COMPARING ANGLOPHONE AND FRANCOPHONE APPROACHES TO FARMING SYSTEMS RESEARCH AND EXTENSION

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Office of Multisectoral Development
Bureau for Science and Technology
Agency for International Development
Washington, D.C. 20523

NETWORKING PAPER NO. 1

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This paper was presented at the 4th
Annual Conference on Farming Systems Research
at Kansas State University, Manhattan,
Kansas, October 1984

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Introduction

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COMPARING ANGLOPHONE AND FRANCOPHONE APPROACHES TO FARMING SYSTEMS RESEARCH AND EXTENSION

Throughout the evolution of research on tropical agriculture a similar shift of emphasis has occurred quite independently in different parts of the world. The central idea now emerging is that technology aiming at agricultural production increase must take explicit account of farmer's ecological and socio-economic environment. In other words, new technology is nothing but an element, or a combination of elements, introduced into an existing system. This fact has considerable implications for research methodology by stressing the need for interdisciplinary and off-station work.

The resulting systems approach to tropical agriculture has been elaborated in many different fashions, according to the ecological environment and the prevailing research structure and priorities. An important part of the agricultural systems literature has been overlooked by current farming systems research because it does not explicitly refer to farming or cropping system terminology. An early example of a farming systems approach is provided by the work of dutch colonial agronomists on Java (e.g. de Vries 1931), who collected detailed data on all farm household subsystems and defined homogeneous recommendation domains.

The present paper discusses the systems approaches to agricultural productions that have evolved in the 1950's in the former Belgian Congo, and during the 1960's and 70's in the former French speaking colonies, in particular in Africa. These approaches will be refered to collectively as the Francophone approach to farming systems research, while bearing in mind that no unified or standard research method exists in this field.

From the late 1970's onwards, farming and cropping systems research have evolved at the International Agricultural Researech centres, to several U.S. universities, and in some national or regional research programmes throughout the developing world. For the sake of simplicity, we will call these the Anglophone approaches, although the term 'Anglophone FSR' has been used by Richards (1983) in his discussion of colonial research in British West Africa.

The use of such a simplistic dichotomy seems justified here because, on the one hand, the similarities between the different Francophone approaches are far greater than the differences between them, as is the case for Anglophone FSR. On the other hand, there seems to be some fundamental theoretical differences in perspective between the respective Francophone and Anglophone traditions. It appears worthwhile to explore these fundamental differences in view of the growing popularity of farming systems research and the rising expectations about its results. It must be noted however, that recently, exchanges between national programmes inspired by either the Francophone or

Anglophone tradition, have become more frequent, and many national programmes are developing their own specific blend of FSR.

As the Francophone approaches have been relatively neglected by the Anglophone literature, the emphasis in this paper will be on these rather than on a description of farming and cropping systems research. FSR has been maintained as a general term to indicate:

1. The study of existing farming systems in a holistic way a view to increasing the body of knowledge.
2. On-farm research with a farming systems perspective complementary to station research, usually only concerned with a subsystem of the farming system and not with linkages.
3. The development of new farming systems on the assumption that complete restructuring of existing systems is required and not only changes in subsystems (Simmonds 1984).

Our comparison of the two sets, Francophone and Anglophone, of approaches to farming systems, will highlight some of the general issues that FSR faces today, in particular with respect to its institutionalization and the extension of its results.

1 THE FRANCOPHONE APPROACH TO FARMING SYSTEMS RESEARCH

In the past the structure of French research on tropical agriculture was dominated by a commodity/sector approach as reflected in its organisation. From 1924 onwards, eight research institutes were created, respectively concerned with: livestock; oil crops; textiles and fibres; timber and forrestry; coffee, cocoa and other stimulants; rubber products and plastics; agricultural machinery; and food crops.

The latter institute, IRAT (Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières), has developed a concern for a systems approach with a view to integrating the results of component research programmes in field projects. In first instance, this integration included only the biological and agronomic sciences, later also the economic, and to some extent also the social sciences.

The institutes each created their own programmes in the field; in this way, the agricultural research structure in many former French colonies became also organised along commodity lines. Francophone agricultural research, in particular in West-Africa, has always maintained strong links with parent institutes in France. Usually, a distinction is made between basic research ('recherche fondamentale') and adaptive research ('recherche d'accompagnement') which is undertaken in the context of a development programme.

In 1974, the eight sector institutes decided to coordinate their efforts in order to centralize some of their services in GERDAT (Groupe d'Études et de Recherches pour le Développement de l'Agronomie Tropicale). The integration of the institutes will be completed in 1984 with the creation of CIRAD (Centre International de Recherche pour l'Agriculture et le Développement).

In addition to the eight institutes mentioned above, which will become departments of CIRAD, two more departments will be created, one of them concerned with farming systems (DSA, Département Systèmes Agraires).

1.1 "Les Unités Experimentales" in Senegal

The history of agricultural research in Senegal provides a good example of the evolution of thought on the role and concerns of agricultural research in France and Francophone Africa. This evolution can be viewed as having had the following phases (Tourte, 1977):

1. *1921-1940*: a nearly exclusive focus on groundnuts as an export crop, and on varietal improvement (mainly at the groundnut research station in Bambey). Some exploratory work on food crops such as millet, sorghum and cow pea.
2. *1938-1950*: a wider focus on the soudano-sahelian physical environment whereby Bambey becomes the centre of French West African agricultural research. Detailed studies identifying the specific climatological and natural constraints, in particular the extreme variability of yields.
3. *1950-1960*: a concerted effort to overcome the technical constraints to production. Large scale soil surveys in order to determine fertilizer (mineral and organic) and soil preparation requirements. Introduction of animal traction and ploughs, breeding of heavier oxen, detailed recommendations concerning cultivation techniques (esp. planting densities). Also varietal improvement of millet and sorghum; studies on cassava, coarse grains, fodder crops. The technical basis for more intensive cropping systems is laid.
4. *1960-1970*: whereas research up to then had been nearly exclusively component and commodity oriented with a view to developing cultivation techniques, varieties and equipment as inputs for government or parastatal development companies, research orientations changed considerably. Questions regarding the role and methods of agricultural research were raised by the failures of many development programmes in the 1960s. Some of the new insights were:
   - the awareness that agricultural production is carried out by farmers who seek production systems that best fulfill their needs given the socio-economic and ecological environment;
   - the need to define research priorities on the basis of an understanding of the rural environment and national objectives;
   - the inadequacy of the transfer of research results through the extension service to farmers, while at the same time these results were often no more than basic themes developed in the artificial context of research institutes;
   - the necessity to study the combination and application of technologies as well as the development of integrated production systems;
   - consequently, the desire to test integrated systems in reality with a view to identifying constraints to their application.

The focus during this period was on further intensification of cropping patterns, diversification, the refinement of fertilizer recommendations and the development of light machinery. However, the major innovation was the concept of *system* and the definition of production systems that are adapted to the technical and economic environment. Potential and actual yield increases were considerable.

In 1968 the Unités Expérimentales were initiated by the Senegalese Government and IRAT/GERDAT, in which the national agricultural research programme ISRA has participated from its creation in 1975. Its headquarters are located at the research station in Bambey, whereas the two "Unités Expérimentales" are situated in the Sine Saloum. An "Unité Expérimentale" is defined as a geographical and social unit where the results of agricultural research will be tested on a real scale with a view to developing and refining production systems that take into account the interactions between the physical and human environments. The two Unités covered 6000 ha (2200 inhabitants) and 4500 ha (2000 inhabitants), respectively, and included several villages and hamlets that were united into cooperatives. The creation of the Unités Expérimentales (U.E.) must be considered a milestone in the history of FSR. For the first time, production systems became not only subject of research, but their study was also institutionalised within the existing research structure. At the same time, the U.E. were considered as a pilot project where technically sound interventions were tested for their economic and social feasibility. More precisely, the objectives were:

- the promotion of intensified production systems under real conditions, taking into account the physical environment, national development goals, economic constraints and farmers' possibilities, on the basis of technical and economic recommendations from trial fields;
- the definition of attitudes and behaviour that these intensive production systems require, of both the extension agent and the farmer, according to farm type;
- the identification of technical, economic and social constraints to farm level production increase and to the diffusion of the proposed production systems;
- the assessment of the real potential of the area and the description of the steps needed in the transition of traditional to intensified systems; the follow-up of interventions on a larger scale.

