SETTING RESEARCH PRIORITIES WITH FARMERS: COMPLEMENTARITY OF REGIONAL, FARM AND PLOT DIAGNOSES TO IMPROVE THE COMPETITIVENESS AND SUSTAINABILITY OF THAI PRODUCTION SYSTEMS[1]

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ABSTRACT

Since 1982, a Development-Oriented Research on Agrarian Systems (DORAS) approach has been sucessfully used at four complementary sites in southern, central and western Thailand to improve the competitiveness and sustainability of 50 to 80% of small-scale and resource-poor farming systems facing elimination.

Setting research priorities in close collaboration with farmers was made through complementary diagnoses at regional, farm and plot levels. Based on the Agrarian, Agricultural Production, Cropping Systems and Itinerary of Techniques concepts at each of these three complementary analytical scales, the theoretical framework and derived comparative, systemic and historical DORAS approach favors a relevant understanding of key interactions between bio-physical, technological factors or conditions and socio-economic circumstances. The finalised initial diagnosis emphasizes a comprehensive approach to farmer differentiation process and characterization of the functioning of the main types of farming systems.

Farmer participation is again emphasized during design and testing of innovations to satisfy farmers' objectives by using a rigorous articulation between on-farm experiments and agronomic surveys in farmers' fields to design new types of trials. They aim at building different itineraries of techniques and cropping systems according to criteria in agreement with the functioning of target farming systems. Such farmer-researcher partnership guarantees the elaboration of well-adapted solutions and later accelerates their dissemination among organized producers. Evaluation of their adoption is carried out rapidly but systematically using a network of reference farms. Four complementary case studies from various Thai agroecosystems provide key illustrations, assessments of economic returns to investment in DORAS approach as well as future directions for theoretical and methodological research.

Key words: AGRARIAN, PRODUCTION, CROPPING SYSTEMS, ITINERARY OF TECHNIQUES, THAILAND

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INTRODUCTION

Since 1982, a Development-Oriented Research on Agrarian Systems (DORAS) approach has been sucessfully tested and refined at four complementary sites in southern, central and western Thailand to improve the competitiveness and sustainability of small-scale, resource-poor farming systems facing elimination. As seen in Table 1, they make some 50 to 80% of the total number of farms at the different sites which are also briefly characterized. The four selected sites correspond to a wide range of Thai agroecosystems, displaying especially very different degrees of integration in market economy, and they were used to demonstrate the universality of the DORAS approach. Particularly, it proved to be an efficient tool to grade and prioritize farmer problems to be addressed by research and extension agencies, in close cooperation with concerned producers, from the diagnosis to the evaluation of "solutions".

The DORAS methodology was presented in detail in a previous paper (TREBUIL, DUFUMIER, 1990). It is based on the key concepts of Agrarian System (AS) at regional or national levels, Agricultural Production System (APS) at farm level, Cropping System and Itinerary of Techniques (IT) at plot level. Their latest definitions are provided at the end of this paper. Such theoretical framework and derived comparative, systemic and historical DORAS approach favors a relevant understanding of key interactions between bio-physical, technological factors or conditions and socio-economic circumstances. Figure 1 displays the four phases of the DORAS iterative process. From the initial diagnosis (TREBUIL, 1988b) to the systematic evaluation of farmer adoption of innovations (TREBUIL et al., 1988c), this whole process could be implemented in a minimum of three years at Kamphaengsaen site.

An original feature of the DORAS approach is its emphasis on understanding the differentiated functioning of farmers' APS in the target region. The analysis of APS functioning is a key tool of the preliminary diagnosis, during which it contributes significantly to cement the on-farm researcher-farmer partnership. But it is also an essential source of information to conceive and plan subsequent on-farm trials, then to target the extension of innovations and later to evaluate their adoption by farmers.

1. UNDERSTANDING THE FUNCTIONING OF FARMING SYSTEMS: a central tool of the initial finalised diagnosis for managing farm diversity, grading farmer problems and targeting research and extension priorities

