A FUNCTIONAL TYPOLOGY OF FARMING SYSTEMS IN SATHING PHRA AREA - SOUTHERN THAILAND

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by

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INTRODUCTION:

Since January 1982, the "Research on Farming Systems Project" based at the Faculty of Natural Resources - Prince of Songkla University (FNR/PSU) has undertaken a detailed analysis of the farming systems in Sathing Phra area - Songkhla province (see map no. 1).

The objective of the first phase of the project was to build a functioning typology of those farming systems based on their respective socio-economic strategies. Then, contraints and bottlenecks faced by each type of farm to reach its own objectives are clearly identified and provide basic information for the launching of an on-farm cropping systems research and development programme starting this year (CROZAT Y., CHITAPONG P. - 1984).

The methodology used during this first stage of "diagnosis" finds its source in the basic concept of an Agrarian System. It allows us to understand the origins, transformation and differentiation of agrarian society. At the same time the relationships and qualitative changes between the essential variables which define this fundamental concept are studied (MAZOYER M. - 1978):

- "the cultivated environment : original environment and the historical changes which it has undergone.

- instruments of production: tools, machines, crop varieties, breeds of livestock and the (physical and intellectual) labour which uses them. The type of modification ("artificialisation") of the environment by man which results from this (maintenance and exploitation of the cultivated ecosystem).

- the division of labour among agriculture, crafts and industry which provides for the replacement of equipment and, as a result, for the attribution of agricultural surplus beyond the needs of agricultural producers.

- the economic relationships between the associated sectors, the property and power relationships which regulate the distribution of the fruits of labour, production and consumption goods.

- the collection of ideas and institutions which are necessary for society to reproduce itself: production, economic relationships, distribution, etc."

Based on this theoretical concept, a whole "Methodology of Research Development in Agriculture" (TREBUIL G. - 1982) has been built and applied in the case of the Sathing Phra area.

Now we shall describe briefly the main features of the kind of approach adopted. This methodology is deliberately

- global (particularly owing to the combination of both agro-ecological

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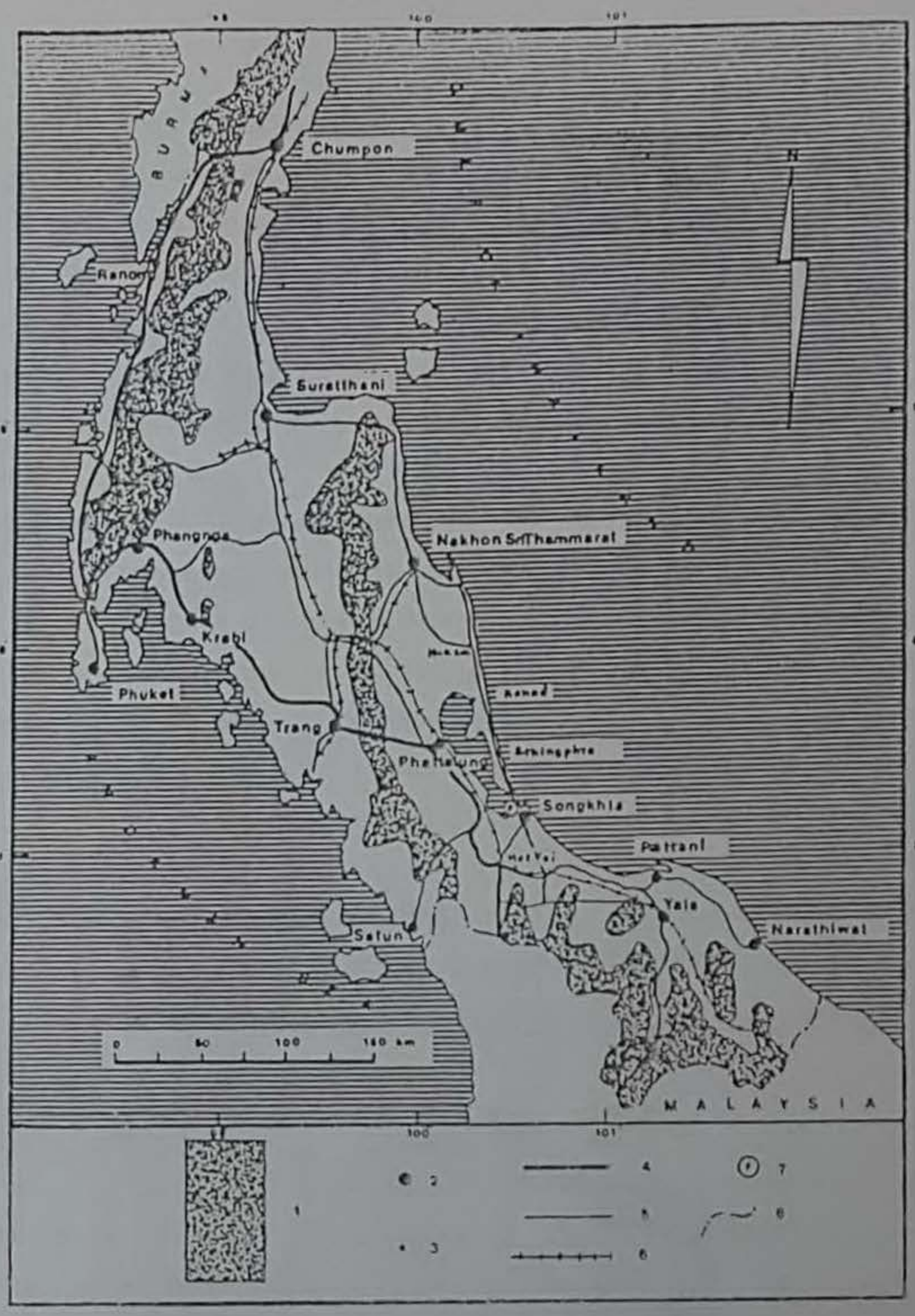

Map no. 1: POSITION OF THE SATHING PHRA PENINSULA IN SOUTHERN THAILAND:

1 - Upland, mainly forested
2 - Provincial capital
3 - District headquarters
4 - National highway
5 - Provincial road
6 - Railway
7 - Ferry
8 - International frontier

and socio-economic approaches)

- systemic (because it is especially interested in the identification of interactions between systems at various levels of perception: the plot of land, the household, the village, the area and the exterior system)

- historical (using knowledge about origins of present agro-ecological imbalances and socio-economic differentiation among the villages and households to reach a better understanding of present situation, and dynamics of the agrarian system studied).

In addition, Research-Development in Agriculture methodology implies to the association of two complementary functions, i.e.:

- a function of evaluation covering the ecological, agronomical and socio-economic fields and combining inventories (productive resources, agricultural production structures, ...) and concurrent evaluation (flows, functioning, dynamics) through following up of selected farms and runs of well chosen line-transects.

- a function of experimentation intended to corroborate or invalidate exploratory hypotheses deriving from the first phase of evaluation - diagnosis as well as to identify more adapted and controllable technical combinations.

Finally, it also distinguishes itself from other approaches through the systemic research of phenomena observed in real conditions of production.

I - SUMMARY OF PREVIOUS FINDINGS AT THE AREA LEVEL:

An agro-ecological diagnosis of the starting situation was first undertaken to contribute to the understanding of the main mechanisms originating the present agro-ecological imbalances. It helped to identify the ecosystem determinant variables according to the level of perception considered (from the plot to the small area) at the same time taking into account both historically and dialectically, the agricultural activity (on the basis of the mode of ecosystem artificialisation) and the natural resources (their nature, state and reproducibility). So the impact of those essential variables on the distribution of cropping patterns and the differentiation of agricultural production systems was evaluated as well as the feed back effect of cropping systems and the effect of agricultural practices on the state and reproducibility of natural resources. Then a general problematique and explanatory hypotheses were derived about the elements that have been, or that are still, determinant concerning the agricultural production systems choices and differentiation. Relevant criteria for the definition of a reasoned and restricted sample of farming systems to be observed throughout an annual cultivation cycle have been chosen on the basis of this first area level, mostly agro-

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ecological diagnosis. It was completed by the reconstitution of the recent technical and socio-economic transformations of the agrarian system (through guided interviews with local old people) and also regular runs of several selected line-transects, from the lagoon to the sea so crossing the main heterogeneity of the landscape, for the observations of the cropping systems performed.

The complete results of that work have been detailed in the project second report (TREBUIL G. and al. - 1983) and are only summarized here.

