
Direktorat Jenderal Transmigrasi
(Republik Indonesia)

Office de la Recherche Scientifique
et Technique Outre-Mer
(République Française)

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CENTRAL KALIMANTAN
PHASE 2 REPORT
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INDONESIA - ORSTOM TRANSMIGRATION PROJECT PTA-44
JAKARTA, APRIL 1982

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SUMMARY

After outlining the broad objectives and general guidelines of the Directorate General of Transmigration, this report analyses the general evolution of existing upland Transmigration projects with respect to the generally recommended development strategies.

It appears that due to labour and cash scarcities this development strategy does not permit the assumed objectives to be reached. After observing the manner in which local farmers in Central Kalimantan solved similar problems, we propose a new development strategy more suited to the local conditions.

It is recommended that priority be given to clearing and tree-crops planting, using an ameliorated shifting cultivation technique. Such a technique would enable the transmigrants to save enough labour for planting work and hence assure food self-sufficiency. After 5 to 8 years the first planted tree-crops will begin to produce and regular cash income will become available. Meanwhile, average labour availability will have risen from 350 to 450 Man-Days/year/family. Thus, the settlers will be in the best situation to face the necessary agricultural intensification. With respect to the major constraints on sustained dryland arable farming, it is recommended that food-crop areas be limited to irrigable valley-bottoms and tree-crops to dryland areas. Each family should be granted a minimum of 1.0 to 1.5 ha. of irrigable low-land and 3.5 to 4.0 ha. of upland for plantation purposes.

In view of the low level of development of the Central Kalimantan Province, a particular effort should be made in research, extension services, and supply of planting material. Prospects for animal husbandry, pisciculture, and future development of the project are given in the last chapters of this report.

A Transmigration project in the Tumbang Sangai priority area can only be developed on primary forest or on secondary forest areas. However, in the first case there will be potential conflict with the interests of logging companies (or Forestry Department) and in the second case there will be potential conflict with the interests of local shifting cultivators.

As a result, discussions between all parties concerned are of the utmost importance in order to avoid drastic political problems in the region. The determination of the precise number of families which could be settled in the Tumbang Sangai priority area should be a result of these discussions. Therefore, in the present report, no attempt is made to estimate carrying capacities.

RINGKASAN

Setelah memperoleh gambaran obyektif secara luas dan pedoman yang digariskan oleh Direktorat Jenderal Transmigrasi, maka dalam laporan ini akan diuraikan secara umum Proyek Transmigrasi di daerah dataran tinggi (upland), dengan memperhatikan strategi pengembangan yang biasa digunakan.

Strategi pengembangan di dataran tinggi yang biasa digunakan sulit untuk mencapai sasaran secara obyektif, karena timbulnya masalah kekurangan tenaga kerja dan modal. Namun demikian setelah diadakan penelitian di Kalimantan Tengah, tentang bagaimana cara petani setempat dalam mengatasi masalah yang sama, maka dapat disusun suatu strategi baru dalam usaha mengembangkan Proyek Transmigrasi di dataran tinggi yang lebih sesuai dengan keadaan setempat.

Dalam hal ini diusulkan bahwa prioritas yang harus diberikan kepada transmigran (petani) terutama pembukaan tanah untuk usaha penanaman padi ladang dan tanaman keras, dengan menggunakan tehnik "shifting cultivation" yang disempurnakan. Tehnik ini memungkinkan para transmigran dengan tenaga kerja yang masih ada cukup untuk menanam tanaman keras (untuk perkebunan) sedangkan hasil dari tanaman pangan cukup untuk memenuhi kebutuhan makan.

Dalam jangka waktu 5 - 8 tahun tanaman keras yang pertama kali ditanam sudah akan mulai memberikan hasil, dan pada saat ini merupakan pendapatan yang secara teratur dapat diharapkan. Selama waktu tersebut rata-rata tenaga kerja yang tersedia sudah akan meningkat dari 350 s/d 450 h-k/th/KK. Dengan demikian pada situasi ini merupakan saat yang baik bagi transmigran untuk melakukan intensifikasi pertanian.

Sesuai dengan pembatasan, bahwa pada tanah kering yang diutamakan dapat ditanami secara terus menerus, maka diusulkan untuk selanjutnya tanaman pangan dibatasi pada dataran rendah dengan irigasi dan tanaman keras pada tanah kering (dataran tinggi). Untuk itu sebaiknya setiap kepala keluarga dapat menerima paling sedikit 1.0 s/d 1,5 ha di daerah dataran rendah yang dapat dibuat irigasi, dan 3,5 s/d 4,0 ha di daerah tanah kering untuk perkebunan.

Mengingat tingkat pengembangan di Kalimantan Tengah masih belum maju, maka perlu ditingkatkan usaha-usaha penelitian, penyuluhan pertanian, dan pembibitan pertanian.

Kemungkinan-kemungkinan untuk pengembangan peternakan, perikanan dan jangkauan lebih jauh untuk pengembangan proyek akan diuraikan pada bagian terakhir dari laporan ini.

Proyek Transmigrasi di daerah Tumbang Sangai hanya dapat dikembangkan pada daerah hutan primer (rimba) atau hutan sekunder (belukar). Apabila dikembangkan pada hutan primer akan timbul konflik dengan Hak Pengusaha Hutan (atau Departemen Kehutanan), dan jika dikembangkan pada hutan sekunder akan timbul konflik dengan petani penduduk asli.

Oleh sebab itu perundingan antara semua pihak yang bersangkutan perlu dilaksanakan untuk memecahkan masalah-masalah yang tidak diinginkan terjadi pada daerah tersebut.

Perkiraan banyaknya kepala keluarga yang dapat ditempatkan di daerah Tumbang Sangai akan dapat ditentukan dari hasil perundingan yang dilaksanakan. Karena itu dalam laporan ini tidak dicantumkan berapa banyaknya kepala keluarga yang dapat ditempatkan di daerah Tumbang Sangai.

CHAPTER I

INTRODUCTION

The transmigration programme is one of the first priorities of the Indonesian government. The targets of the last five-year plan (Repelita III) are rather ambitious as they imply the transmigration of 500,000 families (more than two million inhabitants) from the overcrowded islands of Java, Bali, and Madura to the less populated outer islands of the archipelago : Sumatra, Sulawesi, and Kalimantan.

For the last few years, priority has been given to the Sumatra and Sulawesi projects; however, in the near future most programmes in these islands will be fulfilled. The next priority being Kalimantan, the Directorate General of Transmigration (DGT) requested the survey of a large part of the Central Kalimantan Province (Kalimantan Tengah) in cooperation with the Office de la Recherche Scientifique et Technique Outre-Mer (ORSTOM).

After some difficulties caused by the absence of aerial photographs and of reliable basic data such as topographical or geological maps, a first reconnaissance survey covering 2,250,000 hectares was made by a multidisciplinary team of ORSTOM and DGT pedologists, agronomists, and geographers. The aim of this survey was to determine suitable locations for Transmigration projects and to collect the data necessary for further development planification of the Central Kalimantan Province.

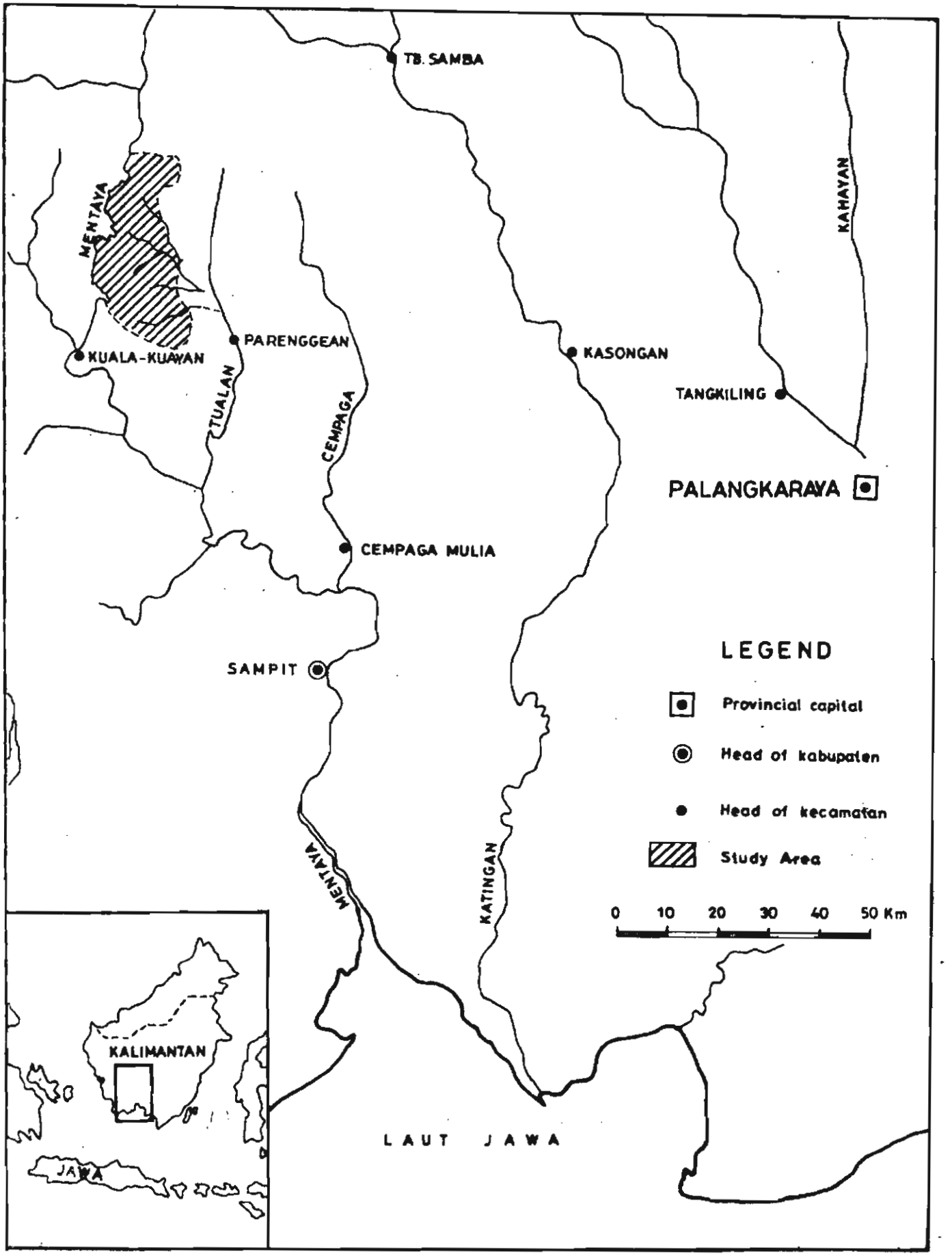
The results of the phase 1 studies have been summarized in four technical reports and in an atlas of 14 maps :

Technical Reports :

1. Soils
2. Land Suitability
3. Agronomy
4. Geography

Maps of the Atlas :

1. Situation Map
2. Hydro-meteorological Data
3. Geographical Map
4,5. Population
6. Dominant Religion per Village
7. Main Ethnical Groups
8. Potential Accessibility
9. Main Income of the Local Population
10. Area Under Shifting Cultivation
11. Reconnaissance Soil Map
12. Map of Land Suitability for Agriculture
13. Land Suitability for Specific Crops and Project Types
14. Site Identification



TEXT MAP 1 LOCALIZATION OF THE STUDY AREA

As a result of the reconnaissance survey, a semi-detailed survey (phase 2) was implemented on one of the proposed locations for Transmigration development : the East Mentaya Priority Area (or Tumbang Sangai Priority Area). [1]

The results of these phase 2 studies have been summarized in three reports :

1. Physical Environment
2. Human Environment
3. Agricultural Development

The present report deals with the agricultural development of the Tumbang Sangai Priority Area.

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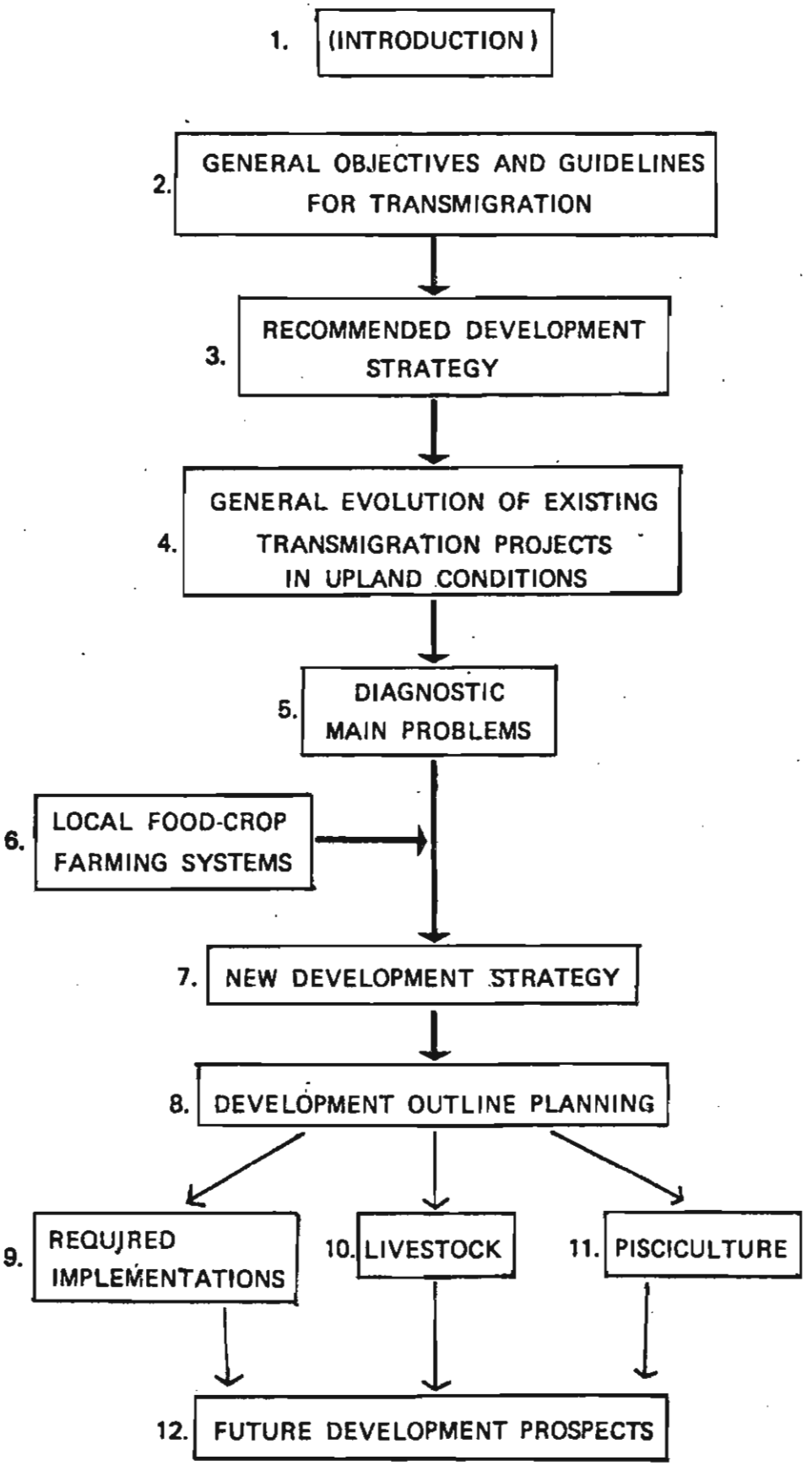
1 See Localization Map no. 1.

REPORT STRUCTURE

(Fig. 1)



CHAPTER II

GENERAL OBJECTIVES AND GUIDELINES FOR TRANSMIGRATION

According to the very ambitious targets of the last five-year plan of the Republic of Indonesia (500,000 families should transmigrate between April 1979 and April 1984), the general objectives of the Transmigration projects do not aim at establishing the most efficient farming systems but at optimising returns for capital investment.

This means that the most efficient Transmigration project will be the one with the lowest capital investment per transmigrant family. Particular attention is given to the carrying capacity of the projects, that is, the number of families per project unit. Thus, the smaller the area allotted per family, the higher the carrying capacity of the project, and the lower the capital investment per family. Such criteria precludes any extensive or semi-extensive farming systems, the largest allotments being two hectares in irrigated farming and five hectares in dryland farming.