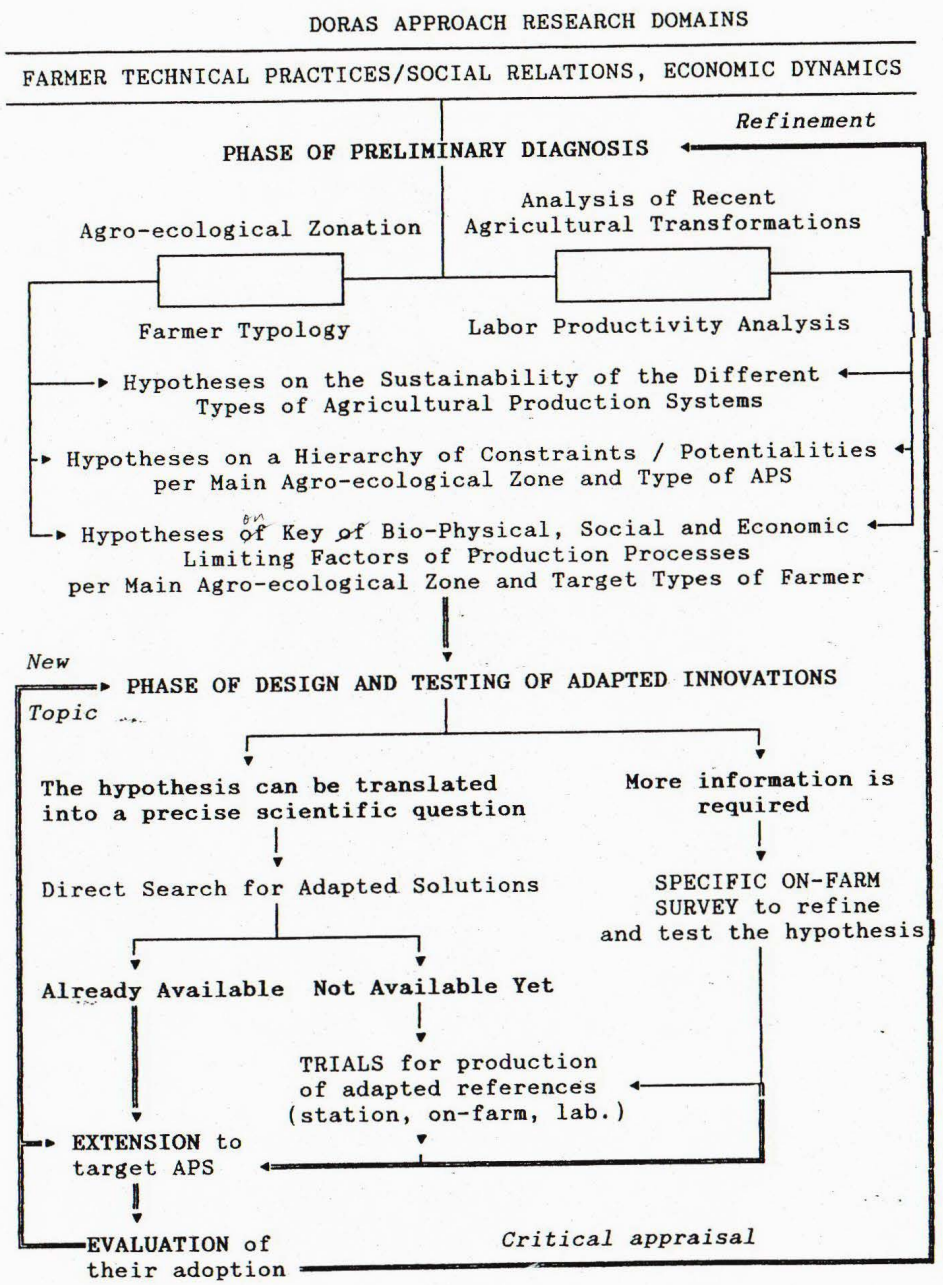
1.1. Definition

To analyse the functioning of a farmer system is to elucidate the logical sequence of strategic and tactical decisions, taken in a given set of constraints and potentialities, made by the farmer and

Table 1. Brief characterization of the 4 DORAS complementary case studies carried out in Thailand

District / Province	Sathing Phra / SONGKHLA	Khao Chaison / PHATTHALUNG	Kamphaengsaen / NAKHON PATHOM	Saiyok / KANJANABURI
Period	1982 - 1988	1985 - 1989	1989 - 1991	Since 1991
Agroecosystems	Rainfed lowland, alluvial plain Rice-Sugar palm	Partly irrigated alluvial plain Rice in+off - Rubber	Irrigated terrace, Rice in + off, Sugarcane, Vegetables	Pioneer front Mixed forest Annual + Tree Cash crops
Bio-physical constraints	Soil(Heavy)-Water drainage	Water control in Rice	Loamy (crust) soil structure	Pests and diseases
Integration in Market economy	Low to medium	Medium to High	Very High	Low to medium
Characteristics Indicator (land/labor) Frequency (%) Management criteria Sustainability	**of Target** < 0.8 ha 80 Optimize family labor productivity in palm sugar Very low	**Group of** < 1.5 ha 60 Optimize net margin in rainfed lowland rice Low to medium	**resource - poor** < 0.8 ha 60 Maximum net income per land unit in vegetables Very low (debts)	**farmers:** < 1 ha 55 Optimize net margin of maize-cotton relay crop Low (land tenure)
Type of innovation	2 pan stoves (x2 of labor productivity)	Recommendations on rice density, N. fertilization	Green Asparagus for exports (income up to 15.000 USD/ha/year)	High lint quality, glandless, hairy cotton + IPM
Impact of innovation	400 stoves and families (1/3 total)	No monitoring - Evaluation	250 Ha, 900 families 1 producer group	(Early stage of testing)
Level of return on investment	High first,then decrease of marginal rate	No monitoring-Evaluation	Very high	(Early stage of testing)
Comments	Rapid individual adoption of a needed technique, difficult to organize tappers	Costly investment in building regional agronomic references in rice	Very favorable economic environment, exceptional farmer leadership	(Early stage of Testing)

Figure 1. Articulation between the four iterative phases of DORAS approach and the integration of its research and extension activities



his family to achieve his proper objectives, that govern production processes carried out on the farm. A theoretical representation of the APS functioning is proposed in Figure 2.

This makes it necessary to understand how and why farmers are making their decisions before establishing relevant technical references. To organize the volume of information to be taken into account, it is useful to distinguish between strategic and tactical choices. The former are related to the main characteristics of the APS and its bio-physical and socio-economic environment. They represent aspects that cannot be modified at short notice. On the contrary, the later correspond to decisions (made following the classic process of diagnostic -► forecast -► intervention) to be made to correct a situation differing from the "average", "normal" states of the APS and its environment.

