



WEST AFRICAN FARMING SYSTEMS
RESEARCH NETWORK

RESEAU D'ETUDES DES SYSTEMES
DE PRODUCTION EN AFRIQUE DE L'OUEST

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CONTRIBUTION OF FARMING SYSTEMS RESEARCH TO THE DEVELOPMENT OF IMPROVED TECHNOLOGIES FOR THE DIFFERENT AGRO-ECOLOGICAL ZONES IN WEST AFRICA.

REPORT & ABSTRACTS OF PAPERS.

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West African Farming Systems Research Network
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WAFSRN

WEST AFRICAN FARMING SYSTEMS RESEARCH NETWORK

WAFSRN is a professional association of active West Africa scientists interested in involving farmers themselves in the research for finding means to improve agricultural productivity.

WAFSRN's objective is to promote and facilitate collaboration amongst national, international and external scientists, programmes and institutions working on farming systems research in West Africa.

Its activities are meant to support scientists and national programmes through information dissemination, training, exchanges of experiences in methodology, comparison of findings and collaborative research.

The orientations of the network are drawn up at a General Assembly of members who elect the Steering Committee. The latter's responsibility is to develop the work programme and monitor its implementation by a functional secretariat headed by the Coordinator.

WAFSRN enjoys institutional support from the Organization of African Unity (OAU) through its Scientific, Technical and Research Commission (STRC) and the Semi-Arid Food Grain Research and Development Project (SAFGRAD).

WAFSRN also enjoys the financial support of the International Development Research Centre (IDRC), the French Ministry of Cooperation and the Ford Foundation.

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INFORMATION SERVICES OFFERED BY WAFSRN.

WAFSRN has already started offering various information services to its members and other users of farming systems research findings. It also produces the documents mentioned hereunder regularly.

Publications.

WAFSRN Bulletin is a quarterly that is meant to be a medium for both liaison and dissemination of FSR information. It contains the following sections: (i) "The Network in Progress" announces or gives accounts of activities of the network's various organs and activities organised by the network, either alone or jointly with other organizations. (ii) "General Information" announces scientific meetings, training courses, research grant programmes, etc. that interest the scientists. (iii) The "Research Note" can be a short account of on-farm research work or a note of reflexion on methodology. (iv) "Recent Publications" is a selection of recent books, articles etc, providing bibliographic references and abstracts.

Agricultural Systems in Africa is a semi-annual multidisciplinary scientific journal which publishes original works in all aspects of farming systems (cropping systems, land use systems) including issues related to local or regional agricultural economics, and more specifically original accounts on research, proceedings of scientific meetings on agricultural systems, articles presenting current information on a given topic. Articles are in English or French and cater for the needs of scientists, extension professionals and decision-makers for agricultural policies in sub-Saharan African countries, especially in West Africa, but also other regions of Africa.

The **Directory of Members** is published yearly and gives basic information on each network member, including his/her discipline, the organization he/she is working with, areas of activity and interest, and work programme. The directory is compiled from detailed information provided by members themselves and stored in our PROCURE database, that is also available for consultation. The 1991 edition contains data on 330 scientists.

The **Directory of West African FSR Programmes** will be published yearly. It will give detailed information on on-going FSR programmes in all the institutions in each country in the sub-region: composition of research team, agro-ecological features of research zones, research and trials being carried out, list of publications. The detailed information provided by national programmes and stored in the BAPIR database (also available for consultation) will be used to publish the Directory. The maiden issue is scheduled for the end of 1992.

The **Selective Bibliography Series**: Each volume in the series will contain bibliographic references with abstracts on a specific aspect of cropping and livestock systems research in the various agro-ecological zones of West Africa; or on animal traction or FSR methodology. Each volume will be based on information stored in BIRES, the Network's computerized bibliographic database. It is envisaged that each volume should have an English edition designated "E" and a French counterpart designated "F". The first pair of volumes is on maize-based FSR. You can request a free copy.

Documentation Services.

WAFSRN's documentation and information services focus on literature on FSR in West Africa and on FSR methodology. The following services are available for network members as well as interested individuals or organizations:

Abstracts of recent documents published in each issue of WAFSRN Bulletin.

Selective Dissemination of Information (SDI).

Retrospective Search on demand in BIRES.

The Network's **Reading Room** is open to the public.

Photocopying of documents in stock in the Unit is done on request.

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need was especially felt in many cases where exogenous factors rank first among the identified constraints.

Transfer and Adoption of Technologies. There was much discussion about the degree of involvement of the research personnel in the process of dissemination of results. Some were hesitant, others thought it necessary that FSR researchers should engage themselves in the process of transfer of technology, and include in their research the aspects of extension methodology. There was however, a consensus that a strong linkage with the extension services has to be established in an early stage of the FSR-process, and good communication should be maintained all the time, based on common involvement with farmers in experiments and demonstrations. A major difficulty arises where the extension service is weak, or non-existent. Interesting experiences are going on with farmer-organised associations, as well as with non-governmental organizations, in some places.

General Aspects. As far as objectives are concerned some major observations have been made. Many feel that it is an absolute necessity to identify research programs in terms of their contribution to specific rural development objectives. However in many cases these objectives have been very poorly defined, and one of the tasks of FSR could be to contribute to the identification of development objectives and the formulation of policies. There is much questioning on how, and through which channels the FSR efforts in this domain could gain importance. First there is much discussion on the idea of reshaping the whole research programming process based on its possible contributions to agricultural development in the short, medium and long terms. On-farm and FSR programmes could then be defined with a much larger time perspective in view, according to well identified objectives in terms of agricultural development perspectives and foreseen problems, to be adjusted during the process. A second important point is the problem of natural resource degradation. Very strong emphasis is to be given by all FSR programmes to the issue of natural resource management, including physical aspects as well as socio-economic aspects; and the role of the farmers themselves in the management of their own environment. Thirdly a strong contradiction is felt between the urge to produce rapidly, high performing technologies that can easily and extensively be adopted by large groups of farmers, and the need for sustainability. Both needs are important but there is little optimism about the possibility of achieving both objectives in a short time with very limited means. There is consensus that no intensification and increase in productivity in sustainable systems can be achieved without an important increase in fertilizer use. This is to be combined with a much better use of existing resources for organic manure such as dung, compost and green manure. A fourth important item is diversification and the problems of marketing and market structures. Many members observed that among the factors that restrain agricultural development, lack of markets, lack of information about possible markets, both internal or external, are most important. In many countries traditional farm products are facing severe marketing and price problems. There is an urgent need to diversify production or go into more post-harvest technologies for getting more value added before selling.

II. Stock Taking on FSR.

A. Achievements so far.

- **Technologies developed.** These include improved technologies on millet/sorghum, maize/cotton, maize/cowpea, millet/cowpea, maize/soyabean, sorghum/soyabean and the development of no cost and low-cost technologies. There had been a lot of technologies that did not work. This has forced researchers to concentrate effort on real issues relevant to farmers' conditions.

Influencing on-station research to address farmers' priority problems . Successes comprise research emphasis shifting from sole cropping to mixed cropping ; getting research station scientists to work on farmers' fields ; soil fertility maintenance ; adding to genetic base available from farmers' collections.

Improved research-extension-farmer linkages. Researchers are now in direct contact with extension workers and farmers on the fields.

Institutionalization: In some countries FSR is reaching the stage of institutionalization.

B. Deficiencies of FSR observed in the Savanna Zone.

- It has not been possible to address policy issues of macro-medium and long term-nature.

- Issues of **marketing and commercialization** of crop and animal products have not received adequate attention.
- **Crop-livestock integration research** is lacking.
- **Socio-economic experimentation** is still weak.
- **Exchange of experiences and information** between countries is not yet effective.
- **Methodology** to incorporate farmer participation is weak.
- Inadequate attention is paid to **pest and disease management**.
- **Farmer education** has not been adequately dealt with.
- **The analysis of on-farm research** can be strengthened statistically as well as by including farmers' evaluation.

C. What are the Problems?

- **Long term funding** and meagre present funding.
- **Lack of commitment** to FSR in some countries.

III. Collaborative Research.

- A. **More exchange of information is required between specific programmes working on similar themes and in similar zones.** How could visits to each others' research areas could be facilitated, without going through the official procedures? Would it be possible to agree mutually that "private visits" will be allowed, and be used for informal professional exchange purposes?
- B. **The following suggestions were made for more specific themes for collaborative research between programmes.**
- Increased effort on **crop-livestock interaction**.
 - Increased effort on **soil fertility problems** particularly the interaction of short-term chemical input versus long term organic-matter build-up.
 - Research methodologies for more rational **land management** with considerable farmer participation.
 - Increased effort on improving the **productivity of existing mixed cropping systems**. (population, varieties, pests, diseases, fertilizer used, etc.).
 - Increased effort on **marketing and infrastructural development** with the objective of increasing the range of crop and animal alternatives the farmer can choose from.
 - Increased effort to improve **linkages with other institutions** such as credit, extension, training and farmers organizations including women.

SAHELIAN ZONE.

A dozen papers were presented and discussed. As a general trend, one notices **the limited number of FSR programmes in Sahelian and Sudano-Sahelian Zones and the inadequate resources allocated to them**. On the whole, the papers gave evidence of the **magnitude of endogenous and exogenous constraints** to the improvement of farming systems in the Sahelian region. Technical solutions tested on farmers field (combined mineral and organic fertilizers, grain and legume rotation and intercropping, improved varieties, animal traction, etc) stand little chance of adoption by farmers due to climatic vicissitudes, environmental degradation, farmers limited resources and input cost. Additionally, structural adjustment policies have tended to aggravate the exogenous constraints.

From a methodological point of view, the group noted that the FSR approach must seek to further understand the interactions between endogenous and exogenous factors which militate against the adoption of innovations by

farmers. In this respect, FSR programmes should show a keen interest in analysis of the environmental degradation and in farm management by farming communities. The implications of structural adjustment policies for farming systems in the Sahel must also be better studied. This broadening of FSR perspectives presupposes a strengthening of multi-disciplinary and collaboration with other disciplines (ecology, macro-economics, etc) and other research bodies (universities,...). The group selected two themes which may be the subject of collaborative research projects:

- Research on interaction between endogenous and exogenous factors in the adoption of technologies in Sahelian and Sudano-Sahelian zones.
- Research on the dynamics of agrarian systems and strategies of farmers' communities in the face of resources degradation.

IRRIGATED OR LOWLAND ZONES.

The sub-group on Irrigated Farming.

The sub-group on irrigated farming discussed six papers presented. The first three papers concerned the farming systems research programme undertaken by the Senegalese Institute for Agricultural Research in the Senegal River Delta. One of the papers outlined the research carried out for the purpose of developing intensive farming systems as part of a project for the rehabilitation of the RETAIL Project at the "Office du Niger" in Mali. In the ensuing discussions generated by the different papers, members of the group made some general remarks in connection with the modalities for the conduct of FSR in irrigated areas.

1. First and foremost, it was stressed that **water control through irrigation makes for indepth transformations of farming conditions which require that new farming systems be designated through research.** The relatively all-embracing character of the transformation of these systems and the gradual nature of the transformation were also discussed. It became clear that farming systems and their degree of intensification necessarily have to be adapted to the degree of water control. Since the history of farm management is often characterized by the gradual pace of water control, the result has been the gradual adaptation of farming systems. Consequently, at each level of advancement, technical recommendations need to be consistent among themselves and be adapted to farming conditions. Some research programmes such as that of the Senegal River Delta have taken into account this necessary flexibility of recommendations to be made to farmers by testing the technical paths corresponding to the different levels of advancement.
2. It was clearly demonstrated that in irrigated areas, the **functioning of farming systems, whether in land management, water management or cropping, is partly determined by organizational levels above the farm units:** irrigation units, hydraulic sectors, perimetres, etc... Consequently, the endeavour to improve this system cannot proceed without taking account of the organizational levels. This need is further buttressed by new development policies aimed at curtailing the role of state companies while farmer organizations take over a greater responsibility in the valorization of irrigated areas. Hence, this makes them privileged research partners in the development of new farming systems. Even though these new policy orientations seek to modify the roles and functions of extension units in charge of irrigated areas, it is worthy of note that these units are not going to be phased out altogether. They would still be playing a monumental role in the implementation of new farming systems. This calls for the strengthening of relations between research and development agencies in irrigated farming. It was noted that apart from some exceptional cases, national research systems play inadequate role in irrigated farming and this explains why farming system research is often conducted as part of the allied research of development projects. Accordingly, it is recommended that FSR programmes and the number of national researchers in this zone must be reinforced.
3. Similarly, a recommendation was made for a **simultaneous conduct of research** aimed, in the medium and long term, at valorizing irrigable lands yet to be developed and short term research that will help to improve the performance of existing farming systems.
4. Finally, emphasis was placed on the importance of developing **research on farming systems sustainability**

in irrigated areas. This sustainability is to be considered from various view points:

- Agro-ecological, particularly by considering the risk of soil degradation and toxicity.
- Macro-economic: consideration of the cost-effectiveness and expediency of investments made by the national projects.
- Micro-economic: consideration of farmer choices and strategies when it comes to irrigation.