5. *1970-1980*: definition of pathways to agrarian reform; attempts to involve farmers in the formulation of new technologies. A distinction is being made between 'light' innovations and more 'fundamental' innovations (thèmes légers et thèmes lourds). 'Light' or 'classical' innovations include improvements added to the traditional production system without altering its structure, such as new food crop varieties[1], fertilizer, light equipment. 'Fundamental' innovations, however, are a coherent

[1] in particular groundnuts, millet, cow pea, corn, rice, D. lablab.

package aiming at an overall intensification leading towards a profound transformation of the traditional production systems: land improvement and reorganisation of land holdings in order to allow permanent cultivation ("amélioration foncière"); use of heavy equipment and animal traction; destumping; heavy fertilizer and phosphate dressings; improved rotation patterns; ploughing and green manuring; improved seed and seed quality control; reafforestation with Eucalypt and Neem on erosion-prone fields.

The two sets of innovations or themes are not necessarily diametrically opposed but rather complementary: while the thèmes légers constitute an efficient instrument to assist the rural population in its transition from a subsistance economy, they may by no means be considered an end in themselves. IRAT has clearly expressed its conviction that the classical themes are inadequate to develop the full agricultural potential of Senegal, for which the thèmes lourds are essential (Tourte, 1971). In this view, restricting research to the development of improvements in the traditional production systems will necessarily limit economic growth.

This brief and necessarily incomplete description of the historical evolution of the "Unités Expérimentales" makes it possible to highlight three new features that were introduced into agricultural research:

1. Detailed procedures for *data collection* outside the research station throughout the process of technology formulation (Billaz and Dufumier, 1980:128):
   - case studies of farm enterprises, covering several years, undertaken by a resident observer;
   - follow-up studies of a sample covering 15% of the farms to obtain data on relations between climate, soils, yields, management, income, adoption of "thèmes" through factor analysis;
   - several types of surveys, e.g. nutritional, demographic, cadastral;
   - examination of the cooperatives' financial status;
   - group and individual interviews.
2. Explicit *linkages between research and development* organisations: working on a realistic scale outside the agricultural research station (a scale intermediate between the 36 m^2 standard trial plot and the 1000 km^2 area usually covered by an extension service branch) made it possible for agronomists and development workers to interact on a continuing basis. The delivery of appropriate recommendations to the extension services became a priority rather than the last minute preoccupation it had sometimes been before. In this way the process of development itself becomes subject of research, and the researcher must express him(her)self in "development terms" (Tourte, 1977:19) in order to be understood. The SODEVA[1] (formerly SATEC) was created to strengthen the agricultural de-

[1] Société de Développement Agricole.

velopment of the region through input deliveries; SODEVA became also responsible for the extension of the technical "thèmes" outside the initial two U.E. The notion of direct feedback into research through field trials, farmers' reactions and environmental changes became acceptable, as well as the combination of short term (thèmes légers) and longer term (thèmes lourds) research goals.

3. The acceptance of the "système de production" in all its complexities as a unit of analysis, leading to a decentralisation and location-specifity of research and to the recognition of farmers' motivations as well as national development goals as evaluation criteria next to agronomic criteria.

The concrete results of the U.E. approach may be summarized as follows:

- in 1980, the intensified "système de production" (*thèmes lourds, amélioration foncière*) includes over 40% of all the cultivated land in the two U.E., while cropping patterns have been diversified to replace the traditional cash crop (groundnuts) with cotton and corn. It must be acknowledged that the thèmes lourds were adapted by farmers to suit their needs: destumping proved to be a primary bottleneck, while the acreage under cotton was ultimately reduced. Moreover, post-harvest plowing under of straw was hardly adopted due to labour shortages;
- introduction of modern small scale equipment for soil preparation (animal traction) and cereal processing;
- development of traditional livestock management systems, including veterinary coverage;
- design of a farm enterprise monitoring system (based on a simulation model). However, insufficient experience has been gained in the extension of "thèmes" on a larger scale;
- the establishment of a (para-statal) cereal marketing system, parallel to the private sector (ONCAD);
- development of extension methods involving farmers' groups as well as influential individual farmers in the transfer of new messages and the administration of short term credit; the "conseil de gestion", a special counseling technique adapted to a farmer's specific situation helping him to formulate his road to intensification;
- remarkable increases in potential farmer grain yields (groundnut, sorghum, millet) through the introduction of high fertilizer dosages (5-600 kg/ha), ox-drawn ploughing and high-responsive varieties (average maximum grain yields 3-5 t/ha).

Yet, these results also raise two types of questions. Firstly, a numb : of technical issues that need further research and on-farm experimentation, on an interdisciplinary level, such as: a better integration of livestock and food crop production (manure, fodder, animal traction), testing of adequate equipment for land preparation and post harvest processing, and optimal water and soil conservation methods, in particular to stabilize phosphate levels.

Secondly, a number of problems remain that require more reflection:

1. *the definition of the basic unit of analysis*: the concepts of 'carré' (residential unit) and 'exploitation' (farm enterprise) do not necessarily overlap. It has been pointed out that this leads to an overestimation of the available labour per production unit (Venema, 1978:84). Certain innovations, therefore, are not within reach of poorer households with a more limited labour force. The sexual division of labour should be taken into account when estimating labour force. The effects of technical innovations on the intrahousehold distribution of resources and wealth should be examined.
2. *target group categorization*: within the U.E. three types of farmers have been distinguished: large influential farmers, medium and poor farmers. It has been documented that farmers have been reached according to their farm size, in decreasing order. The U.E. did not make an explicit choice for resource-poor farmers. On the contrary, it is likely that wealthier farmers have participated in the farmers' tests, and, therefore, some care should be taken in the interpretation of the results of 'successful' tests. Elsewhere in Senegal, it has been demonstrated that small farmers tend to cultivate the poorest soils, and the cultivation techniques aimed at large farmers with fewer labour and fertility constraints may not be applied by them (Angé, 1982).
3. *extension and farmer participation*: the development of extension methods with a view to increasing farmers' awareness and participation has lagged behind, in particular in the evaluation of the on-farm tests. There is no clear effort to include women in technical extension programmes.
4. *input delivery mechanisms and marketing* have been included as an explicit objective of the U.E., which promotes a type of action research to create or strengthen producers' organisations, but it is doubtfull whether self-sustaining structures do now exist.
5. most pressing is the issue of *replicability* and *scale*: how is it possible to extend this approach beyond the two experimental units to a larger region?

It must be concluded that the U.E. have been successful because of the specific political and institutional context of Senegal; this included a dynamic, decentralised research structure where multi-locational testing had already become part of a long standing tradition. In this way, the integration of non-agronomic socio-economic variables did not constitute a radical break with the past. Last but not least, it must be underlined that the socialist policies as reflected in the agricultural sector plans more or less explicitly supported the conscientization and active participation of farmers.

1.2 Theoretical framework and concepts of the Francophone approaches to FSR

The Unités Expérimentales in Sine Saloum are only one, albeit perhaps the most well-known and best documented case of early FSR experiences. Other programmes that should be mentioned are the Opérations Intégrés de Recherche-Développement in Algeria, a French bilateral aid programme in Nicaragua, the agricultural intensification project in northern Tunesian cooperatives and state farms, the ORD/Yatenga in Upper Volta, the ISRA/MSU project in the Casamance (Senegal), IER/DRSPR in South Mali, as well as numerous more recent activities in Ivory Coast, Brasil, Niger, Cameroun and elsewhere, not in the least in France itself (see also: Billaz and Dufumier, 1980).

It goes without saying, therefore, that there is not a single Francophone approach to FSR. Yet a number of key concepts common to most of these programs may be identified.

Central to the Francophone approach to farming systems is the idea of *"Recherche-Développement"* (R-D), pointing to the essential linkage of agricultural research activities to (rural) development actions[1]. It stems from the awareness that solutions to concrete farm level problems can come neither from isolated research stations nor from the simplistic formulas often used by development workers. R-D is the study of the application, on the basis of tests conducted under real physical and socio-economic conditions, of technical and social changes, in particular the intensification of agricultural production (including the management of natural resources) and the creation of producer organisations and delivery systems. R-D comprises three, complementary, *activities*:

- the study of the conditions of application of production systems that have been developed in agricultural research stations, in particular through field tests;
- the identification of the principal factors that limit agricultural production and the choice and testing of solutions to overcome these constraints;
- the development of policies and methods improving the socio-ecomomic conditions of production (Billaz and Dufumier, 1980:19).