To show the relevance of this global approach to farmers' APS, it is necessary to define the nature of a "farmer problem" that the on-farm agronomist has to tackle.

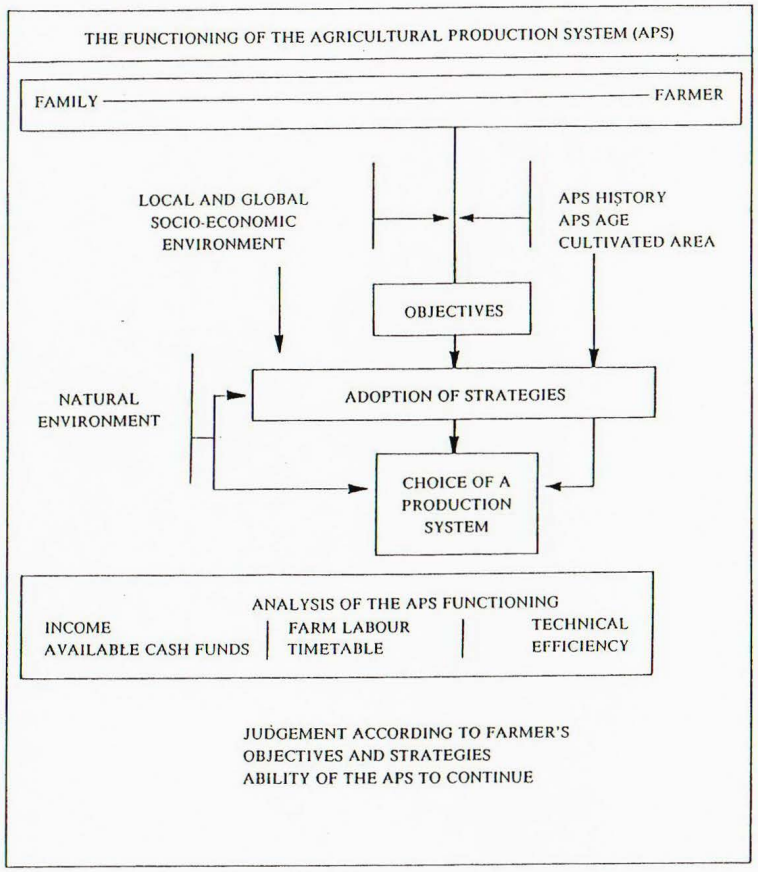
1.2. What is a farmer agronomic problem?

The farmer is managing a system which is finalised by objectives defined by himself, in relation with his family and taking into account his actual environmental situation. To him, an agronomical problem is made of any constraint that impedes what, according to his own representation, he considers as the optimum functioning of his APS to achieve his objectives.

The "solutions" that he requests should first be compatible with the functioning of his existing system and contribute to optimize it. For example, in direct seeded rainfed lowland paddies of Phatthalung area in southern Thailand, farmers most interested by the use of a row seeder to implant their in-season rice crop were those rearing a large number of cattle. As weeds from paddies are the main source of forage during the rainy season, they noticed that weed gathering in the interrows took only one half of the time spent in collecting the same amount of weeds in broadcast plots, thus increasing very significantly the labor productivity in this tedious activity (DUPOND-LE GOUIS et al., 1990).

Such a definition is very important because it guides the attitude of the on-farm agronomist, the choice of research methods, and the tools to identify, understand and grade them. It also implies that it is the one who must live from his APS and ensure its maintenance on the long term that should finally decide how land must be cultivated (SEBILLOTTE, 1989). The on-farm researcher and extensionist roles are just to provide him with pertinent advice to do so. To put the farmer at the centre of the FSRE process, means that we postulate that he retains a certain level of decision-making power to act, and that only the knowledge of his objectives can enlighten his observed behaviour and guide a decision-making helper approach. Facing the increasing diversity of farmer situations, it also means the rejection of the elaboration of standard and normative farmer recommendations.

Figure 2



1.3. Farming systems diversity and the importance of the identification of differentiated farmer economic management criteria

For the on-farm agronomist, the APS diversity can be seen in the variability of farmers' responses to development actions, or through the different modes of agricultural use of a given homogeneous natural environment. To take into account the APS diversity is for him to establish that, even in a relatively homogeneous bio-physical environment, farmers do not (and cannot) produce in the same way. Table 2 shows the extent reached by the farming system differentiation process at one project site in Thailand.

Table 2. Assessment of farmer differentiation among 27 farming systems surveyed in Saiyok district, Kanjanaburi province in 1991.

Production factor	Units	Minimum	Maximum
Farm size	Hectare	1	18.5
Total laborforce	% of hired labor	0	85
Productive capital	US dollars	Negative (debts)	20,000

Any diagnostic activity (especially those dealing with the pertinence of the adoption of a given technique) should be first carried out in the global framework of the whole farming system (CAPILLON, 1985) and any judgement should be based on farmer objectives guiding the functioning of his APS. For a long time, APS diversity was considered as an obstacle to the dissemination of technical innovations. Today, the analysis of APS diversity and the understanding of their varied functioning patterns, that are necessary to provide a relevant interpretation of their technical and economic results, provide the quantity of elements to:

- orientate current farmers' choices,
- imagine new production processes, respectful of farmers' diverse objectives and adapted to rapidly changing sets of constraints.