A regional zoning into homogeneous units has been carried out. Sketch maps of the district have been drawn showing morpho-pedological units, forms of vegetation and the evolution of their distribution (using the interpretation chronological series of aerial photographs) and finally synthetic agro-ecological units identified. Runs of line-transects and interviews gave us information about the mode and degree of artificialisation in each of them and their evolutive trend (expansion/regression). Map no. 2 and the joint topographical profile show the distribution of these agro-ecological units South of Sathing Phra district.

The geomorphological process which is still taking place on this young peninsula is dominated by sedimentation of clay and mud in the West and the addition of new sand bars formed of marine deposits in the East. It determines the nature of the two major soil groups: acidic sandy regosols and flood-prone hydromorphic clay on the small alluvial plain sheltered by the coastal sandy formations. Active sedimentation taking place in the natural North-South drainage channels tends to reduce their effectiveness and facilitates their reclamation for cultivation (unit 9). To a certain extent, it determines also the localisation of human habitation on the sandy crests, 3-5 m. above sea level (villages types A and B), where there is a continuous line of villages protected from the floods which affect the more concentrated smaller population on the edge of the lagoon (village type C). So, the topographical situation and the related pedological and hydrological conditions derived from it explain the major features of the agro-ecological units and distribution of cropping systems in the landscape.

But it cannot be denied that a longstanding and significant human factor has shaped this young manageable environment to its own ends. Thus, located on the route of the ancient indo-chinese trade, the Sathing Phra area has been directly or indirectly influenced by the process of "indianization" of South East Asian societies for many centuries. As a result, hillocks wooded with Dipterocarpus alatus (unit 3) and grid pattern of the palmyra palm Borassus flabellifer groves surrounding paddy fields (units 7-8), two species frequently found on the sites of past "indianized" societies, are still abundant nowadays in the area studied.

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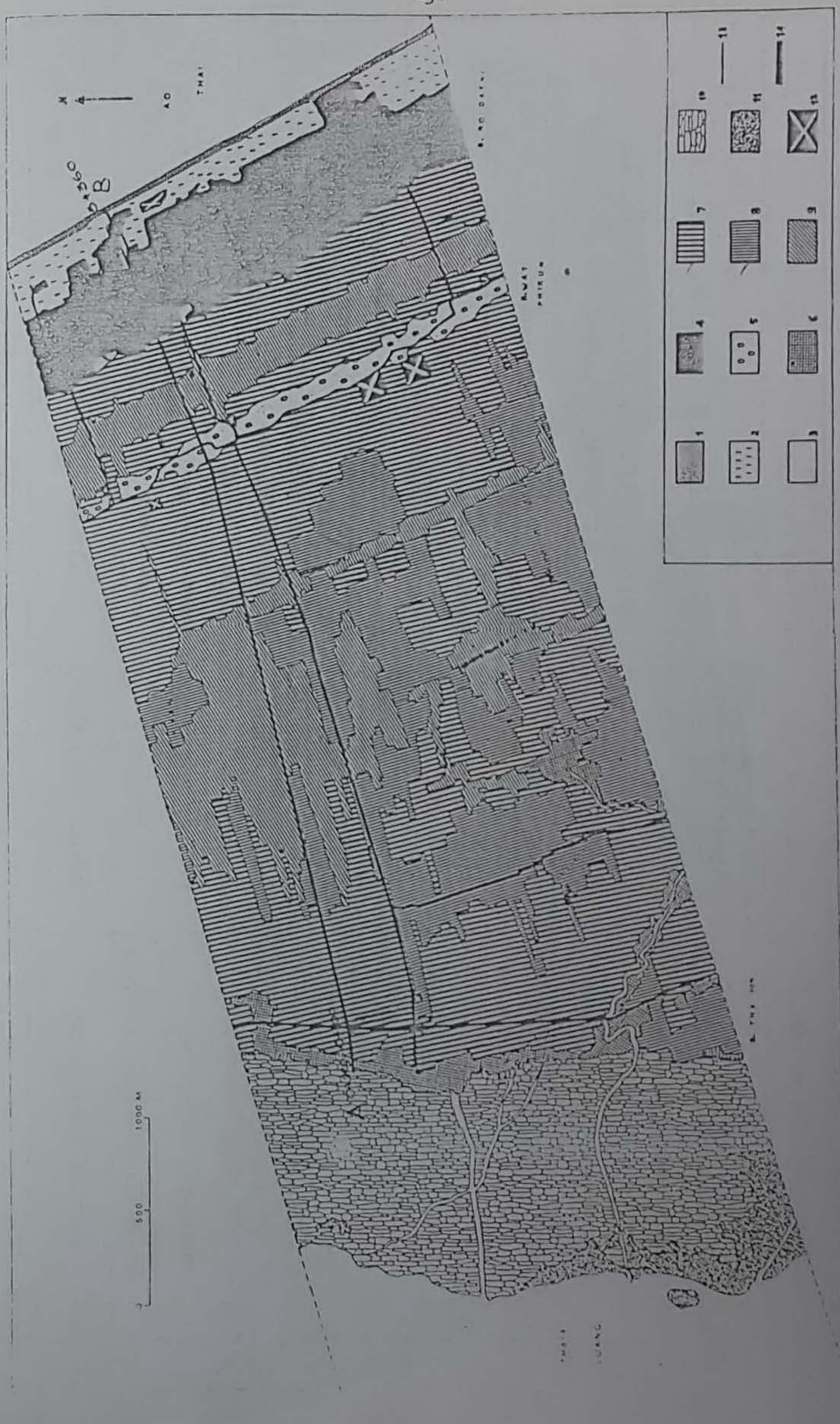
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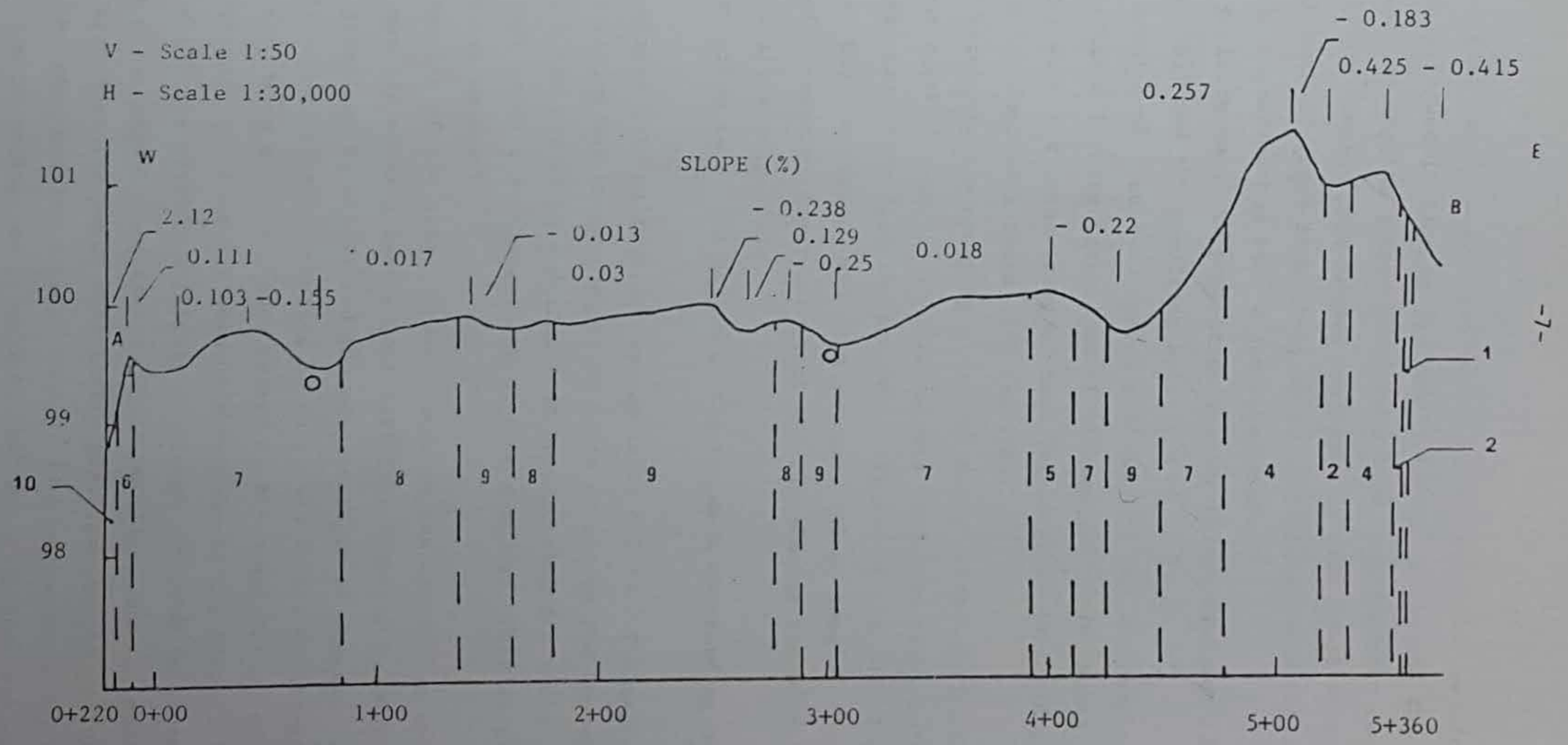
...gical units along an East-West transect from Ban Bo Daeng to Ban Tha Hin:

NO.	AGRO-ECOLOGICAL UNITS:	MORPHOPEDOLOGY:	VEGETATION:	EVOLUTIVE TREND:	DEGREE OF ARTIFICIALIZATION:
1	Sand dunes on present existing coast:	sand	bare soil	expansion	none
2	Uninhabited coast land:	sandy regosols	coconut palm, Casuarinas, Eugenia, Pandanus, Vitex, Spinifex, Ipomea.	recession	very low
3	Hillocks with large dipterocarps;	sandy regosols w. humus	Dipterocarpus alatus...	recession	low
4	Type A village on old sand ridge - many gardens:	ash-coloured podzalized sand regosols.	Coconut palm, Mango tree, Cashew nut tree, Bambusa, Pandanus, many market garden crops	expansion	very high
5	Type B village on old narrow sans ridge - few gardens:	as above	as above	as above	as above
6	Type C village beside the lagoon;	flood prone hydromorphic clay.	Tamarind, Leucaena, Bambusa.	expansion	high
7	Palmyra palm groves closely associated with rice:	hydromorphic clay	Borassus fl., Oryza.	expansion	very high
8	Palmyra palm groves loosely associated with rice:	as above	as above	as above	high
9	Rice fields without palmyra palm:	moderately to strongly hydromorphic heavy clay	Oryza, Cyperus	recession	medium
10	Grassland beside the lagoon:	flood prone clay	Paspalum scrobiculatum, Eleocharis dulcis.	expansion	very low
11	Mangrove swamps:	permanently saturated soil	Sonneratia, Rhizophora, Acrostichum.	recession	none

12 - Freshwater ponds 13 - Dirt road 14 - Provincial highway

Topographical profile and agro-ecological units along a line-transect in the Ban Bo Daeng - Ban Tha Hin area (see map no. 2):



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Profile prepared by Mr. Amnuay Sittichareonchai - F.N.R./P.S.U.

But the last decades have been marked by a spectacular reinforcement of the rice-palmyra palm combination in the small alluvial plain and the development of very sandy soil on coastal ridges which have been progressively converted into gardens "outside" or "behind" the houses containing a wide range of market - garden crops. Although both of these techniques of artificialisation of the ecosystem preexisted, their expansion has been a consequence of:

- the rapid increase in population density in the district (297 persons/km^2 in 1960, 372 in 1981) and the resulting splitting up of farms.

- the opening of a well-connected road network and the resulting penetration of more commercialised farming (exchanges of consumption goods, means of production and labour force) with the urban areas of Haad Yai-Songkhla in rapid growth (their municipal population doubled between 1970 and 1980).

So, if market-garden cropping gives job opportunities during the dry and pre-humid seasons (January-August) in this densely populated area, palmyra palm cultivation linked with rice planting provides full use of the existing workforce available on more and more farms, and even the survival of some of them thanks to the many informal systems of tenure, both of the rice-fields and of palm cultivation, which are still widely used.

This evolution is at the origin of the two main observed agro-ecological imbalances:

- the palmyra palm cultivation system is in crisis. The expansion of "Tan Tanod" cultivation has brought about an acute crisis in the households'supply of wood fuel which has now to be imported from neighbouring districts. As a consequence, the final product is viscous and of poor quality. This is placed on a highly speculative market.

- the opening of the area to market economy has brought an upheaval in the traditional methods of maintaining soil fertility formerly based on the grazing of unreclaimed grassland by cattle and the concentration of organic manure on the few rice-plots. Now, organic manuring is only used in the market-gardens cropping systems on sand bars and the change marked by the substitution of chemical fertilizers for organic manuring has been unfavourable to the rice-fields located on clayey soils which are already difficult to plough and poor in phosphorus content. In addition, the past peasant colonization which permitted the reclamation of uncultivated marshland over the years left little grassland available for the cattle to graze during the rice-growing cycle. Partly, as a consequence and concurrent with the penetration of mechanized ploughing, the crop-livestock association is changing with fewer cattle on the farms and the appearance of small production

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units specialized in large scale, capital intensive, rearing of ducks or chickens. As a result, globally, less and less organic fertilizer is available on the farms to improve soil structure (heavy clayey soils) and fertility (poor sandy regosols).

The broad analysis of the local agrarian system summarized here shows that it has become recently very dependent on the outside (both for supply of means of production and as a market for its surplus production) and has undergone profound changes. The technical content of these changes (mechanization, chemical fertilization, introduction of high yielding rice varieties, ...) and the socio-economic rules (expansion of market economy, relations with rapid industrializing urban areas...) which govern them are now out of its control. This first regional diagnosis has enabled us to choose a limited number of farms belonging to the three types of villages noted. The general rule was to search for the most important diversity possible between the production units to be selected. Thus, derived from the previous analysis, three types of villages have been identified according to their topographical situation, the presence of gardens, their location with respect to the principal communication axis and finally the incorporation of agriculture with sea or lagoon fishing. Inside the three villages selected in Tambons Tha Hin and Bo Daeng (see map no. 2), a restricted sample of ten farms with various agro-ecological and socio-economic circumstances has been chosen. Selection was based on criteria issued of the observations of cropping systems performed along several line-transects (combination of rice and palmyra palm, rice varieties used, spacing of the rice-fields, out of season and market-garden cropping, agricultural implements used) crossed with general structural characteristics of the farms (cultivated area, cultivated area per worker, other economic activities performed such as fishing and shelling, hired labour on the farm). In depth study of these ten production units has been carried out throughout the agricultural year July 1982-June 1983, the results of which are presented below.

II - DETAILED ANALYSIS OF THE FUNCTIONING OF A RESTRICTED SAMPLE OF FARMS:

This detailed analysis is the key of the finalising diagnosis. By focussing the study on the technique/environment interaction it provides precise knowledge about real practices performed and the logic of the peasant system can be identified. Then the diagnosis is able to conclude with a definition of research and extension topics non-contradictory with regard to the dynamics of the global agrarian system.. Through a hierarchical classification of the constraints and bottlenecks the most easily accessible margins of progress for each main type of farming system analysed become evident.

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Data collection have been carried out through three phases:

1-inventory of means of production, workforce in agriculture and the reconstitution of the recent history of the agricultural producing systems.

2-regular visits to each plot of land with the farmer at the main stages of the rice cycle (observation of the technical itineraries(1) performed and crop state). Regular runs of two selected line-transects (North and South of the district) to verify if all the main technical itineraries and cropping systems performed have been taken into account when building the sample.

3-after a first data treatment, a restitution of the results to the farmers and a study of the financial functioning of the production unit took place.

Treatment and analysis of the data have been realized at four levels:

- the plot of land: judgment on the agricultural practices and identification of the main cropping systems, their localisation and performances.

- the crop: main technical itineraries performed are compared in the same agro-ecological unit and under the climatological conditions of that year; propositions to improve the less efficient ones can be made.

- the farming system: a detailed monograph shows the socio-economic objectives of the unit and the technical problems faced to reach them, to realize all the agricultural work in the best conditions possible.

- then technical problems identified find their explanations at the socio-economic level (respective availability of producing factors on the farms) and allow us to draw the main lines of the socio-economic strategy pursued by each type of farm. These socio-economic objectives can be estimated through different ways:

* the history of the production system shows according to what kind of objective changes occured on the farm during the past years (medium term strategy).

* the observations through the agricultural year give clear indication of how the farmer takes his daily decisions (tactic level).

* a synthesis to identify a global coherence on the farm between these two levels is then made by the light of the theories in social sciences on accumulation and reproduction of social groups.

- The relation between technical facts and different interests of the farm types is cleared at the agrarian system level completed with a general understanding of the evolution of technical practices and socio-economic relations between the various kinds of farming systems identified.

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(1) Technical itinerary: the logical and well-ordered combination of the techniques applied to a crop by the farmer to reach his objectives (SEBILLOTTE M. - 1978).

Although this was the method used for data analysis, a more synthetic presentation of the results has been chosen here.