In practice, R-D concentrates mainly on innovations and/or packages in the field of labour (input and skills), types and quantities of agricultural inputs (seeds, fertilizer, tools and machinery), and the organisation and management of production systems. R-D projects rarely tested economic innovations in the field of marketing, price policies, agricultural wages, credit or agrarian reform in general. The question has been asked, of course, to what extent economic structures can be included at all as experimental variables. R-D has never conducted experiments on variables for which

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[1] Recherche-Développement should not be confused with the American term "R&D".

the centres of decision-making were located outside the sample or beyond the level of organisation that is being studied, e.g. prices or marketing, and this remains one of its limitations.

In all cases, however, the objective of R-D has been the gradual transformation of the physical as well as the socio-economic environment whereby a set of technical innovations constituted the starting point. R-D actions have been limited in time as well as in space, as is required for a scientific experiment, although there have been large differences in the number of years and surfaces and areas covered. R-D is not able to formulate an overall agricultural or rural development policy, but may provide important elements for such a policy. The *subjects* of R-D studies are summarized below:

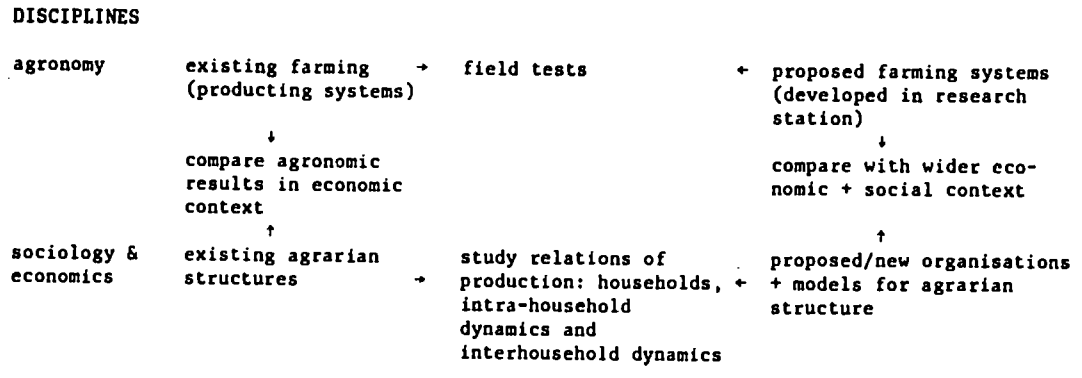


Figure 1. Subjects of study of the R-D (recherche-développement) approach to farming systems (adapted from Billaz and Dufumier, 1980).

It may be deducted from the figure that R-D makes a distinction between several types of environment in which research takes place (GERDAT, 1982):

- the real environment: the domain of extension more than of research since the researcher will only observe and evaluate the application of technology but will not intervene in an active way;
- the controlled environment: the real environment where the researcher and/or extension worker intervenes in order to try out and to test innovations. This calls for rigorous observation methods depending on the type of experiment;
- the managed environment: research station setting where all external variables are strictly managed by researchers.

It becomes clear from this table that R-D is more than the study of farming or production systems (étude des systèmes de production), and that the two concepts are not interchangeable. R-D operates at 4 levels of observation to which 4 units of analysis correspond. From the specific to the general these are:

Table 1. Levels and units of analysis in the R-D (recherche-développement) approach to farming systems research (adapted from de Miranda and Billaz, 1980).

Level	Unit of analysis	Study of:
1. field/plot	a. cropping system (système de culture)	a. soils, agro-ecological history, crop/weed/insect populations, micro-climate
	b. livestock system (système d'élevage)	b. also: herds, grazing conditions
2. farm	farming system (système de production)	means and methods of production, incl. non-agricultural work; recent history, past change in capital and technology utilization; labour films; household budgets
3. village	village production systems (système agraire/terroir)	management of natural resources, land evaluation, climate, vegetation, morphology, etc., (social) control of natural resources and water
4. subregion	subregional production system (système agraire/petite région)	idem but on a scale of 10.000 ha and over

GERDAT (1982) defines the farm ("exploitation agricole" or "unité de production agricole") as a combination of a production system, the agents of the system (those who work, those who benefit) and the environment put into production. Thus, farming system is a combination of productions and production factors applied by a farmer to satisfy his needs: a combination, therefore, of all the subsystems of land utilization (crops, forests, herds, hunting and gathering). An agrarian system is then a combination of agricultural activities undertaken by a community or (sub)region to satisfy its needs.

The results of this type of analysis must be integrated in such a way that it becomes possible to;

- diagnose the conditions of natural resource utilization,
- define the existing production patterns,
- analyse the impact of these patterns on the natural resource conditions, and vice versa the impact of natural resource conditions on yields.

This requires an integration of the usual disciplinary approaches: "downstream" ("en aval") from the general to the more specific, most often practised by geographers and economists who take the (sub)regions as their starting point, and "upstream" ("en amont")[1] from the smallest units (fields, crops, herds) to the more general, which constitutes the normal approach in agronomy.

The role of the social sciences in R-D deserves mention. Multidisciplinary research is required at each level and in each stage; this requires a joint definition of the objectives, of the time frame and of the area under

[1] again these terms should not be confused with the Anglophone concepts of "upstream" and "downstream" FSR

study. The socio-economic sciences participate from the beginning and not after the technical research is well under way. In the R-D approach, the socio-economic contribution comes from three parties: from scientists participating in the research team, from development workers and, last but not least, from farmers. Social science is required to understand the "real structures of production".

The role of R-D research is to develop and test technically possible production systems, given a number of external constraints and criteria. These criteria are: (1) production, per hectare and per worker, (2) value of the work invested, i.e. man hours in comparison to the value of the crop yield, (3) energy balance, calorie/protein yield versus calorie/protein investments, (4) ecological costs, (5) integration into national objectives.

Recently, it has been suggested that one should aim at an integrated R-D approach to overcome the Anglophone distinction between upstream and downstream research, whereby upstream research endeavours to produce experimental solutions to technical problems, and downstream research is site-specific and addresses the entire agrarian system. In the definition of Lefort (1983:4) integrated R-D or IRD involves "action research and participation, closely linking research workers, development agents and producers in a common approach to a comprehensive analysis, experimentation and action for the development of production systems and agrarian structures". It follows that IRD must be based on the requests and needs of development agencies and producers.

In the context of Francophone agricultural research, a distinction is also made between analytical research (recherche analytique), usually referred to in English as component research, and systematic research (recherche systémique), which aims at integrating the results of component research, while at the same time assessing economic feasibility and practicality at farm level (sometimes called "downstream" in English).

It is possible to distinguish several *phases in R-D*, but it must be noted that in practice these phases do not necessarily constitute a chronological sequence and often occur simultaneously or as problems are emerging during the research process:

1. observation and analysis of constraints to rural and agricultural development; this requires a multi-disciplinary effort whereby action is mainly taken by researchers. Surveys are carried out, leading to a "zonage" (homogeneous units, based largely on agro-biological and technical criteria) and to a typology[1] of farm enterprises;
2. formulation of farm models or new farming systems formulated in a quantitative way and comprising the hypotheses to be tested;
3. definition of multi-locational trials on substations, on farms and in "test-villages";
4. evaluation and interpretation of trial results;

[1] "zonage" and "typologie" together are roughly equivalent to the Anglophone "definition of recommendation domains".

5. proposals for and discussions with development programmes;
6. definitions of new hypotheses for further research (cf. Ramond, 1970; Billaz and Dufumier, 1980; Tourte and Billaz, 1982).

Great emphasis is placed on the classification of farms according to types. The criterion for classification is that between farms of the same category, which therefore are similar in size and number of people employed, no significant differences are to be found in terms of annual per capita income. Within each agro-ecological zone as defined through the 'zonage' several socio-economic types of farms may be found. Farm models are in fact the proposed combinations of improved or new technologies, i.e. the proposed farming systems, and include in particular mineral fertilizer and manure applications in combination with land preparation with draught animals. Destumping constitutes an essential step in land improvement.