Policy objectives retained by the Directorate General of Transmigration are :

1. Food self-sufficiency by the end of the second year;
2. Promotion of commercial crops;
3. Development of small-scale industries, mainly initial processing of local productions;
4. The target income of the transmigrant should quickly attain the level of his former one on Java and, within five years, equal the income of the local farmers;
5. The level of investment should be as low as possible and not exceed 5,000 - 6,000 US dollars per family;
6. Further development of the project should be planned, with particular attention given to the employment of the second generation of transmigrants and of spontaneous transmigrants.

CHAPTER III

RECOMMENDED DEVELOPMENT STRATEGY

The Directorate General of Transmigration recommends the following development strategy :

First phase : Priority is to be given to the development of the food-crop area and the home garden. Arable crops should be confined to a maximum of two hectares per holding. One hectare is cleared before the settler's arrival and the clearing of the second one is generally the responsibility of the settler. Poultry should be the only livestock raised during the first years.

Second phase : As soon as the arable crops area is established, the development of tree-crop plantations should be promoted. Block planting by or under the supervision of PTP's (Industrial Plantation Societies) is highly recommended. At this stage cattle can be introduced on the project, in numbers in accordance with grazing capacities.

For one year (or one and one-half year in tidal area projects) the settler is provided with free rice, fish, cooking oil, salt, sugar, and lamp oil. Average supplies are :

Rice	50 kg per family per month
Fish (ikan asin)	7 kg per family per month
Cooking oil	3 kg per family per month
Salt	1 kg per family per month
Sugar	3 kg per family per month
Lamp oil	8 lt per family per month

Since the settler must be food self-sufficient by the second year, and as most tree-crops only begin producing 4 to 6 years after planting, it is logical to give priority to the development of the food-crop area and to promote tree-crop planting only when this arable crop area is established.

But this strategy supposes, of course, that the arable crop area can be established in the short term. In the following chapter we shall see that it is in upland conditions that settlers face the greatest difficulties in establishing their food-crop area and are thus unable to reach the second phase of development, i.e. the planting of tree-crops.

CHAPTER IV

GENERAL EVOLUTION OF EXISTING TRANSMIGRATION PROJECTS IN UPLAND CONDITIONS

A comparative study of existing transmigration projects enables us to list the major problems and to evaluate the adequacy of the retained development strategy. The general evolution of existing upland projects can be summarized as follows :

1) The first year :

During the first year, on the average, barely half of the already cleared land is cultivated. There are several explanations for this, not the least of which is, naturally, the stress caused by transmigration. Many settlers originate from densely populated, irrigated, rice cultivation areas and are not sufficiently prepared for life in a totally new environment.
The proximity of the forest, the presence of unfamiliar wild animals, and the many stories told on Java about the primitive outer islands of the archipelago very often lead to irrational fears. There is a lack of sociological studies in these colonization areas that should quickly be remedied. In addition to this, as very few of the newly-arrived settlers were very rarely smallholders on Java, most having been only agricultural labourers with no ruling decisions to make, the lack of enterprise spirit is quite general. From a more technical point of view they are very often unaware of the techniques of dryland cultivation of arable crops and are almost always absolutely ignorant of the management of tree-crop plantations (except at the scale of the home garden).

The first year nearly 75% of the available labour goes to off-farm work. Since rice, fish, cooking oil, salt, etc. are supplied for one year, there is no real incentive for agricultural work. The settler prefers paid off-farm work, such as additional clearing on other units, building houses, administration buildings, schools, dispensaries, and so on.

2) The second year :

By the end of the second year, the settler should be food self-sufficient. But the yield of the small plot cultivated during the first year is usually not sufficient to cover his needs.

The settler then tries to extend the cultivated area to 0.75 hectares. He is generally surprised by the luxurious growth of weeds and in the best cases manages to cultivate only 0.5 hectares properly. As soon as the rice stored during the first harvest comes to an end, he needs money to feed his family and looks for off-farm work again. This is naturally to the disadvantage of proper farm management, the search for immediate satisfaction of his needs necessarily relegating the planting of tree-crops to the coming years.

3) The third and fourth years :

In the third and fourth years the situation becomes more critical. Under permanent cultivation with poor weeding due to labour scarcity, the growth of weeds regularly increases. Furthermore, the reduction of the soil's fertility, the swarming of pests, and diseases necessitate higher inputs in order to obtain correct yields. Having no available cash and not wanting to go deeper into debt, the settler generally refuses to buy the necessary materials.

On the average, during the third and fourth years, the cultivated plots only cover 1.0 ha. per family and the yields range from 300 to 500 kg/paddy per hectare. The farmer is still reluctant to clear new land for plantations.

At this stage the cropping system is very labour-intensive but there is little hope of making profits from arable cultivation which could in turn pay for fertilizers, pesticides, or draught animals. At best there is a possibility of off-farm work and the settler will become an agricultural labourer again. His only chance of remaining a smallholder is to get cash income from tree-crops if they have been planted by PTP's as on the Rimbo-Bujang and Baturaja Transmigration projects in Sumatra. On projects where this implementation has not been provided but left to the settler himself, the long-term prospects are rather dim.

The Directorate General of Transmigration is now aware of the fact that tree-crop development cannot be left to the initiative of the settlers alone. In many projects block-planting, mainly of rubber and coconut, has been promoted by the DGT with the help of the PTP's.

CHAPTER V

DIAGNOSTIC - MAIN PROBLEMS

In most upland Transmigration projects, the greatest difficulties are encountered by those settlers who are trying to establish intensive food-cropping systems.

Since the nutritional level of the soils is generally very low, a high fertilization rate is always necessary. The intense leaching due to the heavy rainfall strongly reduces the efficiency of manuring. The luxurious growth of weeds requires a high labour availability and restricts the cultivated area to less than 1.0 ha. per family. Under continuous cultivation the swarming of pests and diseases do not enable the farmers to obtain high yields and in any case the input is very high - labour, fertilizers, pesticides - while the output is always rather low.

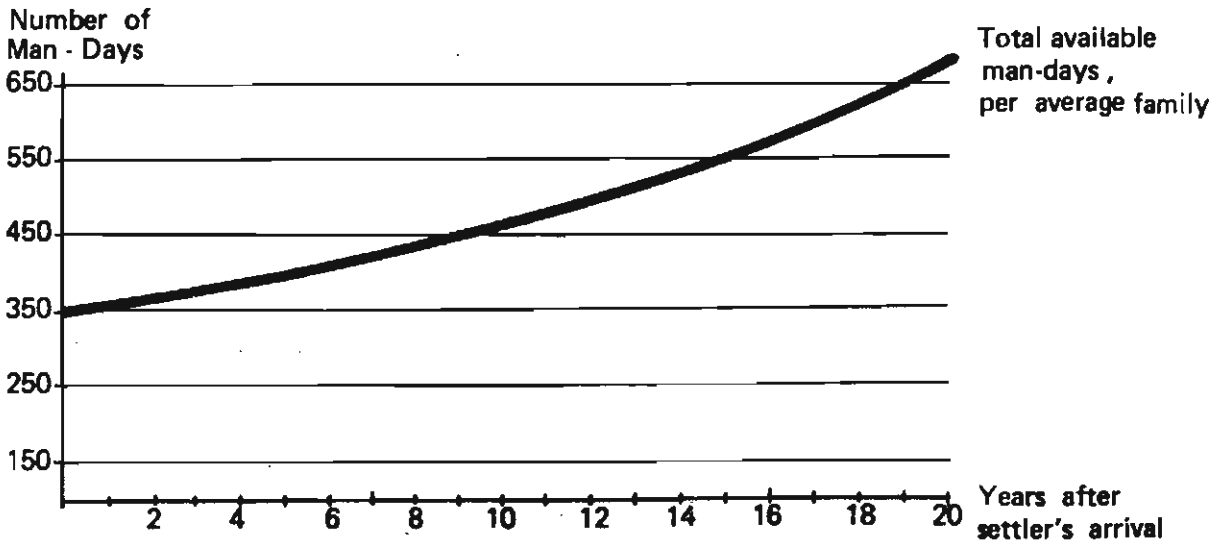
Although some settlers do possess the required knowledge and technology, they generally fail in establishing their food-crop area, mainly due to labour and cash scarcities.

1) Labour scarcity

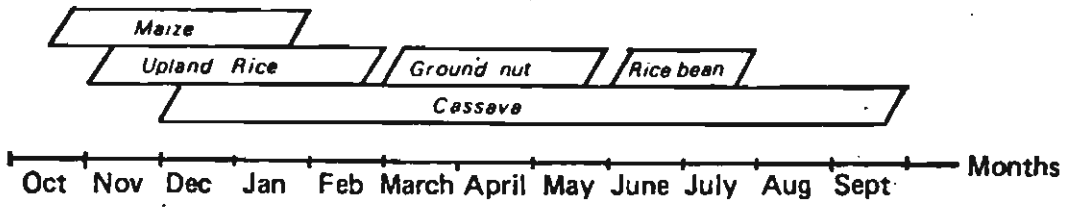
The average transmigrant family ranges from 4 to 5 members : the settler himself, his wife, and two or three children, usually under the age of 15 years. Younger children confine the settler's wife to housework, in the absence of grandparents or a younger sister (of the wife), who generally look after the children on Java.

During the following years, the labour availability rises rather quickly. The diagram below, from Hunting Technical Services (Southeast Sulawesi, TAD project, Agricultural Development 2, Jakarta, 1977) gives a good estimation of the labour availability of the average transmigrant family :

Fig. 2. Labour availability of an average transmigrant family.



Intensive cropping systems like those tested by the Central Research Institute in Agriculture at Bogor (CRIA-LP3) are, in many Transmigration areas, always very labour-intensive. For instance, the following cropping pattern was tested in Way-Abung (Sumatra) in 1977 - 1978 :



This pattern implies three consecutive crops during one cropping year, interplanting and relay-planting of maize and cassava. The total labour requirement for the three crops was 672 M-D/ha. This means that, according to the labour availability of the average transmigrant family, only 0.5 ha. could be cultivated during the first years of settlement. Not until twenty years after his arrival could the settler manage to cultivate one hectare under this cropping pattern, and of course there would be no available labour left for plantation management.

Nevertheless, this cropping pattern could be further ameliorated through the implementation of techniques which demand less labour, such as the use of draught cattle, herbicides, or mechanization. In such cases, however, the problem of cash scarcity arises, for an increase in the technical level always implies an increase in the input level; this further necessitates available possibilities of obtaining cash or credit.

2) Cash scarcity

The cropping pattern mentioned above presents a material cost of Rp 162.000,-/ha and a labour cost of Rp 138.000,-/ha. If the settler manages to cultivate only 0.5 ha. during the first years, this means an overall cost of Rp 150.000,-

The socio-economic surveys of previously established Transmigration areas indicate that the average gross return of the settlers barely reaches Rp 130.000,- per year during the first four years, the gross return per man-day being inferior to Rp 400.-. Under such conditions there will be no available cash for investments in inputs, though there would still be the possibility of credit through BIMAS or INMAS programmes. Yet intensive agriculture implies high risks : unforseeable drought periods, great numbers of pests, or diseases may lead to misharvests. However, the inputs needed for such cropping patterns are considered too costly for farmers to afford.

Therefore, due to labour and cash scarcities, farmers are encouraged to reduce inputs to the utmost and take up "mining agriculture". The fact is that the general evolution of intensive upland cropping systems under such conditions is towards cassava monoculture.

This leads to the exhaustion, within four to five years, of the very low nutrient reserves in the soil, and the plots rapidly turn into alang-alang (Imperata cylindrica) wasteland.

Thus, the recommended development strategy is obviously not adapted to reach the targets set by the Directorate General of Transmigration.

In Central Kalimantan, local farmers face exactly the same problems of labour and cash scarcities. Yet their standard of living is much higher than that of the average Javanese or Balinese farmer. The study of how they solved their problems is of the utmost interest before trying to define a new development strategy more suitable to conditions in Central Kalimantan.

CHAPTER VI

LOCAL FOOD-CROP FARMING SYSTEMS

With an average population density of 4 inhabitants per square kilometer, the Dayaks of Central Kalimantan had to face a very drastic labour scarcity. Where available land is not a limiting factor, they developed one of the most efficient farming systems in terms of return for invested labour : shifting cultivation.

1) Shifting cultivation of upland rice :

We have already pointed out the numerous advantages of shifting cultivation in the phase 1 agronomic report and the local farming system is thoroughly described in phase II report : human environment. Hereafter we shall limit ourselves to analyzing labour requirements and economic returns for invested labour.

The following figures are the mean values of the labour requirements for the slash-and-burn upland rice cultivation practiced by the Central Kalimantan Dayaks. They were obtained through a survey of a randomized sample of 60 cultivators in 7 villages of the study area in 1980 - 1981.

Table 1.

Labour requirements in Man-Days/ha. for shifting cultivation of upland rice
(One year of cultivation only)

Operations Indonesian name (English name)	slash-and-burn of virgin forest	slash-and-burn of 15-year-old secondary forest
1. Menebas (Clearing the undergrowth)	21 ± 7	28 ± 4
2. Menebang (Felling the trees)	27 ± 7	24 ± 4
3. Membakar (Burning)	1.3 ± 0.4	2.4 ± 1.3
4. Menugal (Dibbling and casting)	20 ± 5	31 ± 5
5. Merumput (Weeding)	3 ± 3	15 ± 7
6. Memagar (Fencing - facultative)	11 ± 3	11 ± 3
7. Bikin pondok (Farm huts construction - one year out of two)	7	7
8. Mengetam (Harvest)	31 ± 6	44 ± 5
TOTAL	121.3 ± 20	162.4 ± 17

All work is done manually with axes and knives. No chemical manuring or pesticides are applied. The average yields range from 1000 to 1500 kg paddy per hectare. Some years they can reach 2500 kg but a drop to 500 kg/ha. is more frequent (unexpected drought period, heavy rain during the burning period, or severe pest attacks). Nevertheless, should misharvest occur, the situation is not as critical as on colonization projects, since the only inputs are labour and seeds. Moreover, the Dayaks are still able to buy rice with the money they can get from commercial crops such as rubber and rattan or from ironwood (Eusideroxylon zwageri).

With an average yield of 1250 kg paddy/ha. and an average local price of Rp 125/kg paddy, the gross return per man-day is around Rp 1.290 for a ladang on primary forest and Rp 960 for a ladang on secondary forest.

As land is not a limiting factor, the Dayak shifts his ladang every year. Sometimes, however, (5 times out of 60 in our sample) he cultivates his ladang for a second year. In such cases there is no felling work to be done, but a more careful weeding is necessary. Total labour requirements remain at the level of that for secondary forest, about 160 man-days/ha. Yields are generally lower (mainly due to in-sufficient weeding) and range from 750 kg paddy/ha. to 1250 kg paddy/ha., making the gross return per man-day around Rp 780.

These figures can be bettered still. For instance, with a chain-saw the felling can be reduced to 3 to 5 man-days/ha. and more effective weeding can increase yields to 1750 kg paddy/ha, as proved by experiments at the GKE Agricultural School of Tumbang Lahang in Central Kalimantan.

At any rate, even if ameliorated these techniques lead to surplus only if there is a great deal of available land. As fifteen years of bush fallow are necessary to restore the possibility of fertilization through burning, the average holding should cover at least fifteen hectares, in order to assure food self-sufficiency.

In most parts of Central Kalimantan enough land is available to allow for long bush fallows. But in some cases, like the middle Katingan area where fertile soils are limited to the narrow alluvial valley, a more intensive farming system had to be developed to adapt to the increasing demographic pressure of the last forty years.

2) A first step towards intensification : the development of low-lands

Because the luxurious growth of weeds on the uplands rendered continuous cultivation impossible (with the available technology), the inhabitants of the valley tried to develop the flooded low-lands behind the banks of the river. There, after cutting and treading in the low-land weeds (mainly Cyperaceae), transplanted rice could easily choke the regrowing weeds. Some fields have been cultivated continuously for 20 years (one crop per year) with neither soil work, nor chemical manuring, nor pest control, nor any indication of a decrease in the soil's fertility. The main problems reported to us were damage caused by regional flooding, as there is no water control, and the regular swarming of rats.

The next table summarizes the agricultural operations, labour requirements, and timing of operations obtained from the survey of a randomized sample of ten cultivators from Buntut Bali and Tumbang Lahang on the Katingan River :

Table 2.

