Farming systems research in Ethiopia

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ABSTRACT

Agricultural research in Ethiopia has not led to rapid technological change in the small farm sector. Over the decade or more since the Institute of Agricultural Research began work, the research programmes of the disciplines have grown apart. Despite significant accomplishments by particular disciplines, there has been little success in integrating the results. Until recently there was a tendency to identify research problems without direct reference to farmers, and technology produced by research was not tested in the actual farming environment.

In order for research to make a greater and more rapid contribution to farmer and national welfare through improved design of technology, a Farming Systems Research Project was proposed in 1976 within the Institute of Agricultural Research. The basic tenets of the Project were a whole farm systems approach, consideration of farmers' perceptions and the extension process, including dynamic elements, and testing recommended technology in the farming environment. The objective of producing appropriate technology which would be widely adopted was to be achieved through several steps. Firstly the delineation of a homogeneous farming system zone was followed by the collation of existing information for the zone and a sample survey of farmers, conducted by socio-economists with cooperation of researchers from other relevant disciplines. Second, in the light of the results of both survey and available tested research, a whole farm package of simple synergistic innovations was developed by a multidisciplinary team. The selection of the package focussed on the small farmer with medium managerial ability, and involved interaction with extension personnel and farmers. Third, two groups of representative farmers were selected to test the package and to serve as controls.

The FSR Project is in the second season in one of the farming system zones and the first season in another two farming system zones. Farmers are proving cooperative, and extension personnel are participating. Experience shows that it is necessary to supervise closely some innovations, such as seed and fertilizer application. The Project is providing a link between researchers and farmers. Examples of gaps in the present research effort which have been identified include oxen tillage and weed control. Farmer testing of wheat varieties, tested on the research stations, raised questions of acceptability from the point of view of taste and problems associated with oxen threshing, neither of which were apparent during station trials.

Initially, considerable difficulty was associated with cooperation between membres of different disciplines. Although potential contributions of other disciplines were recognized, familiar problems usually assumed greater apparent importance. Often members of a discipline preferred to leave the role of critic of other disciplines to agricultural economists. Inter-disciplinary links between soils-agronomy-plant protection were more easily forged than between crop production and animal production, although in Ethiopian mixed farming the latter interaction is crucial. The consideration of real situations in a whole farm perspective facilitated resolution of conflicting ideas of different disciplines. Agricultural economists have, in Ethiopia, considerable experience of work with farmers. Also, agricultural economists have traditionally been integrators of technical agricultural information and therefore, logically, provided the coordination in the Farming System Project. Overall, considerable progress towards the goal of better design of technology was made by the Project.

RÉSUMÉ

La recherche agricole en Ethiopie n'a pas engendré un changement technologique rapide dans le secteur de la petite exploitation. Pendant les dix ans de vie de l'Institut de Recherche agricole, les programmes de recherche des différentes disciplines se sont développés séparément. Malgré les réalisations importantes de certaines disciplines, l'intégration des résultats n'a pas eu beaucoup de succès. Jusqu'à une date récente, il y a eu une tendance à identifier les problèmes de la recherche sans chercher un contact direct avec les exploitants et la technologie mise au point par cette recherche n'a jamais été testée dans l'environnement réel de l'exploitation.

Dans le but de donner une contribution plus efficace et rapide au niveau de vie de l'exploitant en particulier et du pays en général au moyen d'une technologie plus avancée, un Projet de Recherche des Systèmes d'Exploitation a été proposé en 1976 pour être réalisé par l'Institut de Recherche Agricole. Les principes de base du Projet étaient : une approche globale des systèmes d'exploitation, la prise en considération des réactions des exploitants et du processus de vulgarisation, y compris les éléments dynamiques, et l'essai de la technologie recommandée par les chercheurs dans l'environnement de l'exploitation. Le but de créer une technologie appropriée susceptible d'être adoptée sur une grande échelle devait être poursuivi en plusieurs étapes. Tout d'abord il fallait délimiter une zone homogène de systèmes d'exploitation et cela devait être suivi par le rassemblement de toute information existante sur la zone en question et une enquête-type des exploitants réalisée par des économistes sociaux avec la coopération de chercheurs d'autres disciplines y afférant. Deuxièmement, à la lumière des résultats de l'enquête ainsi que de la recherche appliquée dont on disposait, un ensemble d'innovations simples synergétiques au niveau de l'exploitation a été mis au point par une équipe multidisciplinaire. La sélection de cet ensemble se concentrait sur le petit exploitant ayant une capacité moyenne de gestion et nécessitait l'interaction avec le personnel chargé de la vulgarisation et les autres exploitants. Troisièmement, deux groupes d'exploitants-type avaient été sélectionnés pour tester cet ensemble et servir de modèle.