The most advanced farm model tested by IRAT in eastern Senegal combined intensive rotation, heavy fertilizer dressings (up to 500-600 kg/ha, basic phosphate and lime dressings during fallow), high-yielding varieties, deep tillage with one yoke of draught oxen, use of three permanent labourers, on an average farm size of 10 ha, divided into 4 fields. The proposed pure cropping system consisted of a rotation with 50% under cash crops (groundnut and cotton) and 50% under cereals (maize, millet sorghum). The fallow was eliminated progressively. There has been a strong emphasis on semi-motorized cultivation, which later shifted towards animal traction. Although there was a need to increase the acreage under cultivation, in many instances bottlenecks appeared at weeding and harvesting which could not be overcome. Detailed study has allowed the calculation of economic constraints. It turns out, in fact, that the gross product per hectare is relatively low in spite of satisfactory yield levels (2500 kg/ha for groundnut and sorghum, and 2000 kg/ha for cotton), due to high input prices.

GERDAT's broad classification of existing farming systems in West-Africa illustrates the Francophone use of the concept of farming system (GERDAT, 1982):

1. shifting cultivation systems: extensive, without real land shortage, usually mixed cropping;
2. semi-sedentary systems: moderate land shortage, cash crop production integrated with subsistence production at plot or field level (e.g. millet/groundnut rotations in Senegal), at farm level (separate fields for subsistence and cash crops) or at village level (permanent cash crop production areas (périmètres de culture modernisée). Possible introduction of small scale mechanisation allowing increases in acreage, reduction of mixed cropping;
3. sedentary systems: acute land shortage, (very) short fallows depending, among other things, on the stability of soil fertility levels and on technology levels. There are three types of sedentary systems:
   a. stable integrated livestock-crop systems (woodland savanna), e.g. Serer tribelands in Senegal;

b. livestock-crop systems that have been destabilized by the introduction of cash crops and by population pressures but that have maintained a more or less satisfactory equilibrium through the use of improved technologies (inputs and resource management); e.g. cotton growing areas like western Upper Volta, southern Mali, northern Ivory Coast;
c. mono-crop (or crop association) systems often resulting from this destabilisation process: a vicious circle of diminishing yields and over-exploitation of land (without fallow) leading to low input/investment levels, e.g. northern Senegal, Mossi plateau (Upper Volta).

4. Livestock dominated systems: different types being: nomadic (Sahel); seasonal nomadic; herds integrated at village level under joint management; herds integrated at farm level (animal traction).

Forestry subsystems are supposed to be part of each farming system. Within each class of this classification, variability between farming systems may be high and further subtypes need to be defined according to the specific situation. De Miranda and Billaz (1980) suggest the following dichotomy in semi-sedentary farming systems (FS) in Niger: intensive FS (weed control, organic matter input, high plant density) versus extensive FS (little weeding or manuring, low plant density). Up to 50-100% differences in yield occur, between the two types of farming system, the differences increasing if the average annual rainfall decreases.

One of the aims of R-D has been to define, for each class of FS, the sequence of thèmes légers - thèmes lourds - systèmes intensifs ("itinéraire technique"), i.e. the technical and socio-eonomic changes and pathways required to reach optimal production levels.

The three partners of any R-D process are farmers, development workers and researchers. Usually farmers and researchers do not communicate directly but only through established development agencies. R-D proposed a radically different pattern of communication whereby all three partners communicate with each other:

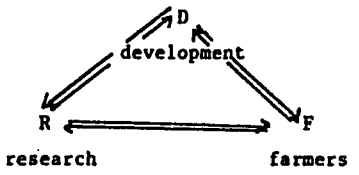


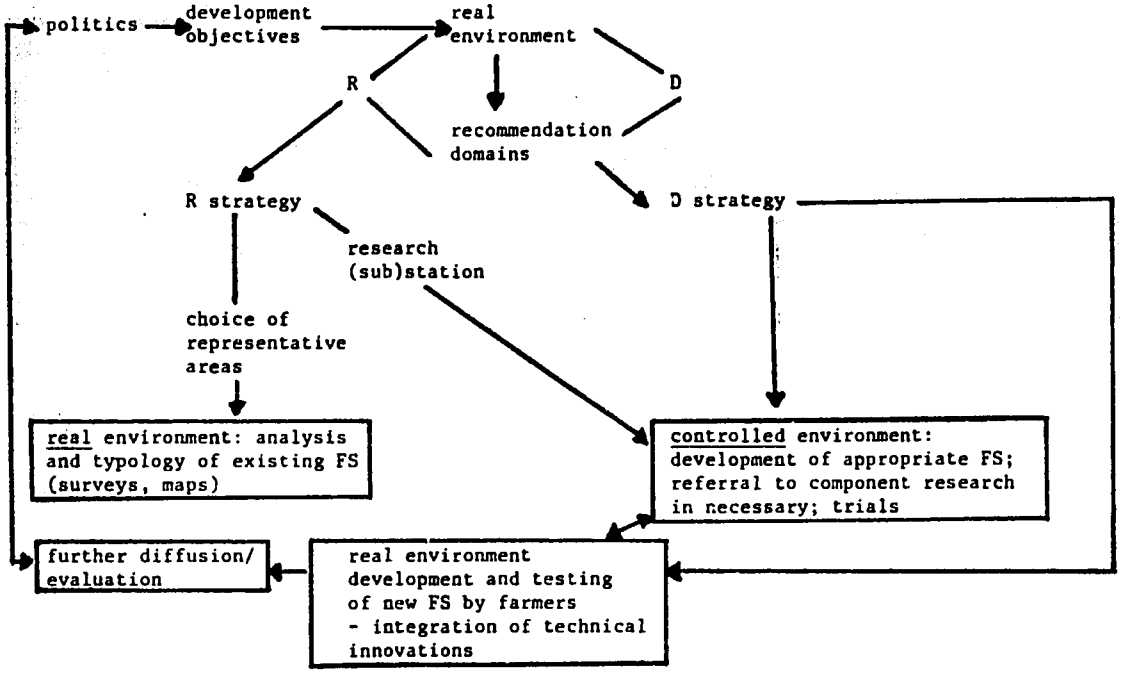
Figure 2. Communication between researchers, farmers and development workers.

This direct communication is necessary because researchers need to learn from farmers how they manage their existing farming systems, and farmers need tc be able to try innovations as they are proposed by researchers. The role of development is mainly one of long term diffusion of innovations,

while research assumes the entire responsiblity for their development and direct dissemination.

Tourte and Billaz (1982:226) have defined the triangular linkages between research, development and farmers in each phase of the R-D process.

The following table summarizes the joint action of research and development:



Figuur 3. Joint action of R-D (adapted from GERDAT, 1982).

2 BELGIAN CONTRIBUTIONS TO THE STUDY OF FARMING SYSTEMS

2.1 The agricultural anthropology of de Schlippe

A special place must be reserved here for one of the founding fathers of the study of farming systems, Pierre de Schlippe, whose work in Central Africa has been neglected for a long time. During the 1950s, his study of the traditional agriculture of the Zande has led him to the conclusion that the development of agricultural technologies in research stations must be preceded by a detailed analysis of local agricultural traditions and the rationale behind them.

This analysis involves agronomy as well as anthropology, because "traditional agriculture is at once both a human activity and a natural process". The objective of this analysis is to find ways to improve tradition-

al agriculture "without doing violence to the limiting framework of tradition and environment". De Schlippe warned against interventions in traditional agriculture which are not based on thorough knowledge of farmer practices and constraints.

The study of traditional agriculture constitutes the subject of agricultural anthropology, a discipline that ought to be practised, according to de Schlippe, by all students of traditional agriculture, who need to be both agronomists and social scientists.

Agricultural anthropology is based on two central concepts: the *system of agriculture*, and the *field type*.

A system of agriculture is "the customary pattern of behaviour followed by the individual members of the (ethnographic) unit in the realm of agricultural technology, which results in typical sets of: (1) land utilization in space (pattern of field types on their respective ecological backgrounds); (2) of land utilization in time (pseudo-rotations[1]); (3) of seasonal distributions of labour; (4) of seasonal distribution of nutrition and other needs" (1956a:238). Agriculture, in the view of de Schlippe (an agronomist by training), must be considered an essential part of the culture of any group of people, above other technologies, but more or less in the same way as language, law or religion are parts of culture. Therefore, he speaks of the System of Agriculture, which consists of agricultural as well as cultural elements and is influenced by the whole culture of the group. Agricultural behaviour is governed by social norms and values, and by knowledge of the environment. This knowledge is extremely detailed, covering the criteria for relative fertility of each soil-vegetation pattern, the exact timing of every operation in the process of raising each variety of every crop, the utilization of all sorts of fruits, seeds, leaves, woods, barks and basts for every kind of foods and utensils (1956a: 240).