A - Adaptation of present agricultural practices to agro-ecological constraints:

This part aims at describing how the agro-ecological constraints are taken into account when the farmers have to choose their non-irrigated, mainly rice-based cropping systems in the agro-ecological units significantly artificialised by man: the village-gardens and the rice-fields planted or not with palmyra palm. The adaptation of these agricultural techniques to the topography-soil-water complex is evaluated under the climatological conditions of that year. They were characterized by few rains at the beginning of the rice-growing season (July-September) followed by a sudden submersion of the fields by the end of October and heavy stormy rains during the 1983 pre-humid season (May-June). So, here are some of the major consequences of these climatic events on the techniques applied by the farmers of the sample as well as those cultivated plots located along the two line-transects surveyed:

- a large majority of the fields were planted with direct dry-seeded rice and few were transplanted.

- due to few rains at the beginning of the rice-growing season, there was high weed infestation and weeding which began only at the end of September was only partially achieved when it has to be interrupted after heavy rains at the beginning of December.

- for the same reason, poor germination was observed in broadcasted rice particularly when the seeds have been ploughed in by a second tilling.

1 - Village-gardens on old sand bars (units 4-5):

We distinguish here the backyard fruit and vegetable gardening systems practised on the upper part of the sand ridges from the rice-based cropping systems performed in the small narrow hollows on these same bars.

a - Gardening systems:

They are practised after the end of the heavy rains of the N.E. monsoon (end of December) in villages located on old sand ridges. There, the market-gardens cropping systems constitute an opportunity for labour force employment during the dry season and pre-humid seasons if no other more profitable economic activity is available. Frequently, a single crop of groundnut or watermelon is grown at the beginning of the dry season. Sometimes, a complex succession of crops such as tobacco, maize, cucumber or mungbean can follow. In that case, the area under

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cultivation is always limited by the quantity of water available from traditional wells dug on the sand bars. Planting of thick and layered hedges tends to reduce wind erosion and evapotranspiration on these poor, acidic, very sandy soils. In spite of many techniques of soil improvement, such as localized organic manuring in the plant rhizosphere and the economical use of water through daily split watering of crops implanted on concave ridges or in samll circular hollows to avoid any loss through run off, the yields obtained are low and the quality of the products poor giving them an unfavourable position on the market.

b - Rice-based systems:

Covering only a small amount of land (3% of the sample area), the narrow hollows on sand bars are usually occupied by dry-seeded nurseries at the end of the pre-humid season (August-September). Seeds are covered by a second tillage or harrowing. These plots do not receive any fertilization because farmers objectives are to get non-vigorous, short seedlings which remain up to more than 60 days waiting for the rains which will allow transplanting. Hand lifting of the seedlings is complete and then the plot is transplated, or not. In the second case, there is high weed infestation and weeding very seldom carried out properly, usually after the task had been executed on all the other plots. As a consequence of poor fertility and care, rice yields are always very low (less than 1,2 t/ha). These plots received more attention when a mungbean or cucumber crop is grown there during the pre-humid season.

2 - Very lowland rice-fields without palmyra palm (unit 9):

Eleven percent of the area surveyed were located in these easily flooded drainage channels, nearly completely cultivated with dry-seeded broadcasted rice of local deep water varieties. Heavy clayey soil texture leads to the practice of a single tillage by tractor or hand tractor. The anti-risk strategy chosen by the farmers consists in implanting rice rapidly before sudden submersion. The heterogeneity of plant population is corrected later through realization of a careful and time-consuming weeding-thinning-transplanting to homogenize the plot. Because of soil texture and poor drainage, no other crop can be grown in those places after harvesting rice using the traditional small knife or "kae".

But in 1983, heavy storms in May-June brought very early submersion of these lowlands which then had to be entirely transplanted. This showed that interannual variation of the technical itineraries performed for rice is the highest in that unit. This fact explains the farmers' choice of anti-aleatory methods (early sowing, high rate of seeds, local deep water rice varieties,

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thinning-transplanting, ...) which allow the harvest of up to 2,5 t/ha of paddy.

3 - Rice-fields surrounded by palmyra palm (units 7 and 8):

a - Rice/palmyra palm interaction:

The important of the original plant association between the cereal and the "sugar palm" in the process of artificialisation of the local regional ecosystem has been presented elsewhere (TREBUIL G. et al. - 1983). At the plot level, detailed observations to evaluate the interaction between the two species and the effect on rice yield gave the following results. After sowing, palm rows make the germination of rice very heterogeneous due to irregular distribution of the first rains on the plot. So, manual thinning-transplanting is required to homogenize the rice population and it delays maturity of the late transplanted seedlings. Then varieties resistant to shattering have to be used. Annual burning of palm leaves and better soil moisture at the end of the rice cycle close to the rows counterbalance the shading effect of the palms whereas soil profile observations showed little competition between rice and palm rooting systems. If rice yield is globally not affected by the presence of the palms, the price of it using these traditonal methods is low labour productivity.

b - Methods of rice crop implantation:

Due to less constraining soil and water circulation conditions, a variety of modes of implantation of the rice crop can be met in these agro-ecological units. Direct dry seeded sowing is still predominant (75% of the area surveyed in this environment) but transplanted rice account for 20% of the global acreage with seedlings from various origins: dry-seeded nurseries, inundated ones sown with sprouted seeds, seedlings thinned from other sown paddies.

Direct sowing after a single tillage is also frequent for various reasons: Distance from the plot to the village (particularly in unit 8), financial cost of a second tilling by hired tractor, limited labour force available to prepare all the farm plots, slow land preparation with oxen, etc. On farms where hired tractors are used, the lack of control of the conditions fo realization of the work by the farmer himself leads to the making of a poor seed-bed with large compact clods.

But usually a second tillage is practised to destroy the weeds already uprooted by the first ploughing and to improve the physical structure of the seedbed. Its place before or after sowing is based on a weather forecast by the farmer especially using information of old books of popular wisdom which describe rainfall distribution according to the lunar calendar. If rains are imminent, sowing is

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ploughed in, if not rice is broadcasted after the second tillage. In spite of a higher rate of seeds sown, ploughed in sowings gave bad results because of insufficient rains at the beginning of the vegetative cycle.

Transplanted rice is limited because the submersion of the plots can be neither forecasted nor staggered. The amount of workforce available is also limited because of weeding tasks to be done at the same time on broadcasted rice-fields. Various reasons could lead to the decision of transplanting a given plot:

- because weed control has not been performed properly the previous year.

- the adoption of recommended high yielding varieties implies transplanting if the farmer aims at valorizing their genetic potential and maximizing the yield.

- to spread out the implantation (and so the harvest) of the rice crop over several months then allowing full employment of the family labour force.

- the practice of out of season crops before rice is followed by transplanting of an early maturing rice variety.

- adaptation to micro-topography of the techniques performed on a single plot could lead to the transplanting of the lowest part of the field, directly or after hand lifting of a previously sown rice infested by weeds or with poor plant density. Such practices depend on the labour force availability and underline again the prodominance of blow-by-blow daily decision making according to both rainfall distribution and opportunities for full employment of the workforce on the farm.

c - Logic of crop maintenance and fertilization practices:

Crop maintenance practices are dominated by the anti-risk triple operation of weeding-thinning-transplanting which allows partial correction of bad results at previous stage of crop implantation. This time consuming hand weeding cannot be realized everywhere particularly when plots are located far from the house (usually in unit 8). The absence of proper weeding implies suppression of the second top dressing which usually follows it. Wild rice is the most feared weed and the farmers have developped various methods to control them:

- when it is possible, transplanting is practised on the infested plot.

- varieties with specific morphological characteristics (shape and colour of the leaf, distribution of tillers, ...) are chosen to allow early identification of wild rice.

- when hand weeding has to be stopped after heavy rains, the collect of forage for the cattle in rice-fields allows the cutting of tall wild rice by sickle.

- sometimes, panicles of red rice are harvested by "kae" between flowering and maturity of the crop to limit further infestation.

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But all of these time-consuming techniques are not enough to control effectively the harmful weed.

Such late thinning-transplanting, usually carried out more than 60 days after sowing, are possible if the varieties used are not sensitive to shattering and grain quality not affected by a delayed harvest. The wide range of local rice varieties (more than 60 of them have been recorded in the area) allows the farmer to produce an average of 1,9 t/ha of paddy in these units with poor water control, partial weed control and relatively modest use of chemical fertilizers. They are very often more adapted than the recommended high yielding hybrids to the anti-aleatory traditional practices described above.

As a summary, if constraints imposed by the soil-water complex seem to be significant in units 4-5 and 9, the wider heterogeneity in the technical itineraries performed for rice crops in units 7 and 8 cannot be fully explained by the characteristics of the natural environment. Variations in the management of the farming systems could be more significant and have to be related to differences of socio-economic conditions among the farms of the sample studied.