The sustainability of farming systems developed in irrigated areas and their extension to wider areas poses numerous problems that remain to be appropriately solved. These problems will have to be dealt with by considering the general dynamics of rural communities concerned in these zones and more importantly, the stages of development of the agrarian system. After the discussions, it was concluded that **farming systems research undertaken, so far, in irrigated areas, have already culminated in the achievement of some results:**

- They have helped to properly identify the factors militating against the development of these areas.
- They have made it possible to define the technical and organizational conditions for their intensification.
- They have shed ample light on thematic researches necessary in this intensification.
- Finally, they have confirmed the importance of the interfaces between technical and social issues as well as research and development, thus, demonstrating the comparative advantages of farming systems research. Some of these results are highly satisfactory especially those relating to the conditions for the intensification of irrigated rice-growing. This is evidenced by the yield increases recorded in farm areas where these results were applied.

The fact still remains that **several aspects are yet to be investigated or delved into in greater detail** through farming systems research. Some of these are: - **the mastering of double cropping** which poses the problem of planting material, equipment, organization, development, etc... ; - **the improvement of labour productivity and the reduction of its flexibility** through animal traction development or appropriate mechanization. ; - **the study of the trend of soils under irrigation, toxicity-generating mechanisms and toxicity control measures ;** - **mastering fertilizer use and pest control by farmers.**

At the organizational level, **research themes proposed** included:

- **water management, and maintenance of irrigation** development through the intermediary of irrigation groupings ;
- **the role of farmer organizations** in the transfer and appropriation of technical innovations and in the carrying out of various activities up-stream and down-stream of production (supply, loans, marketing) ;
- **land management** to provide a security for land tenure while farmers are called upon to take charge of maintenance and valorization.

The group expressed the hope that WAFSRN would help strengthen exchanges and cooperation among research teams for the purpose of developing research activities based on these themes.

GENDER ANALYSIS AND FARMING SYSTEMS RESEARCH.

The group chose to lay emphasis on the activities of men and women in farming. **To become more operational, farming system research must take account of the capabilities of men and women.** This approach is indispensable, more so as FSR is aiming at adopting new technologies to overcome certain difficulties identified during the diagnostics phase. How can appropriate technologies be proposed without a prior knowledge of what each member of the farm unit can do ? It is therefore important to underscore the contention of the group (and it is hoped that other participants share this view) that "Gender Analysis" has a socio-cultural and economic connotation. This implies that the approach takes a dynamic look at activities that can be carried out by both men and women. Everything is possible for both men and women when all the socio-economic and cultural conditions are adequately taken into consideration.

A brief overview of papers presented at the Symposium points to the following facts:

A consideration of the three conventional phases of the FSR namely the phases for diagnosis, experimentation and transfer clearly point to the fact that **the participation of women in farming activities is more pronounced especially at the diagnosis level.** This is particularly true of studies on labour time and zoning. In

the Sudanian and Sahelian regions, for example, experience has demonstrated that women's contribution to labour input is considerable and may in some cases exceed 50% of the total volume of work in such croplands as the groundnut farm in Côte d'Ivoire and rice-growing farm in Senegal. In the forest zone, the bulk of food production (up to 95%) is undertaken by women. Unfortunately, there is an imbalance in FSR efforts towards the work of women in the zone. On the one hand, there are very positive experiences as in the case of South Western Cameroon where virtually all research activities are conducted jointly with women. The reverse is the case in Sierra Leone where a project designed to work on crops produced by women, turned out to be involving less than 9% of women in the trials with the group of farmer-cooperatives which led to zero adoption of new technologies by female farmers. For reasons unknown for the time being, **hardly is any mention made of the participation of women in the two other FSR phases, i.e. testing and transfer of technology.** The working group considered this situation as alarming and called for greater consideration of the concerns of women in farming and a better valorization of their participation.

The group recommended that at future meetings of WAFSRN, paper presentations must better specify farmer participation measures and results to help ascertain the genuine clients of FSR and how they are intergrated in the process. **The working group recommends the formalisation of the group and the holding of a training workshop on this theme.**

GENERAL CONCLUSIONS AND RECOMMENDATIONS.

Paper presentations by participants and discussions by working groups and the plenary session gave evidence of progress in farming systems research in West Africa and Cameroon. Except for the Cape Verde Islands about which no information was provided, all countries in the region have adopted the methodology even though there is a high inter-country variability in the degree of its institutionalization in national agricultural research systems. Some results were also noted in the evaluation and dissemination of improved varieties (maize, cassava, sweet potatoes, etc...) and mineral fertilization recommendations. These technical results are however limited to the forest and savannah zones. In sahelian and Sudanao-Sahelian zones, the technical solutions tested turned out to be outside the affordable reach of the broad majority of farmers owing to the acute constraints confronting them. The situation is similar in the irrigated farming zone.

To provide more technical results for the benefit of farmers, participants recommended that research programmes should accord added importance to natural resources management, agriculture livestock complementaries, inter-cropping and alley-cropping and finally pest control.

In connection with the physical degradation of agricultural farms, several participants advocated a broader concept of the FSR methodology. It was pointed out that the methodology must not focus solely on farming systems but must also take account of agrarian systems. This presupposes that a longer time would be devoted to the diagnosis phase. Similarly, the teams should, in addition to technical experimentation on aspects such as the organization of farmers in farm or credit management or in the take-over of the dissemination of innovations. Proponents of this broad FSR concept acknowledge that this must be done sequentially using appropriate techniques and measures and that short term objectives must not be sacrificed.

In view of the limited financial resources and the lack of well-trained and experienced researchers, other participants advocated the limitation of FSR programmes to diagnosis and experimentation.

The participants recommended: (1) that inter-disciplinarity be strengthened in FSR teams; (2) that closer collaboration be nurtured with extension bodies in order to improve the transfer of results. In areas where such services are lacking or limited, collaboration with Non-Governmental Organizations and farmers' associations will have to be established; (3) closer involvement of farmers in the design, conduct and evaluation of experiments; (4) more systematic collaboration amongst research programmes in matters concerning farm produce marketing and processing; (5) organization and development of cooperation among research teams by WAFSRN in the form of information exchange, study trips and collaborative research programmes.

ABSTRACTS OF PAPERS.

THEME PAPERS

1. ABALU, Georges. (UNECA, Addis-Ababa, Ethiopia). **Towards sustainable agriculture in Africa : the role of agricultural research and African organizations.** (-p.).

(Keywords: Africa sustainable agriculture, Agricultural research, African organizations).

Abstract: This paper examines the relationship between the on-going African food and agriculture crisis and problems associated with the attainment of agricultural sustainability in the continent. The requirements of African agricultural research for achieving agricultural sustainability and the important role for African Organizations must play in this process are discussed. The paper finally reviews the past performance of African organizations with respect to the development of effective agricultural research systems in the continent and identifies the roles that these organizations must play in the future if sustainable food and agriculture production is to be achieved for the peoples of the continent.

2. ARIAS, Roberto. (GGDP/CIMMYT Project, Accra, Ghana). **Effective orientation of on-station research through an operational integration with on-farm research.** 15p.

(Keywords : On-Station research, On-Farm research, Appropriate technology, Extension activities).

Abstract : After examining the respective functions of on-station and on-farm research, the author analyses the constraints to and the favourable factors for their integration. The constraints include, among others, the importance attached to the role of liaison for on-farm research, the respective profiles, experience and orientation of scientists on both sides, and also the complementarity of their objectives in the generation of appropriate technologies for resource-poor farmers. The author stresses the importance which research managers should place on the definition and coordination of the roles and responsibilities of the two types of research, on the selection and training of on-farm researchers in order to ensure their scientific credibility. Various mechanisms for collaboration between both types of research at different stages of on-farm research are examined: joint sessions at the diagnostic, planning, evaluation stages and at the stage of formulation of recommendations. The author also examines the need and the modalities for the participation of extension agents and farmers in the process of technology generation.

3. BAKER, Doyle. (Agricultural Economics Unit, IITA, NCRE, Cameroon). **Economic research in farming systems research: steps in methodology.** 13p.

(Keywords: Economic research, Farming systems research, Farmer participation, New technologies).

Abstract : The methodology of Farming Systems Research (FSR) has minimal impact on the performance of the African agricultural sector as is evident from experiences in the forest zone of West and Central Africa. The contribution of economic research was limited to rapid diagnosis, marginal analysis, partial budgets and to liaison with extension. In this paper different techniques and methods of diagnosis and analysis of trials are proposed for correcting the weaknesses of the contribution of economists. The broadening of their research to include the analysis of the impact of policies and alternative choices is also proposed. In view of limited resources and capabilities, these proposals can only be progressively implemented. After defining short, medium and long term priorities, the author gives five stages of the implementation as well as research themes to be handled and the recommended methods. From a micro-economic view-point focused on the process of developing new technologies with greater farmer participation, it would be possible in future to advance to a macro economic view-point.

4. FAYE, Jacques. (WAFSRN/OUA/SAFGRAD, Ouagadougou, Burkina Faso). **Present state of Farming Systems Research in West Africa and Cameroon.** 16p.

(Keywords: Farming systems research, Research & development, West Africa).

Abstract: After a rapid review of research activities conducted by national agricultural research systems and called farming systems research, on-farm research, research-development and supporting research, some characteristics of these activities are examined. The problems encountered in the implementation of these

researches and which hamper continuity and efficacy are identified and discussed.

5. MERRILL-SANDS, Deborah; EWELL, Peter; BIGGS, Stephen; BINGEN, James; MCALLISTER, Jean; POATS, Susan V. (ISNAR, The Hague, The Netherlands). **Institutionalizing on-farm client-oriented research: the management of key-linkages. Reflections on the experiences of nine National Agricultural Research Systems.** 33p.

(Keywords): On-farm research, Client-oriented, Farmer selection, Farmer participation, Human resources, Research extension linkages, Linkages with on-station research, Interdisciplinary research).

Abstract: Agricultural research systems in developing countries have confronted significant problems in developing and sustaining dynamic on-farm research efforts focusing on resource-poor farmers. Many of these implementation problems stem from the unfamiliar organizational and managerial requirements of on-farm, client-oriented research. This paper, reporting the findings of a major research project conducted by the International Service of National Agricultural Research, reviews the experiences of nine agricultural research systems which have at least five years experience in building on-farm research capacity. The analysis focuses on the management of four sets of linkages which are critical for successful on-farm, client-oriented research : linkages between on-farm and experiment station research; linkages between on-farm researchers and resource-poor farmers; linkages among researchers working in different disciplines and commodities ; and linkages between on-farm research and technology transfer agencies. Comparative analysis across the cases reveals predictable problems as well as common areas of success in managing these critical linkages. The discussion highlights key lessons for research managers striving to strengthen on-farm, client-oriented research as an integral and stable component of their research systems.

6. OKIGBO, Bede N. (Director, Programme on Natural Resources in Africa, The United Nations University, New York). **The Challenge of Farming Systems Research in tropical Africa.** (15p.).

(Keywords): Tropical Africa, Interdisciplinarity, Farming systems, Networks).