As for the bio-physical components of the farm environment, methods are now available to characterize and typify APS regional diversity (CAPILLON et al., 1979). To be operational at the regional level, the knowledge of the on-farm diversity should be organized in the frame of various typologies relevant to the nature of the problem to be addressed (AUBRY et al., 1988). Generally, the establishment of APS typologies based on their differentiated functioning and history proved to be very useful to set research and extension priorities in close cooperation with farmers (TREBUIL, 1988a).

1.4. Procedures for the analysis of APS functioning

The series of diagrams presented in Figure 3 epitomize the various parts of the "APS analysis guide for the agronomist" (CAPILLON & MANICHON, 1991). First, it is necessary to identify the farmer's major strategic choices (that cannot be modified at short term) leading to the selection of the APS production combination. It is necessary to understand the determining factors of such a combination by characterizing (constraints vs potentialities) the production system, its history as well as bio-physical and socio-economic environment that either limit farmer choices or explain the occurence of a given sub-system. Next follows the identification of the coherence between farmer strategic choices and the farmer-family objectives and projects. Then, the APS strategy and its determining factors can be formulated, followed by the proposition of a complete diagram of the APS functioning.

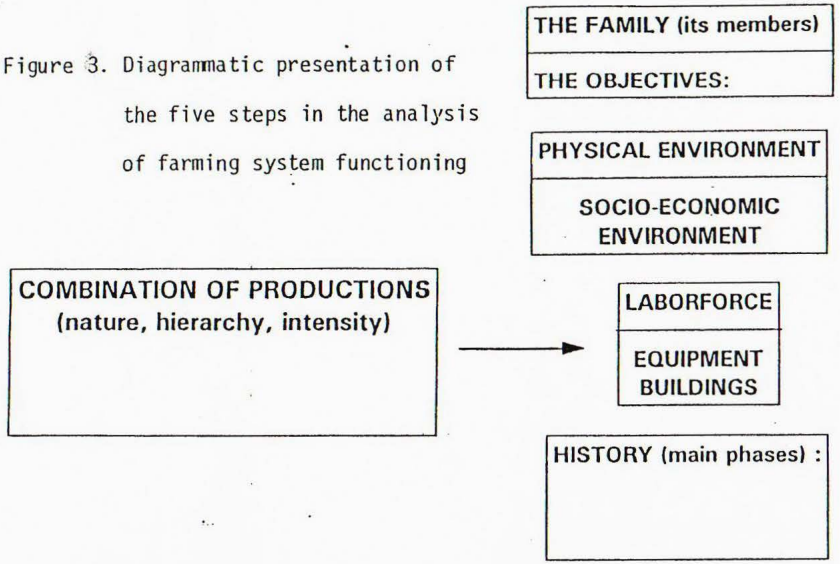
In a second phase, based on the previous global analysis, the particular importance of a given sub-system (a crop or kind of animal, but also possibly the farm equipment, labor management or financing, etc) is emphasized because of the possibility to improve it significantly. This sub-system is then well-characterized (detailed analysis of production processes and establishment of relevant balances) and a diagnostic judgement, independent from the farmer's opinion, is made on it. The assessment of the degree of achievement of farmer objectives is always made by looking at the APS economic results measured through the most relevant criteria for each given type of APS (net income per land unit, gross or net margins, family or total labor productivity, rate of profit, etc).

Finally, such technical results on key production processes are confronted with the functioning of the whole farm established in the first place. Strategic choices can then be confirmed or modified and APS problems formulated, as well as propositions of possible solutions to be experimented. Then the APS can be classified in the different ways they produce.

1.5. The farmer typology: an on-farm agronomist tool to manage farming system diversity, to choose testing sites and to delimit extrapolation domains of a given innovation

Taking into account farmer diversity does not mean the conception of development projects based on individual advice. Because of the scarcity of resources, one can then have only a limited impact on a few farms and does not know how to extrapolate those results. To avoid this trap and guarantee a better efficiency of the FSRE process, rather homogeneous groups of APS having similar functioning characteristics, that will be concerned by the same types of problems and development actions, are categorized in a farmer typology validated at regional level (TREBUIL, 1988ab).

Figure 3. Diagrammatic presentation of the five steps in the analysis of farming system functioning