Labour requirements for "padi luau", local low-land rice cultivation

Operations Indonesian name (English name)	Labour requirement M-D/ha.	Timing
1. Pesemaian (Nursery preparation)	12 ± 3	End August, beginning September
2. Menebas (Cutting of weeds)	49 ± 10	September - October
3. Menanam (Pulling out)	51 ± 15	October - November
4. Merumput (Weeding)	13 ± 14	December
5. Memagar (Fencing - facultative)	14	January
6. Mengetam (Harvesting)	58 ± 17	Maret - April
7. Processing	18 ± 7	April
TOTAL	215 ± 44	7 to 8 months

Some years when the field is not yet flooded the pulling out can be replaced by dibbling and casting or by direct seeding. Thus total labour requirements can be reduced to :

- 175 M-D/ha. if dibbling and casting
- 156 M-D/ha. if direct seeding (weeding requires two times more labour in this case)

Low-land rice yields can be much higher than upland rice yields, and sometimes reach 3000 kg/hectare. But quite often regional flooding and rats can totally destroy paddy fields. As a result, average yields over a long period are similar to upland rice yields, around 1500 kg paddy/hectare. The average gross return for invested labour is 7 kg paddy/man-day or Rp 875 per man-day at a local commodity price of Rp 125 per kg paddy. These figures could still be easily ameliorated by water control and rodenticides, for instance.

If we compare the results of the so-called "primitive" Dayak agriculture with the results obtained on most Transmigration projects, we have to admit that the most intensive is not necessarily the most efficient. The analysis of problems occurring on existing Transmigration projects and the observation of local agriculture are of the highest interest to the developer because they enable him to define more suitable development strategies.

CHAPTER VII

NEW DEVELOPMENT STRATEGY

Due to labour and cash scarcities, short-term promotion of intensive arable farming on Transmigration projects is nearly impossible. The only solution under such conditions is the promotion of farming systems which have the highest possible returns for invested labour. Therefore, the development of commercial perennial crops should receive priority. However, as tree-crops only begin to produce four to six years after planting, in the meantime food self-sufficiency should be assured. Thus ameliorated shifting cultivation could provide an acceptable transitory answer to the settlers' problems.

With a regular shift of 0.5 to 1.0 ha. every year, a transmigrant could manage to clear his 5-hectare allotment in 5 to 8 years after his arrival and be food self-sufficient during this period. As shifting cultivation techniques are not very labour-intensive, the saved labour could be utilized for the planting of tree-crops, interplanted with upland rice from the first year if the crops are wide-spaced, like coconut, oil palm, or rubber; in pure stand after the first rice harvest if the crops are narrow-spaced, such as coffee or pepper. According to the growth of the tree-crops, rice or cassava could be interplanted during the second year or even during the third year on the same plot.

Of course this shifting can only be a transition to a more intensive arable cropping system. Between the fifth and the eighth year, nearly all of the holding will be cleared. But from the fourth year, coffee, pepper, and coconuts have already been producing and the settler will soon come into cash. Also, during this same period, labour availability has increased from 350 to 400 man-days/year on the average (cf. figure 2) and labour requirements for perennial crops will only be for maintenance and harvest.

With an increasing income from commercial tree-crops and available labour at his disposal, the transmigrant will be in the best conditions to develop his food-crop area. He will be able to purchase fertilizers, pesticides, or even draught cattle and animal drawn equipment, the necessary agricultural intensification will be possible. If irrigable low-lands are available - which is the case in most of the land-units of the Tumbang Sangai priority area, - food crops should be limited to those areas.

This kind of development strategy has the advantages of being adapted to the capabilities of the new settlers as well as to the local conditions. It avoids stagnancy and permits further development and intensification by means of reinvestment of benefits and not by means of credit. Therefore, the use of this "primitive" agriculture will be a determining factor.

In the next chapter we shall analyse more precisely the possible outline planning and suitable alternative farming systems with respect to the above-mentioned development strategy.

CHAPTER VIII

DEVELOPMENT OUTLINE PLANNING

1) Timing of operations :

Development planning can be divided into three successive phases. The first, or phase A, will begin at the settler's arrival and last for approximately one or two years. It is merely an acclimatation phase. Still under the shock of transmigration, the settler will be very busy with home and garden work. His participation at collective works is very often required and he generally manages to cultivate properly barely half of the cleared hectare of his grant. This phase should be as short as possible and with proper management it could be kept to one year. But this period is also an acclimatation phase for the local Transmigration authorities. Services have to be organized; seeds, seedlings, fertilizers, pesticides, machinery and tools are not always available at the planned time. Then, when everything and everybody is ready the second phase, or phase B, can begin.

Phase B is the most active period of clearing and tree-crop planting. It will last from four to eight years according to the clearing rythm. This is naturally the most important period because on its success will depend the success of the entire plan. Highly trained extension workers are absolutely necessary for accurate supervision. Seedlings, fertilizers, and pesticides must be available in sufficient quantities and in due time.

Phase C begins when the entire holding is cleared. The tree-crops that were planted first have begun to produce and shifting cultivation comes to an end. It is now time to intensify arable farming in order to achieve the food self-sufficiency target on a one-to-two-hectare parcel under continuous cultivation.

The most adequate cropping patterns, which will have been tested on experiment farms during phase B, can very quickly be transferred to the transmigrants' plots. In this way, the necessary experiments can be performed in advance and not afterwards, as is frequently the case. Those patterns that are best adapted to the needs of the project can be determined, suitable varieties can be multiplied and made available in time.

2) Phase A : Acclimatation

The date of the settlers' arrival is not without importance. To avoid any unnecessary waste of time the transmigrants should arrive in the units between May and July. This period is closely linked to the clearing time. According to climatic data and to the local agricultural survey, the clearing of the granted first hectare has to be performed between May and July. Mechanical clearing is absolutely unsuited to the climatic and edaphic conditions of Central Kalimantan, the fertility of all Kalimantan soils being closely linked to organic matter. The fertile topsoil is in general very shallow and clearing with bulldozers would scrape it away. If the clearing should be done under humid conditions with heavy machinery, the clayey soils would be dangerously compacted. Due to the high erosion risk, stumping should be avoided if

not absolutely necessary. During July and August there is generally a remission of rain [1] which enables a correct drying of the felled wood and a good burning afterwards.

The ashes obtained from the burning have a fertilizing effect which could only be equaled by large quantities of chemical manuring. The following figures obtained from H. LAUDELOUT (1954), gives an idea of the soil's fertility increase after the clearing and burning of a secondary forest in Zaire. In the last column we give the equivalent amount of chemical fertilizers necessary for the same increase :

Table 3.

Increase of soil fertility after burning

	Before burning	After burning	Increase	Fertilizer equivalent
pH	4.4	6.0	1.6	3700 kg CaO/ha
Calcium kg/ha	53	377	324	420 kg CaO/ha
Magnesium kg/ha	25	98	73	120 kg MgO/ha
Potassium kg/ha	30	148	118	142 kg K_2O/ha or 500 kg Patentkali/ha

Since in mechanical clearing the logs are usually pushed to one side of the cleared plot, this important amount of natural fertilizing material would be wasted. The burning also destroys fast-growing weeds and many pests at the same time. The aspect of a newly-burnt ladang may of course surprise some foreign agriculturists because it looks more like a battle-field than a field. Yet the many advantages of burning thoroughly offset its bad esthetics.

Obviously, the many partially-burnt logs or stumps will preclude ploughing with machines or draught animals. This, however, is not really bothersome because draught cattle are rarely available on Transmigration projects for many years. Moreover, according to the recommended development strategy, arable crops will be grown for only two years in the cleared fields; afterwards, tree crops will take over and as a result no ploughing will be necessary.

2.1. Working plan for phase A :

The following is a suggested working plan for the first year :

Table 4.

Working plan during the first year

April :	Purchase and storage of upland rice seeds from local farmers.
May - June :	Manual clearing (knives & chain saws) of 1 ha per family by hired labourers.
June - July :	Arrival of first settlers.
August :	Arrival of last settlers, home gardening.
September :	Burning of dried wood and maize planting.
October :	Upland rice planting (Dibbling & casting).
November :	Manual weeding. Cutting back the regrowth.
December :	Second weeding and pest control. Maize harvest.
January - February :	Planting of quick-producing crops, e.g., coffee or pepper. Cassava relay-planting.
March - April :	Rice harvest.

[1] See ORSTOM report on agronomy, phase 1.

2.2. Detail of operations

Seed purchasing

April is the best time to purchase seeds from local farmers, as the harvest is ending and enough seeds in good condition are available. At this time the prices are also at their lowest level. Seeds could be purchased directly with cash but a better solution would be to exchange seeds for hulled rice to prevent shortages among the local population.

Manual clearing

Manual clearing can be done by hired local workers. Local farmers are not as busy during May and June, and their clearing ability is widely reputed. Chain saws and skilled operators must be available in adequate numbers. The felling requires approximately three man-days per hectare with a chain saw. Slashing the undergrowth requires 20 to 30 man-days per hectare. If smaller chain saws are available, which would facilitate the latter task, the labour requirement could be reduced to 10 man-days per hectare. While the purchase of chain saws will be the largest expenditure in the budget, clearing with chain saws is definitely less costly than with heavy machinery. Furthermore, the saws will pay for themselves within five years, and this form of manual clearing will both provide employment for the local population and be a first step towards a good integration of the transmigrants.

Arrival of the settlers

The settlers can arrive progressively from June to August; by the end of August the last settlers should have arrived. A late arrival would compromise the entire cropping season. The settlers' first on-farm work will be home gardening in order to ameliorate their diet as quickly as possible.

Burning

The burning usually takes place at the end of September. The exact date depends on the climatic conditions of the particular year; the better the burning, the better the harvest.

Casting the food-crops

As soon as possible after the burning, maize should be planted in rows three to four metres apart. Ten to fifteen days later upland rice should be sown between the rows. The quickest way to perform the seeding is to use a dibbling stick and to cast 5 to 15 seeds in each hole. The sowing of a one-hectare parcel should be performed in one day. This is very important for further management and pest control. Required labour for dibbling and casting ranges from 20 to 30 man-days per hectare. Dibbling is usually done by men and casting by women and children. A group of ten to fifteen families, working together (gotong royong) could achieve the sowing of one hectare in one day. In ten to fifteen work days all the fields of "the gotong royong" group could be planted.

Weeding and pest control

Weeding and pest control should take place in November and December. Properly done, these are the best means of increasing yields under shifting cultivation conditions. Up to now local farmers have not used pesticides and the damage caused by stem-borers often leads to misharvests. Weeding is generally poorly done and in many places in the fields the rice plants are often choked.

After the clearing of primary forest, weeding is almost unnecessary and the only maintenance work consists of slashing the forest regrowth. In the case of fields on secondary forest, weeding is always required; the younger the bush fallow, the more important the weeding.

Parcels near uncleared land should be protected from damage by wild animals (deer, wild boar, monkeys) with fences and traps.

At least three pesticide sprayings will be necessary to reduce stem-borer damage to an acceptable level.

Tree-crop planting

Immediately after the maize has been harvested, at around the beginning of January, quick-producing perennial crops such as coffee or pepper, should be planted in the rows left vacant by the maize. This work should be closely supervised by extension workers or by PTP (Industrial plantation societies) staff.

At the same time cassava could be relay-planted under the maturing rice. Certain local varieties grow very quickly and can be harvested from the fourth month after planting. Cassava would also provide the necessary shading for young plants such as coffee.

Rice harvest

Local rice varieties have a cycle of about five months and the first ripe panicles could be harvested at the end of February. As the ripening is rather irregular the harvest period will extend to the end of March. After the panicles have been sun-dried, they are threshed, dried again, and can then be stored in field huts.

April is generally devoted to feasts, marriages, and rest. In May the new cropping season will begin and the transmigrants will enter the B phase of the development strategy, that of active clearing and planting.

2.3. Labour requirements for the first year

According to Hunting Technical Services LTD [1], the average annual labour availability of an average transmigrant family during the first year is equivalent to 1.36 man-year, the farmer supplying 1.00 man-year and his wife and children the remainder.

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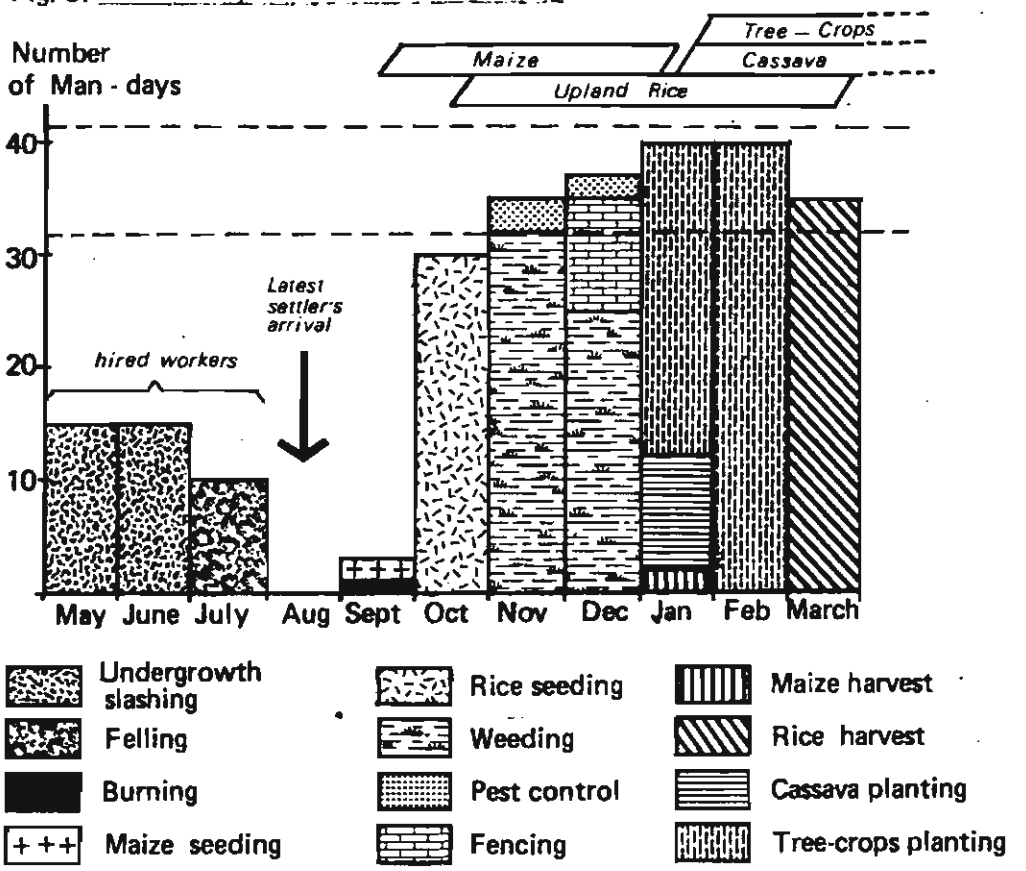
[1] South-east Sulawesi TAD project, Agricultural Development 2, Jakarta, 1977.

However, during peaks in crop labour requirements, the wife and children can increase their contribution (except for heavy work). Thus it may be assumed that there are on the average 32 man-days available every month and 42 man-days/month for peak labour periods.

Fig. 3. Labour requirements on the ladang : 0.75 ha.



Operations requiring the most labour on the 0.75-ha. ladang will be rice-seeding, weeding, tree crop planting, and rice harvesting. Actually, during the first year, rice could also be grown on the 0.25 ha. home garden, but vegetables would be more suitable in order to vary the settler's diet.

If the target of planting tree-crops on 0.75 ha. has not been reached by the beginning of the rice harvest, the remaining planting could still be done in April and May.

2.4. Estimated results of the first cropping year

Inputs :

Labour :	30 to 40 man-days of hired labour and 220 to 270 man-days for the settler.
Material :	Knives, chain saws, and fuel.
Plant material :	35 to 45 kg of rice seeds per hectare and the necessary tree-crop seedlings (1000 coffee plants or 150 coconuts).
Other :	Adequate pesticides.