Abstract: The gravity of the food crisis in tropical Africa justifies strong agricultural research especially in the area of farming systems. The author examines the challenges posed by the complexity of African Farming Systems, the development and management of new systems, and the practice of interdisciplinarity in research systems. He also looks into the question of viability, and the vital role of collaboration within networks in order to ensure faster progress and the development of the capacities of National Agricultural Research Systems through benefits that can be drawn from the advances made by the international centres.

FOREST OR HUMID ZONE

7. ALMY, Susan; WOLDETATIOS, Tsegazeab Same; MESSIA, Mboussi, A. (TLU, IRA-Econa, Buea, SWP, Cameroon). **Evaluation of adaptation of improved varieties to diverse environments : a low-cost minikit method.** 10p.

(Keywords): Farmers' trial, Evaluation, Adaptability, Consumer acceptance, Improved maize varieties).

Abstract: On-farm, farmer-managed variety trials are a standard item of farming systems work. At Econa, in the South West Province of Cameroon, a variant of this methodology has been evolved to permit low-cost, multi-environment evaluation of maize variety performance and acceptability. Maize packets are distributed to farmers by their extension agents to be planted by the farmer's usual method with her own variety. The agent uses a form to evaluate performance and acceptability together with the farmer. Yield measures are based on the farmers' own method of evaluating maize, a measure which has produced results similar to those obtained by standard techniques in our researcher-managed on-farm trials. This has enabled us to measure variety performance in zones we seldom reach, as well as to study the effects of late weeding, over-planting and heavy intercropping. Farmers' opinions on consumer quality and marketability allow judgment of acceptability

throughout the region and by zone. The environment, method, costs, and illustrative results from the first 1988 maize season are described.

8. BESONG, Manfred. (IRA Econa, Buca, SWP, Cameroon). **Yield stability analysis in farming systems with regard to economic analysis and varietal development.** (-p.).

(Keywords: Yield stability, Varietal environment, Recommendation domains and gross returns).

Abstract: The concept of yield stability widely used by plant breeders for varietal improvement has gained considerable acceptance by economists with regard to recommendation domains, and evaluating other factors that affect farmers' production. The modified stability analysis (MSA) uses criteria other than yield for a more complete analysis which might result in different conclusions. The relevant criteria include return to cash invested, return to labour and net income per hectare etc. There are the economic criteria for which MSA is used by economists to evaluate the appropriateness of a technology from the farmers' perspective. One improved (8017) and one farmers' local variety were tested across 15 locations in Fako Division, South West Cameroon. Six treatments involving three levels of N-P-K constituted as compound fertilizer were used to evaluate both varieties. Overall, the improved variety outyielded the local variety and showed better stability across locations. On the average the local yielded 15.6 tons while the improved yielded 24.7 tons. Also, the improved variety had a better response to fertilizer treatments. Economic analysis based on the Fako, 1988 market price of cassava (53 francs/kg), the gross returns to cassava farmers were 1,309,100 FCFA/ha and 826,800 FCFA/ha for improved and local varieties, respectively. Implications for varietal improvement and recommendation domains will be discussed.

9. EREMIE, S.W.; CHHEDA, H.R. (World Bank, Lagos, Nigeria). **Technology generation and transfer in Nigeria : the farming systems research network and the agricultural development project interface.** (8p.).

(Keywords: Technology generation, Extension, Agricultural development projects, Farming system research, Small scale farming).

Abstract: Small scale farmers in the humid zones of West Africa have been in a technology trap inspite of the fact that they account for most of the agricultural production. Research and extension activities largely ignored these farmers in Nigeria until the recent introduction of the agricultural development projects and the beginning of farming systems research (FSR). Despite the initial weaknesses of the ADPs and FSR, clear benefits are emerging from the closer linkages fostered between research and extension. Diagnostic surveys are providing better understanding of the farming systems; extension functionaries are getting more involved in the planning and implementation of research and technological recommendations for farmers are becoming more refined. Improved technologies generated so far include multiple cropping arrangements which are improvements over existing farming practices, integrated and low-cost weed control, and rapid identification of high yielding, location specific and disease-tolerant cassava and rice varieties. The benefits of the new linkages can be maximized with further refinements in the adaptive research methodologies, greater attention to the social systems within which the generated technologies will operate, legal backing to the collaborative arrangements and strengthening of the production support systems.

10. EZUMAH, Humphrey C. (RCMP, IITA, Ibadan). **On-farm technology testing; For whom ? What ? And how ?** (17p.).

(Keywords: On-farm research, New technologies, Testing, Cassava, FSR methodology).

Abstract : On-farm research is aimed at developing technologies which match the goals and environment of farmers. At its various stages of diagnosis, choice of techniques, testing and validating technologies one should always ask questions : what technologies are developed, for whom and how ? In this paper methodological questions are examined with emphasis on the testing stage by means of a case-study of cassava-based farming systems research at Ohosu, in South-Western Nigeria by the on-farm research team of IITA's Resource and Crop Management programme.

11. FILLONNEAU, Claude. (ORSTOM, Montpellier, France). **Observations on on-farm agronomic research approach with reference to different types of problem-solving techniques: the case central Côte d'Ivoire** (-p.).

(Keywords: Agronomic research, Mechanization, Cropping systems, Multidisciplinary research, Côte d'Ivoire).

Abstract: From examples of agronomic research on rural situations in central region of Ivory Coast

(mechanization and yam cropping), it is shown that, according to problematics, levels and methods of agronomic analysis, interaction to deal with natural environment and farming systems are varying or moving with research stages. At least for small teams, this calls for managing possible links with experimental research, socio-economic research and agricultural extension organizations.

12. KAINDANEH, Peter. (Njala University College, Freetown, Sierra Leone). **The effects of improved agricultural technologies on women in the rice farming systems of Sierra Leone.** (-p.).

(Keywords: Improved technologies, Women, Rice farming systems, Sierra Leone).

Abstract: Several improved technology packages including improved seeds, cultural practices and labour saving devices have been introduced to the small-scale farmer in Sierra Leone, yet the level of food crop production, to say the least, has not caught up with consumption levels over the past 2 decades. It is no secret that women play vital roles in the farming systems in developing country. In Sierra Leone, it has been estimated that women constitute as much as 60 % of the labour for growing rice. This paper intends to throw light on how the policy makers responsible for designing agricultural projects that bring in improved technologies have handled the position of women. Have they been slighted in the development of improved technologies? Have these technologies improved the women's livelihood ?

13. KOUDOKPON, Valentin; VERSTEEG, Mark. (DRA, Cotonou, Benin). **An approach to applied research under real environment: on-going experiences in Mono (Republic of Benin).** (-p.).

(Keywords: Methodology, Applied research, On-farm research).

Abstract: The paper presents the experiences of three years of research within a project of applied research under real environment (PRAMR), in South Eastern Benin. In the paper special focus has been made on the methodology applied. The process starts from the selection of an innovation to be tested up to the adoption by the farmer on a larger scale - the problematic of relationship between researchers, developers and farmers forms the essential part of the paper.

14. LAHAI, Mohamed T.; DANHIYA, M.T.; LAMIN, A. (IAR, Freetown, Sierra Leone). **Contribution of Farming Systems Research to the development of the improved technologies in Sierra Leone.** 13p.

(Keywords: F.S.R. project, Objectives, Technologies, Lessons learnt, Rice, Maize, Cowpeas, Fertilizers, Cropping systems).

Abstract: Farming Systems Research Project (FSRP) is being undertaken in six villages in Sierra Leone. The overall objective of the project is to identify appropriate methods of crop and land management to enable sustained and gradual improvement in the farmers' present systems. Results of the four-years of operation of the project indicate that technologies such as the use of improved varieties of rice, maize and sweet potatoes and of fertilizers have met with great success in farmers' fields. The high yielding and/or early maturing abilities of these improved varieties, and the significant response of both local and improved rice and maize varieties to fertilization have caused rapid acceptance of these technologies by farmers. Lessons learnt which have helped to gear research towards farmers's needs include the rejection of the improved cassava and cowpea varieties because of poor cooking quality and lack of white seed colour, respectively. Emphasis is now being placed on selecting cultivars with appealing characteristics to farmers. Recently improved cassava with good cooking quality and white-seeded cowpea varieties have been released, ready for on-farm testing.

15. MCHUGH, Dermot; SAMATANA, Marc; MEPPE, François. (IRA-Bambui, Bamenda, Cameroon). **Use of minikits to supplement on-farm maize variety verification trials.** (11p.).

(Keywords: Minikit, Maize variety, Verification trial, On-farm trials).

Abstract: The Testing and Liaison Unit (TLU) is a farming systems research and pre-extension team working within the framework of the Cameroon National Cereals Research and Extension (NCRE) Project. Since the inception of the project in 1982, four TLU's have been established; one in each of the principal ecological zones in Cameroon. Among the responsibilities of the TLU's is the carrying out of farm-level verification trials as a final step before defining farmers' recommendations. In the past, logistic considerations limited the TLU at Bambui (Western highland zone) from directly implementing more than 40-60 on-farm maize trials in a given year. However, the large degree of environmental and cropping systems variability within the zone dictated a much larger number, in the case of maize variety verification trials, to adequately cover the highlands. To address

this constraint, the TLU-Bambui adopted the minikit trials approach. The minikit is a trial-in-a-bag, of simple design, to facilitate the assembling, distributing and, ultimately, the implementation of the trial and information feedback by field extension workers. It is designed to compare a single improved maize variety with the farmer's local variety, with and without fertilizer. Each kit contains seed of the improved variety, pre-weighed fertilizer, a measuring cord, plot labels, an instruction sheet and an observation form with pre-addressed return envelope. From 1983 to 1988, one thousand nine hundred seventy (1,970) minikits were distributed to extension workers, with an average response rate of 36 %. Another 300 were distributed in 1989. In this paper, the authors describe the "TLU-Bambui maize trial minikit", present a summary of the 1983-88 results, and discuss the usefulness of the minikit approach in improving the efficiency of the TLU in screening maize varieties for release to farmers.

16. NOUNAMO, Laurent; FOUAGUEGUE, Augustin. (IRA, Yaoundé, Cameroon). **Maize variety trial in maize/groundnut/cassava intercrop.** (-p.).

(**Keywords:** On-farm experimentation, Maize, Intercropping, Forest zone).

Abstract: Maize (*Zea mays* L.) is the forth most important food crop in the farming system of the farmers in the forest zone near Yaounde (Nounamo et al, 1987). Maize varieties cropped are of poor germination and poor yield. The production is non efficient and does not meet the demand of the fast growing population of the city of Yaounde. Variety introduced (TZESR-W) and varieties selected on station in Cameroon (BSR, CMS 8507, CMS 8501) were tested on farmers' field with farmers' participation to compare their yield performance to that of the local. Maize was intercropped with other two major crops, cassava (*Manihot esculenta*) and groundnut (*Arachis hypogea*). The design was a randomized complete block with three replications. Maize was fertilized four weeks after planting (Nounamo et al) with fertilizer 20-10-10 at a rate of 15 g/pocket (600 kg/ha). The experiments were conducted in the first and second season 1987 and in the first season 1988. For the 1987 first season trial, there was no significant difference in yield between the three varieties (TZESR-W), CMS 8501, and Local) tested. However the variety TZESR-W was harvested 10 and 14 days earlier than CMS 8501 and Local, respectively. The earliness of the variety TZESR-W rendered it very attractive to the farmers, since early harvest means early food and early source of income. For the 1987 second season trial and 1988 first season trial, there was a significant difference in ear fresh weight yield between the four varieties tested: BSR, CMS 8507, TZESR-W, and local. In both seasons, CMS 8507 significantly yielded higher (4080 and 9008 kg/ha) than BSR (3447 and 5930 kg/ha), than TZESR-W (3160 and 4417 kg/ha) than local (3253 and 1080 kg/ha). Though variety CMS 8507, for not having soft endosperm, is less attractive for local consumption, farmers now widely cultivate it for the markets of Yaounde and Mbalmayo.