B - Functioning and socio-economic strategies of the three main types of farming systems identified:

The study of the main socio-economic characteristics of the farm types identified will show us that the variety of technical itineraries performed in rice-fields is only as many appropriated answers to structural constraints or favourable factors found on the different farms types.

1 - Various modes of labour force management:

Table 1 shows the heterogeneity of the sample for the determining criteria of "number of raĭ" cultivated per economically active person in the household. The variation observed goes from 1 to 4.5 and the hired labor employed could be non-existant or account for up to one third of the total workforce engaged in agriculture. Such a strong differentiation leads farmers to find different ways to assure full labour employment according to the availability of other factors of production.

The general objective pursued, which is to get the highest daily return possible, explain the eventual choice between labour opportunities at a given period of the year. Such an economic goal is only sometimes compatible with the search of the highest paddy production per unit of land on which all the technological models and recommandations of the extension service are built. Then, three main types of farming systems have been distinguished according to the importance of non-rice and non-agricultural economic activities in the seasonal functioning

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of the farms. Their respective main characteristics are shown in table 1:

- type I: the rate of family labour force participation in agricultural work is low. All around the year, most of the family workforce is invested in non-rice economic activities internal (ducks and chickens raising, sugar palm making, backyard gardening) or exterior to the production unit (fishing, small marketing, shrimp shelling, temporary jobs in Haad Yai-Songkhla or daily work on larger farms in the area). These more or less seasonal activities provide all the cash revenue of the household and allow the farmers to free themselves from the limitations of their farm acreage.

- type II: the ratio of labour participation in agriculture increases and all the family workforce is mobilized on paddy fields during the wet season. Other labour opportunities available are only dry and pre-wet seasons ones such as sugar palm making or backyard gardening and the farm acreage is still limited.

- type III: the ratio of labour involvement in agricultural tasks is high then decreases when there is a lot of hired labour on the farm to face peaks of work at weeding-transplanting and harvesting periods. Other labour opportunities around the year are mainly internal to the farming system (out of season crops, cattle and pig rearing, rice-milling, etc...).

Thus, the use of hired labour on the farms differs according to the type of farming system. Farms of the first kind usually have to hire tractors for land preparation. If other more profitable jobs are available for family workforce, day labourers weed and harvest rice. Although the total amount of hired labour is not important, it is a determining factor in the global results of the crop if the mobility of the family force is not sufficient. Recourse to hired labour is exceptional on farms belonging to the second type because family labour and spreading out of the agricultural tasks to be carried out allow peaks of work to be avoided. Whereas on the third kind of farm, a major part of the rice harvest is completed by hired labour. On the largest farms this is also true at weeding and transplanting time.

The different ways of achieving labour force full employment allows the distinction of three groups of labour productivity in rice cultivation corresponding to our three main kinds of farming systems (see table 1). More than this, on each producing unit, the distribution of labour tends to equalize labour productivity at its higher possible level between the plots; this in spite of the wide variety of technical itineraries performed on the same farm. However this behaviour seems to be more easily applicable on farms belonging to the first and third types where choice between rice cultivation and other jobs or between plots on the same farm is possible. In the case of the second kind of farming system.

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Farming systems per type:	TYPE I			TYPE II			TYPE III			
	A	B	C	D	E	F	G	H	I	J
LABOUR 1 - Number of raï[1] cultivated per economically active person in the household:	1.7	2.1	2.8	3.7	4.2	4.5	7.5	5.7	7.7	7.6
2 - Participation in agricultural work (number of workers in agriculture/number of economically active person in the household): (%)	25	50	50	35	66	66	75	75	63	43
3 - Hired labour compared to total labour engaged in agriculture (%):	4	3	15	-	1	-	1	5	16	34
4 - Global labour productivity in rice (kg paddy/half day of work):	11.8	11.6	9.6	6.9	7.6	6.5	14.9	10.8	10.0	12.9
LAND: (raï) 5 - Owned with formal land title (no so 3):	2.5	3.5	-	9.25	22.0	33.0	22.5	27.25	7.5	40.0
6 - obtained against loan on security:	-	5.0	5.0	2.25	4.75	1.0	-	-	1.75[2]	-
7 - rented or share cropping:	3.5				3.5				6.25[2]	
8 - belonging to relatives-no rent or in kind:			0.5							7.0
9 - Total land area per household:	6.0	8.5	5.5	11.5	30.25	34.0	22.5	27.25	15.5	47.0
RICE: 10 - Average yield of paddy harvested (t/ha):	2.3	1.8	1.3	1.9	1.5	1.7	1.9	2.1	1.8	1.9
11 - % of the rice growing area planted with high yielding varieties:	93	-	-	-	3	15	49	93	28	19
12 - % of transplanted rice in total rice growing area:	69	-	-	9	8	-	21	19	16	15
13 - % of the total rice harvest commercialized:	-	-	-	5	59	93	44	42	59	a
14 - % inputs in agriculture/family consumption & savings:	17	222	994	21	31	31	957	107	40	a

1 - 1 raï = 0.16 ha 2 - Land owner is farmer's mother. a - no data available.

the lack of choice forces them to carry out the work on a limited number of plots even if labour productivity is low. Consequently, the reasons for the choice of technical itineraries become clear with that method where general ideas are not relevant. For example, labour productivity in dry-seeded broadcasted rice is often lower than on transplated plots according to the degree of the time-consuming triple practice of weeding-thinning-transplanting which is undertaken. Also, such short term and "moving" planning of the work to be done does not facilitate the adoption of the "green revolution" inherited technological model proposed by the agricultural extension services. This recommended technical itinerary, very standardized and pre-programmed, is constraining for the functioning of the whole system of production.

In the same way, the different kinds of farming systems used various methods to build their land acreage.

2 - Access to land on the various types of farming systems:

According to the kind of farm we are dealing with, various land tenure systems are used to obtain sufficient acreage (see table 1). Loans with the security of farm land are the cheapest way to increase acreage for the farm types I and II if they have enough savings. The usual rate is nearly 3,000 ฿ per raĭ of paddy field pawned for usually not less than 3 years. In other situations, rent or share-cropping are the solutions when the amount of land under the formal land title "no so 3" is not enough. Large farms of the third type have nearly all their land under a "no so 3" and can have access to even more land especially through the system of loans on security. They use the loan to buy a new piece of land from a small farm in crisis such as "A". Sometimes, part of the capital so accumulated on farms like "J" is invested into non-agricultural activities (construction, transport, etc.) according to the relative rates of profit offered. The search for the best rate of capital remuneration guides the economic functioning of those few farms. Globally, this process of concentration of land into a few farms does not favour general intensification of the local agriculture and tends to accentuate existing socio-economic differentiations between our types of farming systems.

3 - Managment of cropping and livestock systems:

The knowledge of the structural characteristics of the various farm types with regard to labour force employment and access to land and capital allow a better understanding of their technical choices.

Usually without equipment for land preparation, farms of the first type have few choices for the methods of rice inplantation. Dry-seeded broadcasted

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rice, the least risky in the local conditions of production is usually chosen with the exception of farm "A" where total absence of cash did not allow the farmer to hire tractor to plough the fallow. On farm types II and III, on the other hand, the amount of transplated rice increases but for different reasons (see table 1):

- type II: transplanting is still modestly practised and aims at spreading out rice implantation as much as possible on farm plots.

- type III: transplanting is more important particularly on farms which have adopted on some plots the whole recommended technical itinerary (G.H.) characterized by transplanting of young vigorous seedlings of the R.D. 7 hybrid, split chemical fertilization, pest control through use of pesticides and harvest by sickle followed by on the plot threshing. The amount of transplanted rice decreases on farms I and J where labour is scarce at several periods of the year. A more "labour extensive" management of the numerous plots is then adopted avoiding the peaks of work that adoption of the recommended whole technical itinerary would imply.

Such differentiated choices in methods of rice implantation correspond also to various attitudes concerning varietal choice. Globally, recourse to early maturing varieties (most of them being the recommended ones R D 5 and 7) increases when we consider farm type I then II and III. Being easy to integrate into traditional dry-seeded based technical itineraries, the medium naturing variety R D 5 penetrates some farms of the first and second types when adequate agro-ecological conditions can be met. But the high productive early maturing and non photosensitive R D 7 is only found on farms of the third type where the economic objectives pursued (high labour productivity and rate of the rice crop to be marketed) are compatible with the requirements of the techniques recommended, particularly the availability of hand tractor for land preparation. However, limited workforce and lack of water control limit its cultivation.

If maintenance is always undertaken late, the care with which it is conducted varies from one kind of farming system to the other:

- type I: even if the cultivated area is limited, hand weeding is very often only partially achieved because of strong competition for labour with other economic activities.