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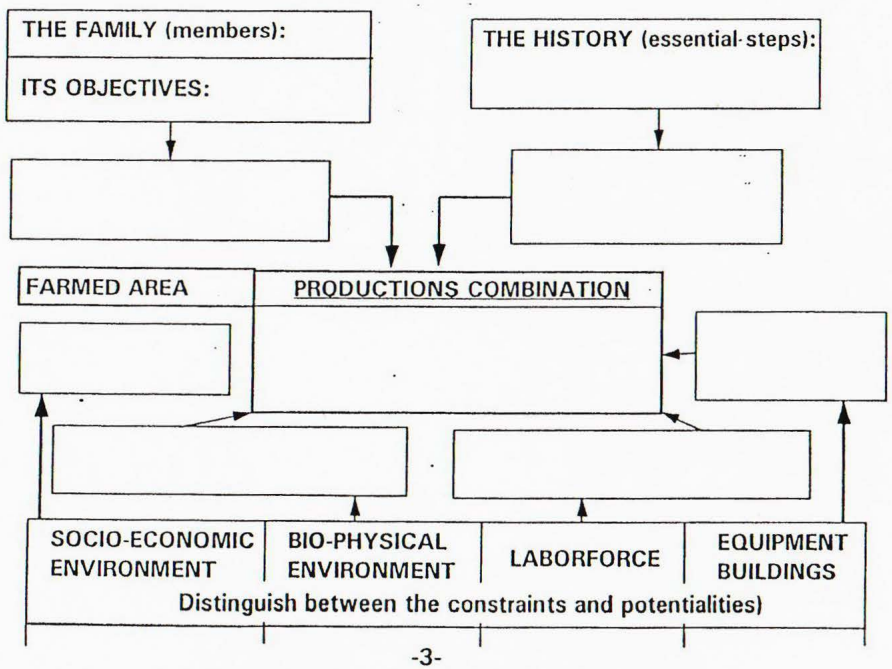
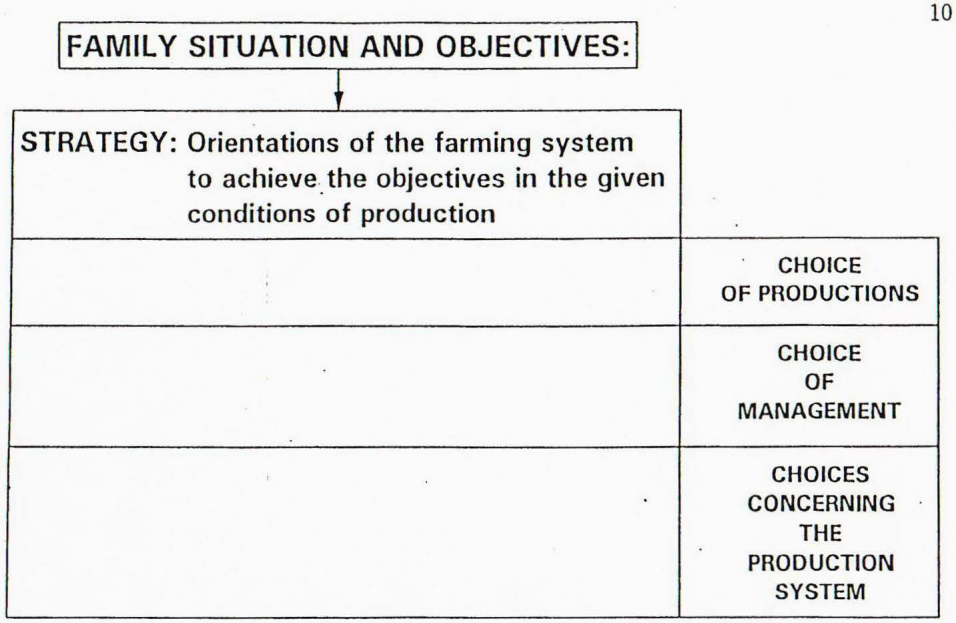
THE COMBINATION OF PRODUCTIONS
Chapter 1

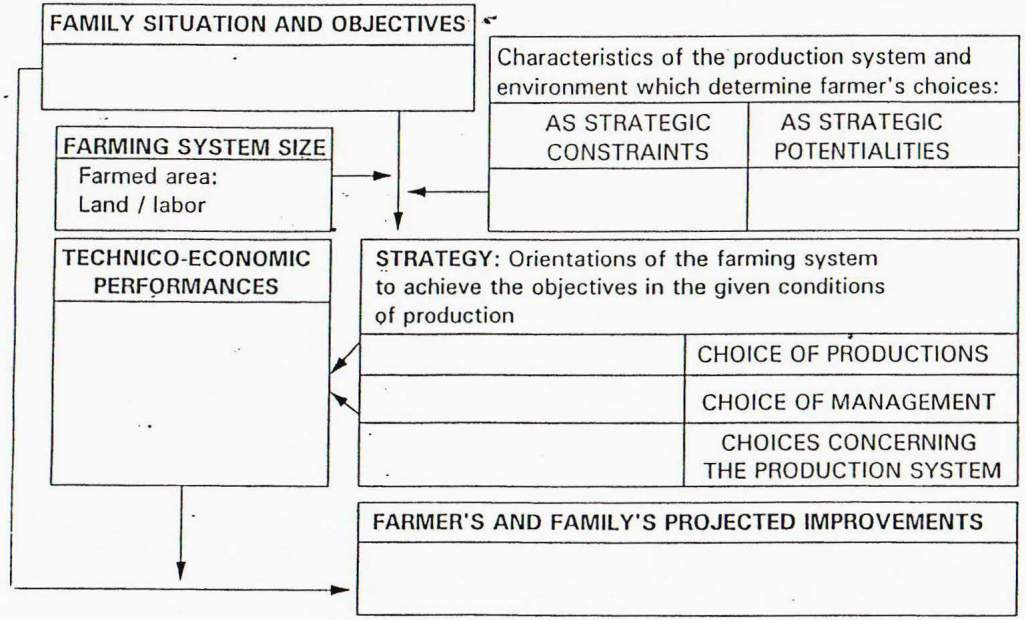
-2-
THE DIFFERENT TOPICS (description)
Chapters 2,3,4



-3-
THE DETERMINING FACTORS AND CONDITIONS OF THE COMBINATION OF PRODUCTIONS
Chapter 5



-4-
PRESENTATION OF THE STRATEGY
Chapter 5



-5-
DIAGRAMMATIC PRESENTATION OF THE GLOBAL FUNCTIONING OF THE FARMING SYSTEM
Chapter 5

Very often, the various types of APS functioning identified can be plotted on several trajectories that display phases and evolution mechanisms to explain and monitor the transformations of the APS in the region (TREBUIL et al., 1988a; CAPILLON & MANICHON, 1979). Keys and indicators are then defined to assign, rapidly and with a high probability, a given APS to one of the several main types of functioning.