17. NOUNAMO, Laurent; FOUAGUEGUE, Augustin. (IRA, Yaoundé, Caméroof). **Timing of fertilizer application on maize.** (-p.).

(**Keywords:** Fertilization, Maize, Intercropping, On-farm experimentation).

Abstract: Maize (*Zea mays* L.) is the forth most important food crop in the farming system of the farmers in the forest zone near Yaounde (Nounamo et al, 1987). Low soil fertility constitute one of the major limiting factors to its production. The response of maize to fertilizer 20-10-10 in the zone was proven (Nounamo et al, 1988); but the application time that satisfies the farmers' habits and gives higher yield and economic return was yet to be determined. A study was therefore conducted to this effect, considering the planting time and the usual weeding period of the farmers (4 weeks after planting) as the two dates of fertilizer application. Zero fertilizer application was used as control. Maize was intercropped with other two major crops, cassava (*Manihot esculenta*) and groundnut (*Arachis hypogea*), in a randomized complete block design with three replications. The results of the two years studies (1987 and 1988) showed a significant difference in yield between the two dates of fertilizer application. Fertilizer 20-10-10 applied four weeks after planting gave, for four seasons in a row, the highest maize mean ear freshweight of 3533, 2567, 667, and 4767 kg/ha, compared to 2767, 2067, 567, and 4533 kg/ha, respectively, when fertilizer is applied at planting. For all the experiments, fertilized maize outyielded non-fertilized one. Maize fertilized four weeks after planting brought to the farmers an average additional benefit of 57.470 and 46.300 FCFA/ha over non fertilized maize and maize fertilized at planting, respectively. In conclusion, farmers of the zone should fertilize maize during weeding period (4 weeks after planting).

18. OBOUAYEBA, Samuel. (IRCA/CIRAD, Abidjan, Côte d'Ivoire). **Study of some hevea/food crops intercropping at village level : the case of south eastern Côte d'Ivoire.** 21p.

(Keywords: Hevea-food crop intercropping, Village environment, Survey, Farming system, Fertilization and variety trials).

Abstract: Hevea-food crop mixture, village environment, survey, farming system, fertilization and variety trials. The research conducted on hevea and food crop mixtures among seven small village farmers in South-Eastern Côte d'Ivoire has revealed on the one hand the incidence of the diversity of the patterns of plot development on the quality of crop management and on the other hand the influence of such a management on the establishment and growth of hevea seedlings. This work has also shown low to moderate levels of food crop yields (yam, maize, groundnut and various vegetables) because of the poor physical/chemical status of the cultivated soils. The interest of mineral fertilization on some yam and maize varieties has been reported.

19. ONU, Orji, Donatus (College of Agriculture and Veterinary Medicine, Imo State University, Okigwe, Nigeria). **Communication and adoption of improved soil conservation technologies by small-scale farmers in Imo State of Nigeria.** 25p.

(Keywords: Nigeria, Soil conservation technology, Small scale farmers, Adoption, behaviours, Information source use).

Abstract : Improved soil conservation technologies have been recommended to farmers as measures to abate the agricultural intensification problem in Imo State. Little is yet known about how these technologies are communicated to farmers and farmers' adoption behaviours. This study examines the influence of farmers' characteristics and information source use factors on improved soil conservation adoption behaviours. Data were collected from 420 randomly selected small scale farmers in 21 agriculturally intensified communities in the 6 agricultural zones of the state. The study reveals that there were generally low adoption levels for all the technologies. Adoption decisions were influenced by the farmers characteristics and information source use factors including farmers' level of education, attitude towards change, social participation, availability of information sources, farmers interest in source of information and frequency of use of information sources. These factors also patterned farmers exposure behaviour, thereby confounding the relationship between exposure and adoption behaviour. It is recommended that extension soil conservation programme should be planned in consonance with these farmer and information source use attributes for more effectiveness.

20. OSSENI, Bouraïma. (IRFA/CIRAD, Abidjan, Côte d'Ivoire).

Study of pineapple and food crops-based farming systems in the forest zone of southern Côte d'Ivoire. First results. (11p.).

(Keywords: Soil acidity, Cropping basis, Crop succession, Stabilisation, Reproductibility).

Abstract: With a view to stabilizing the food crop based farming systems in the Southern Côte d'Ivoire forest zone specialized in pineapple growing, two approaches have been investigated. These are intercropping and crop rotation. The food crops likely to be intercropped with pineapple have been identified, namely groundnuts, rice, okra and tomato the cycle of which is less than or equal to four months and a half. With the follow up of the behaviour of the major food some crops such as yam, cassava, sweet potatoe, maize and ground nut lead to the proposal of new crop successions (base crops) which takes into account what the environnement offers (water requirement and tolerance of soil acidity) for the stabilization of food cropping systems in Southern Côte d'Ivoire.

21. TETIO-KAGHO, Fidèle; KAMAJOU, François; DUCRET, Guy. (Dschang University Center, Cameroon). **Farming Systems Research at the Dschang University Center. Activities and future prospects.** 7p.

(Keywords: FSR, Chieftainry, Interdisciplinary analysis, Research organizations, Training programmes, Rural development).

Abstract: The University Center of Dschang (UCD), established to train Cameroonian agronomists, has conducted for several years research, training, and rural development relative to FSR/E. It is UCD's intention to become a leading institution in this field. A study area of 200 km² (a chefferie of 5,000 rural families) was chosen for interdisciplinary analysis of farming systems. This permitted the establishment of farming systems, cropping systems, and animal husbandry types. Some disciplinary studies already conducted have led to diagnosis and proposals for improved production systems. Multidisciplinary studies to diagnose the constraints to animal production are in progress. UCD organized a FSR/E workshop in January-February 1989 with the help of various organizations (CIRAD, IITA, IRA, RESPAO, University of Florida, A.I.D. Agricultural Education Project) with the goal of improving UCD faculty understading of FSR/E methodology and approach. A practical

training experience in the analysis of the rural environment at three levels (community, production systems, and cropping systems) was included in the course work for the Agricultural Engineers as of 1988-89. This course reinforces the course in farming and cropping systems techniques taught in the program for Agricultural Engineers since 1980. Various studies already concluded will be used to indicate appropriate on farm experiments that can be initiated now. In the near term, UCD hopes to improve the method for identifying constraints and for carrying out multidisciplinary diagnosis, to extend the diagnostic-analytic phase to other rural zones, to intensify development activity in the current zone of activity, and to establish UCD as a regional center of excellence for training in FSR/E for West and Central Africa (the first course will be in January 1990). In the long term, UCD will strive to become a leader in rural development at the national level and to create at UCD a network of support for and information on FSR/E for research organizations, training programs, and rural development activities in the region.

22. TONYE, Jean. (IRA, Cameroon). Contribution of Farming Systems Research to the improvement of the yield of some food crops in the forest zone of Cameroon. 22p.

(Keywords: Farming systems, Cultural techniques, Agroforestry, Fertilization, Field trial).

Abstract : Farming systems research in the forest zone of Cameroon effectively started in 1983 at the Institute of Agronomic Research (IAR). The agro-socio-economic surveys, first step of this research, have identified the major constraints to agricultural production and described the land use systems. The reduction of the duration of the forest fallow due to a heavy population pressure and to a lack of agricultural land, the subsequent decline in soil fertility, the unavailability of inputs such as fertilizers, credit, improved seeds and the low income of farmers are some constraints to the agricultural production and the productivity of farmers in the forest zone. The development of more performing intercropping systems, of more efficient fertilization methods and of agroforestry technologies for agricultural production has significantly increased the yield of some staple crops (maize, cassava, groundnuts).

23. UNAMMA, Ray P.A. (National Root Crops Research Institute, Umudike, Umuahia, Nigeria). Moving improved cassava/maize production technology from research to farmers fields: the case of the Nigerian Farming Systems Research and Extension Network. 23p.

(Keywords: Cassava/Maize, Production Technology, Nigeria, Farming systems research).

Abstract: The paper briefly outlines the strategy adopted by the Nigerian Farming Systems Research and Extension Network in moving improved cassava/maize intercrop production technology from research to farmers' fields in the South-eastern agro-ecological Zone of Nigeria, between 1982 and 1988. On-farm research and extension field teams conducted on-farm researcher-managed and multi-locational adaptive research, using upstream developed prototype technologies on cassava/maize intercrop to formulate appropriate technologies under the farmers field conditions. These they did in collaboration with the farmers to resolve the identified problems - low cassava productivity due to use of unimproved varieties. The identified solutions were mass-diffused through a sequence of properly coordinated annual workshops and Monthly Technology Review Meetings. The present approach stimulates a more rapid diffusion of intensive and higher yielding techniques and technologies by way of nation-wide farming systems Research and Extension strategy in which extension workers supported by researchers and input agencies helped farmers to combine the best of traditional and improved methods.

24. VERNIER, Philippe; NDABALISHYE, Ildéfonse. (IDESSA/DCV, Bouaké, Côte d'Ivoire). Developing alternative cropping systems in the forest zone of Côte d'Ivoire. Experimental devices in real environment envisaged by IDESSA. 5p.

(Keywords: Cropping systems, Crop rotations, Agricultural fixation, Mixed cropping, Forest zone, Côte d'Ivoire).

Abstract : The paper presents a methodology for developing alternative systems to traditional farming in forest zone which is based on clearing by burning, shifting cultivation of food crops and cash crops of coffee and cocoa, currently in a crisis situation. The proposed method, which has been applied successfully in other tropical countries, is based on focussing research activities on one or several representative sites of a given ecological zone. The experimental designs are located in real environment so as to fully take into account agro-socio-economic constraints. The designs incorporate the bases of agricultural fixation by using the current agronomic experiences : soil preservation through anti-erosive techniques, use of crop rotations associating food

crops and perennial crops, definition of gradual levels of intensification adaptable to different categories of present or future farmers. The designs include two complementary units using the same rotations : really big plots managed by farmers where the combinations of rotations - the technical itineraries - are compared agronomically and economically; and small thematic trial plots managed by the researcher in order to adapt cropping techniques to each system. Upstream of these devices (diagnosis, definition of technical itineraries) and downstream (pre-extension, training of extension workers), a large scale pluridisciplinary and multi-institutional (research institutes, development agencies) coordination is carried out.

25. VERSTEEG, Mark N.; KOU DOKPON, Valentin. (IITA-Bénin, Cotonou, Bénin). **Current practices by farmers and innovations regarding soil fertility in southern Benin.** 19p.

(Keywords): Soil degradation; Soil fertility regeneration, Soil management systems, Benin, Humid zone).

Abstract : Problems of maintaining and regenerating the fertility of degraded land in Southern Benin are presented. After short description of traditional systems, farmer's reactions and innovations introduced to them by researchers are presented. Some results obtained in the real environment and in station are also given. Various systems are discussed in the final part.

SAVANNAH ZONE

26. AMPONG, Eric. (NAES, Nyankpala, Ghana). **Contribution of FSR to the development of improved technologies for northern Ghana.** (-p.).

(Keywords): Soil fertility, Small scale farming, Intercropping, Crop rotation, Diagnostic surveys, Recommendation domains, Groundnut, Maize, Sorghum, On-farm research).

Abstract: A methodology to develop and test appropriate technological alternatives is described. The over-riding topic of the station's research has been the rapid decline in soil productivity in the target area. The target group of main concern is the small scale farmer. Experiments on the station, therefore center around improving soil fertility by increasing the legume component in a farmers cropping pattern through intercropping, rotation, and the inclusion of bushy legumes. New crop varieties are continually being developed. On farm work began with extensive surveys to identify the prevailing farming systems and delineate recommendation domains. On farm experimentation has involved testing some of the strategies developed on the station under farmers' conditions. Some of these include cropping patterns with a higher proportion of legumes, rotations, and paired row cropping with sole crop groundnuts. New crop varieties developed on the station are also tested towards their suitability to farmers cropping patterns and ecological conditions as well as their acceptance in terms of taste and other characteristics. Recommended patterns include a crop sequence of sole groundnuts followed by a major sorghum intercrop or a double row pattern with sole groundnuts and mixed maize/sorghum rows. An adoption survey conducted revealed a stepwise adoption of the recommended alternatives and indicated the need for the recommendations to be delivered in a piecemeal fashion instead of the usual package approach which accentuates risk.