Le Projet de Recherche des Systèmes d'Exploitation pendant la deuxième campagne œuvrait dans une des zones des systèmes d'exploitation et pendant la première dans deux autres zones. Les exploitants se montraient prêts à collaborer et le personnel chargé de la vulgarisation participait aux travaux. L'expérience nous a montré qu'il est nécessaire de superviser étroitement quelques-unes des innovations telles que la technique d'ensemencement et l'application des engrais. Le Projet sert de lien entre les chercheurs et les exploitants. On a noté les limites de ce travail de recherche et des exemples en sont le labourage par les bœufs et le contrôle des mauvaises herbes. Des essais effectués par les exploitants sur les variétés de blé déjà testées dans la station de recherche ont soulevé des problèmes d'acceptabilité du point de vue du goût et des problèmes relatifs au battage effectué à l'aide de bœufs. Ni les uns ni les autres problèmes n'avaient été relevés au cours des essais à la station.

Au début, la collaboration des membres des différentes disciplines avait posé des difficultés considérables. Même si des contributions potentielles de la part d'autres disciplines avaient été reconnues, on a accordé une importance excessive aux problèmes quotidiens. Souvent les membres d'une discipline préféraient laisser la critique des autres disciplines aux économistes agricoles. Une collaboration inter-disciplinaire entre l'étude des sols, l'agronomie et la protection des plantes pouvait se réaliser plus aisément qu'entre la production végétale et animale, bien que dans l'exploitation mixte de l'Ethiopie cette dernière interaction soit fondamentale. La considération d'une situation réelle dans le contexte de l'exploitation rendait plus facile la résolution de conflits causés par des idées opposées provenant de différentes disciplines. Les économistes agricoles en Ethiopie ont une expérience considérable du travail avec les exploitants. De plus, les économistes agricoles par tradition ont été les interprètes de l'information et par conséquent ont assuré le travail de coordination au sein du Projet des Systèmes d'Exploitation. Le Projet a cependant pu obtenir des progrès certains dans la réalisation d'une technologie plus avancée.

INTRODUCTION

Ethiopia is an ecologically diverse country with an agricultural sector which contributes the major share of Gross National Product and practically all export earnings. About fourfifths of the population depend upon agriculture for their livelihood. Recent time have brought a new and socialist framework for rural development in Ethiopia. Farmers are now organized into farmers associations, which are a vehicle for cooperative activities. Land reform in particular set the stage for rapid agricultural development, but due to a variety of reasons technological change in the agricultural sector remains slow.

This paper explores some of the reasons for slow technological change, especially those pertaining to the agricultural research process. It is maintained that more useful research results can be derived by farming systems research. The experience of a Farming Systems Research Project in Ethiopia is described.

Land Use

There is no question that small farmers, characterized by high labour/capital ratios, account for the major portion of agricultural production in Ethiopia. Both food and industrial crops are produced by a relatively capital-intensive state farm sector which was estimated at 63,300 ha in 1976/77 (1). A further 45,500 ha was under cooperative farms. Since the same source estimated national cropped area in 1976/77 as 5.23 million ha, state and cooperative farms were minor sources of production.

An estimated 4.6 million small farmer holdings existed in

(1) *Land Utilization and Crop Production* : Ministry of Agriculture and Settlement, Addis Ababa, 1977.

1976/77, with an average farm size of 1.48 ha. One rough estimate located half of small farmers more than 30 km from a read (2). About one quarter of farmers fell into each of the farm size groups 0.11 - 0.50, 0.51 - 1.00, 1.01 - 2.00, and 2.01 - 5.00 ha reflecting the ecological diversity and varying man/land ratios in the different regions.

Area of perennial crops was 0.5 million ha, mainly coffee, false banana and chat. Five annual crops, namely teff, wheat, barley, maize and sorghum, accounted for 10 percent of sown area and 83 percent of grain production, as illustrated in Table 1.