This knowledge shared by every individual Zande finds its expression in practice, which in turn is codified by rules and commandments that govern behavioural patterns. Each farmer is forced to respect certain rules that tell him when and where each agricultural activity must be undertaken (1956b:2-4).

The system of agriculture is composed of several elements:

1. ecological conceptions: types of fallow, "soil-vegetation mosaic", "catena" (i.e. hill to valley sequences of soil types) and other concepts in relation to swidden agriculture.
2. crops: characteristics of every crop and variety of crop and of cultivation techniques. De Schlippe distinguishes many crop varieties and their specific uses, as well as subspontaneous crops that are not cultivated on purpose.

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[1] i.e. also including cases of staggered planting.

3. tools and general cultivation techniques: all tools and the ways they are used in the fields. This element is closely related to the next one:
4. crop processing and domestic work: all functions performed at the homestead, including consumption, cooking, storage, and the utensils used.

These elements only become meaningful when the structure of the system of agriculture is discovered (the elements may be compared to words in a sentence (the structure) of a language (the system) (1956b:117). The structure is provided by defining field types. Careful observation throughout the year of all agricultural activities of each member of the homestead allows one to see regularities that are specific for people (or categories of people: male and female, young and old) and for certain types of fields. Shifting cultivators classify fields into a number of types (1) in terms of crop associations and crop successions, (2) in terms of specific positions in the ecological pattern and in the season and (3) in terms of methods of management (1956a:106). Each smallest economic unit, i.e. each woman, possesses a complete set of field types. A field type is at the same time an agronomic term as well as a sociological one. In the sociological sense, a field type is a cluster of behavioural constraints that describe rigidly in what way fields are to be cultivated and what are the obligations of the cultivator of a field towards others. In the agronomic sense, a field type consists of an association and/or sequence of crops with the following chararacteristics (1957:12-13):

- a prescribed combination of crops and varieties
- a determined ecological environment (toposequence, fertility, water supply, natural vegetation)
- a fixed succession of cultivation practices throughout the season to take place at predetermined moments in time.

De Schlippe gives a detailed description of the seven field types of the Zande, the way they relate to nutrition and labour inputs throughout the agricultural year, and the way in which cooperation between households is structured through field types. The combination of field types allow a population to make optimal use of its ecological environment and of its labour.

Field types evolve over generations: under certain conditions, farmers will conduct trials which, if they are successful, may lead to the emergence of new field types. Changes also occur as a result of the process of incorporation and the introduction of innovations such as cash crops, or resettlement (and in particular of colonial legislation); in that case cooperation between group members and soil fertility may suffer (1956a:226-235). On the other hand, new varieties of existing crops such as short cycle groundnuts, may induce new field types and a better use of fields.

Thus, the study of traditional systems of agriculture must proceed through observation of agricultural activities and through interviews - the latter giving an idealised picture of reality, de Schlippe cautions.

Agricultural research stations should focus on an agro-economic analysis of field types. They should construct models of field types in order to simulate farmers' conditions; these models must reflect existing practices (such as mixed cropping) and labour input as well as ecological conditions.

It may be concluded that de Schlippe has emphasized the notion of agriculture as a cultural-agronomic phenomenon (rather than an economic phenomenon, as he was mainly speaking about subsistence production). There is no real equivalent in to-day's FSR theory to his concepts of system of agriculture and field system although they may be compared to farming and cropping system, respectively. He makes no mention of on-farm experimentation.

2.2 INEAC and the paysannats

Extensive research has been carried out on many aspects of agricultural development in the former Belgian Congo. Although the development of export and industrial crops has been stressed, basic work on the classification of soils and vegetation patterns has been undertaken, as well as studies on subsistence production and consumption and the improvement of food crops, from 1933 onwards. In that year INEAC (Institut National pour l'Etude Agronomique du Congo Belge) was created and soon nearly 40 research stations and centres were established in the Congo and Ruanda-Urundi. INEAC was completely independent vis à vis the local administration, as the only supervision was exercised at the Department of Colonies in Belgium. As a result great flexibility and continuity were achieved, but the absence of direct links with the extension service has not facilitated the application of research results. As has been pointed out, "by its independence, its strongly centralised organisation and the quality ..... of its leaders, INEAC played a more important role ..... than is usual for a research organisation" (Drachoussoff, 1965:187).

Miracle (1967:243) has remarked: "the volume, scope and quality of the resulting research is unparalleled in tropical Africa". Particular emphasis was placed on increasing potential yields under peasant conditions, and yield increases ranged from 87% (beans) through 150% (groundnuts) and 233% (rice) to an astonishing 380% for cassava (Jurion, 1952:8). The diffusion of selected varieties tested in local trials was therefore an important activity.

The transformation of traditional agriculture necessitated a study of the physical and human environment with a view to defining the plant and animal species most profitable for the area concerned and the new socio-economic structures to be established. In chronological order, the following disciplines had to contribute to such a study (Jurion and Henri, 1967: 71-72): geography and demography - law and social science - soil science and botany - climatology - agronomy. The area was then classified into different zones according to development potential.

In 1917 legislation was passed to enforce compulsory cultivation of predetermined acreages ("Cultures Imposées") in order to encourage food production (Fresco, 1982). The establishment of resettlement schemes supplementary to the system of obligatory acreages became a necessary instrument in the development policy of Belgian administrators. INEAC assisted in elaborating the technical features of this resettlement policy: the concept of "*paysannat*". This organisational structure aimed at helping farmers to become "true farmers ..... able to manage their resources and apply agricultural techniques with a view to maximizing (their) profits, the welfare of (the) family ....." (Jurion and Henry, 1967:75). "Paysannats" were mainly created at a pilot scale, directed by a team representing the research station, the colonial administration, the extension service, the veterinary services, the local (tribal) authorities and private companies. "Paysannats" had first and foremost an educational function, to develop and disseminate improved and sometimes intensified farming methods. Simultaneously, the paysannat was to create cooperatives to supply inputs and buy products at stable prices. A main feature was the spatial reorganisation of agriculture to make optimal use of and improve the physical resources. For each ecological region of the Congo the exact location as well as the necessary improvements of each spatial unit were determined: the village, the fields under cultivation, the fallows, the rotations, the pastures, the perennial plantations, firewood lots, fish ponds and roads. Fields and fallows were laid out in "*couloirs*", corridors with a width of 100 m, in East-West orientation (to assure maximum sunlight). The length of the couloir depended on the number of farmers. The number of the couloirs equalled the total number of years in the cultivation and fallow cycle, so that alternating couloirs could be opened up annually. This basic system has obviously been modified to suit each ecological and social setting. The objectivewas to encourage modern farming techniques including the use of machinery, fertilizer and pesticides, but also, of course, to facilitate supervision by the administration. At the same time, the couloir system was to be an adaptation of the "Bantu" system of farming, a rationalisation of the traditional system (Drachoussoff, 1965:53).

The couloir system was far from successful everywhere, although in the decade of its existence (1950s) about 200.000 households had been included, but the expected productivity break-through did not materialise. The introduction of modern cultivation techniques was still limited; fertilizer and mechanisation were only used on a pilot scale. INEAC itself has attempted to find explanations for the slow rate of development of the indigenous agricultural sector. The gap between average farm yields, even within the paysannats, and those obtained in research stations has been pointed out. The great variation in yields and income between farmers in the same paysannat is cited to explain this yield gap: some farmers are more capable than others (Jurion and Henry, 1967:362). There has been little systematic

attempt to analyse specific constraints to production at farm level, although it is acknowledged that land tenure, lack of capital, insufficient extension efforts, and low labour productivity play their role, as well as linkage problems between research and extension.

Paysannats remained a colonial invention and have been severely criticized for their paternalistic and authoritarian features (Dumont, 1962:55). It must be acknowledged, however, that some of the concepts underlying the paysannat strategy - the holistic approach, the detailed study of agro-biological as well as socio-economic aspects of the environment, and to some extent, the gradual introduction of appropriate technical innovations - cannot be ignored in an analysis of the roots of FSR.