27. BOUARE, Saydou. (PIRT, Bamako, Mali). **Integrated survey of resources in the sudan zone of Mali.** 12p.

(Keywords): Survey, Resources, Farming systems, Evaluation).

Abstract: Farming systems research is necessarily connected with the methods of survey and evaluation of land resources. A "landscape ecology" approach based on floristic composition, plant groupings, plant communities per type of land where the farming systems are evolving must be considered as prerequisites for any such farming systems research. The paper provides a better understanding of the geographical distribution of the land use patterns as well as a prediction of the best functioning and management of rural land space. In the CMDT supervised zones there are about 80 to 90 plows and about 75 pairs of draught oxen for 100 farmers. Rice is the predominant irrigated crop and is grown under free or controlled flooding. Cotton has always been grown and it receives an organised technical supervision. It can be grown in rotation with millet/Sorghum. Fields are usually used for both cotton and food crops production. Common crop mixtures are: rice and tree crops in the alluvial

soils and the lowlands; maize and/or sorghum, and tree crops in the dry valleys; maize, sorghum and tree crops in the flood plains; millet and groundnuts in the intermediary glacies.

28. DOUMBIA, Sékou. (IDESSA, Bouaké, Côte d'Ivoire). **Some methodological aspects of the time surveys of agricultural activities in African rural environment.** (-p.).

(Keywords: Methodology, Working time, Rural environment).

Abstract: The study emphasizes the labour factor in African agriculture where land is abundant and very little capital is used for production. At the methodological level one may note the critical nature of data collection, analysis and interpretation. As regards this last point, it should be reminded that only a relative value need to be given to the results obtained which bear their genuine meaning only in the socio-economic and agro-climatic context in which they have been obtained. The extrapolation of these results to other different contexts remains therefore extremely hazardous.

29. ELEMU, K.A. (Ahmadu Bello University, Zaria, Nigeria). **Farmers participation in on-farm research : a case of cowpea varietal evaluation in the northern Guinea savanna agroecological zone of Nigeria.** (-p.).

(Keywords: On-farm, Cowpea, Variety, Savanna).

Abstract: Cowpea (*Vigna unguiculata* (L.) Walp) is the most important grain legume in the Nigerian Savanna along with groundnut. The most important constraint to cowpea production is insect pest, and sole cropping technology of cowpea has been developed by research to solve this problem. However, this technology has proven difficult to extend. This paper addresses an on-farm research aimed at generating new cowpea production technologies that are relevant to the circumstances and goals of the small farmers who produce the bulk of the food crops. The setting is Bomo village in the Northern Guinea savanna agroecological zone where five elite cowpea cultivars from IITA (IT84E-1-108, IT84S-2246-4, IT84E-124, IT81D-994 and IT82D-699) and Sampea 7 from IAR were tested with farmers varieties with or without chemical insect pest control. The project has provided information that cowpea is not sown alone as sole crop by small farmers but serve to complement millet or sorghum/millet mixture in the system. Nevertheless, sorghum/millet/cowpea system was found to be most popular followed by millet/cowpea system. Generally, chemical insect pest control increased cowpea grain yield dramatically in both systems. In the sorghum/millet/cowpea system, none of the elite varieties outyielded the local cultivar. In the millet/cowpea system, the farmers varieties generally outyielded IT84-1-108, IT81D-994 and IT84E-124, irrespective of pest management. Sampea 7 variety ranked highest in acceptance by farmers. The farmers preference for a genotype was based more on seed quality and other related attributes other than grain yield. The implication is discussed.

30. GILBERT, E.; POSNER, J.; SUMBERG, J. (GARD Project, Yundum, The Gambia). **Farming Systems Research within a small research system.** 18p.

(Keywords: FSR/E, Institutionalization, Farmer participatory research).

Abstract: Through an example from The Gambia, this paper explored issues relating to the establishment of sustainable farming systems research capacity within small agricultural research systems. The Gambian Agricultural Research and Diversification Project's effort to initiate and institutionalize farming systems research is reviewed. We conclude that in the context of relatively weak research and extension systems, 'classic' farming systems research, which demands a heavy investment of time and resources, is not particularly suitable. Rather, many of the goals of farming systems research might be met by developing strong links with organizations involved in extension and development activities, through which farmers' constraints can be identified, and feedback relating to new innovations passed. In addition, working links with other national and international research institutions will be vital.

31. GOÏTA, Mamadou (IER/DRSPR, Bamako, Mali). **Farmlands management: the new philosophy of Systems Research in Southern Mali zone.**

(Keywords: Farm management, Farm inputs, Production factors, Soil degradation, Resource management).

Abstract: Farmlands management is a new way in which Systems Research in Southern Mali has started to direct its activities. In order to realize this programme DRSPR works in close collaboration with several services: the water and forest protection services, the animal husbandry service, the development organization (CMDT) and the administrative authorities. The management of agricultural lands has become a necessity in Southern Mali as the rate of degradation of the ecosystem has been growing higher and higher whereas the

carrying capacity of the land is almost reached.

32. KIPO, Timothy. (CRI, Tamale, Ghana). **Sociological characteristics of small holder farming systems of northern region, Ghana.** (-p.).

(Keywords: Small scale farming, Economic sociology, Traditional farming, Mixed cropping, Land use, Fallow cropping).

Abstract: Traditional small holder farming systems of Northern Region are characterized by a host of factors which need to be understood by innovators generating technology. In an attempt to have a thorough knowledge and understanding of the prevailing farming systems of the Northern region, the Agricultural Economics section of the Nyankpala Agricultural Experiment Station (NAES) conducted a socio-economic survey of the farming systems of the region. This paper presents the observations and important findings made in the area which lies within the Northern Savannah zone. The climatic conditions and other factors such as soil fertility, types of farming and labour requirements have affected the cropping systems and consequent yields of crops per unit area. The yields are low and can barely sustain a farming family. The small holder farming systems in this region are the result of many years of evolution and selection by farmers generally directed towards self sufficiency in food. The traditional family division of labour, land tenure system, methods of cultivation and farmers' relation to the adoption of innovation and other sociological factors have led to a small farm situation. The prominent cropping system, as shown by the survey, is characterized by a method of mixed cropping, a rotational bush fallow and a low interaction between crop production and livestock production. The traditional cropping system of the area is based on mixed cropping with cereal mixtures, cereal/legume mixtures and root crops/vegetable mixtures being the most predominant. Operating under a simple land tenure system which allows every number of the clan usufructary rights over areas they cultivate, farming families can afford the luxury of allowing an exhausted piece of land to lie fallow for a period of time. There is very little interaction between crop production and livestock rearings. Livestock keeping is seldom considered agriculture. Animals are kept as an insurance against risks and are considered a symbol of wealth. For a small holder who is subsistence oriented, and working in an environment of uncertain weather and input supply, risk aversion plays a vital role in technology adoption and diffusion.

33. KOLI, Stephen Esah. (CSIR, Accra, Ghana). **Review of the farming systems practices in Ghana.** (-p.).

(Keywords: Small holder farmers, Mixed and intercropping simple hand tools).

Abstract: In Ghana and other West African countries several kinds of farming systems have been practised from time immemorial and they continue to be in operation side by side with modern methods of farming. This is because the small holder farmers who practice it supply about 80 % of the agricultural output. Hence researchers have an obligation to find ways of improving the system to enhance profitability. The notable farming systems are shifting cultivation, collecting, fallow, unregulated ley, intercropping relay cropping, irrigated, rain-fed, subsistence, commercialised, total nomadism and stationary animal husbandary systems. The practices in the savannah areas are distinct from those in the forest belt.

34. MILLS, Bradford; SENGHORE, Tom. (DAR, Yundum, The Gambia). **The cost effectiveness of fertilizer on manured and non-manured fields in the Gambia.** 25p.

(Keywords: Fertilizers, Manuring, Profitability, Maize, Sorghum, On-farm trials, Crop rotation, Costs).

Abstract: This paper examines the results of twelve maize and twelve sorghum on-farm trial conducted in The Gambia during the 1988-89 cropping season. The objectives of the trials was to document the benefits from inclusion of manure in common crop rotations and to determine the most cost effective fertilizer treatments within the same rotations. Four fertilizer treatments were super imposed on fields in continuous maize and sorghum - groundnut rotations. In addition, six fields in each rotation received dry season applications of manure previous to cereal crops. The results for maize indicated an insignificant response to inorganic fertilizer treatments. However, manure, plant population, and a weed control variable were found correlated with farmers yields. The results for sorghum indicated significant responses to the manure, extension recommended NPK treatments, plant population and weed competition (Striga). Using regression models, crop budgets were developed to determine implications for crop production. The implications include: 1) use of manure substantially increases yields, 2) for manure sorghum fields, a balanced NPK fertilizer application is found to be more cost effective than the current extension recommendation of urea only, 3) the extension recommendation of thinning sorghum to two plants per hill would result in a net yield loss given farmers planting patterns, 4) low

plant populations are substantially reducing yields on most farmers fields and hence efforts by research and extension to mitigate these constraints represent an area of high potential benefits. Overall, the paper shows that through carefully monitoring of farmer practices, important farm level constraints to production can be identified even though the constraints may lie outside the specific objectives of on-farm trials.

35. NDIAME, Fadel; SONKO, M. Lamine; FALL, Alioune. (ISRA/Djibelor, Ziguinchor, Senegal). **Problematics of Farming Systems Research: the experience of the Djibelor systems research team. (-p.).**

(Keywords: Lower Casamance, Farming systems, Diagnosis, Technical itineraries).

Abstract: Having conducted a pluridisciplinary work on constraint diagnosis, development and testing of solutions over five years and in close collaboration with farmers, the systems research team has now technical references suitable for release. In the current phase, the team is putting emphasis on the transfer of innovations developed through various programmes among which a research/development project associating a farmer organization, research and other partners. In addition to the dissemination of technical solutions, the team has been participating in the development of organizational and social innovations.

36. NKWAIN, Sama Joseph. (University Centre of Dschang, Cameroon). **An improved multi-cropping model as a solution to attendant problems of competition between coffee and arable food/cash crops in Menoua division of the savannah highlands of Cameroon. 15p.**

(Keywords: Permanent tree crops, Arable crops, Multiple cropping, Mixed cropping, Inter-cropping, Under cropping, Regeneration).

Abstract: Various types of competition between export tree crops (notably cocoa, oil palm, robusta coffee and arabica coffee) and arable food/cash crops, are evident in South Cameroon. The nature and gravity of such competition and their attendant problems deserve appropriate attention and studies. This paper focuses on one of the cases, in the Savannah high lands of Cameroon, that has recently attracted attention and public concern. It proposes an improved multiple cropping model as a solution to some of the nagging problems posed by the existing system. The model suggests the replacement of the coffee-based and arable food crop-based haphazard multiple crops cropping systems that prevail in Menoua Division, by a multiple crop row and/or strip inter-cropping system that achieves certain desired objectives without seriously violating the major farming principles, norms and traditions of the farmer. The model therefore attempts to minimize the risk of outright rejection by farmers. It also attempts to minimize the extent of the competition between arabica coffee and the now rival arable food/cash crops in the region. This is done through a five years coffee regeneration/system replacement program that throws a challenge to agronomists, extension specialists, and other Farming Systems scientists.

37. OLUKOSI, James O.; ELEMU, K.A.; KUMAR, V.; OGUNGBILE, A.O. (IAR, Ahmadu Bello University, Zaria). **Farming Systems Research and the development of improved crop mixtures technologies in the Nigeria Savanna. 23p.**

(Keywords: Nigeria, Crop mixture, Farming Systems Research, Production technology).