TABLE 1 : AREA, PRODUCTION AND YIELD OF MAJOR ANNUAL CROPS

Sorghum

CROP	AREA		PRODUCTION		YIELD
	'000 ha	%	'000 ha	%	q/ha
Tef	1,217 (4) (a)	26 (b)	9,132 (11) (a)	20 (b)	7.5 (c)
Barley	652 (104)	16	7,192 (1261)	19	11.0
Wheat	489 (45)	11	5,223 (314)	12	10.7
Maize	623 (21)	14	8,324 (294)	19	13.4
Sorghum	628 (1)	13	6,303 (3)	14	10.0

(a) : Bracketted figures are for the small rainy season.
(b) : Percentage of total crop area or production.
(c) : Calculated for main cropping season only.

Cropping patterns on a national basis according to farm size, admittedly involving aggregation over quite diverse farming systems, are illustrated in Table 2. These four farm size strata covered 95 percent of farmers. Very small farmers were commonly coffee producers, and the stratum otherwise had quite mixed cropping patterns.

TABLE 2 : IMPORTANT CROP DIFFERENT SIZE STRATA

	HOLDING SIZE (ha)			
	0.11-0.50	0.51-1.11	1.01-2.00	2.01-5.00
Percentage of cropped area in stratum				
⩾ 20 %	tef, sorghum	tef, maize	tef	tef
10-19 %	maize, barley coffee	sorghum, barley, wheat	maize, barley sorghum, wheat	maize, barley sorghum wheat
4-9 %	wheat, horsebeans, ensete	horsebeans coffee	horsebeans	wheat, horsebeans
Percentage of farmers per stratum				
⩾ 40 %	—	tef	tef, maize	tef, maize, barley
30-39 %	coffee	maize, sorghum	sorghum, barley, wheat	sorghum
20-29 %	tef, sorghum, maize, ensete	barley, wheat, coffee	horsebeans	wheat, horsebeans

(2) HAMERSLEY, A. : pers. comm.

Tef production was widespread. After tef, the important grains for the smaller farmers were maize and sorghum. Other data demonstrated that as holding size increased the area of perennial crops, the fraction of cropped land sown to the major five cereals and the fraction of cropped land sown to legume (10-12 %) remained relatively constant. Unfortunately at the time of writing similar information on livestock production was not available to the author.

Research

The Institute of Agricultural Research was established in 1966 with FAO/UNDP support. To cover the numerous agro-ecological zones, several stations and many sub-stations were set up. The Institute has about 70-80 researchers, including about 15 FAO staff. Most disciplines relevant to adaptive agricultural research are represented. The mandate of the Institute of Agricultural research does not extend to provision of extension services.

Technological change

Ethiopian agriculture is for the most part animal and human powered, and traditional technology mostly employed (3). Where Extension Project Implementation Department (EPID) agents exist, some change has occured. The most widespread innovation for crop production is artifical fertilizer which in 1976/77 was used on 9 percent of all holdings (4), but often at very low levels. The two crops with the greatest proportion of their crop area fertilized were tef (11 %) and wheat (12'%). TOBORN (5) found from 1975/76 survey data drawn from extension areas that fertilizer application gave significantly higher yields (P = .10) in only 44 percent of cases. In areas serviced by veterinary agents vaccination, particularly for rinderpest, has been common. There are some notable exceptions to the generally poor innovation adoption rates, such as Arussi Regional Development Unit ARDU (previously Chilalo Agricultural Development Unit CADU) and Wolamo Agricultural Development Unit (WADU). Both are confined to few farmers, and the methods were too costly of finance and trained manpower for implementation throughout the country (6). Although the extension service EPID was created for low cost provision of a minimum package to farmers, in practice EPID's activities have been mainly associated with fertilizer distribution.

Consequently, few farmers have been affected by improved technology, and the effectiveness of the most widespread crop production innovation, fertilizer on 9 % of holdings, has been challenged. The farmers that have benefitted have been in accessible areas with some integration into the cash economy. Certainly in remote areas virtually no impact exists.