3 ANGLOPHONE FARMING SYSTEMS RESEARCH IN ALL ITS VARIATIONS

Farming Systems Research or FSR can be considered an outcome of two interrelated patterns of evolution within post-war thinking on agricultural development strategies. First, there has been an increasing emphasis on small farmers as a target group for development assistance (see, for example, Röling e.a., 1979), as a reaction to the widespread failures occurring in large scale food production schemes (Lele, 1975). Secondly, agricultural research in low income countries has moved from a focus on export crops through the wholesale transfer of modern technology to an awareness of the need to adapt successful western techniques to third world conditions, supplemented by a "bottom-up" orientation (Norman, 1983:3). There is more and more evidence today, that the "very style and organisation of most current agricultural R&D will not adequately take account of the circumstances of small farmers and improve their productivity" (Whyte, 1981:X). Hence the need for new strategies in agricultural research, which have assumed different names but all come under the heading farming - or cropping-systems or participatory research.

Participatory research is the term used to describe an approach to the generation of new agricultural technologies for limited resource family farms. It is thereby assumed that the generation of new agricultural technologies is an important tool for improving both the optimal use of the farm household's resources and the welfare of family members. In contrast to traditional agricultural research, which often neglected the interaction between the elements of the farming systems and focussed on agro-ecological components (soils, crops, livestock), participatory research emphasizes a holistic approach to the farm and its socio-economic environment whereby the active participation of farmers in the research process becomes a goal in itself. It is recognised that farmers' knowledge and experience can play an important role in the improvement of their practices. The main characteristics of FSR will be discussed briefly below.

3.1 *Farming Systems Research sensu stricto*

A great number of activities is conducted in the name of FSR, and definitions of farming system as well as farming system research are numerous. They may be defined very broadly: "a farming system ... . is not simply a collection of crops and animals to which one can apply this input or that and expect immediate results. Rather it is a complicated interwoven mesh of soils, plants, animals, implements, workers, other inputs and environmental influences with the strands held and manipulated by a person called the farmer who, given his preferences and aspirations, attempts to produce output from the inputs and technology available to him ..... FSR ..... is aimed at enhancing the efficacy of farming systems through the better focussing of agricultural research so as to facilitate the generation and testing of improved technology" (CGIAR, 1978:8)[1]. Some definitions are rather fluid: "an approach to agricultural research and development that views the whole farm as a system and focusses on (1) interdependencies between the components under the control of members of the farm household and (2) how these components interact with physical, biological and socio-economic factors not under the household's control" (Shaner e.a., 1982:13).

Research with a farming systems perspective can have various objectives such as increasing the body of knowledge about farming systems or solving specific problems in a given system (Byerlee e.a., 1982:897). It would seem that there is substantial agreement that increasing the productivity of small farmers is a primary aim of FSR. Productivity may be improved through the development of relevant technology and complementary policies, and FSR is concerned with both (Gilbert e.a., 1980:2) although in practice the main emphasis has been in agricultural or even crop technology development. Chambers and Ghildyal have recently questioned the explicit focus on resource-poor farmers as a genuine concern of what they call 'farmer-first-and-last' methodologies, arguing that there is no guarantee in FSR type programmes that the conditions and needs of the poor will be catered for (1984:15).

Much of the confusion over the nature of FSR can be explained by the fact that the term 'system' is used at two different levels: at the farm enterprise level (farming system) and at the regional or area level (agricultural systems or recommendation domain). Moreover, apart from work on cropping systems (Ruthenberg: 1980), no useful typology or classification of systems exists (Simmonds, 1984).

A review of the literature shows the ways in which the term farming system (or also 'cropping system') is used to designate different concepts:

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[1] If this definition is maintained, "there is little activity concerned with agricultural and rural development which cannot claim some relationship with FSR" (Gilbert e.a., 1980:3).

- a complex of agricultural practices, i.e. the description of current practices: what do farmers actually do?
- a package of innovations, e.g. in "the development of new farming systems", i.e. a prescription: what farmers ought to do in the future.
- as a category in a classification of farming c.q. cropping systems; Ruthenberg distinguishes farming system (a category) from farm system (a concrete set of activities of one farmer), e.g. "farming systems with permanent unpland cultivation".
- the farm household, e.g. "the farming system and its (labour) resources" or "the farming system's access to cash".

Likewise, FSR, or, for that matter, CSR, have acquired two distinct meanings:

- a method of research, with an emphasis on informal surveys and on-farm experiments,
- a development strategy, in contrast to the "top down" imposing of technology on farmers (see also Sadikin, 1982).

Another distinction is the one between "upstream" and "downstream" FSR. Upstream programs use a systems approach to provide proto-type solutions on experiment stations to major constraints and contribute to the body of knowledge. Downstream programs aim at developing and introducing strategies that will improve the productivity of existing farming systems of defined categories of farmers (Norman, 1982).

Hart and Pinchinat (1981:564) suggest that farming systems research involves a minimum of three levels in the hierarchy of systems, e.g. the levels: agro-ecosystem, crop system, and individual crop.

The best way to examine FSR is through its concrete activities. Simmonds (1984) lists the following characteristics of OFE/FSP as it is practiced by most of the institutes of CGIAR:

1. multidisciplinary team, usually attached to an IARC (International Agricultural Research Center)
2. identification of target farming systems (or recommendation domains)
3. analysis of technical and economic structure of farming systems
4. identification of potential innovations
5. testing on experiment station and farms
6. collaboration with national agricultural research programs
7. repetition of experiments (in associated countries)
8. successful innovations transmitted to the extension services
9. feedback from extension transmitted to national program and IARC
10. IARC assumes responsibility for training and networking.

Within the actual process of FSR or FSR/E the following stages may be distinguished:

1. identification of existing farming systems (diagnostic stage) through informal surveys and case studies (techniques elaborated by Hildebrand (1981) and Collinson (1982)),
2. definition of recommendation domains consisting of categories of homogeneous farming systems,
3. thorough analysis of each recommendation domain and its constraints, sometimes through a formal, quantitative survey,
4. selection of known interventions that are likely to increase the productivity of existing farming systems and overcome constraints,
5. pre-screening of these interventions with respect to the resources of the farming system, and with respect to local delivery and infrastructure systems,
6. testing and adaptation of interventions under farmers' conditions through on-farm trials,
7. evaluation of interventions with farmers and in comparison to existing production levels,
8. extension of successful interventions to farmers outside the trial area.

Two central concepts in the FSR approach are the *recommendation domain* (RD) and *on-farm experimentation* (OFE). The definition of RDs is essential because FSR is most efficient for relatively homogeneous categories of farmers. The criterion for distinguishing categories is the extent to which final technological recommendations are affected: each category comprises farmers with similar practices and circumstances for whom a given recommendation will be broadly appropriate (Byerlee e.a., 1982). RD is mainly based on stratification of farmers and not so much on geographical area, so that socio-economic criteria are combined with agro-climatic ones. As a result, farmers of different RDs may be interspersed in a given area. FSR aims to focus on those RDs that conform to policy objectives. Rapid rural appraisals provide the basic data for distinguishing RDs. It is often emphasized that FSR is location-specific: the interventions and solutions resulting from the FSR process are only appropriate for the RD where it has been developed and they cannot be transmitted to other RDs without going through the FSR sequence again.

On-farm experiments (OFE) may involve different levels of researcher supervision and farmer management. Farmer control in the management of trials increases throughout the process of testing and adaptation. In general, the researchers involved in OFE are agronomists, or, sometimes, economists (Matlon, 1983).

The linkages between FSR and "main stream" agricultural research have been the subject of many discussions (e.g. Whyte, 1981; Andrew and Hildebrand, 1982). The major question remains how individual pilot programs with an FSR perspective can be integrated into the established structure of research stations and national programs. One of the most successful examples

of integration of FSR into a national program has been the establishment in Zambia of the ARPT (Adaptive Research Planning Teams) with a FSR perspective to complement already existing commodity research teams with a view to defining recommendation domains and planning on-farm experiments.