Abstract: Growing crops in mixtures is a common feature in the Nigeria Savanna due to yield advantage, efficiency of resource utilisation, provision of insurance against crop failure and provision of a steady supply of a range of products destined to family consumption. Less emphasis has been placed on developing technologies for mixed cropping until the Farming Systems Research approach was adopted in Nigeria. Through diagnostic surveys, constraints to production are identified. On-station experimentations are carried out to alleviate such constraints. Promising crop mixture technologies are carried into farmers' fields to test their technical feasibility, economic profitability, social acceptability and constraints to their adoption. Demonstrations on small plots are conducted in numerous farmers' fields by extension agents to make farmers become aware of the superiority of the improved crop mixture technique to their practices. This is to speed up mass adoption. Gaps in diagnostic surveys, on-station and on-farm research, mass adoption and institutional supports have been identified. Bridging these gaps identified could form a basis for collaborative research in the West African sub-region.

38. OWUSU-BENNOAH, E. (Soil Science Department, University of Ghana, Legon, Accra). **Soil Fertility**

Constraints in Relation to Farming Systems in Northern Ghana. (14p.).

(Keywords: Ghana, Soil fertility, Farming systems, Traditional farming systems).

Abstract: This paper describes the soil fertility constraints in relation to major farming systems in Northern Ghana. The traditional farming systems in northern Ghana range from shifting cultivation to compound farming. The bulk of upland food crops is produced by subsistence farmers in extensive systems that rely mainly on bush-fallowing system for modest nutrient input. Unfortunately the increasing demand for firewood and the annual recurrence of bush burning have continued to reduce soil quality primarily through loss of organic matter. Lack of phosphorus, nitrogen and sulphur are the major nutrients limiting crop production in the savanna soils under the traditional bush fallowing system. It is suggested that proper management of soil fertility is needed in order to sustain crop yields in the interior savanna zone of northern Ghana.

39. SANOGO, Zana Jean-Luc (DRSPR, IER, Sikasso, Mali). On-farm research in Southern Mali. 17p.

(Keywords: On-farm trials, FSR methodology, Multidisciplinary teams, Typology, Technology evaluation, Constraints).

Abstract: The objectives of FSR are: (1) Acquiring a deep knowledge of the environment in which research findings are being used: zoning, typology of farms etc. To achieve this, scientists have to develop very close contacts with the environment they are investigating. (2) Identifying with the farmers the various constraints to production (at plot, farm, village, zone level ...) and understanding farmers' problems. (3) Classifying the multiple and complex constraints in order of importance with a view to drawing up a priority order of intervention. (4) Experimenting approaches and technical solutions to identified constraints. Therefore, experiments are carried out: 1. On the farmer's plots: indeed "systems researchers" work in a multidisciplinary team at the farmer's in the setting of implementation of innovations. 2. With the farmer: experience has so far proved that the farmer's empirical knowledge of his environment should not be overlooked. In this regard, he is an active, and not a passive partner and an important interlocutor for systems research. He is closely involved in the search for solutions to his problems. The experience of "Volet Fonsébougou" proved that informal surveys or interviews seem to be an excellent means of involving the farmer more effectively. 3. For the farmer: taking farmers' priorities into account in research themes is a sine-qua non condition to the adoption of the result findings. Research topics must therefore be related to the farmer's immediate interests. (5) Scientists should make available to the extension services those technologies which aroused positive responses from the farmers. (6) FSR teams should improve or send back to the research station unadapted technical innovations and also guide the investigations of sector-based research. This multidisciplinary approach takes global account of all the problems that are obstacles to development.

40. UVAH, Ignatus I.; OLUKOSI, J.O. (IAR, Zaria, Nigeria). A review of sorghum-based Farming Systems Research at the Institute for Agricultural Research, Samaru, Nigeria, in the Savannah and Sahel ecological zones. (16p.).

(Keywords: Sorghum-based systems, Adaptive research).

Abstract: The paper presents highlights of research on the major sorghum-based farming systems conducted at the Institute for Agricultural Research, Samaru, Nigeria from the mid-70's to the present date. Results of on-farm adaptive research so far conducted on interim recommendations are presented. Prospects and problems of adoption of some of these technologies are discussed.

SAHELIAN ZONE

41. BADINI, Oumarou; OUEDRAOGO, Souleymane. (INERA, Bobo-Dioulasso, Burkina Faso). Farming Systems Research and evaluation of recommended technologies in the agricultural settlement area of Dogona (northern Bobo - western region of Burkina Faso). (-p.).

(Keywords: Migration, Typology farm, Agricultural constraints, Farming system, Western region, Burkina Faso).

Abstract: Research has been carried out as from June 1986 in the Western region of Burkina Faso which enjoys favourable agro-climatic factors and where farmers and cattle from the Northern and Mossi Plateau regions

migrate spontaneously. The study which is designed to define a FSR programme for the whole Western region has consisted in a follow-up of 15 farms in the Dogona settlement, Djiguema village, during the first cropping season. Following the analysis of results, the farms have been classified in 2 groups : (1) farms of new migrants essentially devoted to self-subsistence crops, (2) farms of autochtones and former migrants combining self-subsistence crops and cotton cash crop. Both groups include however some livestock breeding integrated to crop production with mostly small ruminants. The constraints identified include (1) the decline in soil fertility associated with intensive cotton growing and population pressure, (2) the insufficiency of family labour for weeding and harvesting, (3) the poor health and nutritional state of draught oxen and animal wandering, (4) the inadequate control of improved technologies. During the 1987-88 and 1988-89 cropping seasons, the improved techniques for plant and animal production have been tested more or less successfully in the two farming groups.

42. BATIONO, A.; CHRISTIANSON, B.C.; MOKWUNYE, A.U. (IFDC-Africa. B.P. 4483 Lomé, Togo). **Organic recycling of crop residue and fertilizer use for pearl millet production on the sandy soils of Niger.** (16p.).

(Keywords: Niger, Crop residue, Fertilizer use, Millet production, Sandy soils).

Abstract: In the region, between 400 and 600 mm isohyets in Niger the food needs of the increasing population could only be met through increased cereal yields. In a trial over a long period starting from 1983 at Sandou near Niamey (Niger) the authors studied the effects of recycling organic matter and application of phosphate fertilizers and urea on the yield of millet (*Pennisetum typhoides*) in sandy soils. The experimental design was a randomised complete block. The grain and straw yields of the different treatments were compared. The authors explained the positive effects of crop residues through the analysis of mineral and organic balance. They concluded that the only combined application of crop residues and fertilizers can give high and sustained yield of millet, but did not give the reasons for such an effect. On the other hand the exclusion of crop residues and fertilizers led to a sharp drop in yields.

43. COULIBALY, Boubacar ; CUNAR, Alex C. **The evaluation stage in Farming Systems Research methodology: results of the evaluation of FSR work in OHV zone (1987/1988 cropping season).** (-p)

(Keywords: FSR methodology, Technology evaluation, Constraints, Technology transfer, Groundnut, Millet, Maize, Sorghum, Varieties, Soil preparation).

Abstract: During the 1987/1988 season, the Farming System Research Team in "Haute Vallée" zone of the river Niger (Center of Mali) which were at their 2nd year of intervention, launched a program of agro-zootechnic tests, backed by socio-economic surveys. The main objective of this program was to uncover the obstacles related to farmers' adoption of the technical themes put forward by research and extension. In reality, it was a comparison between recommended practices and farmer practices. The program was based upon the main crops of the North zone (groundnut and millet) and the South zone (maize and sorghum). The evaluation of these different activities carried out by a multidisciplinary team at the end of the season showed that themes as put forward by rural development services were not adoptable to the whole of farm-systems. Therefore, it appeared necessary to make a screening of different technological packages in order to adapt them to different categories of farmers. In conclusion, this evaluation has enabled the research team to focus its programs better towards a solution to farmers real constraints.

44. DUGUE, Patrick (DSA, Montpellier, France). **Improvement of farming systems in the Sudano-Sahelian zone : refinement of technical innovations and the capacities of farmers to adopt them. The case of Yatenga in Burkina Faso.** (25p.).

(Keywords: Farming systems, Millet, Intensification, Technical innovation, Soil tillage, Management, Fertility, Yatenga, Burkina Faso).

Abstract : The West Africa Sudano-Sahelian zone has been experiencing for more than twenty years a degradation of production conditions. Farmers have to cope with a strengthening of the climatic hazards and a depletion of national resources (arable land, pasturelands, water, etc..) These constraints are all the more pronounced as population density is high as is the case in the centre of the Yatenga Province (Burkina Faso). Technical proposals aiming at improving food production have been tested by the farmers involved in the Research-Development Project in Yatenga. It rapidly appeared that two focuses of intervention were priorities : improvement of crop water supply (soil tillage, crop maintenance, runoff control) and the improvement of soil

fertility (organo-mineral manure). These proposals have been tested on small experiment plots but also on farms. This second level of intervention makes it possible to take into account the working capacities of producers : labour time and resources available for agriculture. The study of the conditions of implementation of these technical innovations by farmers in several villages has evidenced the limitations of the process of farming systems intensification. This has to be reasoned in terms of the diversity of the regional potentialities and of the functioning of farms (typology). In areas where the increase in food production requires an increase in yields, the availabilities of production factors (labour time, inputs, organic manure) limit the intensification of farming systems which can only be achieved on part of the farm.

45. GAYE, Matar (ISRA, B.P. 199, Kaolack, Sénégal). **The challenge of fertilizer use in the agricultural policy of Senegal.** 21p.

(Keywords: Fertilizers, Prices, Profitability, Fertilizer distributors, Small scale farmers).

Abstract: Until 1980, fertilizer and other agricultural inputs were supplied to farmers by government. Since then, unsuccessful attempts have been made to set up a new system in accordance with the decision to remove previous and burdensome facilities from state institutions. Fertilizer use remains marginal particularly in rainfed agriculture. The most important constraints on demand are related to farmers motivations and limited resources. On the supply side, the difficulty to sell fertilizer for cash and the high risk of credit to farmers are the major obstacles for private distributors government tries to push ahead.

46. KABORE, P. Daniel. (INERA, Ouagadougou, Burkina Faso). **Agricultural production risks in Burkina Faso.** (-p.).

(Keywords: Production risk, Advisable rates, Chemical fertilizers, Opportunity cost).

Abstract : The study deals with the production risk in the use of chemical fertilizers (NPK and urea) and the attempt to determinate advisable rates in three agro-climatic zones of Burkina Faso. The data used have been derived from on-farm trials conducted by ICRISAT over two cropping seasons on sorghum and millet with the participation of some 150 farmers. The coefficient of variation and the loss probability (losses of yield, net grain and opportunity cost) are the major criteria for assessing the risk. The analysis reveals a lower yield risk for white sorghum in the Boromo and Djibo areas (where it is grown exclusively in lowlands). In Yako on the Central Plateau pearl millet has however the advantage. Nevertheless, the results show that without state subsidy to fertilizer prices, this input would not be advisable if not at low rates in view of the net gains.

47. KABORE, P. Daniel. (INERA, Ouagadougou, Burkina Faso). **Contribution of fertilizer to agricultural production in Burkina Faso.** (-p.).

(Keywords: Chemical fertilizers, Use of inputs, Ordinary mean squares).

Abstract : The study analyses the contribution of chemical fertilizers (NPK and urea) to the solution of food problem in Burkina. The objective is to identify the favourable and unfavourable conditions of utilization of these inputs under the farmer management of soil fertility. For this purpose, on farm trial data allocated by ICRISAT over two years in three agro-climatic zones with the participation of some 150 farmers have been analysed using the method of ordinary mean square (OMS). The major interaction factors evidenced are the poor rainfall in the North of the country which has a negative interaction with NPK and some cultural practices (sorghum/cotton rotations, ox ploughing and urea) which valorize it in cereal production in the South of the country where cotton growing is more developed.

48. KLEENE, Paul; SANOGO, Bakary. (IER, B.P. 9030, Bamako, Mali). **F.S.R. in South-mali: major achievements for development.** 27p.

(Keywords: Technology development, Animal traction, Mixed farming, Cowpea feed crops, Composts, Technology transfer, Extension, Small scale farmers).

Abstract: Farming System Research in Mali has been initiated by a Project called "Volet Fonsébougou" since 1977. From the very beginning one of its major aims was to come along with applicable recommendations for extension, on major items. The Project, which is geographically limited to the Mali-South area, has elaborated technology packages in the fields of mixed farming, erosion control and extension methods. A specific procedure called "prae-extension" has been developed, which has provided a good linkage between the regional

rural Development Agency (the C.M.D.T.) and the F.S.R.-Project. In this way the extension agents became close associates in the R-D process.