The elaboration of such kind of farmer classification and APS evolution trajectories also leads to a relevant understanding of the social relations between different types of APS (TREBUIL, 1988a), as well as the identification of the local dominating capital accumulation processes at farm and regional levels (NARITUM, 1992). These tools provide the key information to study the APS and AS economic sustainability and equity issues.

It should be noticed that the analysis of APS functioning and farmer typification are powerful tools for training in system analysis applied to agriculture for students, extensionists, planners, researchers including non FSRE specialists. But more theoretical and methodological work is still needed to improve the rapidity of such analyses and avoid a too lengthy phase of constraint analysis in FSRE.

Because it provides a pertinent knowledge of the determining factors of farmer practices, the APS typology based on their functioning and history contributes also to:

- the elaboration and grading of the list of needed technical references needed by a specific type of farmer,
- the sampling of relevant sites (bio-physical conditions and type of APS functioning) to experimentally apply them,
- the design of an appropriate protocol for on-farm experiment-survey to be implemented,
- the delimitation of the domain of validity of the established technical reference,
- the elaboration of a limited network of well-known reference APS to facilitate regular systematic evaluations by updating the information on them and monitoring the trajectories of evolution of the regional APS (identification of a new one implying the incorporation of a representative APS in the network),
- the setting up of a monitoring-evaluation unit to make critical appraisals of the effectiveness of the FSRE process, propose timely re-orientations, and to renew and reinforce the farmer-researcher partnership.

The farmer typology contributes significantly to the management of the APS regional diversity in FSRE as well as the increased complexity of on-farm problems to be adressed through trials and surveys.

2. PROPOSITION OF NEW KIND OF TRIALS RESPECTFUL OF FARMING SYSTEM DIVERSITY

2.1. The APS functioning provides another kind of set of constraints to be taken into account when designing trials

Beyond the classic constraints of bio-physical nature that are usually taken into account, this approach delimits another set of constraints coming from the general functioning of target APS, that also contribute to limit the choice of farmer practices. If such constraints are not taken into account in the design and testing phase, later a restricted adoption of the innovations can be expected and hence the limited impact and effectiveness of the FSRE process will be underlined.
When such APS functioning constraints are not taken into account during the extension phase, the adoption by farmers of an innovation cannot be properly evaluated.

For example, in Sathing Phra area, southern Thailand, the extension of early maturing rice varieties RD 5 and 7 started in 1978. In 1982 by occupying 5% of the rice growing area they had already reached the limit of their dissemination according to the outputs of the DORAS diagnosis such as the agro-ecological zonation (occurrence of deep water paddies), frequential climatic analysis (high probability of a long dry season) and farmer typology (only 15% of APS types C and D interested by market rice production). In the event, Training and Visit extension workers considered this as a failure whereas it was in fact a complete success! As most of their "contact farmers" did not belong to the group of resource-poor farmers, what they adopted could not be transfered to the majority of the local APS.

The DORAS preliminary diagnosis also demonstrated that some 80% of the most resource-poor local farms were surviving thanks to palm sugar production, but no extension activities at all were underway to improve their working and living conditions! When simple but innovative and relevant sap evaporation technology was made available to tappers, approximately 100 households decided to switch to the new fuel and time saving 2 pan stoves each year.

2.2. Farmer advice should be diverse

This points to the importance of diversifying farmer advice, according to the functioning of their respective APS, in a given context characterized by the relative homogeneity of its bio-physical conditions. Then comes the necessity to think about what could be the pertinent observation criteria and more generally what kind of new on-farm experimental designs could be adopted (CAPILLON, FLEURY, 1986).

Risk taking, for example, which is part of the APS ojectives / strategy, differs between types of APS and reveals the existence of various farmer decision-making rules, that may or may not already be known. Modeling of these differentiated farmer decision-making processes is now explored to guide the conception and testing of adapted itinerary of techniques that are respectful of the regional APS diversity characterized by APS having different socio-economic objectives (SEBILLOTTE & SOLER, 1988).

Taking into account farmers' decision-making conditions, such new kind of trials aims at building coherent itineraries of techniques or cropping systems, and not only at measuring physical yields that can be produced. Advances in agronomy, particularly in the fields of characterization of the crop environment and yield elaboration processes, lead to improvements in our knowledge of the effects of techniques and crop population responses to them. Most of the time, it is now possible to propose different ways (various I.T., all of them being "adapted" to the situation) to either reach a given target production level or to define the most adapted yield objective according to the available resources that can be put coherently into action.