Amidst hundreds of reports mentioning FSR activities, how should FSR as such be judged? It seems that the farming systems approach deserves merit for drawing attention to a number of neglected issues:

- a holistic view of the farm as a system including non-agricultural work,
- categorisation of farmers into homogeneous target groups,
- detailed diagnosis of constraints to (agricultural) production at farm level,
- participation of farmers in the research process,
- informal survey and sondeo as a rapid and cost-effective technique to gain substantial information.

3.2 Cropping Systems Research

Cropping Systems Research (or CSR) has first evolved at IRRI and is still mainly undertaken by this institute or by institutes participating in the Asian Cropping Systems Working Group. There have been many misunderstandings concerning the nature and aims of CSR, and its relation to FSR. In fact, CSR is not a component or an earlier stage of FSR, but a research method with an altogether different perspective. The concept of cropping systems owes much to Ruthenberg, who considers the farm as a hierarchy of subsystems, of which the main intermediate levels (between soil and farm level) are the crop system and the livestock system (and, to some extent, also the processing level) (Ruthenberg, 1980).

The cropping system is defined as "the crop production activity of a farm. It comprises all components required for the production of the set of crops of a farm and the relationship between them and the environment. These components include all necessary physical and biological factors, as well as technology, labour and management" (Zandstra e.a., 1981). In practice the cropping systems studied have mainly been (irrigated) rice based cropping systems. Annual production from a given area of land can be increased by improving the yields of a crop or by growing an extra crop during the year. CSR seeks technology that will increase production by both methods: the introduction of improved management practices into existing systems or the introduction of additional crops. In this process technology is subjected to carefully specified resource limitations (Zandstra, 1982: 16). Improved management, in IRRI's terms, always includes the adoption of new rice varieties and associated intensification of management. The boundaries of rice based cropping systems are thus the borders to the fields in which rice is grown at least once a year, and the objective is to increase productivity of crop production activities on those fields (IRRI, 1984).

However, influences from outside must be recognised in so far as they affect the potential adoption of new cropping systems.

The assumption is that the most important limitation to the adoption of the IRRI package is technological. In many cases, achieving a better fit of production technology to farmers' physical and socio-economic environment requires a change in technology formulation, or, in Zandstra's words, a "submissive approach" to development, although, idealiter, CSR should combine the submissive approach with an "interventionist approach" which aims at changing the production environment (Zandstra, 1982).

The CSR sequence comprises the following stages (see Zandstra e.a., 1981; Zandstra, 1982):

1. selection of target areas: geographical areas representative of a large homogeneous zone, which are also priority areas for national governments.
2. site descriptions: including an identification of land types, a detailed description of existing cropping patterns (i.e. the spatial and temporal combination of crops on a plot and crop management methods) and cropping systems, as well as farm type and farm resource base, whereby both on-farm and off-farm resources must be described, as they relate to rice based cropping systems.
3. design of alternative cropping patterns taking technical and economic viability into account.
4. testing of alternative cropping patterns on farmers' fields monitored by research staff, with a view to assessing responses to input levels of each component.
5. preproduction testing and pilot production programs: multi-locational testing of most profitable cropping patterns in similar sites (with respect to land type). Pilot production programs are tested with a view to extend the institutional structure in order to make the additional resources required by the new technology available to farmers.
6. production program formulation: the training of extension staff by researchers is required and institutional coordination with respect to inputs and marketing must be achieved.

Special mention needs to be made here of *constraints analysis*, also called yield-gap analysis, which provides a method to analyse yield constraints occurring in existing cropping patterns and to assess future constraints in alternative cropping patterns. Starting point is the observation that the IRRI package (HYV and improved management) have not been accepted by all farmers and that even where they have been adopted, farmers do not achieve the potential high yields. In other words, there is a very significant gap between potential and actual farm yields.

Because the limiting factors may be physical, biological, economic or social in nature, constraints analysis requires a multi-disciplinary team effort, although most work in this field has been undertaken by agronomists

and economists. The analysis consists of measuring the on-farm gap between potential (i.e. with input levels for maximum yield) and actual yield, determining the contribution of test factors (inputs and management) to this gap and the extent to which these factors can be profitably increased given the social and institutional environment, in other words the "economically recoverable" yield gap (de Datta e.a., 1978). Constraints analysis has been used either in isolation of in combination with CSR. Both focus on yield per unit of land, although constraints analysis does not attempt to address broader issues such as how management intensity could be increased through technological innovations, nor does it emphasize constraints to (rice) production imposed by circumstances beyond the farmer's control. More so than CSR, constraints analysis tends to be ex-post, assuming that adequate technology has already been developed (Flinn, 1982). CSR as well as constraints analysis put their main emphasis on: the analysis of the bio-physical environment, pest control and the selection and testing of new cultivars.

Both assume that improved technology esp. varieties are available, but might need some adaption and that the yield gap can be bridged by interventions by the farmers themselves through changes in their cropping patterns. Recently, research at IRRI has moved towards the development of cropping systems for drought and submergence prone areas (IRRI, 1984). Work on Integrated Pest Management (IPM) at IRRI also deserved mention here, because it is, if not explicitly so, in line with FSR; the collaboration of entomologists and social scientists has, amongst other things, led to a modification of (purely quantitative) decision rules to ones that farmers can use. As Goodell states: "if technology is to be used by farmers, its development must start with them" (1982:27). A detailed account of CSR, in particular in Latin America, and the importance of the rediscovery of peasant rationality through the study of mixed cropping has been given by Whyte (1981:40-45).

4 LEARNING FROM A COMPARISON OF THE FRANCOPHONE AND ANGLOPHONE APPROACHES

The role attributed to agricultural research reflects more general views about the role of the state and outside interventions in traditional agriculture. Thus, both the Francophone and Anglophone approaches must be interpreted in the light of the colonial and post-independence history of the third world. However, we will limit our discussion to the most important differences and to the questions they raise with respect to the future of FSR.

It is useful to point here to two differences between the older generations of students of traditional agriculture, like de Vries and de Schlippe, and farming systems research today. Firstly, in the past the FSR perspective was confined to individual scholars who spent many years to understand all

the aspects, technical as well as socio-economic, of one particular farming system. Interdisciplinary team work and rapid appraisal methods were more or less unheard of. Secondly, the approach was not experimental but nearly exclusively descriptive; on-farm experimentation did not occur. The objective was first and foremost to accumulate knowledge on traditional farming, not to generate technology that is suitable for small farmers.

In contrast, FSR in general aims at increasing the effectiveness of agricultural research through the development of innovations that take account of farmer's reality. Usual research stations procedures tend to lead to inadequate recommendations because they were developed on plots where the physical and management conditions differ from those of small farmers. As a result, responses to experimental variables are biased in their magnitude and in the shape of the response function (Franzel 1983:3). Moreover, researchers' criteria for evaluating new technologies are very different from those of farmers, because the latter do not necessarily maximise single commodity yields or gross profits, but seek optimality of the entire system.

In table 4 an attempt is made to summarize the major differences between the Francophone and Anglophone approaches, that is to say between "ideal types" rather than between specific FSR programmes.

The basic difference appears to be one of scale and time frame. On the one hand, past French agricultural research, and to a large degree also present day Francophone FSR, constitutes an integral part of a long term, country wide rural development effort. The emphasis lies on developing the potential of a (sub)region whereby technology provides a starting point. On the basis of an assessment of this potential, i.e. the maximum production that can be achieved given the ecological conditions and optimal input and management levels, R-D defines the steps that will lead farmers to a complete transformation of their farming systems. Institutional linkages with development and extension programmes are crucial from the beginning, and in theory, the development process itself becomes a subject of research. One of the goals is to formulate adequate messages for dissemination by the extension service. The existence of concepts like "système agraire" and "milieu réel" point to a concern with development on a scale large enough to have an impact on regional or even national production levels. This also implies that Francophone FSR will not focus exclusively on small farmers but will aim at a measurable impact on yields which is usually more easily achieved through larger farmers. Changes in land tenure and infrastructure are included where appropriate. It is logical, therefore, that R-D programmes are characterised by long term commitments to a particular region or country.

On the other hand, Anglophone FSR is primarily concerned with the adaptation of existing agricultural research to provide technology relevant to low resource, low external input farmers. CSR examines why technology developed in research stations has not led to yield increases and how constraints to adoption may be overcome. The Anglophone approaches do not aim at a profound

Table 2: A comparison between Francophone and Anglophone approaches to FSR.