Many factors have contributed to the poor adoption rates. Certainly extension services have been constrained by a shortage of financial and manpower resources, and the physical infrastructures and institutional environment have not always been conducive to rapid adoption of yield increasing innovations. For instance, fertilizer distribution has been hampered by insufficient transport facilities. Nevertheless, history shows that really appropriate innovations can be rapidly adopted with little or sometimes no institutional support. As will be discussed below, the design of appropriate technology requires consideration of factors affecting the adoption process including the infrastructural and institutional situation. Therefore, researchers cannot wholly blame extension personnel for poor adoption rates of research recommendations.

ESSENTIAL ELEMENTS OF FARMING SYSTEMS RESEARCH

Several attributes of the research process can be crucial in determining the worth of research output and, following adoption, the improvement in farmer and national welfere.

Whole farm systems approach

The subsistence farmer usually manages a complex whole farm system of at least several enterprises, which at the research level comprise many disciplines. At one level of thinking the system approach merely permits the scanning of a broad canvas in order to select the most limiting factor. Sometimes single factor amelioration can be impressive in the early stages of agricultural development. However, in time usually progressively smaller advances are made with each successive alleviation of a limiting factor.

A systems approach encourages the identification of multiple factor interactions with grater potential whole system effects than single factor amelioration, particularly when systems output is judged by a multi-goal objective function.

At the practical level, gains in one area of farm operation often derive from changes made elsewhere on the farm; and those gains may be neutralised by losses in another part of the farm. In one area in Ethiopia, improved livestock husbandry could lead, at the end of the dry season, to oxen in reasonable condition capable of early ploughing, permitting timely maize planting and consequently improved yields. However, with low neo-harvest prices, the gains from sale would be moderate; or without improved storage technology much of the yield increase would be eroded by subsequent storage losses. A whole farm approach may identify a combination of slight improvements in dry season feeding of oxen, timeliness of first maize weeding and on-farm grain storage as superior to a simple fertilizer application.

The agricultural sector has several levels of systems and subsystems. The farm production system is part of the farm-family system which includes the very important family aspects. Here a farm is considered a single management unit, so a production cooperative would be regarded as a farm. The

(3) The following discussion pertains to the small farm sector.

(4) ANON : *Land Utilization and Crop Production*, Ministry of Agriculture and Settlement, Addis Abada, 1977.

(5) TOBORN, JOHAN : *Diffusion of Innovations under EPID/MPP* : Two Partial Studies. EPID, Addis Ababa 1978.

(6) LELE, U. : *The Design of Rural Development*, John HOPKINS University Press, Baltimore, 1975.

farm production system comprises a number of sub-system or component systems, for example enterprises. The farm-family system is but one of many units in the community system. In Ethipia, the farmers' association is a convenient community unit for analysis. Community systems in turn constitute parts of the regional and national systems.

Many of the important elements in community systems are of a socio-economic nature, although there are also significant aspects involving land use, storage or livestock breeding. However, the farm-family system is a suitable focus for a primarily technical agricultural research group. Furthermore, the farm-family system is the adopting unit for improved technology. This system is also readily comprehensible by participating researchers. Community influences are considered as exogenous or outside variables, which often have considerable importance.

Farmer Participation

In the absence of a strong and widespread extension service, rapid adoption of innovations depends importantly on farmer perceptions of how well the inovation facilitates goal achievement. Rarely is there a complete correspondance between researchers' and farmers' perceptions of the farming environment and constraints.

In one survey in the Bako area of Ethiopia, farmers identified disease as the most important problem of livestock production (7), whereas livestock research on the local research station comprises, for the most part, cattle breeding. In the same area climate, wide animals and disease were identified as the major problems of crop production but there is no research on methods of minimizing wild animal damage.

The search for adaptive research topics should be made in the overlapping domains of the real and farmer perceived problems. In fact, relatively little is known about traditional farming systems and, therefore, identifying even the real technical problems is difficult, let alone considering farmer values and perceptions. The search is likely to be successful when both real and farmer perceived constraint sets are better specified.

Also, care is needed that the goals implied by problem definition by researchers correspond to the farmers' goals. Increasing agricultural production, frequently a national objective, is not necessarily a farmer goal, although considerable agricultural research has been directed to this end.

Farm improvement must be analysed in a dynamic framework. Small farmers cannot make « quantum » leaps to exotic or new farming systems. By nature, by virtue of their often risk minimizing goals and because of few resources, small farmers move in small steps. Design of new farming systems requires plotting the transition from the present.