Outputs :

Yield estimations are always hazardous and can never be guaranteed. Nevertheless, if no unexpected drought period or heavy pest damage occurs a target yield of 1250 to 1500 kg paddy per hectare should be a minimum if proper weeding and pest control have been performed. For maize 500 to 600 kg/ha. should also be a minimum. Cassava is usually highly productive but in the absence of marketing possibilities cassava planting should be limited to the farmer's needs. With such food-crop yields the settler will at least be food self-sufficient during the next year. The average hulled rice requirement of a transmigrant family being 50 kg per month or 600 kg per year, a 1200 kg paddy production will be sufficient. Thus it is assumed that with the addition of maize, cassava, and vegetables from the home garden, a surplus is possible.

Of course, such figures are too low and therefore not acceptable for an intensive food-cropping system. But at this stage of development the aim is not to get high yields in food-crops but to save labour for the planting of tree-crops and still assure food self-sufficiency.

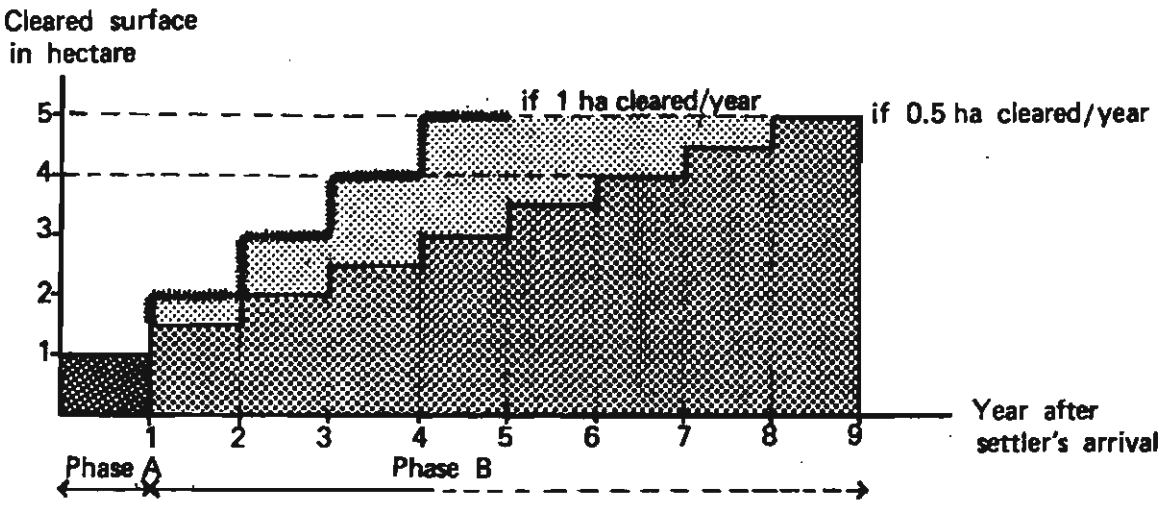
3. Phase B : active clearing and planting

The second phase of development, or phase B, will begin in May of the second year, more or less one year after the settler's arrival, and will last from five to eight years according to the chosen clearing rythm. If both dryland and irrigable parcels are available, the dryland parcels should be cleared first to allow for the planting of perennial crops. As soon as the last irrigable parcels have been cleared the settler will enter phase C.

3.1. Clearing rythm

The most efficient clearing rythm should be determined with respect to the first field experiments. In theory, one hectare per family could be cleared every year. But such a rythm would provide full employment for the settler and it is feared that this would lead to poor management of the already-established young plantations. Therefore, we recommend a less intensive clearing rythm of 0.5 ha. per year. Thus, the food-crop area must be divided into two parcels, one on the newly-cleared half-hectare and the other on the half-hectare cleared the preceeding year.

Fig. 4. Clearing rythm during phase B.



As soon as the surface devoted to tree-crops has been cleared and planted, the clearing rythm could be increased to 1.0 ha. per year, (as no planting work is required for the next cropping season). Therefore, phase B would last 7 years for a five-hectare holding and 5 years for a four-hectare holding.

3.2. Annual working plan for phase B

Timing will be nearly the same every year during this phase for clearing, food-crop cultivation, and tree-crop planting. Only plantation management will progressively require more work as the planted area is enlarged. Every cleared half-hectare plot will be cultivated for two consecutive years and afterwards left for perennials. Thus, with a yearly shift of 0.5 ha., 1.0 ha. will be available every year for upland rice cultivation. Hereafter the newly-cleared plot will be called Field 1 and the plot cleared the former year Field 2; "other plots" refers to the formerly cleared fields, now covered in perennial crops. (Refer to table 5 and figure 5).

Table 5.

ANNUAL WORKING PLAN FOR PHASE B

MONTH	FIELD 1 (0.5 ha.)	FIELD 2 (0.5 ha.)	OTHER PLOTS
May	Slashing of undergrowth		Cover-crop seeding
June			Maintenance
July	Felling of trees	Cassava harvesting	
August	Drying	Slashing of regrowth. Land preparation	Maintenance
September	Burning and maize seeding	Maize seeding	
October	Upland rice seeding	Upland rice seeding	Maintenance
November	Weeding and pest control	Weeding and pest control	
December	Weeding, fencing, pest control	Weeding and pest control	
January	Maize harvest. Tree-crop planting	Guarding. Maize harvest	Maintenance
February	Harvest preparation. Tree-crop planting	Guarding. Harvest prep. Cassava planting	
March	Rice harvest	Rice harvest	
April	Maintenance		Maintenance

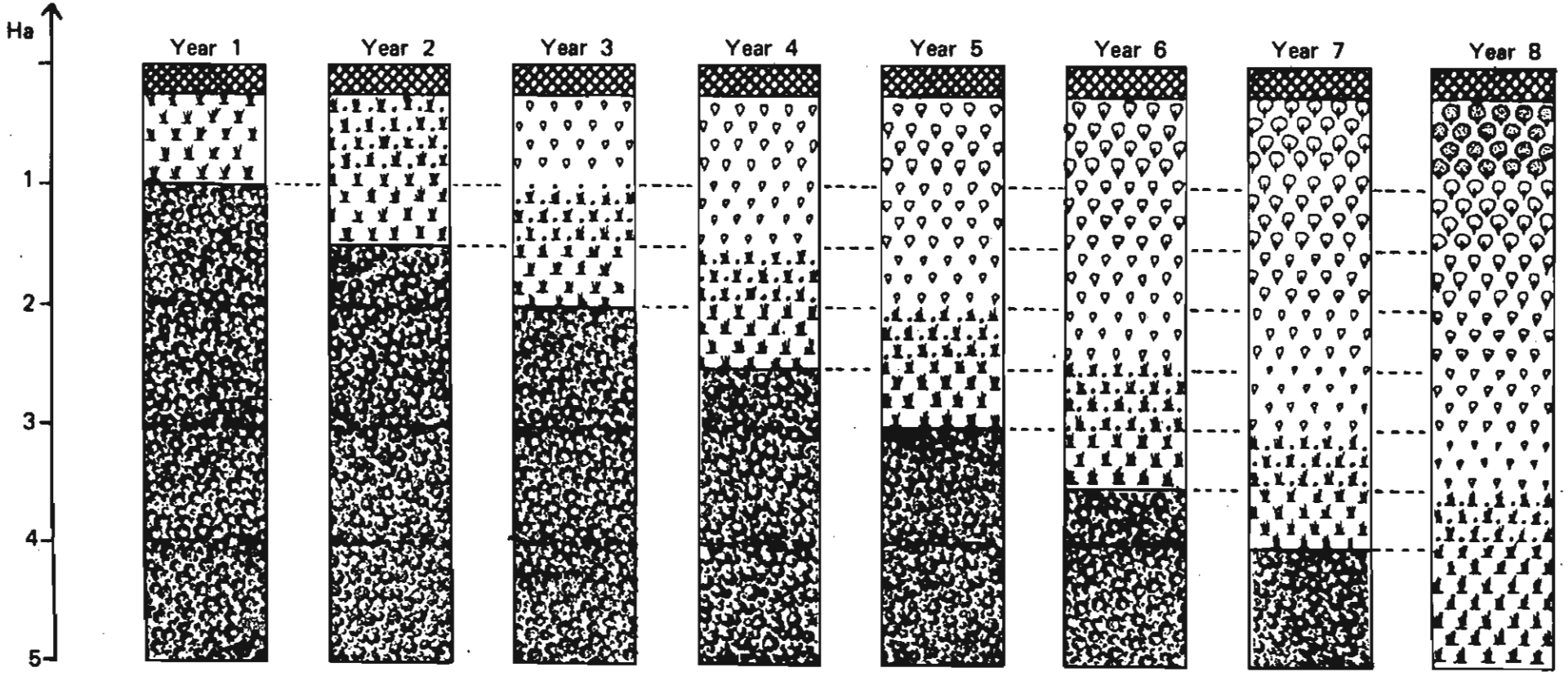


Figure no. 5 Cultivation rythm during phase B

3.3. Detail of operations :

On Field 1, the operations are exactly the same as those carried out during phase A, but restricted to 0.5 ha. Clearing can be done with axes and knives, but the use of chain saws (handled by skilled operators) would reduce labour requirements.

Field 2 will be cultivated for a second consecutive year; hence, no felling is required. After the cassava harvest, land preparation will involve slashing the forest regrowth and weeding between the rows of young perennial crops. Slashed wood and weeds should be gathered in heaps or rows and burned with great care - so as not to damage the tree-crops - after sundrying. If labour is still available, the ashes could be buried by light hoeing at a proper distance from the tree-crops to avoid damage to superficial roots. Since this will be the second cultivation of this field, more labour for weeding and a more efficient pest control will be required. If fertilizers are available, split dressing at the tillering, stem-elongation, and flowering-maturing stages would be recommended. All other operations remain the same.

On the other plots which were formerly cleared and planted only maintenance work is required. Approximately four years after planting the coffee bushes, pepper plants, and coconut palms begin to produce, and there will be a regular increase in labour requirements for harvesting and processing.

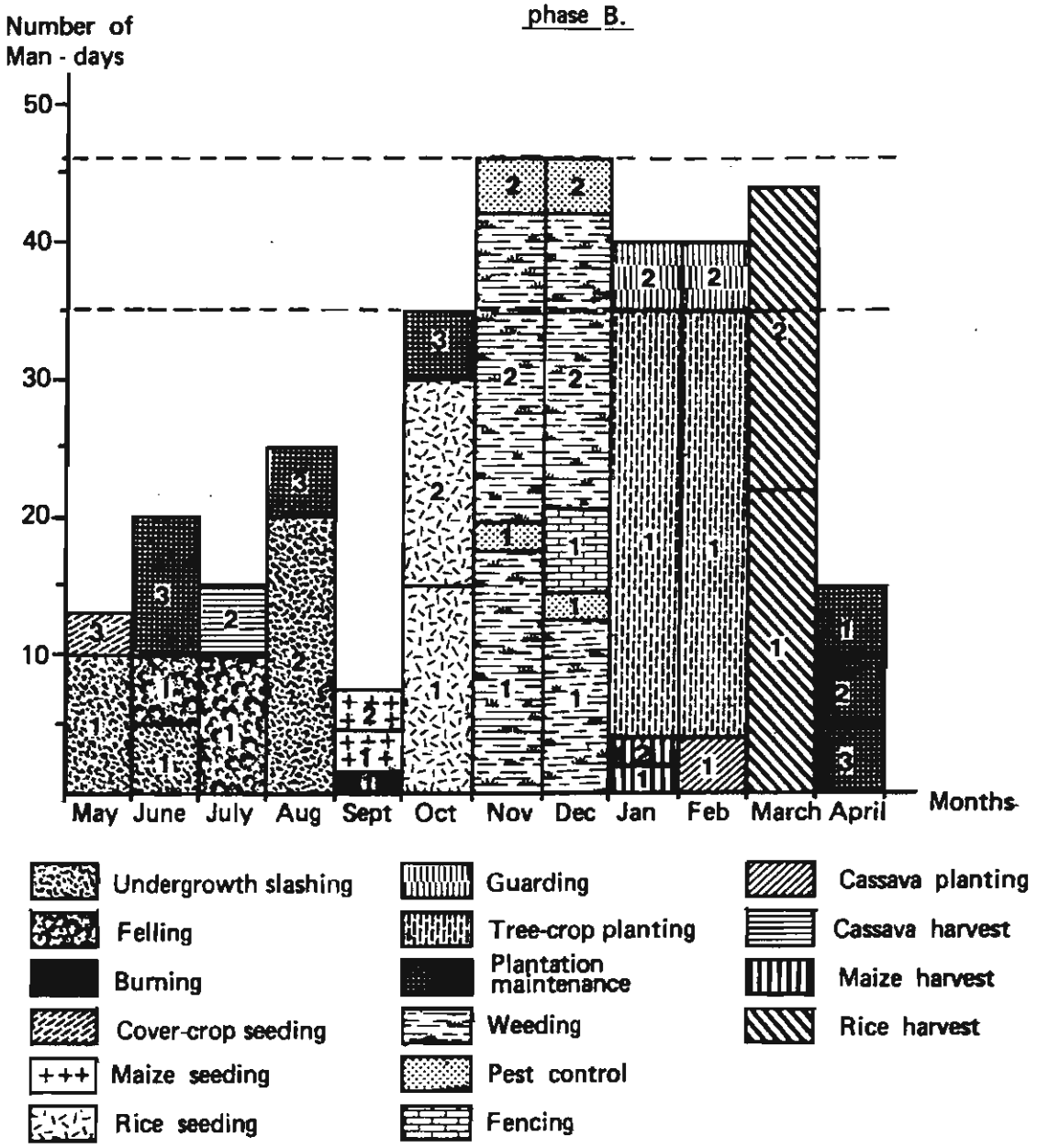
3.4. Labour requirements :

As in phase A, the operations requiring the most labour will be weeding, harvesting, and planting the perennial crops. Clearing is also labour-demanding, but it can be extended over three months so that no peaks will occur even if performed with axes and knives. If the chain saws previously recommended are available, 15 man-days would be sufficient to do the clearing.

Actually, the average labour availability of the average transmigrant family regularly increases, from 42 man-days/month during the first year to 50 man-days/month during the fifth year.

On the following chart we have retained an average labour availability of 35 man-days/month and 46 man-days/month for peak labour periods :

Fig 6. Labour requirements on field 1, field 2 and other plots (3) during phase B.



From October to March, we almost reach full employment. But from April to September a rather large amount of labour is still available. This saved labour force (115 M-D) could be profitably employed in off-farm work such as additional clearing of new transmigrant units, construction of houses, home industry, and so on.

3.4.2. Labour requirements for perennial crops planting and maintenance, in Man-Days per hectare : (Table 6)

	First year	Second year	Third year	Fourth year	Fifth year	Sixth year
Coconut						
Planting (& replanting)	25	8				
Cover-crop seeding *		3	2			
Fertilizing	5	4	4	4		
Weeding, maintenance	2	10	15	10	5	5
TOTAL	32	25	21	In production		
Coffee						
Planting (& replanting)	100	20				
Cover-crop seeding *		2	1			
Fertilizing	3	3	3	3	3	3
Weeding, maintenance	2	10	15	15	15	15
Pruning (incl. suckers)		10	17	25	25	25
TOTAL	105	45	36	In production		
Pepper						
Cutting preparation	60					
Planting (incl. poles)	140	60				
Fertilizing (compost)	20	10	6	6	6	6
Maintenance	5	15	60	60	60	60
TOTAL	225	85	In production			
Rubber						
Planting	60					
Cover-crop seeding *		3	2			
Weeding, maintenance	2	15	15	10	10	10
TOTAL	62	18	17	10	10	prod.

* In April after the second upland rice harvest.

With a labour availability of 60 days for planting, a settler could manage to plant 2.4 ha. of coconut, 0.6 ha. of coffee, 0.3 ha. of pepper, or 1.0 ha. of rubber in January and February every year. Since upland rice is interplanted for one-and-one-half years, labour requirements for weeding are very low for the first two years.

3.5. Estimated results per year during phase B :

Inputs :

- labour : 346 man-days
- material : fuel for chain saws, spare parts
- plant material : 40 kg rice seeds
  12 kg maize seeds
  cassava cuttings for 0.5 ha. tree-crop seedlings for 0.5 ha.
- other : pesticides, fertilizers for tree-crops

Outputs :

In normal conditions the lowest yields should be 1250 kg paddy/ha. and 500 kg maize/ha. In abnormal conditions the cassava production alone could achieve food self-sufficiency. Moreover, if the saved labour force of about 115 man-days is employed in off-farm work, the settler's income could be far above the subsistence level. Nevertheless, it should be pointed out that the farmer is still in an investment phase and not yet in a production phase.