- type II: the lack of other job opportunities during the rainy season allow the practice of long and careful weeding-thinning-transplanting in broadcasted rice.

- type III: strong competition with transplanting work leads to only partial achievement of the weeding task on broadcasted fields.

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On farm types I and II, the harvest is spread out over many weeks from January to the end of March and is always achieved with a "kae". This allows the early investment of male labour in other dry season jobs such as sugar palm cultivation.

Livestock systems differ significantly from one farm type to the other. Cattle breeding, a low productivity activity, especially due to troublesome forage collect during the humid season, is nearly absent on farm type I, but is still a permanent activity on farm type II. Here, as on some farms of the third types cattle are used as draught animals and constitute a form of savings for future investment (purchase of a hand-tractor or of a new piece of land). Pig raising is more concentrated along the lagoon where algae and rice bran are cheap fodder. If breeding with sales of 50-60 days old piglets is practised on farms of the third type, most of the producing units of the first and second types feed a few animals to be fattened and sold after several months. This last type of production does not need high capital assets but allows quick cash rotation. When enough savings have been gathered, there can be full labour employment on farms of the first type through the launching of large scale rearing of ducks for egg production (B, C). This boosts their relations with the market, and financial management of the farm becomes a dominant preoccupation (see table 1). As on the third type of farms, these small units have to invest a large part of their return as inputs in agriculture. This is not the case on the other farming systems belonging to the first and second type where the ratio inputs/consumption and savings is lower.

Numerous interactions exist between the above mentionned three main types of farming systems. Farms of the first type provide most of the hired labour used on larger ones, and with those of the second kind, they try to widen their land basis mainly through loans on security with third type farms because they are not able to mobilize enough capital on a long-term basis. In this way, their savings are drained towards a few large farms like J characterized by land accumulation and management based on the search for the best profit for the capital invested. Farms of the second type try in this way to reach the upper category where a better work remuneration can be obtained through the distribution of labour on numerous fields.

C - <u>Performances of present agricultural techniques and propositions for adapted methods of technical improvement</u>:

At this stage, we can now evaluate and compare the performances of the principal types of technical itineraries practised by the farmers in rice-fields by placing them in their agro-ecological setting (which unit ?) and socio-economic

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context (on what kind of farming system ?).

1 - Technical itineraries based on dry-seeded broadcasting:

In unit 9, when rice is sown after a single ploughing of the fallow on heavy clayey soils, the average yield obtained is significantly higher when land preparation has been done with a hand-tractor than when a four-wheel tractor has been used. This is mainly due to the size of the cleds made in the seed-bed. Meanwhile in units 7 and 8, farms equipped with draught animals only tend to have to weed less and apply less chemical fertilizer (14.6 kg N/ha) than those using hand-tractors (27.3 kg N/ha). But the response to increasing fertilizer application is higher when oxen are used for land preparation of ploughed in sowings. Diagram no 1 shows also the strong correlation existing between hand-weeding and fertilizer application. On units 7 and 8, direct sowings after a single ploughing of the fallow show a paddy yield higher than 2.2 t/ha only when weeding has been carried out for at least 47 days/ha and fertilizer application was higher than 25 kg N/ha. The total absence of response to increasing fertilizer application if hand-weeding has not been carried out enough underlines the importance of this time-consuming agricultural practice which at present is uncompleted. Thus in the case of the plots implanted with dry-seeded rice sown after two tillages (cf. diagram no 2) the difference between the average yield on weeded plots (and then better fertilized ones) is significantly higher than that on non-weeded ones (2.2 t/ha against 1.1 t/ha).

2 - Technical itineraries based on transplanted rice:

In units 7 and 8, three main types of technical itineraries are considered here: transplanted seedlings of local varieties after puddling by oxen or hand-tractor, and the recommended technical itinerary based on transplanting of 25-30 days old vigorous seedlings of the R.D. 7 variety. Yield variation on the same farm and among farms is far higher on plots receiving the technological model proposed (variation from 1 to 4.8) than on those planted with traditional methods or incomplete recommended techniques (1 to 1.7 and 1 to 1.3 respectively). This fact underlines a clear lack of control of the new techniques proposed on certain plots (poor method of crop implantation, unmarked and uncontrolled attacks of stem borers, ...). But when applied in good conditions, these recommended techniques give the highest yields and labour productivity recorded as shown on diagram no 3, where the good response of hybrids R.D. 5 and 7 to fertilizer application is also clearly shown. In the case of the local varieties fertilizer has no significant effect on the yield obtained from generally old transplanted seedlings.

So while studying the interactions between manuring, farm equipment for land

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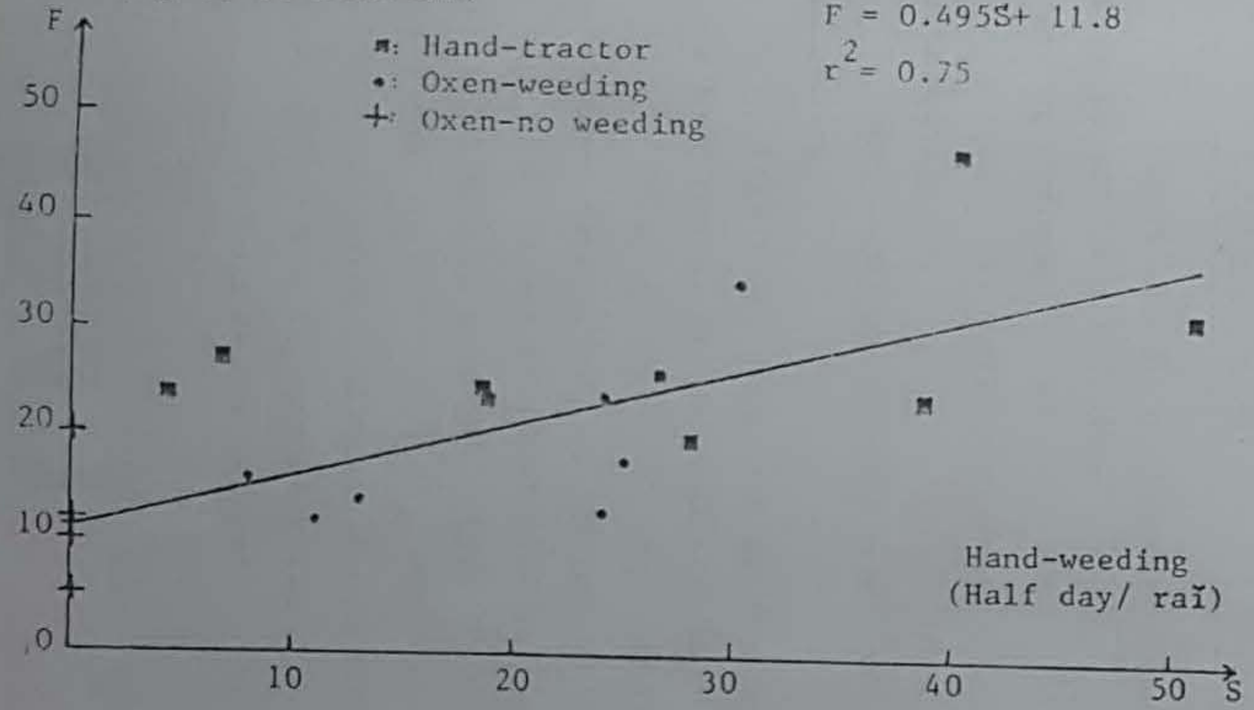
Diagram no. 1: Correlation between hand-weeding and fertilization in the case of ploughed in sowings:



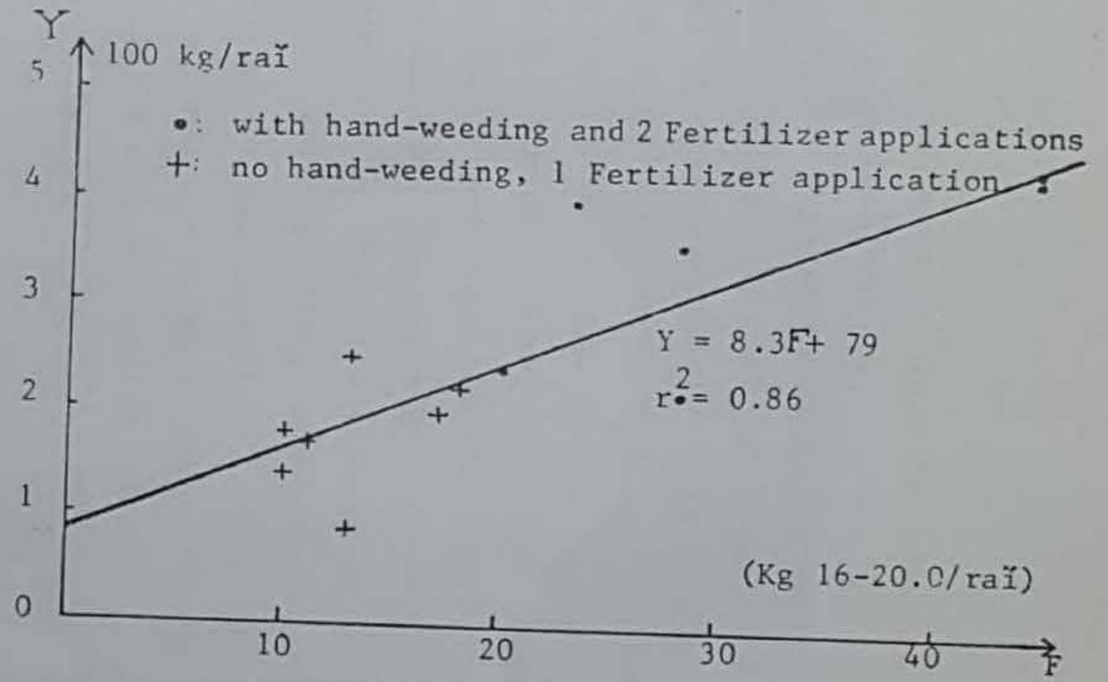


Diagram no. 2: Correlation between hand weeding and chemical fertilization and response to fertilizer application in the case of sowing after two tillages.

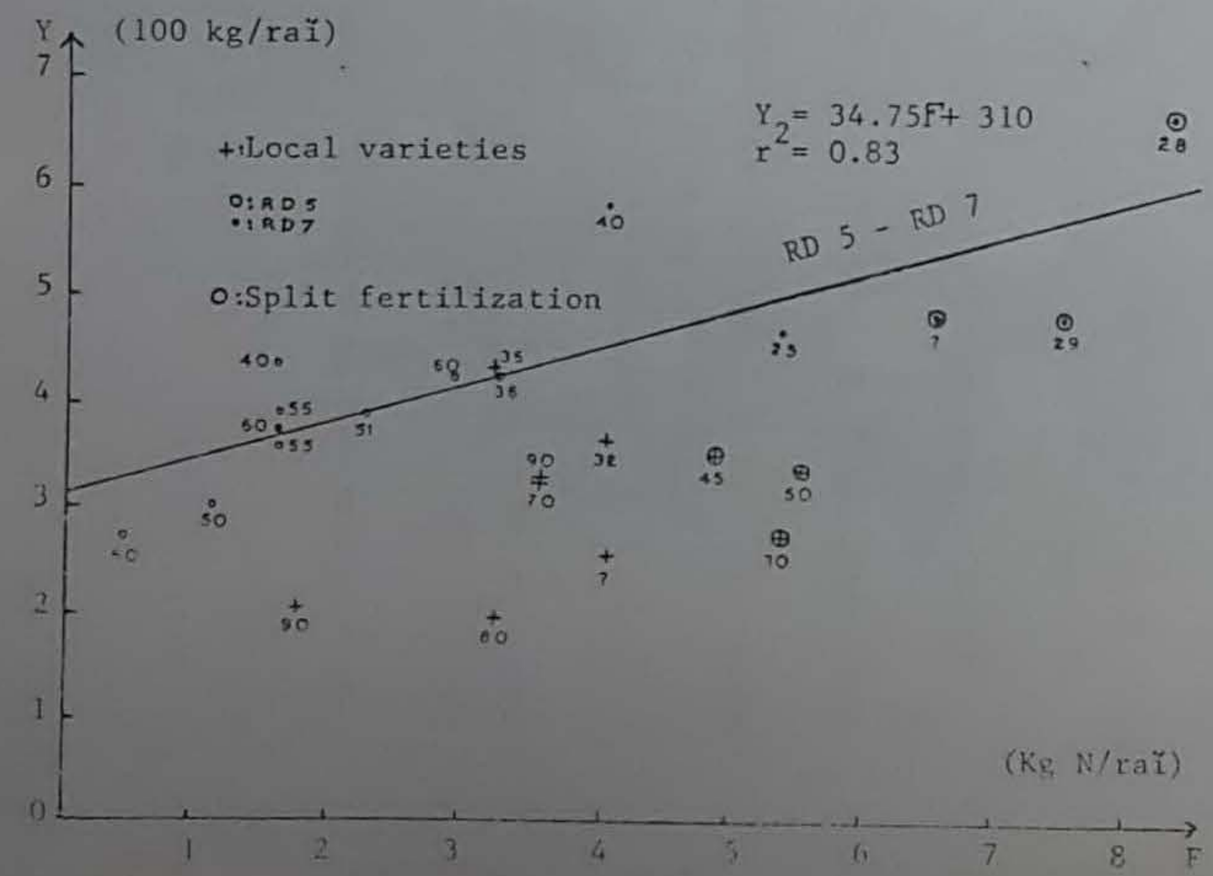


Diagram no. 3: Response to nitrogen fertilization on transplanted plots for various rice varieties. Ages of the seedlings in days at transplanting time are shown.

preparation, modes of rice implantation, maintenance practices and the partly resulting varietal choice, we have observed the emergence of a technological model from direct dry-seeded sowing on a single ploughing to the sophisticated recommended technical itinerary. On the other hand the whole package proposed by the agricultural extension services can be adopted only on certain fields of the third type farms where both agro-ecological and socio-economic conditions are adequate. In that way, it seems that without a radical transformation of the present mode of artificialization of the ecosystem, leading especially to better water control, this model has already reached its limits. In another way, we have identified possibilities for improvement of the other technical itineraries by testing new technical combination on the three closely inter-related following topics namely weed control in broadcasted paddies, land preparation and rice implantation improvement and amelioration of soil fertility. Research on these linked topics has to be reasoned in the framework of whole new technical itineraries or even cropping systems when a suitable crop succession will be tried i.e. rice-mungbean rotation for example (CROZAT Y., CHITAPONG P. - 1984).

III - DETERMINING INDICATORS AND DISTRIBUTION OF TYPES OF FARMING SYSTEMS AT THE VILLAGE LEVEL:

Based on the socio-economic objectives followed by the farms, we have been able to define a functional typology dominated by the following three kinds of farming systems:

(i) the small production units where non-rice economic activities are predominant;

(ii) the market-rice production units of medium size with low labour productivity;

(iii) the market-rice production units with high labour productivity based on a high degree of "intensification" (G, H) or "extensive" management (I, J).

In order to be able to identify any farm as a member of one of the above mentionned categories, the following synthetic indicators are proposed:

1) number of cultivated raĭ per economically active person in the household: from 0 to 3 for farm type I, 3 to 5 for the second and more than 5 for the third one.

2) ratio of family labour participation in agricultural work around the year, or better, per cropping season.

3) land tenure systems on the farm.

4) degree of adoption of the recommended "green revolution" technical itinerary (rice area cultivated with high yielding varieties, farm equipment for land preparation and irrigation).

These determining factors are the result of the whole work of diagnosis and could not be defined "a priori" such as in other methods of large sample description survey undertaken without that stage of preliminary in-depth analysis on a restricted sample of households covering the whole range of farm circumstances (ABHA SURIVONGS and al. - 1980, THAI UNIV. RES. ASS. - 1981).

Using the first of the above-mentioned indicators, we have evaluated the distribution of our types of farming systems for two villages located in the northern part of the district, one alongside the lagoon in tambon Khlong Ri and the other close to the sea on sand ridges in tambon Sanam Chai. The results are presented on the following histograms and show that in both cases, farms of the first type are the most frequent (65 and 66% of total households respectively) followed by those belonging to the second type of farming system (23 and 19%) and then the third kind of farm (12 and 15%). Such a distribution confirms our main conclusions at the end of the diagnosis about the dynamics of the local agrarian system.