On-farm testing

A criticism common in varying degree to much research is that the research environment is unrepresentative of farming conditions. The nature of research, of course, calls for the fixing of many factors in order to determine the influence of one or more other factors on production. Nevertheless, the results have more validity for farming conditions if the fixed factors are set at levels similar to on farm circumstances, or at least to levels that are likely to be attained in the foreseeable future by the farming community. Further, the good management obtaining on research stations does not reflect on-farm management, so experimental variability does not reflect the temporal and inter-farm variability encountered. Therefore, where farmers are not risk-neutral, an important attribute of the experiment is not monitored properly.

Although some factors can be efficiently investigated under farm level experiments, say fertilizer application, more fundamental research, such as livestock or plant breeding, is more effectively conducted under well controlled conditions. However, the results of these experiments should be confirmed at the farm level.

Evaluation of the package should be done over a period of years, unless the test farmers are dispersed widely enough that between farm variability can be assumed to include normal variability from weather influences. Some innovations yield rapid results, but with soil conservation or livestock breeding benefits are not fully realized for years. Suitable criteria for economic assessment include the productivity of limiting resources, but finally the package must be judged in terms of farmer goals and national goals.

FARMING SYSTEMS PROJECT

The Project began two years ago in one farming system zone and one year ago in two farming system zones. In this paper Project activities in the Bako area are discussed. The three stages of information collation/survey, package development and on-farm testing which are described ideally would be supplemented by an adoption study in the future.

Bako Research Station lies about 250 km west of Addis Ababa, and was established more than a decade ago. Its research activities cover many aspects of plant and animal production. Surrounding the Station is a mixed farming area (cattle, maize, sorghum, tef (8), pepper and noog (9)) with an altitude between 1,600 and 1,900 m. Annual precipitation is approximately 1,200 mm of which most falls between June and September.

Data Collation/Survey

Previous surveys had determined resource bases, cropping patterns and some cultural practices prior to land reform; and some salient socio-economic and marketing features after land reform. This multidisciplinary survey was planned to up-date certain quantitative information but more importantly through refining our understanding of the farming system to identify significant elements of the farming system and of farmer perceptions which might have a bearing on develop-

(7) DIXON and TESFAYE BIRADA : *Preliminary Report on Bako Socio-economic Survey*, IAR, Addis Ababa, 1977.

(8) *Eragrostis abyssinnica.*

(9) *Guizotica abyssinnica.*

ment of appropriate technology. In particular farmer goals and attitudes to change were relevant, and also farmer perceived problems and constraints. Despite the previous farm management surveys, the understanding of the functioning of the farming system was poor. Because there is much traditional wisdom embodied in small farmer practices, the survey enquired into the reasons behind some aspects of farm organization and operation.

The first step was tentative delineation of a homogeneous farming system zone. The rationale of zoning is that by particular groupings of farmers we can more efficiently identify constraints to development, and more effectively administer solutions. Thus the criteria for zoning depends upon the set of possible development strategies and the nature of the farming systems. As the pre-survey progressed the initial tentative definition and delineation of the farming system zone was modified.

All available printed information including aerial photographs on the area was assembled. 1/250,000 maps were used, and some soil survey information existed for some of the area. The criteria for delineation of the zone were relevant to the farming system, or what is now, rather than the agro-ecological zone, or what could be. Our intention was to base packages of technology on the present system not on (theoretical) physical resource bases as identified in agro-ecological zones. In this case the farming system was miwed farming with the important enterprises being cattle, maize, tef and the cash crop pepper. Additional crops grown were sorghum and noog. Pulses, if grown, were restricted to very small areas. Soil was uniform through the zone. One boundary was formed by heavy black soil valley bottoms; and others by a shift in cropping pattern to wheat, barley and pulses over 1900 m, or to predominantly cattle raising.

A list of all farmers' associations (10) in the area was obtained from the Extension Project Implementation Department EPID, and with their assistance all farmers' associations located on maps and their farming systems specified as normal, dubious or different from the farming system in question. For example, some farmers' associations were classified as unsuitable because they were settlements therefore having different community relationships. In practice, the only alternative for delineating zone boudaries to EPID experience was extensive and costly ground survey. During this activity preliminary contact was made with farmers' association officials, and much information on the farming system was assembled during extensive discussions with farmers and extension personnel. First hand observation was invaluable in gaining insights into farming practices.