3.6. Prevention of deviations :

We have already emphasized that the success of the recommended development strategy will depend essentially upon the clearing and tree-crop planting targets of phase B. Therefore, great care must be taken to prevent deviations from the proposed planning. The main problems will stem from the transmigrants' reluctance to follow an unfamiliar farming system. Most transmigrants originate from arable food-crop cultivation areas and are ignorant of the techniques of plantation management. As a result, the new settlers generally focus on intensive food-crop production such as that practiced on Java or Bali. In most projects transmigrants persist for years in trying to get high yields on their one-hectare plot.

There are two efficient ways to prevent settlers from deviating to intensive arable cropping too soon :

- leave the planting and maintenance of perennial crops to the PTP's. This is what takes place in Transmigration centers like Baturaja and Rimbo Bujang (Sumatera), which are organized in a Nucleus Estate scheme. Under such a system transmigrants work as day labourers for the plantation society. Clearing, block-planting, fertilizing, and maintenance are all under the responsibility of the PTP. The settler will not know before the sixth year which plot he will be granted. As soon as the plantation begins to produce (rubber in this case) he receives a 1.0 - hectare plot. The entire production must be sold to the PTP, who recovers its investment in ten to fifteen years.

Advantages : most modern techniques, high-level management, marketing facilities, estate criteria.

Disadvantages : the settler has no initiative, high indebtment, no control on prices. Requires a great deal of capital.

- organize a temporary rental system : The settler would be granted a plot among the cultivated parcels with a two-year's lease. If the necessary clearing and planting has been done in time during the cropping season, the lease for that parcel would be extended for one year and the settler would be granted a new 0.5 - hectare parcel with a two-year lease. Further lease extensions would depend on proper plantation management. After three extensions the settler will own the plots.

If the required planting has not been done in time, the settler will still be allocated a new 0.5 - ha. plot but he will lose his rights to the neglected plot.

Advantages : very strong incentive for clearing and planting. Very low investment level. Development of enterprise spirit.

Disadvantages : can induce inequalities among transmigrants. Lower feeling of security. Realization difficulties (decision criteria).

An intermediate method would be the most convenient. For enterprising farmers the parcel-renting method is obviously the most suitable. But this system could be detrimental to the less enterprising individuals. Thus, if a settler does not meet the recommended target, he could lose his rights to his plot, but only temporarily. The necessary planting would then be performed by the plantation societies. As soon as the plantation begins to produce, the settler would recover his rights but with the obligation to reimburse the society's investment in his plot.

4) The turn to phase C : from shifting cultivation to intensive arable farming :

The period of shifting upland rice cultivation and tree-crop planting will come to an end about six to eight years after the settler's arrival. At this time his four or five-hectare allotment will have been entirely cleared and the parcels devoted to perennial crops planted. Meanwhile, the average labour availability will have risen from 350 to 450 man-days/year and tree-crops will be providing a regularly increasing source of cash income. All available land having already been cleared and most of it planted, the transmigrant will have to assure his food self-sufficiency through intensive arable cropping on a 1.0 or 1.5-hectare plot. The only way to reach this target will be agricultural intensification. Having a regular source of income, higher labour availability, and the results of experiments done on test farms at his disposal, the settler will be in the best situation to face this new problem.

Suitable cropping patterns and precise requirements will be determined by trials and experiments on test farms. We shall hereafter limit ourselves to outlining recommendations for the necessary agricultural research.

4.1. Intensive dryland arable farming :

For years, the Central Research Institute in Agriculture at Bogor (CRIA - LP3) has, in many locations in Indonesia, performed some very interesting research on cropping patterns. Some of the tested cropping patterns could be applied in the Tumbang Sangai Transmigration area.

Additional research must be undertaken in order to determine the most suitable options with respect to the local conditions, seeding dates, fertilization rates, adequate pesticides, etc.

The greatest care must be given to the study of the evolution of soil fertility under permanent cultivation. In the phase 1 Agronomy Report we have already indicated the risks of continuous arable dryland cultivation under the climatic and edaphic conditions in Central Kalimantan. The high erosion hazard will necessitate accurate anti-erosive land management. Cultivation on slopes of over 4% should be avoided in the absence of terrassing. The soils should never be left without vegetal cover and crops such as maize should never be planted in pure stand but always intercropped.

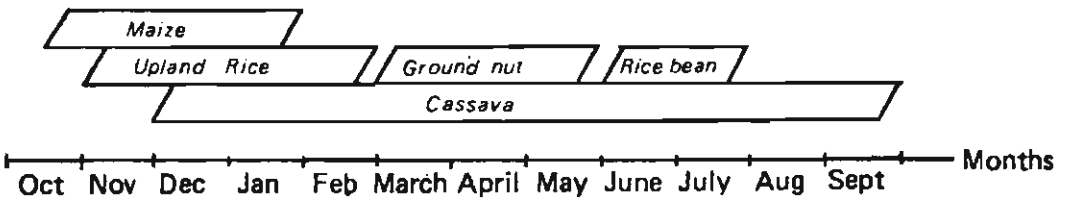
The second danger will be a regular decrease in the content of organic matter in the soil. As soil fertility is closely linked to organic matter, crop residues should be re-used rather than exported. Dung manuring and composting are highly recommended.

On the other hand, the rather high level of chemical manuring required for correct yields, especially that of nitrogen (Urea, TSP), will inevitably lead to a decrease of the soil's pH, resulting in nutrient deficiencies in phosphorous, toxicities due to mangan or aluminium, and a decrease in the soil's microbic life (soya and groundnut symbiotic bacteria). Correction of the pH through liming would be very expensive and the efficiency of such an operation would be very low due to the large amount of rainfall (3500 mm/year on the average). Therefore, regular soil analyses must be made.

Below are the requirements and results of a cropping pattern tested in the Baturaja - Martapura Transmigration area by the Central Research Institute in Agriculture (Bogor) in 1977 - 1978 :

4.1.1. Cropping pattern :

Fig. 7. Proposed cropping - pattern for upland arable farming.



Maize is planted in rows : upland rice, groundnut and rice bean are interplanted. Cassava is relay-planted under the maturing maize. As a result, the soil is permanently protected by food-crops cultivated the year round.

4.1.2. Labour requirements and costs : (Table 7)

Operations (All operations are manual)	First crop maize/rice/cassava		Second crop groundnut		Third crop rice bean	
	Labour M-D/ha	Cost Rp/ha	Labour M-D/ha	Cost Rp/ha	Labour M-D/ha	Cost Rp/ha
1. Land preparation	78	39,000	65	32,500	35	17,500
2. Planting :	84	33,600	54	21,600	55	22,000
(maize)	(18)	(7,200)				
(rice)	(54)	(21,600)				
(cassava)	(12)	(4,800)				
3. Fertilizing :	88	35,200				
(maize)	(10)	(4,000)				
(rice)	(67)	(26,800)				
(cassava)	(11)	(4,400)				
4. Weeding	12	4,800	19	7,600	10	4,000
5. Spraying	11	4,400	7	2,800	8	3,200
6. Harvesting :	60	24,000	95	38,000	47	18,800
(maize)	(10)	(4,000)				
(rice)	(50)	(20,000)				
(cassava)					(43)	(17,200)
TOTAL	333	141,000	240	102,500	198	82,700

TOTAL : Three crops : 771 man-days/ha. 326,200 Rp/ha.

4.1.3. Material requirements and costs : (Table 8)

Material	Quantity kg/ha.	Value Rp/ha.
SEEDS		
Rice	30	3,000
Maize	12	960
Cassava	5,000	10,000
Groundnut	120	42,000
Ricebean	35	7,000
FERTILIZERS		
Urea	460	32,200
TSP	470	32,900
ZK	149	22,350
Lime	200	2,500
PESTICIDES		
Furadan 3 G	30	6,000
Surecide	4.8 liters	4,800
TOTAL COST/HA		163,710

4.1.4. Yields, value, calories, and protein :

Table 9.

Crop	Yield kg/ha	Value Rp/ha	Calorie Kcal/ha	Protein kg/ha
Maize	1,626	97,560	5,772	150
Upland rice	1,076	96,840	2,580	73
Cassava	14,710	147,100	17,652	103
Groundnut	573	200,550	2,590	146
Rice bean	544	122,400	2,459	136
TOTAL		664,450	31,053	608

4.1.5. Cost & return analysis (in Rp/ha.) :

Table 10.

Gross return	Return after deduction of :		Net return
	Labour cost	Material cost	
664,450	338,250	500,740	174,540

4.1.6. Improvement of the proposed cropping pattern :

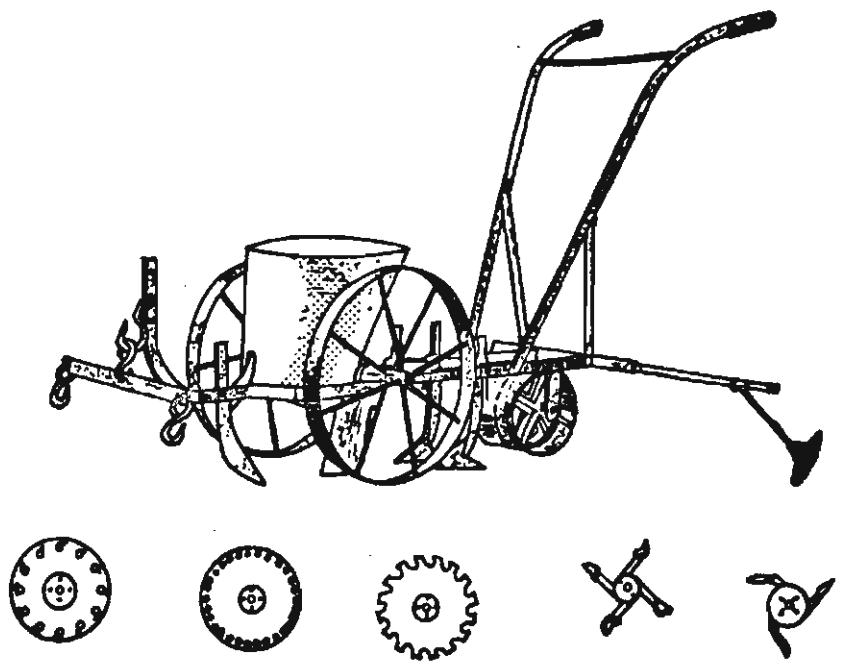
Since the return after deduction of material costs is Rp 500.740/ha., the labour return would only be Rp 650/man-day. While such a low return for invested labour is acceptable on Java, where cheap labour is available in large quantity, the same will not be true on Kalimantan, where labour is the scarcest factor. For example, the labour return is about Rp 1.000/man-day for shifting upland rice cultivation and generally more than Rp 5.000/man-day in the rattan plantations.

Therefore, the very low figures mentioned above must absolutely be bettered by reducing the labour requirements. Higher levels of technology must be promoted.

Those operations requiring the most labour in the described cropping pattern are harvesting, planting, and land preparation, with, respectively, 202 M-D/ha., 193 M-D/ha., and 178 M-D/ha.. Labour requirements for harvesting could be reduced through the use of threshing machines operated on a shared or cooperative basis.

The labour requirement for planting is the easiest and least expensive to reduce. Many models of multi-hopper seeders (from one to six rows) are available on the world market some pulled by hand, others by draught cattle, horses, or donkeys. The model presented below can be pulled by a small horse or donkey and is equipped with interchangeable seed plates and stars for various seeds and spacings. Such equipment could easily be manufactured in small-scale factories on Java.

Fig. 8. Seed planter with interchangeable seed plates and stars for different seeds



A one-row seeder pulled by a pair of draught cattle or a horse and operated by one man with the assistance of a child can perform the seeding of 1.0 hectare in 7 to 12 hours or two working days (at 3 M-D/ha.). In this way, the 193 M-D/ha. required for planting could be reduced to 22 M-D/ha. (1 for maize, 3 for rice, 3 for groundnut, 3 for rice bean, and 12 for cassava). With this implement alone, the return for invested labour would rise from Rp 650/ Man-Day to Rp 835/Man-Day.

Labour requirements for land preparation could be reduced in the same proportion with the implementation of equipment drawn by draught cattle. The most suitable equipment for transmigrant smallholders would be the "POLYCULTEUR", specially designed in France for African farmers. It has been manufactured in Senegal and other African countries on a rather large scale for many years. The "Polyculteur" design is simple and robust, and the equipment can easily be manufactured in small-scale factories and repaired by local blacksmiths. The two-wheeled frame (see illustration) can be equipped with various tools :

- plows (6, 8, or 10 inches)
- cultivator (3-6 tines, rigid or flexible)
- harrow (rigid or flexible tines)
- weeder (1 to 3 weeding shares)
- disk harrow
- ridger or bund former
- hoeing attachment
- lifter (groundnut harvester)
- sprayer or weed cutter or mower
- seed planter (1 to 3 rows)
- caster (for seeds or fertilizer)
- platform cart

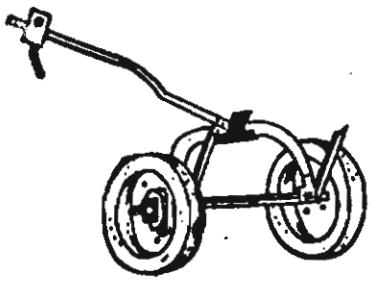
For the generally heavy, clayey soils of the Tumbang Sangai area, land preparation can be performed by a pair of draught cattle driven by one man with one or two helpers (wife and/or children). However, draught cattle in good condition can only work four hours per day.

Table 11

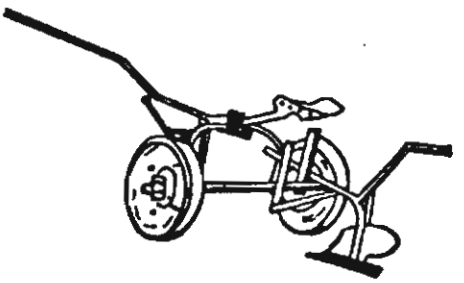
Labour requirements with "Polyculteur" equipment for heavy soils :

Operation	Draught cattle hours/ha.	Operating (1 man + 2 children Man-days/ha.
1. Ridging	30	15
2. Plowing	40	20
3. Harrowing	15	7.5
4. Hoeing	15	7.5
5. Weeding	15	7.5
6. Groundnut lifting	20	10

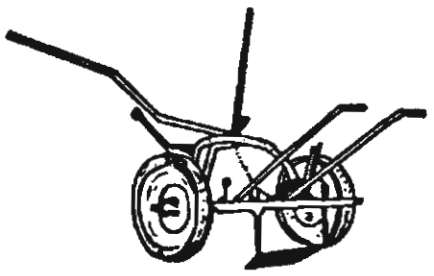
Fig. 9. Polyculteur equipment :



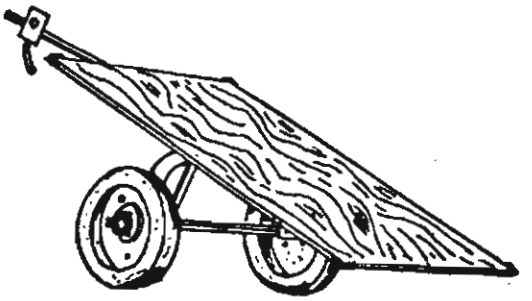
1. Basic frame



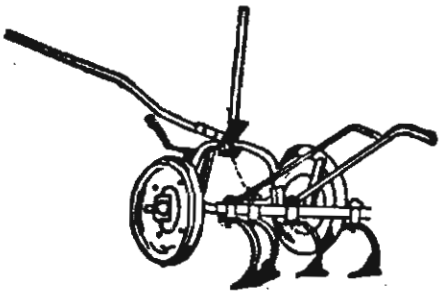
2. Single - furrow plow



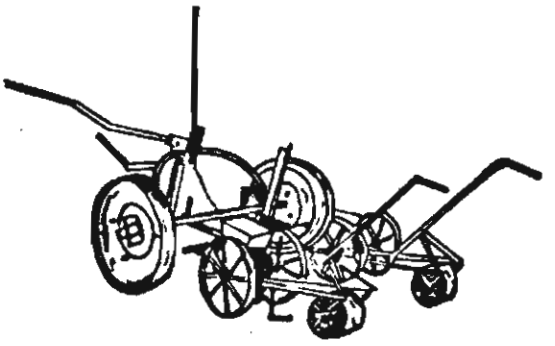
3. Groundnut lifter



4. Farm cart



5. Spring - tine cultivator



6. Two - rowed seed planter

Thus labour requirements for the above-mentioned cropping pattern would be reduce as follows :

Table 12.