	FRANCOPHONE R-D	ANGLOPHONE: FSR	ANGLOPHONE: CSR	NOTES
1 OBJECTIVES				
- explicit mention of national policy	xxx	x	xx	
- generation of technologies relevant to small farmers	x	xxx	xx	
- ex-post analysis of technology adoption results	xx	x	xxx	
2 PROBLEM DIAGNOSIS				
- interdisciplinarity	xxx	xxx	xx	CSR: mainly agronomists + economists R-D: including geography
- emphasis on hypothesis formulation	xxx	x	x	
- holistic approach	xx(x)	xx(x)	x	variable for FSR & R-D
- time perspective	long-term/ several seasons	short-term/ rapid appraisals	medium term	CSR/FSR often one agricultural season
3 TARGET GROUP CATEGORIZATION				
- farm enterprise as a unit of analysis	xxx	xx	(x)	CSR: often field or plot as unit of analysis and little categorisation
- socio-economic criteria for categorization	xx	xxx	(x)	
- geographical and physical criteria for categorization	xxx	x	(x)	
4 ON-FARM EXPERIMENTS				
- farmer participation	x	x	(x)	generally weak
- size of trial plots	entire fields	part of farmer's field	small plots	FSR depending on type of trial
5 TYPES OF INTERVENTIONS				
- dissemination of technology	xxx	xx	xxx	
- spatial reorganisation of agricultural production	xxx	(x)	(≈)	rare in FSR/CSR
- organisation of delivery systems	xxx	xx	(x)	
- scale	area/subregion	pilot	pilot/area	R-D: "milieu réel"
6 INSTITUTIONAL CONTEXT				
- close ties with/integrated in IARCs	x	xx(x)	xxx	FSR: increasing emphasis on national research
- linkages with extension services	xxx	x	x(x)	
- links with (rural) development programmes	xxx	x	(x)	

transformation of the agricultural production structure. The development of an institutional framework is not its main concern: often, FSR projects have created their own delivery structure, and close contact between farmers and researchers diminishes the need for the inclusion of the extension services in all stages of the research. Rapid rural appraisals allow FSR programmes to be flexible and goal-oriented; often one or two major constraints are singled out, usually in the area of crop production.
Obviously there are not just two approaches to FSR. In fact, currentFSR is characterised by a great diversity. National research programmes tend more and more to select those elements that fit their needs, while externally financed FSR should build upon and complement existing agricultural and farming systems research. Francophone and Anglophone FSR are not mutually exclusive but may strengthen each other. Moreover, the above comparison may help us to solve a number of questions related to the institutionalization and extension of the FSR process. A few points will illustrate this.

1. The diagnostic stage
   Sondeos and longer term surveys will often provide a useful combination. The risk of rapid surveys is that only easily observable characteristics of farm households wil be taken into account, resulting in the design of solutions to obvious factor scarcities while complex processes are overlooked. The four levels of analysis (see table 1) allow the inclusion of supra-household, and, to a more limited extent, also intrahousehold factors. The participation of geographers and the emphasis on a historical analysis will be most useful, to provide an understanding of the evolution of the present farming systems.
   At this stage it is essential to define short and long term objectives, the respective target groups and the scale of operation. The Francophone approaches show that a basic knowledge of agricultural practices must be acquired before attempting to elaborate new technology. On-station research is essential to indicate the future potential. A longer diagnostic stage may include some on-farm experiments, since the best way to learn about a farming system is to change it (slightly). There is a need to collect repeated series of quantitative data on labour, land and input-output ratios; the quantification of data, especially on intercropping, requires the development of cost-effective inter-annual procedures (Richards 1983).

2. Technology choice
   Teh definition of the potential of a given region or farming system, the formulation of "pathways" (itinèraires techniques) and farm models may help to introduce a longer term prospective. To what extent farming systems are gradually transformed or radically replaced by new ones, remains to seen. Different technological packages - "thèmes lourds and thèmes

lèjers" - may provide more flexibility than a single set of recommendations aimed at one specific target group. Where the Francophone approaches have emphasized high import levels and small mechanization, the Anglophone focus has been on improved (staple) crop varieties and cultivation practices, as demonstrated by the various FSR projects in West-Africa (see Matlon, 1983, and Tourte et Billaz 1982).

3. Time frame

It would seem that the contribution of short term, externally funded projects is rather limited, unless an existing agricultural and farming systems research system is operational. The present focus on FSR may lead to the neglect of commodity research. A long term financial commitment will allow the inclusion of agro-forestry, watershed management and livestock variables in order to develop stable farming systems. In the long term problems associated with the large-scale diffusion of technology, such as the inelastic demand for output, the limited amount of credit available to the agricultural sector, will need to be addressed. There is also a need to develop methodology to monitor long term complex system changes.

4. Socio-economic constraints

In a wider perspective, many socio-economic constraints may become manipulable variables rather than fixed parameters. Effective transformation of a farming system is impossible without changes in the socio-economic environment, such as prices, infrastructure, marketing, credit. FSR must feed into decision-making at national level so that certain constraints may be alleviated by policy change. However, it will always remain difficult to decide when a political option is an exogenous constraint that cannot be modified on the basis of research results (Elliott 1972:12). FSR's microstrategies should be explicitly linked with macro-level constraints. Anglophone FSR has had a tendency to limit its definition of constraints to the farm enterprise level and does not sufficiently take account of the relation between technology and production relations and the way in which these limit the farmer's potential. Too often, crop technology improvement is seen as a solution to constraints faced by low resource farm households, excluding solutions to constraints for which the manipulable variables are located beyond the farm level. As a result, there has been a tendency to focus on varietal testing and improved seed distribution: easy to multiply, to test and to deliver, easy for farmers to adopt without changing other farming practices, improved seed may make a considerable difference to yields and may constitute a first step toward intensification; and if they don't, at least, seeds tend to persist after the completion of the project (USAID 1982). As Hart and Pinchinat (1981:564) point out, "there are strong arguments for putting aside the naive assump-

tion that complex regional agricultural processes can be improved by independently breeding better crops, setting up more fertilizer experiments or carrying or carrying out another marketing study".

5. Extension

In all FSR programmes there is a need for strong links with extension and (non)-governmental rural development agencies, whose understanding of existing farming systems may prove crucial. Extension's capability to manage a large-scale programme to diffuse the technology developed in the FSR process, may constitute a serious bottleneck. Adaptive testing will have to take place on an institutional level as well as farm level, in order to define organizational structures that fit the need for extention. Training extension staff who will participate in technology formulation and dissemmination, will require considerable funding. More research ought to be devoted to developing adequate extension methods in an FSR context, since it would appear that neither the "conseil de gestion" (individual counselling on farm management) nor the training-and-visit approach are appropriate for larger groups of farmers. If FSR is to have an impact on a large scale, extension's role will be vital and cannot be replaced by individual contacts between researchers and farmers.

There is an evident overlap between FSR and extension, both in objectives and in activities, especially in the areas of:

a. the identification of recommendation domains and target group categorization: local extension agents may be involved in rapid rural surveys with a view to identifying existing farming systems and constraints faced by rural households;
b. the implementation and evaluation of on-farm experiments, in particular in the case of multi-locational testing with large numbers of farmers' requiring multiple visits;
c. the extension of the OFE results through other farmers in the same RD and to farmers in comparable RDs elsewhere: developing methods to transcend the location-specific character of OFE results must be one of the first priorities.

The role of farmers in extension should not be underestimated. Jiggins (1982) argues for an additional intermediate body located between participatory field structures and servicing agencies, initiating the animation process and local organization management, receiving and chanelling external resources, acting as a broker with higher level or technocratic agencies. Anglophone FSR has placed a greater emphasis on traditional farmer knowledge and the use of traditional classification systems in technology design and testing.

It may be concluded that there is no blueprint for the study of farming and cropping systems. In the past, agricultural research in French and English speaking countries (as well as, for example, in Spanish speaking countries and others that we have not dealt with here) has moved in parallel directions. Nevertheless, significant differences occur which may be explained by the greater space and time frame of the Francophone approaches as well as by different ecological environments. A comparison of Francophone and Anglophone concepts has enabled us to obtain an overview of the variety of options in the field of farming systems and general agricultural research. There is a great need to formulate strategies to improve the productivity and living conditions of small farmers throughout the world. An FSR perspective, adapted to each unique situation may provide a contribution towards such strategies.

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