Bako Research Station has less than 10 Research Officers, and thus close contact existed between these individuals. Thus the several multi-disciplinary meetings to discuss and modify the Farming Systems Research Project proposal were quite productive. Research officers from the fields of soils, plant protection, agronomy, livestock pastures and agricultural economics were involved. The strength and practical orientation of the pasture and livestock staff helped balance the traditional bias in Ethiopia in favour of crop production. The questionnaire was formulated over two or three meetings.

In questionnaire formulation the agricultural economists played a catalytic and coordinating role. Initially the questions were put : how much is known about farmer behaviour and perceptions in your field? What do you need to formulate research priorities and a package of innovations? of this, what can the farmer tell you and what other sources of information are there? Drawing upon the survey experience of the agricultural economists, questions were formulated appropriately. Further discussions identified the important links between disciplines and enterprises in the whole farm system, and questions on these topics were formulated as well. During questionnaire formulation it became apparent that considerably more was known about the crop production subsystems than about the pasture-livestook production subsystems, which was a direct result of the historical bias towards crop production referred to above.

The questionnaire was translated and where possible procoded. The sample frame was taken from members lists kept by all farmers' associations. On some occasions updating was necessary. Two stage sampling was done, whereby first stage sample of farmers' associations was about 15 % and the second stage sample of members of selected associations was about 7 %. Both stages employed random sampling.

Normally pre-testing of the questionnaire should be done prior to the survey, but in this case during the first days of the survey unsuitable questions were modified or dropped. One question which proved troublesome was the description of local varieties of maize and sorghum. This was thought important in order to ascertain what attributes might desirable in improved varieties. Interviewers were provided by the various disciplines and the extension service, selected for their reliability and local origin. Agricultural economists supervised interviewer briefing, which took two days followed by very close supervison in the early days of field work. Normal interview duration, after interviewers became familar with the questionnaire, was 60-90 minutes. During briefing interviewers were taught field area estimation and heart girth measurement techniques.

Although questionnaires were designed for direct punching of data, it proved necessary to transfer the data from the questionnaires to coding sheets before punching and transfer to FAO headquarters in Rome for analysis.

Whole farm package development

Earlier the case for a whole farm systems approach was argued. Innovations selected for the package should by synergistic. The focus during the package selection was on the middle level manager. In any farming community there is a spectrum of managerial performance. Technology aimed at the best farmers may produce better per farm results than simpler technology designed for the mediocre farmers, but the latter could be expected to be more rapidly adopted by a larger proportion of farmers and therefore have a grater impact.

Following the survey the « average » farmer was defined. Then the multi-disciplinary team of researchers selected a

(10) All farmers are organized into associations of 140-500 members, with an agerage of about 300 members.

package of innovations, with due regard to the interactions between enterprises. In earlier meetings some of the interdisciplinary conflicts had been resolved; and the concrete task of producing a workable package of technology for real farms facilitated resolution of differences. Many questions concerning interactions between disciplines had not previously been addressed by both disciplines : for example, production and use of crop residues for livestock; use of organic fertilizers; and dry season grazing management. Practical issues were also raised such as methods of row planting using oven. The general issue of differences expected between the Station and small farms for optimal input levels, for example, fertilizer use, had no easy solution. The most contentious issue was the level of confidence necessary in an innovation for it to be included in the whole farm package. This issue was particularly pertinent to improving the genotype of the cattle herds.

After several meetings a package was devised which suited all disciplines. It included establishing crossbred bull stations in three farmers' associations, cutting a small area of local grass Hyparrhenia sp. for hay for dry season feeding, establishing runs of elephant grase on the contour for erosion control and green pick for young animals, use of disease free pepper seedlings and proper planting methode, sweet potato, some improved maize, sorghum and tef seed, row and timely planting of maize and sorghum, and fertilizer application. If anything the package comprised too many innovations, but few of the innovations were complex. Some new skills were required, including row planting and heat detection. The expected benefits of the package were large. Some of the innovations, such as improved livestock, were also unsolicited suggestions from farmers' associations.

On farm testing

The objective of on farm testing was to confirm the acceptability and worth of the whole farm package. Genrally, the test farms were not planned as research plots, so all elements of the package should wherever possible have been proved on the Station. It was expected that the farmers' criteria for judging acceptability would be much broader than the Station's tests. Also, many other factors including communal work and values impinge on the farm. As some innovations, the acquisition of new skills and new facets of management require time, the package should be evaluated over several seasons.