Operation	Manual M-D/ha.	Polyculteur M-D/ha.
1. Land preparation	178	42.5 *
2. Planting	193	22
3. Weeding	41	22.5
4. Groundnut harvest	95	20 **
Sub total	507	107
5. Other operations	264	264 (manual)
TOTAL	771	371

* Plowing and harrowing for the first crop; hoeing for the second and third crop.
** Ten man-days for lifting and ten man-days for gathering and handling.

Average labour availability being about 450 M-D/year, a transmigrant family could manage to cultivate manually only 0.58 hectares following the CRIA cropping pattern, and no labour would be available for tree-crop plantation management. On the other hand, with a pair of draught cattle and "Polyculteur" equipment, the settler would be able to cultivate 1.0 ha. and still have 79 man-days available for plantation management.

However, it must be remembered that in order to employ animal or mechanical traction, the fields must be clear of logs and stumps. This work must be performed before the introduction of higher levels of technology. For fields devoted to arable cultivation, mechanical clearing could be necessary. In this case, medium-sized tractors of 60 h.p. are recommended; heavy bulldozers should be avoided.

4.1.7. Promotion of high-level technology : motorization :

Interesting experiments in motorized upland rice cultivation have been undertaken at the Agricultural School of Tumbang Lahang in Central Kalimantan (PLPP-GKE, Tumbang Lahang). Faced with the necessity of providing food for trainees as well as a drastic labour shortage, the school managers were obliged to look for less labour-intensive techniques. As a result, nearly all operations are performed with the aid of tractors. The figures shown on the following page were obtained in 1973-74 at Tumbang Lahang. They enable us to compare the labour requirements and results of rice cultivation with respect to different technology levels (cf. table 13).

Table 13.

Labour requirements and results of different cultivation techniques and technology levels.
Tumbang Lahang 1973 / 1974

	Upland rice shifting cultivation (manual)		Upland rice cultivation with draught cattle *		Upland rice cultivation with tractors *		Traditional low-land rice cultivation (manual)	
Labour requirements :	Hours/ha	M-D/ha	Hours/ha	M-D/ha	Hours/ha	M-D/ha	Hours/ha	M-D/ha
- Land preparation	642	80	327	41	12	1.5	215	27
- Seeding	168	21	24	3	4	0.5	575	72
- Weeding & maintenance	1141	142	614 **	77	503 **	63	40	5
- Harvesting	463	58	600 **	75	77 ***	10	730	91
TOTAL	2414	301	1565	196	596	75	1560	195
Yields : kg paddy/ha	1800		3200		2700		2500	
Overall cost : Rp (labour & material)	136,800		105,600		110,700		90,000	
Gross return (local price Rp 100/kg paddy)	180,000		320,000		270,000		250,000	
Net return : Rp	43,200		214,400		159,000		160,000	
Net return/kg paddy : Rp	24		67		59		64	

* Initial clearing and stumping is not taken into account (255 M-D/ha. if manual)
** Manual operation
*** Partly manual, partly with combine harvester.

The best results in upland rice cultivation were obtained with draught cattle. But in the second year of cultivation yields generally dropped to 50 - 75% of the first year, and third-year yields scarcely covered the overall cost of cultivation. So, the school's agronomists promoted a rotation over 6 years with grass fallow. Each plot was cultivated for two consecutive years with upland rice and left fallow for four years. Unfortunately, even the strongest draught cattle could not manage to pull the plow through the four-year-old grass fallow and the only recourse was the use of tractors.

Average rice yields during the last eleven years are given below :

Table 14.

	First year rice	Second year rice
Average yield in kg paddy per hectare for 11 years	2,298	1,740
Lowest yield over 11 years	1,579 (75/76)	1,088 (72/73)
Highest yield over 11 years	4,208 (73/74)	2,850 (76/77)

The grass fallow is planted with Panicum maximum and interplanted with Setaria sphacelata and is cut 6 or 7 times a year with an average yield of 30 tons/ha. The labour requirement for mechanized grass cutting is 26 M-D/ha./year (1000 to1200 kg/day). Trials with Pennisetum purpureum (Elephant grass) gave approximate yields of 40 tons/ha. but had not yet been introduced in the rotation.

A Setaria sphacelata yield of 30 tons/ha. corresponds roughly to 7.5 tons of dry matter; thus, the livestock carrying charge on 1.0 ha. is around 340 kg cattle per year.

If such a system is to be introduced among transmigrants, the average size of each holding would then have to exceed 6 ha., making the carrying capacity of the Transmigration project rather low. To assure a high carrying capacity (i.e., the number of families per surface unit), the surface devoted to food-crop production should be limited to 1.0 - 1.5 hectares per family. But such a target under the climatic and edaphic conditions in Central Kalimantan nearly precludes any form of sustained upland arable cultivation. The best solution, then, would consist in developing irrigable valley-bottoms for low-land rice cultivation.

4.2. Development of low-land arable cultivation :

Considering the large extension of valley-bottoms (26.6%) in the Tumbang Sangai area, each transmigrant family could be granted one to two hectares of irrigable land. Most of these valleys could be developed through small-scale irrigation works performed at an individual, sub-unit, or unit level. As Javanese or Balinese settlers are usually very skilled in irrigation techniques, the required works could be left to their initiative.

Regional flooding occurs 2 or 3 times a year, sometimes at unforseeable periods, and lasts from 1 to 4 days according to the river section. Therefore, the arable cropping area of a transmigrant family should be divided into 2 to 4 parcels, with at least 0.5 ha. where the risk

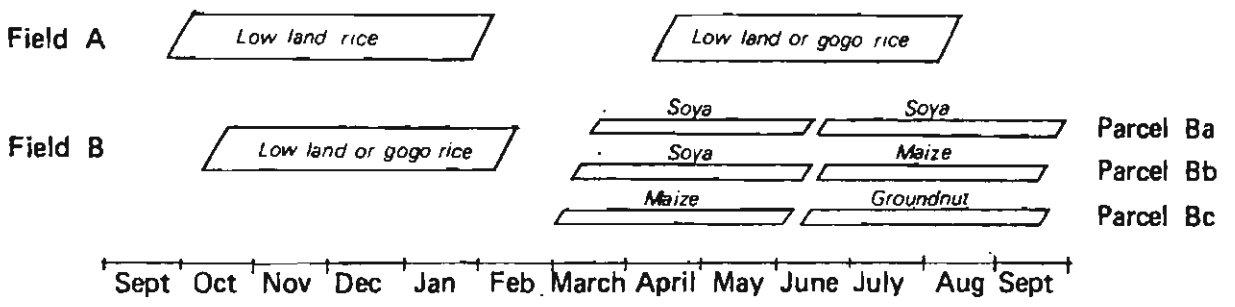
of flooding is low, in order to allow for the cultivation of secondary crops ("palawija" : groundnut, soya, maize, cassava, sweet potato .....). Parcels where the flooding hazard is higher should be reserved for low-land rice monoculture.

To allow for the use of draught cattle for land preparation, the arable cropping area should be properly cleared and burned, and the logs and stumps removed. Manual clearing would require 255 M-D/ha., but this could be reduced to 100 M-D/ha. with the use of medium-range tractors (60-90 h.p.)

4.2.1. Proposed cropping pattern :

The cropping pattern shown below could be tested on two fields of 0.75 hectares each : one field (field A) with a high flooding hazard, and the other (field B) with a low flooding hazard.

Fig. 10. Proposed cropping pattern for low-land arable cultivation.



Low-land rice varieties available in the Tumbang Sangai area have a cycle that is too long (6-8 months) to fit into the proposed cropping pattern. Suitable 120-day low-land or gogo rice varieties should be introduced, tested, and multiplied during phase B. Soya, maize, groundnut, and other palawija crop seeds are not available in sufficient quantities and also have to be introduced.

4.2.2. Estimated labour requirements :

Estimated labour requirements are adapted from data obtained from various trials under smallholder conditions in Tumbang Lahang.

4.2.2.1. Estimated labour requirements for lowland rice :

Four technology levels will be hereafter considered :

1) Local technology. Land preparation consists of cutting the weeds (Cyperaceae) with a long, curved knife and treading them under during the transplanting of the rice. All operations are manual.

2) Improved manual technology. Land preparation is performed with a hoe, the rice is planted out. All operations are manual. However, a small thresher (shared between 4 or 5 families) reduces the labour required for harvest operations.

3) Use of draught cattle. Land preparation consists in ploughing with the aid of a pair of draught cattle; the rice is planted out. All other operations, excluding threshing, are manual.

4) This technology is the same as technology 3, with the substitution of direct seeding for transplanting.

Table 15.

Estimated labour requirements for low-land rice in M-D/ha.

Operations	Tech. 1 (local)	Tech. 2 (manual)	Tech. 3 (draught cattle)	Tech. 4 (direct seeding)
Nursery preparation	10	10	10	-
Land preparation	30	130	40	40
Transplanting	70	60	60	-
Direct seeding	-	-	-	2
Weeding, pest control	5 *	80	80	100
Harvesting & processing	90	60	60	55
TOTAL	205	340	250	197

* No pest control; poor weeding.

In the absence of draught cattle, technology 1 should be preferred to technology 2. If draught cattle are available, technology 4 (direct seeding) could be promoted on field A. Technology 3 should be preferred for field B, to make the more intensive weeding easier.

4.2.2.2. Estimated labour requirements for secondary crops :

Three levels of technology will be hereafter considered :

1) All operations manual.
2) Land preparation with draught cattle and all other operations manual; seeding with a hand-pulled hopper seeder.
3) Land preparation and weeding with draught cattle and "Polyculteur" equipment (including groundnut harvester).

Table 16.

CROP Operation	Technology 1 Manual M-D/ha	Technology 2 draught cattle M-D/ha	Technology 3 polyculteur equip. M-D/ha
SOYA			
Land preparation	70	20	20
Seeding	50	20	10
Weeding & pest control	35	30	15
Harvesting	50	40	40
TOTAL	205	110	85
GROUNDNUT			
Land preparation	70	20	20
Seeding	55	20	10
Weeding & pest control	35	30	20
Harvesting	100	100	20
TOTAL	260	170	70
MAIZE			
Land preparation	70	20	20
Seeding	60	20	10
Weeding & pest control	35	35	20
Harvesting	10	10	10
TOTAL	175	85	60

If we take into account the labour availability for arable food-crop production and the chosen technology level, we can roughly estimate the maximum surface that a transmigrant family will be able to cultivate following the proposed cropping pattern, using the formula given below :

$$X = \frac{6 \cdot LA}{3(Rb + 2 \cdot Ra + S) + 2 \cdot M + G}$$

X = maximum surface cultivable
(Surface of fields A and B = $\frac{X}{2}$; surface of parcels Ba, Bb, and Bc = $\frac{X}{6}$)

LA = labour availability in M-D/year for available food cropping.

Ra, Rb, S, M, & G = labour requirements in M-D/ha. for, respectively, rice on field A, rice on field B, soya, maize, and groundnut.

(Since labour peaks are not taken into account, such a calculation is only a rough estimation).

4.2.3. Maximum area cultivable for an average family at different technology levels

Table 17.

Labour availability / Technology level	400 M-D/year	450 M-D/year	500 M-D/year	550 M-D/year
Tech. 1, Ra & Rb Tech. 2, S, M, G, etc.	0.77 ha	0.87 ha	0.97 ha	1.06 ha
Tech. 2, Ra & Rb Tech. 1, S, M, G, etc.	0.56 ha	0.63 ha	0.70 ha	0.77 ha
Tech. 3, Ra & Rb Tech. 2, S, M, G, etc.	0.82 ha	0.92 ha	1.03 ha	1.13 ha
Tech. 3, Rb Tech. 4, Ra Tech. 2, S, M, G, etc.	0.92 ha	1.04 ha	1.15 ha	1.27 ha
Tech. 3, Rb Tech. 4, Ra Tech. 3, S, M, G, etc.	1.00 ha	1.13 ha	1.25 ha	1.38 ha
Tech. 4, Ra & Rb Tech. 3, S, M, G, etc.	1.08 ha	1.22 ha	1.35 ha	1.49 ha

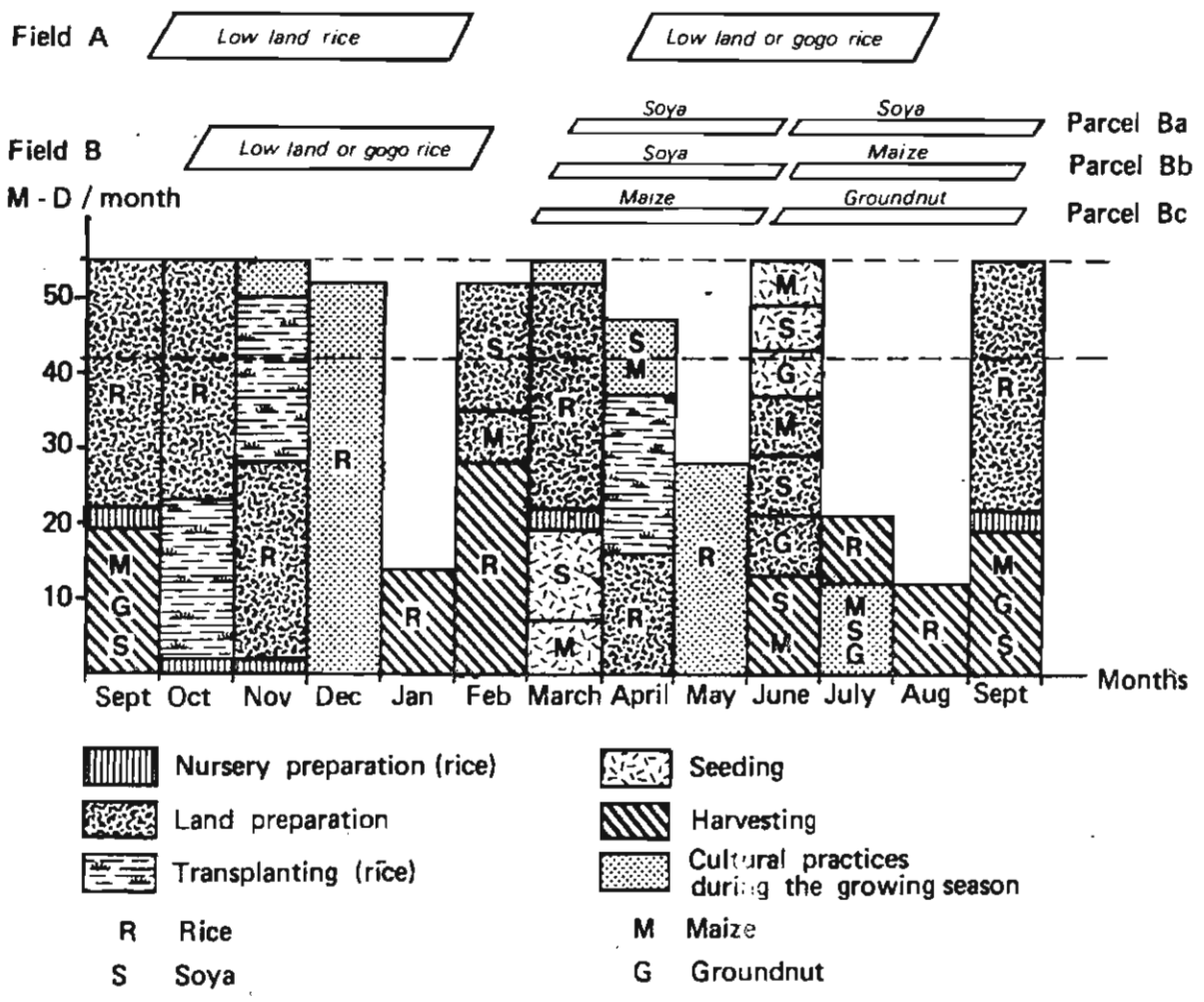
Thus, a food-crop cultivation area of 1.5 ha. per family would best allow for the possibility of increasing the technological level and the employment of the second generation.