2.3. On-farm trials to test itineraries of techniques or cropping systems should be articulated with finalised factorial experiments

Building such I.T. relies on agronomic knowledge provided by finalised sectorial references, that has to be established if they are not yet available. As soon as the aim is not to minimize any risk for yield loss, difficulties are encountered during the implementation of I.T. or C.S. trials to decide technical interventions on the crop population and states of its environment. They are related to the lack of appropriate technical references in the current state of knowledge. To bridge these knowledge gaps, such on-farm trials induce factorial experiments of a new type (CAPILLON, FLEURY, 1986). To answer a given question (definition of a pest control economic threshold, compared efficiency between active ingredients, etc), in the context of a precise I.T. (objective and constraints, type of environment), various solutions can be tested. The selected one will correspond to the best compromise between the achievement of the farmer production objective or the respect of its set of constraints and the optimum states of the crop population and its environment.

Such precise and finalised knowledge and references are absolutely necessary to elaborate I.T. adapted to a given situation. This supposes an in-depth knowledge of the crop population functioning, especially the possibility to build one (or several) yield elaboration model(s) for the concerned species. Such models of crop functioning should provide parameters for a frequential climatic analysis because, for a given area, all the I.T. to be tested cannot realistically be evaluated under a complete range of possible climatic conditions. From this point of view, it can be said that the results of such an experiment are a real test of the current state of agronomic knowledge.

2.4. Problem complexity, generation of knowledge and elaboration of adapted technical references

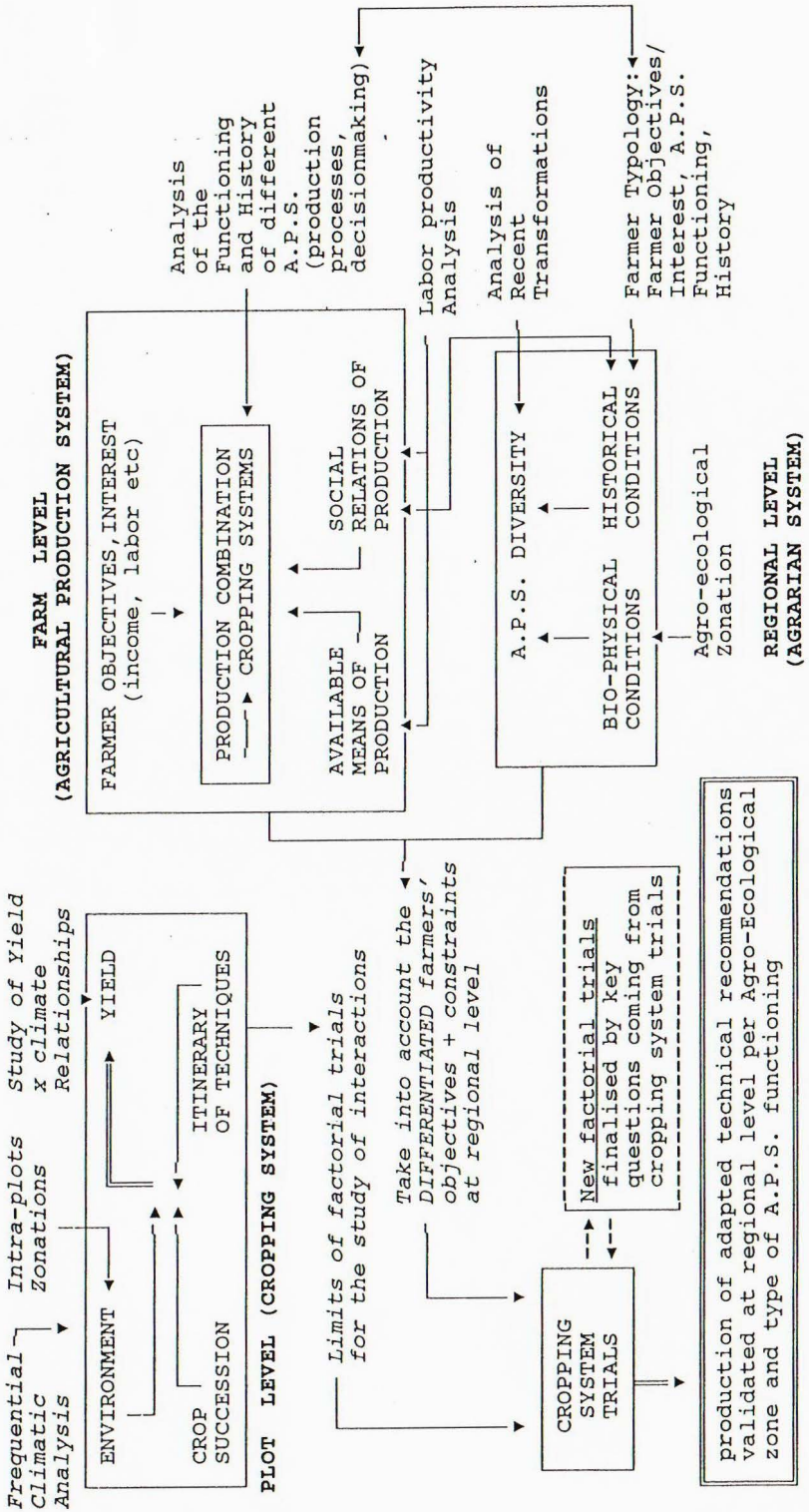
Facing the increasing complexity of on-farm problems and rapidity of technical and socio-economic changes the on-farm agronomist should be more and more preoccupied by the production of the agronomic theory. This is because more and more often, direct assessment of limiting factors does not work anymore, (CROZAT et al.,1988). Past groping and empirical search for solutions to farmer problems cannot meet the challenge of more and more rapid changes (SEBILLOTTE, 1987). Farmer technical but very soon theoretical competence needs to be continuously increased and widened.