49. LEGOUPIL, Jean-Claude (IIMI, B.P. 5373, Ouagadougou, Burkina Faso). **Irrigation management in West Africa.** 10p.

(Keywords: Irrigation projects, Management, Constraints, Collaborative research, Training, Information dissemination).

Abstract: The Institute pursues the following main lines of activity to help it achieve its objectives: (i) field research, in which IIMI staff work in collaboration with partner organizations (usually irrigation-managing organizations) to develop better understanding of management practices and problems; (ii) action research, in which the work is in a similar collaborative mode, but the task involves developing, putting into practice, and evaluating some changes in the management arrangements; (iii) thematic research, which uses the knowledge developed from the above two research modes and aims to formulate generic, rather than location-specific, explanations of irrigation management processes; (iv) management services; (v) information services. Currently, IIMI's research program focuses on field research carried out by its staff and collaborating agencies in its countries of operations. The other two types of research, testing and implementing management innovations through action research and synthesizing research to develop a broad understanding of irrigation management processes, are becoming increasingly important as the base of field research results grows. Action research and thematic research enable IIMI to make these results accessible and facilitate the adoption of changes that are identified. The primary aim of the project is to promote regional exchange of research on irrigation management, thereby enabling national efforts to have a relatively broad impact and facilitating the dissemination of research results. Through the proposed network, the experiences with various management models which are in use in the irrigation systems of Burkina Faso, Mali, Niger, Senegal and Nigeria would also be exchanged, giving rise to management innovations applicable to other systems.

50. KADI, Maliki; CHANDRA, Reddy; DEBOER, Jess L. (INRAN, Niamey, Niger). **Evolution and salient results of on-farm testing of improved technologies on millet/cowpea intercropping.** (-p.).

(Keywords: Technology evaluation, Technology transfer, Intercropping, Millet, Cowpeas, Multidisciplinary research).

Abstract: In 1985, the National Institute of Agronomic Research of Niger (INRAN) initiated through its research group on farming systems a programme designed to conduct on-farm testing of technologies already finalized on research station with promising results. Among the themes introduced at farmers' level, the one on millet-cowpea intercropping was thoroughly investigated by a multidisciplinary team in three different agro-ecological zones of Niger. Highly valuable lessons have been drawn from this experience and a partial analysis of the results has emphasized the need for the technologies developed on station to be tested on farmers' fields before their large scale extension. This is the experience we propose to analyse in order to bring out the lessons drawn.

51. OUEDRAOGO, Nabyouré. (Directorate of Agricultural Extension, Ouagadougou, Burkina Faso). **From supporting research to research/development.** (-p.).

(Keywords: Pilot zone, Villages, Pre-extension stage, Evaluation trial, Full size, On-farm research, Technical approach, Farming systems, Working account, Farmers' participation).

Abstract : Elaborated at a time when the mitigated results of development projects led planners and decision makers to doubt, the Koudougou Pilot Project for Agricultural Development and particularly its Research and Support component appeared concretely as a research-development project. Their example in this area has been reviewed in this paper. An attempt has been made to emphasize the results acquired and released through training and visit, those which need to be reported back to research (feedback) and those which may be further submitted to adaptation work by the Supporting Research Component. Finally, the participation of rural farmers to the evaluation of the technologies is presented.

52. SERPANTIE, Georges; MERSADIER, G.; MERSADIER, Y.; TEZENAS DU MONTCEL, L. (UR Dynamique des Systèmes de Production, ORSTOM, Ouagadougou, Burkina Faso). **The "entrance gates" approach : a way of addressing the dynamics of farming systems by promoting dialogue between scientific**

disciplines and developing rural societies. 19p.

(Keywords: Farming systems dynamics, Methodology, Multisectorial approach, Sudano-Sahelian zone).

Abstract: The objective of the "Dynamics of agropastoral systems in the Sudano-Sahelian zone" programme is to study the evolution of the relationship between farmers societies and environment in the Sudano-Sahelian context of aridification. An attempt is made to identify the evolution of "local" resources and constraints as well as of the strategies of the various groups and to compare them to the development strategies, to the evolution of external conditions and to the management alternatives. This approach requires participation and dialogue from different scientific disciplinary points in view of collaboration with other actors : Yatenga inhabitants, administration, development agencies, at different levels (time, space, organizational scale). Methodologically, each discipline is equipped with specific concepts and reading gates but the interdisciplinary confrontation of these approaches as well as the communicability of results proves to be difficult. We prefer a "specific sectors" or "entrance gates" approach. The risk of tackling only this one aspect or only one projection of production system is largely compensated by the fertility and facility of dialogue between disciplines and with the developing society as well as the possibility of operating a synergy by simultaneously investigating several "entrance gates" (multisectorial approach). Concrete examples are proposed: follow-up of representative and atypical farms, spacial approach, follow-up of trade, collaborative experiment.

53. SIDI, Rachid. (CNRADA, Kaedi, Mauritania). Effects of drought on animal traction in the various farming systems. 20p.

(Keywords: Drought, Environmental imbalance, Animal traction, Regression).

Abstract: Due to its geographical situation, Mauritania is one of the Sahelian countries most stricken by the double plague of drought and desertification which has been raging in the sub-region for several years. Animal traction spread over the other agro-pastoral regions of the country from 1965 to 1978 (Nema, Aïoum, Quidimakha, Assaba, Trarza, Brakna, Adrar) with a diversified range of materials introduced by immigrants farmers, by the Department of Rural Development, the NGO and projects. Animal traction is essentially used for land preparation and for transportation of crop products and by-products. It helps in reducing the hardness of the work and the duration of work or in increasing the cultivated areas. With the persistent drought, the use of draught animals for agricultural activities has regressed in favor of transportation activities in urban centers.

54. SIRIFI, Seyni; BERRADA, Abdel; CHANDRA, K. Reddy. (CNRA-Tarna, Maradi, Niger). Performance of improved millet and sorghum varieties in farmers' fields and on research station in Niger. (-p.).

(Keywords: Multilocal trial, Millet, Sorghum, Yield difference, Implication).

Abstract: Since its inception in 1975, the Niger National Institute of Agronomic Research (INRAN) has initiated a programme of multilocal trials to test the adaptation and performance of several improved varieties in the different agroclimatic zones of Niger. These trials include the major crops of Niger, namely millet, sorghum, cowpeas and groundnuts. They are conducted in farmers' fields in close collaboration with the extension service. The varieties tested vary according to the climatic zone. Two zones have been distinguished : Zone A receiving less than 400 mm average rainfall per year and Zone B more than 400 mm. In this paper, the results for the last four years (1985-1988) on millet and sorghum are presented and compared to those obtained on research stations. The result analysis reveals significant differences between the yields achieved on station and those obtained at farmer's level. For example, the millet varieties GRP1 and HKB Tift whose production may exceed 2,000 kg/ha on research station have produced less than 600 kg/ha on an average in on farm trials. The same is true for most sorghum varieties tested. In addition, the difference between improved varieties and local varieties was not significant in most of the locations where multilocal trials were conducted. The possible reasons for the differences observed between yields obtained on station and on farmer's fields on one hand and between improved varieties and local varieties on the other hand are elaborated in this document. Similarly, we have discussed the implications of these differences on the multilocal trial programme, the breeding and research - development liaison programme.

55. SOHORO, Adama. (INERA, Ouagadougou, Burkina Faso). Simplified study of farming systems : the cultural binomials. (-p.).

(Keywords: Cultural binomials, Technical itineraries, Saria, farming systems, Technical results, Economic evaluation).

Abstract: In liaison with the development leaders, a number of farming systems had been recommended by researchers for the different ecological zones of Burkina Faso. The simplification of research on these systems involves the study of a biennial rotation which generally takes into account the sequence of contrasted crops (cereals - legumes). It is this biennial rotation of two crops which is called "cultural binomials". On the Central Plateau the binomials studied are : Sorghum/cowpeas, Millet/cowpeas, Sorghum/millet. The full size research on these three binomials was conducted at Saria (Boulkiemde Province) for six years with themes on the combination of soil tillage, varieties, mineral manure and crop residue management. In addition to technical results, an economic approach to each binomial was worked out in order to assess the opportunities for their adoption under real environment.

IRRIGATED OR LOWLAND VALLEY ZONE.

56. GADELLE, François. (CEMAGREF, Antony, France). **The development of lakes Tanda and Karbara (Mali): a new approach.** (-p.).

(Keywords: Irrigation projects, Village organization, Flood plains, Irrigated rice).

Abstract: The Lake Zone in the North of Mali is generally characterized by an arid and poor climate, but it has numerous lakes and ponds which are flooded by the Niger River. Under a project financed by the French Caisse Centrale de Coopération Economique and the Région of Rones-Alpes, in October 1988 the Committee for Lere flooded the two Lakes of Tanda and Karbara, which has been dry since 1981 due to the weak flows of the Niger River. This involves large works which were carried out by private contractor : two canals, each 75 km long, and 2 million m³ of earthworks. The project is intended to permit recession agriculture on 3,700 ha, which corresponds to the area cultivated during the best previous years. The social situation of the population living around the lakes is difficult. Seven ethnic groups are dispersed in 11 villages with a total population of 10,000 inhabitants, sharecropping in common, and there are frequent conflicts over the use of farm lands among villages and with livestock producers. The public administration in the area is, unfortunately, more of a brake than a motor. The project, therefore, seized the opportunities of a redistribution of land among the villages, which dates back to 1983 but which has never been applied, and of the farmers's good knowledge of recession agriculture, to organize the development in a way different from the usual approach. Emphasis was placed almost exclusively on the village level organization of farmers to develop and maintain the lake areas. The individual approach, including the distribution of land, was excluded. As a result, there was only a dialogue between a limited staff of two engineers and the village committees, or about 70 persons. Although this is only a recent experience of less than a year, the project seems to have been successful because the population has responded well to the confidence which was placed in them. It has organized itself right from the beginning and has maintained the canals properly, even though sometimes the work sites were distant 80 km from the villages. Now the active groups have been formed, the villagers request advice and services to improve their situation : reforestation, introduction of floating rice, fisheries, health care, and literacy training. These will be provided on a limited scale and, if possible, on a contract basis in order to keep recurrent costs low. The approach which has been adopted, which emphasizes the initial organization of the villagers rather than extension which comes only at a second stage, could well lend itself to other irrigated or dry farming development projects.

57. JAMIN, Jean Yves. ("Retail" Project, Office du Niger, Mali). **Conditions for the intensification of irrigated farming in the large sahelian areas : the experience of the Retail Project at the Office du Niger.** (-p.).

(Keywords: Intensive farming, Irrigated rice, Agricultural projects, Village organization, Yield increase).

Abstract: The Retail Project is one of the experiments conducted by the Office du Niger for the intensification of rice growing. In the three project villages, farmers have increased their yields and practice double cropping on the fourth of the 1,100 ha which they are managing. These results may be attributed to experiments conducted under the project since 1986 (rehabilitation of irrigation and drainage networks, intensive plot management, reduction of allocated areas, land security, planned resorption of farmer's outstanding debts, extension of intensive techniques, development of market gardening) and to action initiated since 1981 in the Office area (suppression of the economic policy, improvement in supply conditions, rapid settlement of purchases to

farmers, development of village associations, equipment of farmers associations with threshers, draught oxen). Under the project a Research-Development type of approach has been used. The national economic environment has improved with the liberalization of paddy marketing, the support to rice prices and the renewal of agricultural credit. The continuation of studies based on a farming systems approach, a good linkage with station research and with research on farmers socio-economic environment as well as a good collaboration with extension seem necessary to specify the conditions of improvement.

58. KAMUANGA, Mulumba; POSNER, Josh L.; DIOUF, Made B. (ISRA, Casamance, Senegal). **Zoning of Lower Casamance (Senegal) and typology of farms : a tool for research and development.** (-p.).