Monthly labour requirements would be as follows :

4.2.4. : Case-study 1 :

0.7 ha. of food-crops; labour availability 500 M-D/year or 42 M-D/month and 55 M-M-D/month for peak labour periods; technology 1 for rice and 1 for secondary crops. (Refer to tables 15 & 16).

Fig. 11 Labour requirements for case - study 1.

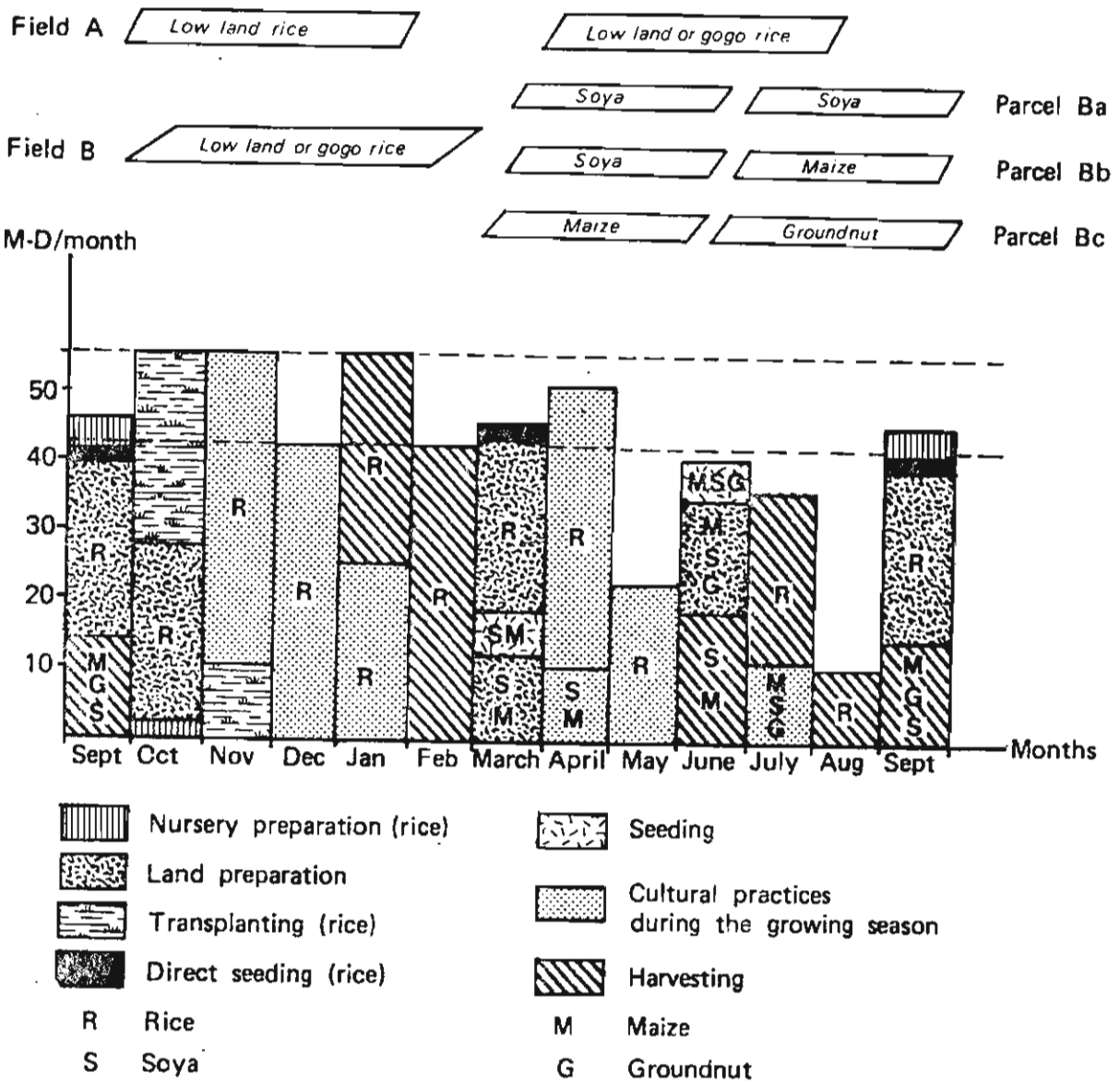


The very high labour requirements for land preparation and transplanting will lead to staggered planting. Should any problem occur during this period (illness, flooding, etc.) the entire cropping pattern will be affected.

4.2.5. Case - study 2 :

1.25 ha. of food-crops; labour availability of 500 M-D/year or 42 M-D/month and 55 M-D/month for labour peaks; technology 4 for ricefield A, 3 for ricefield B, and 3 for secondary crops. (Refer to tables 15 & 16).

Fig.12. Labour requirements for case - study 2.



With the technologies used in case 2, the labour peaks are caused by standard agricultural chores during the growing season and not by land preparation or transplanting as in case 1. If any problem occurs during this period, weeding, for example, could be reduced without any effect on the cropping pattern as a whole.

4.2.6. Estimated results of the cropping pattern :

The following figures are based on average yields obtained during on-farm experiments in Tumbang Lahang. Employed technology is of medium-range : land preparation is performed with draught cattle; seeding is done with a hand-pulled, one-row hopper seeder; all other operations are manual.

4.2.6.1. Crop yields, calories, and protein :

Table 18.

		Rice	Soya	Maize	Groundnut
Average yield	kg/ha	3350	870	1140	1450
Edible matter	%	59	98	100	75
Edible yield	kg/ha	1977	853	1440	1088
Caloric value	Kcal/kg *	3.55	3.35	3.76	3.3
Caloric yield	Kcal/ha	7018	2858	5414	3590
Protein value	g/kg *	87	380	98	270
Protein yield	kg/ha	172	324	141	294

* of edible matter

With the proposed cropping pattern, the average annual production can be estimated as follows :

- paddy production in kg : $\frac{3.R.X}{2}$
- soya production in kg : $\frac{3.S.X.}{6}$
- maize production in kg : $\frac{2.M.X}{6}$
- groundnut production in kg : $\frac{G.X}{6}$

Where X = total surface devoted to food-crop production;

R, S, M, & G = respectively, the average yields of rice, soya, maize, and groundnut.

The production of calories and proteins can be estimated by applying the following formula :

$$P = \frac{R.3X}{2} + \frac{S.3X}{6} + \frac{M.2X}{6} + \frac{G.X}{6} = \frac{(9R + 3S + 2M + G)X}{6}$$

R, S, M, G = respectively, the caloric or protein yields per hectare of rice, soya, maize, and groundnut.

4.2.6.2. Estimated productions according to total food-crop area

Table 19.

Total food-crop area :	0.75 ha	1.00 ha	1.25 ha	1.50 ha
Paddy production kg	3770	5020	6280	7540
Soya production kg	326	435	544	653
Maize production kg	360	480	600	720
Groundnut production kg	181	242	302	362
Caloric production 10^3 Kcal	10.8	14.4	17.9	21.5
Protein production kg	387	516	645	774

Considering that the daily diet of an adult should include :

- 3,000 calories (2,500 from vegetal and 500 from animal sources)
- 80 g of protein (50 g from vegetal and 30 g from animal sources),

the total food-crop production of an average holding could, depending on the cultivated surface, supply during one year :

Surface	0.75 ha	1.00 ha	1.25 ha	1.50 ha
- in calories (vegetal source)	11 persons	15 persons	19 persons	23 persons
- in vegetal proteins	21 persons	28 persons	35 persons	42 persons

Thus, even in the least favorable case, more than 50% of the production could be sold.

4.2.6.3. Estimated economic results :

As no precise and up-to-date data concerning material costs is available in the study area, an average net return cannot be calculated. We can only estimate the gross return with the above-mentioned yields and the following commodity prices :

- paddy : Rp 120/kg
- soya : Rp 250/kg
- maize : Rp 75/kg
- groundnut : Rp 350/kg

Table 20.

Gross return according to the cultivated area :

Surface	0.75 ha	1.00 ha	1.25 ha	1.50 ha
Gross return, Rps.	624,000	833,000	1,041,000	1,250,000

With a total labour requirement of 500 M-D/year and an average cost of Rp 500/day the annual labour cost would be Rp 250,000.

Assuming that the average material cost of such a cropping system ranges between 20 and 30 % of the average gross return, we could obtain the following figures :

Table 21.

Estimated net return according to the cultivated surface and the level of material cost

Net return * Rps	0.75 ha	1.00 ha	1.25 ha	1.50 ha
with mat. cost of 20% of gross return	249,000	416,000	583,000	750,000
with mat. cost of 25% of gross return	218,000	375,000	531,000	688,000
with mat. cost of 30% of gross return	187,000	333,000	479,000	625,000

* Labour cost is considered as fixed, the larger areas having the same labour requirements but being cultivated at a higher technology level.

Obviously the higher technology levels allow for a more efficient use of labour availability and in turn a higher net return. The investment in draught cattle and "Polyculteur" equipment would be highly profitable for the transmigrant.

The aim of the preceding estimates (concerning yields and economic results) is only to give a general idea of the possibilities of the proposed cropping pattern. Reliable figures can be obtained only through on-farm experiments under the actual conditions of the Transmigration project.

4.3. Perennial crops management :

At the beginning of phase C, all perennial crops plantations have already been established, and the only labour requirements involve general maintenance, harvesting, and initial processing. In view of the climate and soils of the area, the most suitable perennials are rubber trees, coconut palms, robusta coffee shrubs, and pepper plants. These crops can easily be managed at the smallholder level. On the other hand, oil palm plantations would require estate or at least nucleus estate (NES) management.

The choice of tree-crops and the respective size of each plantation depends upon the processing and marketing facilities. According to the general conditions of the study area and of Transmigration projects, the priviledged tree-crops should :

- give a high return for invested labour,
- give a product that is easy to store and to process,
- give a product with a high price per weight unit,
- not require a high fertilization rate or expensive pest control,
- not require a dense road network.

In order to avoid labour peaks during harvesting and to scale down the effects of price drops, a larger range of tree-crops should be planted by every settler. For instance, each transmigrant could own four plots, one each of rubber, coconut, coffee, and pepper, in the different plantation blocks, the size of each plot depending on the labour availability (if marketing is assured).

4.3.1. Labour requirements in established plantations : M-D/ha

Table 22.

	Coconut	Coffee	Pepper	Rubber
Maintenance	5	18	66	10
Pruning (incl. suckers)	-	25	-	-
Harvesting & processing	20 *	140 *	500 *	65
TOTAL	25	183	566	75

* Labour requirements for harvesting are closely linked to the yields; these figures correspond to 15,000 coconuts/ha/year, 800 kg coffee/ha/year, and 1,000 kg pepper/ha/year.

In established plantations harvesting requires the most labour. Rubber tapping must be done daily but only requires three to four hours of work, in the early morning, and could easily be done by women. If modern techniques are promoted, such as stimulation or harvesting with plastic bags, the labour requirements for harvesting could be reduced by one-half or more.

Collecting coconuts for coprah production can be performed once every two months without any problem. If the blocks are accessible, small tractors can be used.

On the contrary, coffee and pepper harvesting often leads to labour peaks which compel the hiring of extra workers.

4.3.2. Estimated yields and results :

With proper fertilization, the assumed average yields of the groves of hybrid PB 121 coconut should range from 10,000 to 15,000 coconuts/ha/year, or from 2 to 3 tons of coprah/ha/year. Coffee yields vary greatly between years in local plantations. Average yields should range from 800 to 1,000 kg/ha/year but may reach 1,500 kg/ha or more some years. Pepper yields are generally subject to the same variations as coffee yields. Average pepper productions are estimated at 1,000 kg/ha with yields of over 2,000 kg/ha some years. Under proper management and with productive clones, rubber yields should range from 1,000 to 1,500 kg rubber/ha/year.

As commodity prices (especially those of rubber, coffee, and pepper) fluctuate considerably, it would be hazardous to estimate economic results. However, it can be assumed that

if a transmigrant possess 1.0 ha. of rubber, 1.0 ha of coconut, 0.5 ha of coffee and 0.3 ha of pepper, he could be assured of an annual net income of at least Rp 600,000 from perennial crops if all commodity prices are at their lowest levels. *

In fact, at present very little is known about plantation possibilities and problems in the study area. The only existing plantations are rubber plantations, and they are managed in a way which is too extensive to provide reliable data. To provide transmigrants with the most suitable varieties and techniques, test-farm experiments should be organized as soon as possible.

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* Export prices for commodities are actually at their lowest level for years. For instance :
  - Rubber RSS 1 : 0.82 US$/kg; RSS 2 : 0.74 US$/kg; RSS 3 : 0.72 US$/kg
  - Robusta coffee : 1.65 US$/kg
  - Black pepper : 0.90 US$/kg (FAQ)
  - Coprah : 108 US$/ton

Source : Penepatan Harga Barang-Barang Ekspor (Harga F.O.B.) 1 Januari s/d 31 Maret 1982 Departemen Perdagangan dan Koperasi. Jakarta.

CHAPTER IX

REQUIRED IMPLEMENTATIONS

1) Research requirements :

Up to now no serious agricultural research has been undertaken in the Central Kalimantan upland area, with the exception of Tumbang Lahang. As no sufficiently trained staff is available at the provincial level, the necessary research should be done under the responsability of the Central Research Institute in Agriculture (CRIA) at Bogor, or a university such as Gajah Mada at Yogyakarta, with the possible assistance of ORSTOM agronomists.

The first priority should be research into clearing techniques which conserve or increase the soil's fertility. Particular attention should be given to the erosion hazard, evolution of organic matter and soil structure under different clearing techniques : grubbing and stumping with bulldozers, with light tractors, or manually (with or without burning).

A well-equipped meteorological station could provide the data necessary in determining optimal sowing dates, drought risks, flooding hazard, etc.

The aim of food-crop research would be to determine the most suitable varieties, planting densities, fertilizers, and pesticides. The greatest care must be taken with the evolution of the soil's organic matter and pH. Fertilizers with low solubility and low acidifying action should be tested.

Next, adopted cropping patterns could be defined and tested in on-farm conditions with different technology levels.

All of the above-mentioned research should take place in both low-land and upland conditions.

For tree-crops we propose demonstration plots for long-term research and on-farm experiments to determine the most suitable management techniques.

Last, but not least, processing techniques must receive careful attention. Small experimental processing plants should be promoted; for example, an oil factory for coprah, a crumb-rubber unit, an instant coffee factory, storage and packaging units, and so forth.

Besides agricultural research, the test farms could provide training for local extension workers and thus become the center of an important provincial agricultural school.

2) Agricultural extension services :

Javanese or Balinese farmers transmigrating to Kalimantan will have to face new or unusual, though merely technical, problems which they will not be able to solve with their own knowledge. On the average they are totally ignorant of tree-crop plantation management. During the first years of settlement the transmigrants should not be allowed to focus on arable farming only. This would lead to stagnation and it is feared that they would not be able to surpass the agricultural subsistence level in such conditions.

Therefore, the fulfillment of the recommended development strategy will require reinforced supervision and extension services. The drastic lack of extension workers in Central Kalimantan necessitates a thorough organization of extension services at the provincial level. As the Directorate General of Transmigration has no technical extension staff of its own, and as provincial staff will not be available in sufficient numbers before at least five to ten years, the necessary extension workers will have to be recruited, formed, and trained directly on the project. The staff of the research institutes or universities responsible for agricultural research would thus be the only people who could provide the required formation and training for extension workers. This would, of course, imply a more extensive research organization on the project. But as trainees could provide inexpensive part-time labour on the test farms, this solution would be beneficial for both parties.

At least 30 PPL (Penyuluh Pertanian Lapangan = agricultural extension workers) should be recruited and trained on the project (not only for project needs, but also for those of the Province). Formation charges should be shared between the Directorate General of Transmigration and the Local Government. Training courses at the Tumbang Lahang agricultural school could be organized under agreement with the managers of the school.

Once again we want to emphasize that the success of the proposed development strategy relies entirely on a dense, reinforced research and extension network.

3) Supply of planting material :

Most of the required planting material is not yet available in sufficient quantities in Central Kalimantan. Selected seeds and seedlings should be introduced in larger quantities than needed for the project, in order to supply the local population also. During the first stages of settlement upland rice seeds and cassava cuttings can be purchased (or exchanged) from local farmers. Coffee seeds or cuttings, pepper cuttings, and coconuts are available in small amounts and rubber tree stumps are quite abundant. Hence, selected highly productive varieties, clones, and grafting material should be imported for multiplication.