Strong and well-structured farmer organizations to deal with upstream and downstream partners can help greatly to facilitate the transition and adaptation to new farm environmental conditions for their members. At Kamphaengsaen site in Nakhon Pathom province, the green asparagus producer group is driving the dissemination of the innovation among small farmers allowing them to clear past debts and start again a process of accumulation of means of production (CASTELLA et al., 1992).

More and more sophisticated "solutions" must be tailored to specific types of APS in increasingly diverse rural communities. Their designs rely on theoretical knowledge or various kinds of references shown in Figure 3, that are often simply not yet available and must be established first. All this takes time but the on-farm agronomist does not have another choice if he wants to avoid sacrifying scientific rigor and become an endangered species! Because it is only at the extension phase that simplifications of processes can be made. On the other hand this is a way to reinforce the theoretical background of the FSRE approach, to strengthen linkages with agronomy *sensu stricto* and, hopefully, attract the collaboration of more specialists.

When the FSRE program is institutionaly separated from other research units, it is difficult to attract expertise in key fields of study at the end of the initial diagnostic phase. Very often this limits the efficiency of the following design and testing phase. A solution lies in the reinforcement of the theoretical aspects of FSRE to make it more attractive to discipline oriented specialists deciding to face the reality. In fact, the lessons of past 20 years show that agronomic theory can be produced in farmer plots (SEBILLOTTE, 1987). Particularly the comparison of the extensive variability of on-farm situations can be used to build simple but innovative and operational experimental designs, combining (on-station + on-farm) experiments and surveys, to solve many concrete on-farm problems and establish regional technical references.

Figure 4. ORGANIZATION CHART OF DIAGNOSTIC STUDIES PRIOR TO DESIGNING CROPPING SYSTEMS ADAPTED TO THE DIVERSITY OF REGIONAL AGRICULTURE



CONCLUSION

DORAS proved to be a suitable theoretical and methodological framework to propose a new, more decentralized, system of institutions to cope with the current concealed crisis of the dominating non sustainable ("mining" in nature and extremely unequal) mode of accumulation in Thai villages (TREBUIL, 1989).

By combining diagnostic approaches at plot, farm and regional levels, it is possible to elucidate farmers' technical choices and elaborate adapted technical references. The consideration of the whole agricultural context can then be integrated in the reasoning of techniques and hence the elaboration of diverse but pertinent farmer advice.

Precise targetting of key problems to be adressed in the design and testing phase is necessary to ensure the efficiency of the FSRE approach. Very often, the understanding of the APS functioning of the target group of farmers and their social relations is missing and is, later, considered as an obstacle to the extension of research created "solutions" that are simply not adapted to their situation. To take them into consideration as early as the initial diagnosis, and include them in the on-farm agronomist set of constraints to design suitable innovations, helps improve the effectiveness of the FSRE process, especially when dealing with resource-poor farmers having very limited room for manoeuvre.

As common sense and experience will not be sufficient anymore to solve complex and fast changing problems, farmers and extensionists will need to be trained differently in using various observational but also theoretical tools and decision helpers to make their decisions or provide relevant advice. But diagnostic capabilities of researchers themselves need to be improved significantly to be able to cope with such future challenges.

Training of more "general" or "system" agronomists to ensure a rapid but comprehensive study of the target agrarian system is urgent. They should be relayed by discipline specialists during the phase of design and testing and become again conductors for the evaluation phase (in which researchers should participate to prove the relevance of their "solutions"). As they need to be key players in linking various disciplines (from plant physiology to the study of farmer practices), they have to accept a permanent tension between very analytical work and global assessments when practising and coordinating external and internal interdisciplinary approaches. The improved efficiency of the FSRE process is at this price.

APPENDIX: DEFINITIONS OF DORAS KEY CONCEPTS

▸ **Regional to National level:**

* ***Agrarian System*** **(AS)**: "an historically constituted mode of exploitation of the environment, durably adapted to the bioclimatic conditions of a given area and corresponding to the social conditions and needs at that moment" (MAZOYER, 1985).

▸ **Farm, household level:**

* ***Agricultural Production System*** **(APS)**: the whole structured set of plants, animals and other activities selected by a farmer for his production unit to achieve his objectives. The APS is a global system finalised by farmer's socio-economic objectives and related management strategy.

▸ **Plot level:**

* ***Cropping System*** **(CS):** "The set of techniques performed on plots which are handled in an identical way. Each cropping system is defined by:
- the kind of crops and their succession order,
- the itineraries of techniques applied to these several crops, including the choice of varieties for the selected crops"(SEBILLOTTE, 1990).

* ***Itinerary of Techniques*** **(IT):** "The logical and well-ordered combination of techniques applied to a crop to achieve a given production objective" (SEBILLOTTE, 1978).

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Potassium