(Keywords): Agricultural situation, Diola, Mandingues, Farming systems, Lower Casamance).

Abstract: Under the farming systems research programme in Lower Casamance (Senegal), the area was cut in agricultural zones by the systems research team (1982 - 1986) at the beginning of the exploratory surveys, the agro-economic follow up of farms and sociologic surveys. The repeated agricultural situation (3 criteria) represent space units with homogenous constraints and comparable potentialities. Each situation is considered as a framework for the application of research and/or development action themes at improving technically or socially the underlying farming systems. Emphasis is put on collaboration between research structures and development agencies.

59. LE GAL, Pierre-Yves. (DSA/CIRAD - ISRA, St. Louis, Senegal). **From the analysis of practices to assistance in decision-making. The status of research in the delta of Senegal river.** (-p.).

(Keywords): Cultural practices, Farming systems, Irrigated rice, Decision-making).

Abstract: The cost of irrigated rice cropping in the Delta of Senegal River calls for an improvement of the productivity of farmers plots. This objective implies a better knowledge of the current practices of producers in order to take into account their problems and competences in defining the support they need. The results of a plot survey and observation made over several cropping seasons show the diversity of the technical options made by farmers in the recommendations of the Research and the Development structures. These options depend on collective as well as individual determinants the analysis of which may facilitate the definition of the interventions to be privileged. The shift to an effective assistance to the decision-making by farmers supposes the elaboration of reference systems agronomically, technically and economically adapted and also a better understanding of farmers tactical and strategic decision making process. This paper reviews the achievements of the ISRA-River farming systems research programme in this area and presents the operations planned for this purpose in the near future.

60. MARLET, Serge; BOYER, Georges; BOZZA, Jean. (INRAN/IRAT - CIRAD, Niamey, Niger). **Irrigation of the terraces of the river Niger : assessment of three years of monitoring at farmer's level.** (-p.).

(Keywords): Terraces of the River Niger, Sodic soils, Gypsuming, Animal traction, Irrigated farming systems, Working time).

Abstract: The terraces ultimately represent an important resource, making up 40 percent of irrigable land in Niger. Cropping activities initiated on the SONA lands constitute the first phase of a programme designed to help develop and experiment on an irrigated-farming model of 1 to 2 hectares at farmer's level. After three years of cropping, there are indications that : - the major technical constraint is posed by the nature of the soils. In effect, the soils are heterogeneous in texture and their structure subjected to degradation by widespread sodium. Gypsuming tests made it possible to significantly improve yields in the short-term period while the development of the chain of animal traction, adopted by farmers facilitated cropping on these soils. Whereas the proposed farming system proved satisfactory for farmers in the rainy season, its modest performance in off-season farming coupled with marketing problems led to a decline in farmers' participation. Moreover, the peculiar situation in the valley where cropping on dunes is already combined with double rice-growing, has tended to worsen the situation due to the ensuing rise in demand for farm labour, and the fact that food self-sufficiency is achieved to a large extent. Notwithstanding, the two hectares model seems to attract certain farmers, who, in addition to self-reliance, seek a lasting improvement in their standard of living.

61. MASAJO, T.M.; CARSKY, R.J. (IITA, Ibadan, Nigeria). **Selecting and developing rice and upland crop**

varieties for inland valley swamps with minimum or partial water control. (20p.).

(Keywords: Rice production, On-farm trials, Rice testings programs, Upland crops).

Abstract: Inland valley swamps have the potential for expanding cultivation of rice and other upland crops in Africa. Major constraints to rice production in inland valleys include lack of water control, weed competition, lack of labor, low soil fertility and iron toxicity. Certain morphological traits which help rice to compete with weeds and tolerate physical stresses can be incorporated through breeding. Resistance to major diseases and pests are other important breeding objectives for the inland valleys. Others are varying ranges of growth duration needed to fit varying cropping patterns and grain quality acceptable to farmers and consumers. Breeding lines are evaluated and screened for stresses at IITA headquarters at Ibadan and at off-site locations. On-farm trials are conducted to determine performance of advanced breeding materials at diverse sites under actual field conditions. Promising selections are nominated to organized national and international rice testing programs. Common dry season upland crops in the inland valleys are cassava, sweet potato, and vegetables. The Rice Based Systems Group (RBSG) at IITA, in its farming systems program for the inland valleys, evaluates not only rice but also varieties of upland crops as components of whole cropping patterns. The results of trials conducted in Bida, Nigeria and Makeni, Sierra Leone with rice, cassava, sweet potato, and cowpea are reported.

62. MULBAH, C.K.; MASSAQUOI, W.K.; DAVIDSON, D.J. (CARI, Monrovia, Liberia). **Status and future research strategy of rice-based cropping systems in Liberia.** (-p.).

(Keywords: Rice-based cropping systems, Shifting cultivation, Low-input, Sustainability).

Abstract: Rice is the main staple crop in Liberia and is grown under traditional practices. Liberia produces approximately 50 % of its domestic rice needs. The remainder is imported at great economic cost to the country. About 90 % of the domestically-produced rice is grown on uplands under shifting cultivation practices. The remainder is produced in inland valleys, under hydromorphic conditions. Upland rice yields from 1-2 T/ha while inland valley rice yields 2-3 T/ha. Despite this fact, farmers still practice upland rice cultivation and only adopt inland valley practices when incentives have been offered. These lowland areas are then abandoned after only a few years of production. Previous surveys have assessed the biological and socio-economic constraints to increasing upland rice production. These constraints include : declining fertility, increasing pest infestation, lack of alternative cropping systems, high labor requirements, lack of capital and inputs, and low prices. A survey has been proposed to assess the constraints to sustainable inland valley rice production. The Central Agricultural Research Institute is currently developing strategies to replace current practices. These strategies are based on low-input and sustainable systems which include : alternate crops, alley cropping, crop rotations, green manures, animal traction, and with low labour requirements.

63. NDIAYE, Mamadou. (ISRA, St. Louis, Senegal). **Monitoring agronomic activities in rural areas. A reasoned way to the definition of research and extension programmes.** (-p.).

(Keywords: Agronomic follow-up, Heterogeneity, Density, Weeds, Technical approach, Yield).

Abstract: Two criteria of heterogeneity of rice plots in the Senegal River Delta : population density and weeds, have been selected and their consequences on yield through their components have been studied. The first one does not seem to be a very determinant criterion in yield because of the compensation by tillering or by the panicle weight in the scattered portions. In contrast, the second one seems to be very limiting and the competition appears to be marked only from height growth reducing thus the number of tillers. After a review of the results, some research and extension proposals are brought out in order to verify some hypotheses or to improve farmers practices.

64. SPENCER, Dunstan S.C. (Resource and Crop Management Program IITA, Ibadan, Nigeria). **A Farming Systems Research strategy for the development of inland valleys for increased food production in West Africa.** (18p.).

(Keywords: Farming Systems Research strategy, Food production, West Africa, Water control schemes, Technology production).

Abstract: This paper describes a research strategy for the inland valleys which are flat-bottomed and vary in size from a few to hundreds of hectares. Most of the valleys are not presently cultivated. Where cultivated rice is the most important crop grown in the wet season followed usually by a cultivation in the dry seasons of dryland crops such as sweet potatoes, cassava, groundnuts, maize and short season vegetables. Many attempts

have been made in the past to introduce water control schemes into these valleys. Much of the available evidence shows that the economic return to this investments has been marginal. Also crop and resources management problems are more important than other constraints in the valleys. The paper proposes a research strategy that would concentrate on producing improved technologies for valleys in which there is minimum or no water control. This would involve increased emphasis on the linkages between technologies used in the wet and dry season.

65. TCHALA-ABINA, François; SADO, Ahmadou. (National Agricultural Higher School, Dschang, Cameroon). **From the rod to dialogue in rice production at Yagoua in Cameroon.** (-p.).

(Keywords): Techno-bureaucratis, Social production relations, Responsibilization, Control, Fees).

Abstract: The Corporation for the Expansion and Modernization of Rice Cultivation in Yagoua (SEMRY) is the oldest and most important rice project in Cameroon. The achievement of production objectives of this project has led development agents, since its establishment in 1971, to adopt a top down approach characterized by a rigorous control of resources, means and social product, throughout the irrigation scheme. For some years now, in a limited area of the scheme the top down approach is gradually being replaced by a new approach that puts more emphasis on dialogue between development agents and rice growers. The purpose of the paper is to describe and analyze this evolution of the social relations of production in SEMRY scheme. An assessment of the potential impact of ongoing changes on the standard of living of rice growers will also be made.

66. TOURRAND, Jean François; DIATTA, Ambroise. (IEMVT/CIRAD-ISRA, St. Louis, Senegal). **Livestock in agro-pastoral farming systems : the example of the Senegal river valley.** (-p.).

(Keywords): Agro-pastoral farming systems, Intensification, By-products).

Abstract: The Senegal River Valley located in the Sahel zone (200 to 300 mm rainfall) was traditionally pastoral-oriented. In the last thirty years, the hydro-agricultural management of the delta associated with the detrimental effects of drought spells on livestock productivity has compelled the Fulani shepherds to adopt agro-pastoral farming systems. Furthermore, because of the important availability of agricultural and agro-industrial by-products, some rice farmers are now in a position to develop intensive animal production.

67. WAKATSUKI, Toshiyuki; KOSAKI, Takashi; PALADA, Manuel C. (Shimane University, Japan). **Sawah for sustainable rice farming in inland valley swamps ecology in West Africa.** 21p.

(Keywords): Sawah, Water and soil conservation, Inland valley swamp, Sustainable rice production).

Abstract: Although African rice (*O. Glaberrima*) was cultivated thousands of years ago in West Africa, the Asian type of rice agriculture, so-called "Suiden Nogyo", in Japanese, or "Sawah" in Malayo-Indonesian, which means a leveled and banded rice field, was not practiced. In contrast, rice is grown on a naturally sloping phreatic and flooding land in inland valley ecology in West Africa. In this report, we described that non-Sawah culture limited the improvement of water management and has been accelerating soil deterioration. Non-Sawah rice cultivation prohibits efficient use of fertilizers and high yielding varieties. The on-farm research in benchmark inland valleys in Nigeria showed that the introduction of sawah system doubled the rice yield, and at the same time conserved soil and water. Since the Sawah system has been recognized as one of the best sustainable production systems in tropical monsoon Asia, and because there are no physical or environmental limitations for developing and managing the Sawah system in most of the inland valleys in West Africa, more extensive and intensive research and on-farm testing are necessary for a wider scale introduction or technology transfer of this system.

GENDER ISSUES.

68. MIRANDA, Isabel. (DEPA, CP 71, Bissau, Guinea Bissau). **Role of women in agriculture.**

(Keywords): Role of women, Traditional farming, Rice production, Groundnut, Cassava, Labour, Land, Right of access, Guinea Bissau).

Abstract: - Sociological studies could make the political leaders of the country aware of the fact that women are the first and the main victims of the hard working conditions in the rural and suburban zones. - In Guinea Bissau national institutions - including UDEMU and the Government - have drawn up a women policy that mainly aims at integrating them in development projects and also giving them an assistance that can help alleviate the drudgery of their housework. Because of that, we would like to make the following recommendations: - 1) Women should be helped to launch other lucrative activities that can make up for their loss of income when men sell the cash crops. - 2) Survey should be conducted on women's role, their constraints and needs in order to improve their socio-economic situation (better supply of essential goods, less marketing problems). - 3) Development projects which introduce new techniques should design new technologies that can alleviate the burden of women's household and agricultural activities. They should also make those technologies accessible for them through the extension services and, if need be, through loans and the establishment of village saving banks. - 4) The recruitment and training of rural community counsellors and extension agents for better education of farmers should be strengthened. - 5) Women should be involved in the groups in order to organize the marketing of their products, and negotiate loans to buy machines and other means of production so that the groups can defend the interest of women farmers.

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CONTRIBUTION OF FARMING SYSTEMS RESEARCH TO THE DEVELOPMENT OF IMPROVED TECHNOLOGIES FOR THE DIFFERENT AGRO-ECOLOGICAL ZONES IN WEST AFRICA

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