At the same time low-land or gogo rice varieties of short or medium cycle, along with soya, groundnut, maize, rice bean, mung bean, and various vegetable varieties should be introduced on the test farms. If, after testing, the most suitable varieties could not be multiplied quickly enough, the necessary seeds should be imported.

Precise requirements for the supply of planting material will be closely linked to multiplication possibilities on the test farms. In each village-unit, a few farmers could be chosen to participate in seed-multiplication projects, under close supervision of trained extension workers.

Careful attention should be given to transportation and transit storing, means, and delays. Very often seeds are damaged due to improper storage in unequipped harbours, or are too old upon arrival on the project site because of the sometimes lengthy transportation delays.

4) Supply of agricultural credit :

The Bank Rakyat Indonesia is in charge of supplying agricultural credit, though it is not yet organized in the study area. To avoid deviations from the development strategy during

phase B, credit possibilities should be limited to inputs required for planting and plantation management. Later, during phase C, a more traditional BIMAS organization (Bimbingan Masa = organization for mass guidance for food-crops) could provide farmers with package inputs (fertilizers, seeds, pesticides) on credit.

In the matter of credit, a particular effort should be made to enable farmers to buy draught cattle and "Polyculteur" equipment in order to increase their technological level and thus increase the return for invested labour.

CHAPTER X

LIVESTOCK

In the phase 1 Agronomy report, we pointed out that there is a serious lack of animal proteins in Central Kalimantan, although the local marketing possibilities are very favourable. The average buying power of the local population is far above that of Javanese or Balinese smallholders, and in villages near logging camps, the price of live chicken can be as high as Rp 3,000 to Rp 3,500/kg.

There is no regular meat supply in the local markets other than dried fish (ikan asin) and tinned meats imported from Surabaya. The next most important source of animal proteins would certainly be game. The Dayaks are skilled hunters, and deer, wild boar, monkeys, and other wild animals are quite numerous in primary and even secondary forests.

1) Local animal husbandry :

The aim of local animal husbandry is not to supplement the Dayak's diet with proteins but to accumulate as large a number as possible of animals for secondary burial ceremonies (Festa tiwah) or other religious purposes. The Festa tiwah is the most important ceremony in the Kaharingan religion and the possibility of reaching paradise under the best circumstances, as well as the wealth and position of the soul in Dayak paradise, depends essentially on expenditures during the secondary burial rites. The sacrifice of a great number of bulls, oxen, pigs, and chickens provides graduated residential benefits. (Formerly, human sacrifices gained the departed soul the most favourable locations in Paradise). Nowadays the Dayaks are more aware of the cost and economic consequences of such rites, which are sometimes a strong incentive for conversion to Islam or Christianity.

The following table, obtained from official statistics of the Sensus 1980, Kalimantan Tengah, gives an idea of the present livestock situation in the villages of the East Mentaya priority area and all of Kecamatan Mentaya Hulu :

Table 23.

Livestock population in Kecamatan Mentaya Hulu *

Location	Poultry	Ducks	Cattle	Buffaloes	Pigs	Goats
1. East Mentaya priority area						
Tumbang Sangai	1200	15	21	0	25	0
Rantau Katang	367	18	8	0	0	0
Tumbang Mangkup	208	0	3	0	0	0
Rantau Tampang	164	0	9	0	43	0
Luwuk Kuwan	271	0	15	0	36	0
Tumbang Bajanei	115	0	7	0	23	0
Tumbang Boloi	219	0	20	0	114	0
Tumbang Sepayang	320	26	16	0	169	0
Sungai Hanya	237	12	20	0	54	15
Total E.M.P.A.	3101	71	119	0	464	15
2. Total other villages	6880	241	355	1	1628	18
3. Total Kecamatan	9981	312	474	1	2092	33
4. Average/family	2.6	0.08	0.13	-	0.56	-

* Accuracy of these statistics is doubtful for poultry and ducks but rather good for cattle and pigs (piglets are generally not counted).

2) Animal husbandry development :

The livestock population of the study area is obviously too small to provide transmigrants with animals for meat and/or husbandry needs. Therefore, the necessary animals will have to be introduced and multiplied on the Transmigration project.

During the first stages of development selected laying hens and roosters should be introduced in rather large numbers, in order to provide the settlers with animal proteins. Careful attention should be given to the health of the imported poultry. The current disease situation of poultry in Kalimantan has been very bad since Madurese hens were introduced. Regular epidemics occur in all the villages and often wipe out the entire poultry population. This is the main reason for the high poultry prices in Central Kalimantan. To prevent such problems, the birds should not be left free to scavenge in the villages; proper husbandry should be practiced and the necessary medecines made available.

Ducks are generally less subject to disease, but local farmers reported to us the very low fertility of introduced ducks. This is probably related to nutritional deficiencies and could easily be remedied with proper alimentation.

Very promising experiments in rabbit husbandry are being conducted in Tumbang Lahang. As there are very few introduced rabbits and no wild ones in Central Kalimantan, the disease situation is still at a very favourable level. With adequate quarantine stations to prevent the introduction of unhealthy animals, rabbits could provide a very important source of protein for the settlers' diet. Care is rather easy and feeding 30 or 40 rabbits would not pose any problems for the transmigrant. The only major problem would be to convince farmers that the rabbit is not only a pet but also a plentiful source of inexpensive meat.

3) Working animals :

Of course, the major priority would be the introduction of cattle and buffaloes. These should be introduced and multiplied as soon as possible in order to provide settlers with the draught cattle necessary for the food-crop intensification phase. We have already emphasized the fact that the use of draught cattle is the only way to raise the technology level and increase the return for invested labour.

In order to allow for cattle reproduction, the introduced animals should not be given to the settlers, but rented on a contract basis, as is already usual on many projects. Local prices for cattle are very high, due to the high demand for cattle for secondary burial purposes. The price for one head of cattle often reaches Rp 150,000 or more in Central Kalimantan (two to three times the price asked in other provinces) and the settler would be tempted to sell his animals.

Under a contract basis, the farmer does not become the owner of his cattle until he has provided the project with a given number of calves. For instance, on the Landono settlement in South-east Sulawesi, for 32 cows and 3 bulls on contract in 1972, 38 calves were returned to the project from 1973 to 1975.

The number of introduced cattle will be a function of the annual increase rate and, naturally, of the number of transmigrant families to be supplied. It can be calculated with the formula.

$$No = \frac{Ny}{(1+i)^y}$$

No = the number of animals introduced in the beginning
i = the annual increase rate
y = the number of years after introduction
Ny = the number of animals available y years after introduction

For example, if we want to provide 500 families with two cattle each, 10 years after the beginning of the project, and assuming an increase rate of 12%, the number of introduced cattle should be :

$$No = \frac{1000}{(1+0.12)^{10}} = \frac{1000}{3.106} = 322$$

Table 24.

Evolution of cattle population with a 12% annual increase rate :

Number of cattle introduced	Assumed population after :					
	1 year	3 years	6 years	9 years	12 years	15 years
50	56	70	99	139	195	274
100	112	140	197	277	390	547
150	168	210	296	416	584	821
200	224	281	395	555	779	1095
250	280	351	494	693	974	1369
300	336	422	592	832	1169	1642

According to the recommended development strategy, 9 years after settlement, each family should have at least 1.5 head of cattle. Thus, at least 54 head of cattle should be introduced for every 100 families.

Cattle could be fed with the leguminous cover-crops of the coconut groves or rubber plantations. To prevent the cover-crops from damage caused by overgrazing, the carrying charge should not exceed one head of cattle per hectare. Grazing on the plantation blocks could be organized on the community level to reduce labour requirements for guarding the animals.

The current disease situation is better than in other provinces, but ticks and leeches can be dangerous if animals are left to wander. Therefore, great care should be taken to prevent the introduction of diseases on the project by introduced animals. Quarantine should be compulsary.

There is still too little available experience in cattle husbandry under the conditions in Central Kalimantan to recommend ley farming systems. Hence, introduced animals should be closely supervised and be part of a large agricultural research program. The aim of this program would be to gather the data necessary to determine fodder values and requirements, carrying capacities, population increase rates, production estimations, health problems, suitable animal husbandry techniques, and so on. If the initial results are promising, new farming systems giving a larger place to animal husbandry could be developed.

CHAPTER XI

PISCICULTURE

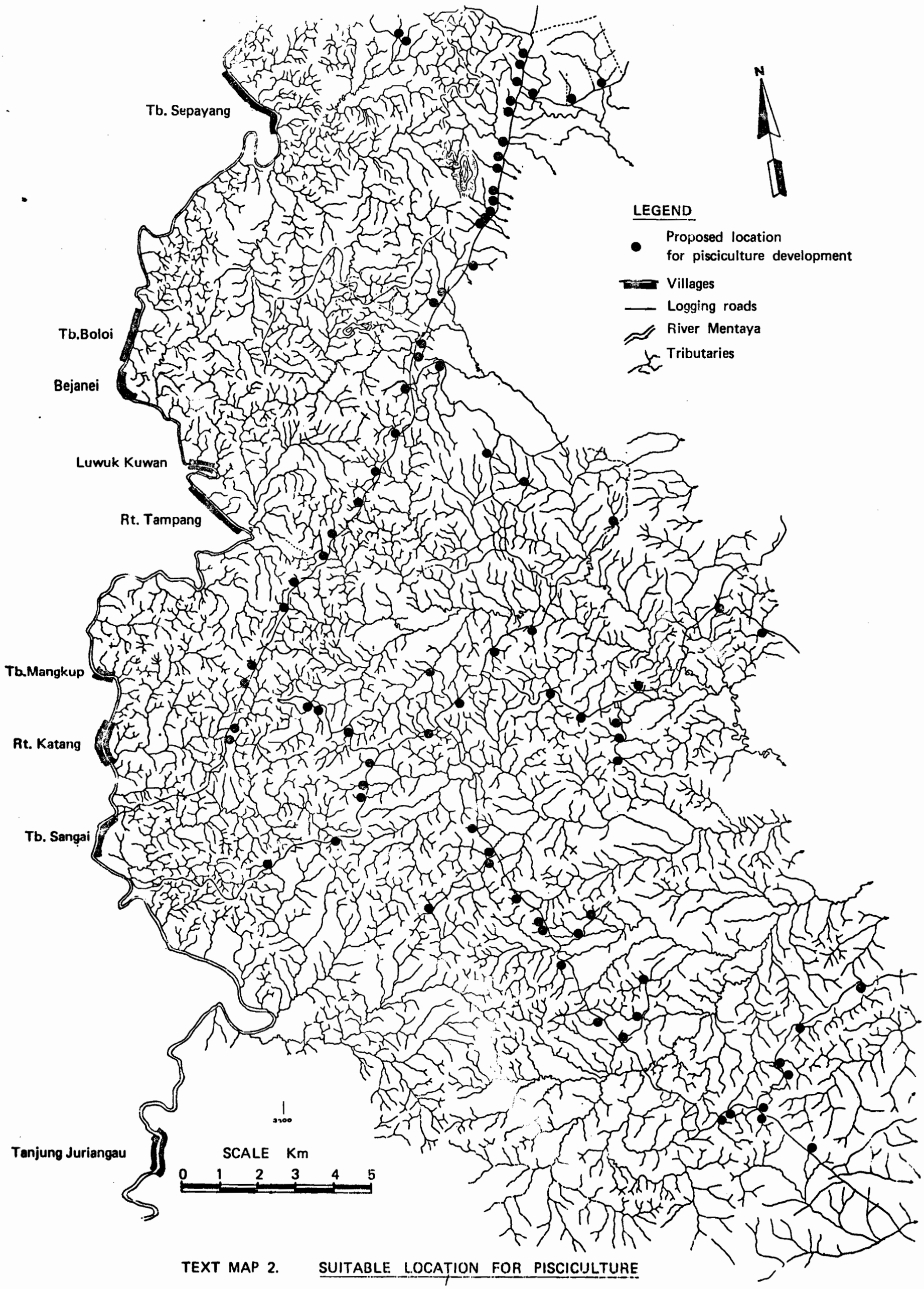
Pisciculture is presently unknown in the study area. However, the number of fish caught in the large rivers (Mentaya - Tualan) through various techniques (nets, traps, angling, spearfishing) is too small to regularly supply the local markets. In order to deter conflicts with the local population, the transmigrants should avoid fishing but be encouraged to develop ponds for pisciculture. Such ponds could be dug near the dwellings or created by building small dams in narrow valleys. Some ponds have already been created during the construction of logging roads and could easily be used for pisciculture.

In the eastern part of the study area, the main tributaries of the Sang-sang River are deep enough, even during drought periods, to permit carp husbandry in bamboo cages, as is generally practiced on Java.

Fish species such as Silver Carp, Tilapia, Gourami, and Puntius should be introduced for fish farming, and small-scale experiments in artificial feeding, fertilization, and water treatments should be implemented.

There is little hope that the production will be large enough to permit exportation or to justify processing plants. However, fish farming will contribute to the amelioration of the daily diet of the settler and the local markets can absorb possible surplus at rather high prices.

The following map shows the most suitable locations for the creation of artificial ponds, and the rivers suitable for carp breeding in bamboo cages.



TEXT MAP 2. SUITABLE LOCATION FOR PISCICULTURE

CHAPTER XII

FUTURE DEVELOPMENT PROSPECTS

The chances of success of an upland Transmigration project are closely linked to the development strategy that is followed. Three main possibilities can be considered :

Strategy 1) Focus on upland arable food-crop farming :

Such a project would have little chance of success in Central Kalimantan. The very low nutritional level of the soils rapidly decreases under the double action of continuous cultivation and leaching. The content of organic matter decreases, chemical manuring is wasted and has little effect (except on the pH, which also decreases), and in a few years the fields turn into alang-alang (Imperata cylindrica) wasteland. Farmers incur heavy debts in order to buy inputs which are only wasted, and food-crop yields are too low to assure food self-sufficiency. The situation declines rapidly as the second generation looks for employment. In the best cases, the settlers only attain the level of subsistance agriculture. However, even in such cases most settlers consider their situation much better than it was on Java : "Here we own a house and land; on Java we had nothing" is a common comment. This psychological point of view is more convincing than any economic evaluation.

Strategy 2) Encourage transmigrants to develop the food-crop area first and leave the planting of tree-crops to plantation societies :

The most recent Transmigration projects on Sumatra follow this development strategy. On the arable cropping fields the situation is exactly the same as with Strategy 1. But 6 to 8 years after his arrival the settler is granted one hectare of rubber plantation which will, progressively, enable him to raise his standard of living. However, it is feared that a large part of the return from plantations will be needed to buy food because the yield from food-crops will not be enough to enable the farmer to assure his food self-sufficiency. As a result, he will be tempted to increase his tree-crop area, become exclusively a planter, abandon arable food-cropping, and buy his food.

After a few difficult years his situation will become better and in no way resemble his former situation on Java. However, the national target of reducing food imports by developing Transmigration areas would not be achieved.

Strategy 3) Develop tree-crop plantations first, in order to enable intensification of arable farming restricted to low-lands :

This is the development strategy we recommend for the East Mentaya priority area (Tumbang Sangai). It supposes, of course, that enough land is available in both low-land and upland areas, which is the case in the recommended land-units. This strategy has been thoroughly described in the preceding chapters. During the first years of settlement, food self-sufficiency is assured through shifting cultivation and tree-crops are planted during the same period. When the perennial crops begin to produce, shifting comes to an end and the low-lands

are developed for food production. At this time, as more labour and cash are available, the settler will be in the best situation to face intensive food-cropping and to raise his technological level. Therefore, it is assumed that both targets - food self-sufficiency and higher standard of living - will be met.

Later on, the same deviations mentioned in Strategy 2 may occur. Settlers will quickly become aware of the fact that economic returns from tree-crop plantations are much higher than returns from food-crops (under the conditions in Central Kalimantan). Thus, they may be incited to become planters and to increase their plantation areas. Such deviations have already occured on some projects in Sumatra but are still limited. There, some wealthy transmigrants invite members of their family to come and work on their little estates. They buy land from less successful settlers (although such transactions are generally not authorized) and create small enterprises. Such deviations are unavoidable, and should be encouraged, as they are a guarantee of success.

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