The test farm programme was developed in cooperation with farmers' associations. The programme was explained at farmers' association meetings, and the members were asked to nominate from among their number possible cooperative representative farmers. The aim usually was to have 2 or 3 test and 2 or 3 control farmers on each cooperating association. The association was asked to nominate twice the number needed for test and control farmers, and the Project reserved the right to screen the nominees. Finally, 10 test farmers and 9 control farmers were selected on 5 farmers'associations.

As far possible inputs were provided through normal channels. Fertilizer was supplied by the extension service on normal terms. Where improved seed were provided by the Station, the farmer will pay back an equivalent amount of seed from his harvest. Initially all feed and management costs for the bull stations were met by the farmers' associations. Owing to poor performance because of poor management, one bull was returned; and it was felt that the remaining bull station should be assisted in order to encourage the farmers' association.

Records are being kept of all labour use, oxen use and inputs and outputs on each field for test farmers and control farmers. An inventory of fixed assets will be conducted at the end of the season. The FAO Farm Management Data Collection and Analysis System will be used to analyse the data. Other information is being collected in order to identify farmer reaction to the package. In particular crop cuts were made. An incentive to ensure control farmers' cooperation was created by offering them the opportunity of participating in the test farm programme the next year, either as full test farmers or as unsupervised and perhaps infrequently monitored control farmers i.e. with access to inputs but no supervision.

(11) DIXON J. : *Farming Systems Research Project for Bako, IAR, 1976.*

DISCUSSION AND CONCLUSION

Results of the Bako test farm programme are not yet available. Nevertheless, some tentative conclusions can be drawn from the experience so far.

The original Project proposal (11) called for more detailed preparation of all steps than in fact transpired. A nucleus team of research and extension staff was to be established. Its first task would be to prepare, using existing information, situation papers on the farming system zone under consideration and relevant research results, from which the broad objectives of the farm survey would follow. Based on the survey results, a whole farm package would be developed during a series of team meetings and with considerable interaction with farmers. The process would entail representative farm planning and appraisal of the relative merits of small changes in the plans, particularly concerning the productivities of scarce resources. Both situation papers and farm plans would be a valuable crystallization of ideas.

In fact the Project was begun with a shortened time frame because it was started late in the cropping season and it was felt necessary to conduct the survey whilst crops were still in the ground. Situation papers were not prepared. Also, detailled farm plans were not drawn up. Because the Bako Research Station staff was a small self contained group with close individual contact shortening the time frame did not jeopardize the success of the Project. However, on a larger research station, with a recently established research effort or where the members of the multidisciplinary team come from different institutions, all steps in the process should be taken.

Initially there was some resistance to the ideas of interdisciplinary work and the need for farmer testing of technology. The resistance soon disappeared, but forging the interdisciplinary links between crop and animal research was not easy. There have been few links, traditionally, between crop and livestock research despite the crucial interaction between crop and livestock production. Such links take time to develop, and certainly the Project has contributed to crop and livestock research cooperation.

The Project has improved the understanding of the local farming systems zone, and through survey and the test farm programme, built a research farmer link. The link must carry a two-way plan of information. The information exchange process was both formal, such as recommendations or survey, and informal as occurred during researcher visits to farms.

Gross disciplinary methodologies are not well established, although systems approaches to agriculture have been widespread. This Project was not primarily multidisciplinary analysis, but required a framework for an extended research concept in which different disciplines could participate. Obviously there should be some optimal balance of input from different disciplines which will make for efficient generation of solutions, but methods of identifying the optimal discipline mix are not well developed. As the Project progressed, areas were identified where a greater input would have benefitted the Project. These areas included weed control, oxen tillage equipment, storage and innovation adoption.

The farmer survey coupled with the close contact with farmers enabled identification of problem areas which were given high priority by farmers.

These problems were considered worthy of attention if they were as well technical problems capable of solution, that is, if solutions were possible and probable. This approach led to be ready acceptance of the whole farm package by the test farmers.

In conclusion, within the framework of previously established guidelines for rural development, the Project utilized systems concepts and farmer participation including on farm testing to improve the process of agricultural research. The approach proved successful, and is being adopted on other research stations of the Institute of Agricultural Research, Ethiopia.