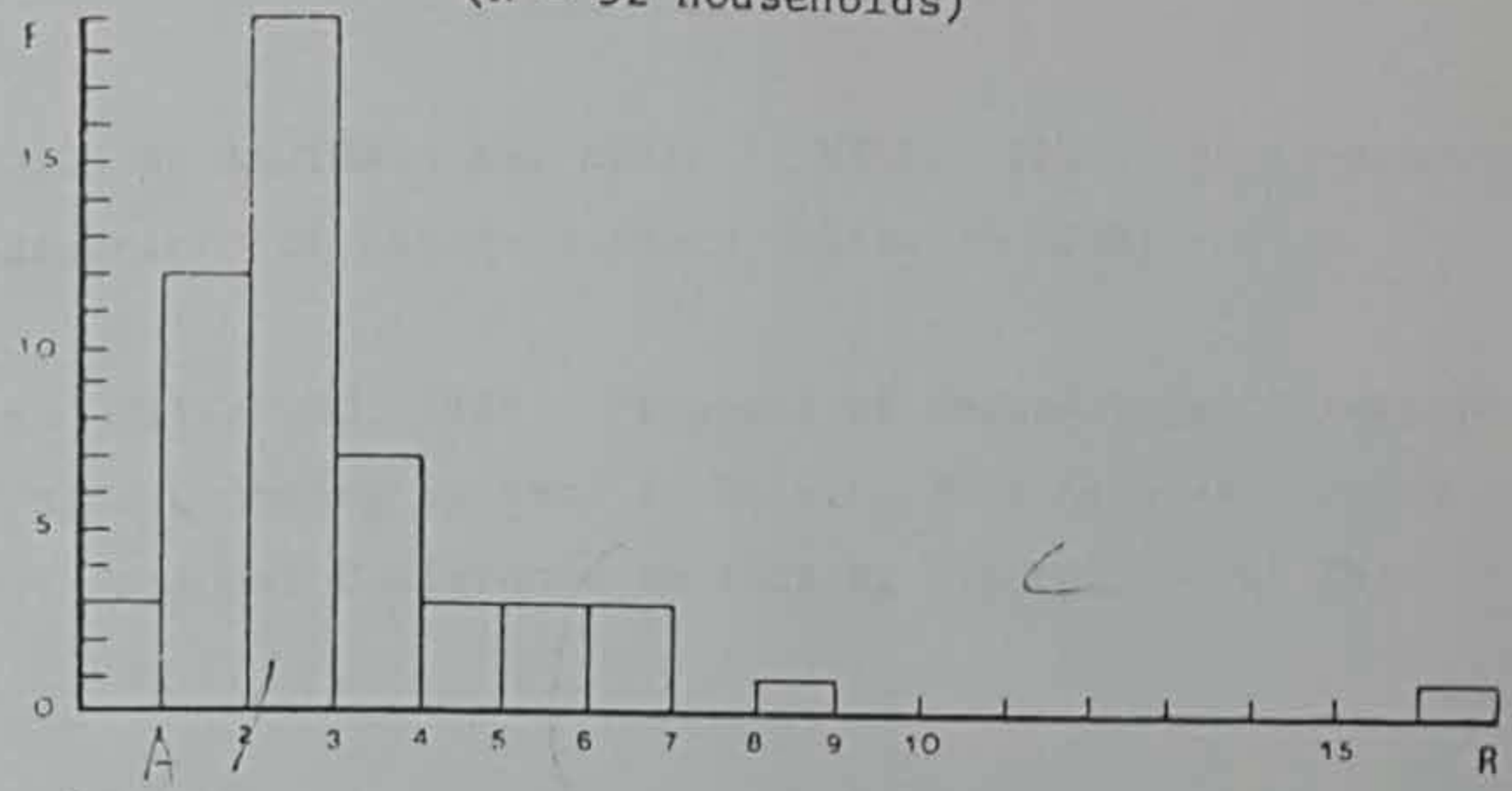
If testing of new methods of weed control should interest the farmers from the three categories defined, research and extension work on land preparation and soil fertility improvemenr (especially through rice - leguminous crop successions) would benefit only farmers of the second and, above all, third kind.

But thorough research work has to be carried out in the field of agro-industry in order to help the largest group of farmers of the first type to solve the crisis faced by the palm sugar industry on which more and more of them are relying. This could be done through testing of new appropriate open pan evaporators and adapted application of the calco-sulphitation process to this traditional rural industry. On a long term basis this only could save this economic activity and the numerous jobs that it provides the small farmers with mainly during the dry and pre-rainy seasons. It would also preserve the basic element of the whole traditional local system of ecosystem artificialization based on this original plant association between the noble cereal and the (no less noble !) "sugar palm".

These original conclusions in the case of the Sathing Phra area derive from the application of the research-development method on agrarian systems presented at the beginning of this paper. At each stage of the work, phenomena recorded can be explained through gradual obervations regrouped into synthesis at each level of

Histogram 1:

Amphoe Sathing Phra - Tambon Khlong Ri - Village 1
(N = 52 households)

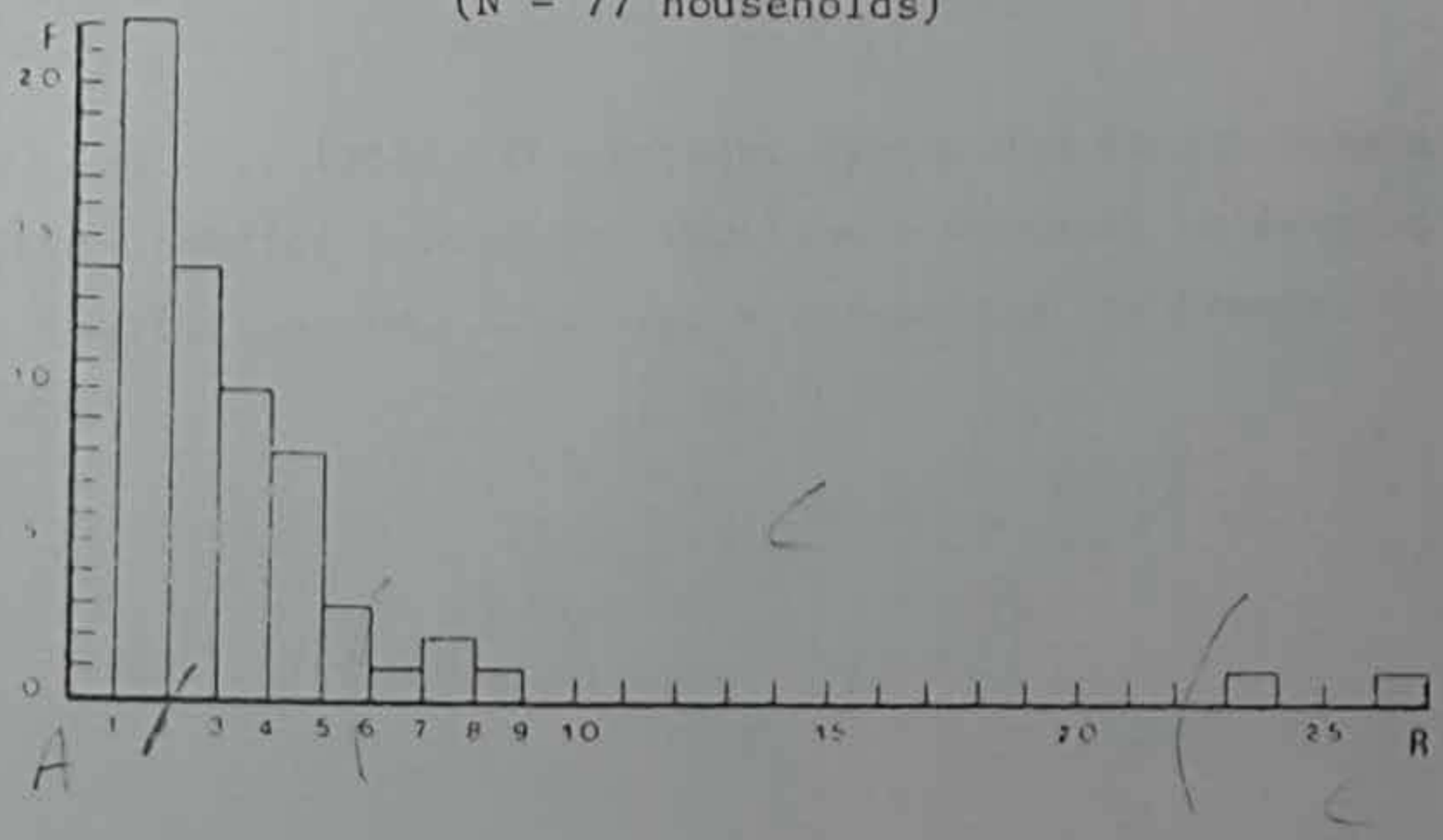


LEGEND:

F = number of households
R = Y/X
Y = number of raï under cultivation on the farm in 1982-1983
X = number of economically active persons in the household in 1982-1983.

Histogram 2:

Amphoe Sathing Phra - Tambon Sanam Chai - Village 1
(N = 77 households)



perception. This approach finally allows understanding of the origin and nature of the evolutionary trends and differentiation recorded in the agrarian system studied. In this way, it is a powerful tool for action in rural planning and africultural extension fields.

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