AN OVERALL FRAMEWORK OF ASIAN FARMING SYSTEMS RESEARCH PROGRAM

Virgilio R. Carangal

I. Introduction

Asian rice farmers are generally involved in various activities in the farm. These are production, consumption, savings and investment activities. Their farm activities are conditioned by their family needs and aspirations and by biological, physical and socioeconomic constraints. Because of the complex activities in the farm and the interactions of farm activities with the environment, cropping/farming systems approach to research appears to have better promise than the commodity approach in increasing farm productivity and welfare of small farmers.

The two major agriculture production enterprises are crop and animal production which constitute about 70-90% of the agricultural enterprises in a small farm. Farmers consciously diversify the use of their resources to produce mix activities to maximize their income. A typical rice farm is generally small with less than 1 ha (Java, Indonesia) to about 5 has (Thailand and Burma). It consists of a cropping area, a homestead with the house, trees, vegetables and livestock. One of the most important crop is rice which is grown during the rainy

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[1]Head, Rice Farming Systems Program, The International Rice Research Institute, Los Banos, Laguna, Philippines.

season and upland crops before or after rice. The common upland crops grown with rice are soybean, mungbean, corn, sesame, sweet potato, wheat, peanut, blackgram, chickpea and mustard. These crops are planted during the dry season on residual moisture or with irrigation when available.

A systems approach to research was started by IRRI on rice-based farming in 1974. A methodology for cropping systems research evolved and was refined by various national programs involved in the Asian Cropping Systems Network. This methodology was further expanded to include not only cropping but also animal production, fisheries and forestry. Some national programs have expanded to farming systems research and in 1983 the Network changed its name to Asian Rice Farming Systems Network. The methodology is used mainly in rice but is also used for other cropping/farming systems.

II. Characteristics of farming systems research

Farming systems research is an improvement of the present research system to help small farmers increase their production and income. The main characteristics of the approach are the following:

a) Interdisciplinary and intercommodity - It involves different disciplines particularly agronomy, economics, entomology, plant pathology, soil science, commodity breeding, social science, animal nutrition, forage crop agronomy, aquaculture, extension and other disciplines. It also involves several commodities depending on the farming systems involved in target areas.

b) Farmer participant research - Farmers participate in the research process. Farmers are very smart in using technology and resources for their environment. Researchers and farmers plan and implement the research together to develop more acceptable technology. Farmers input is not only important in site research but also in experiment station research.

c) Environment conditioned - Research is conducted in defined environments representing the target area. With good data on the environment and production performance, technology adopted for a given environment can be extrapolated in the same environment within the target area.

d) Farm resource conditioned - The approach takes into consideration the resources of target farmers. Available resources are considered in the design and testing of alternative systems.

f) Farmer management conditioned - On-farm research is conducted in farmers' fields and managed by farmers. Researchers prescribe the technology with concurrence of the farmers and farmers implement the agreed-upon systems.

h) Decentralization research - In most national programs research proposals are prepared from the central office at national level. With this approach research is designed at the site level with help from the national level. The researcher at the site level plans and implements the research. Analysis is also done at the site level with help from regional and national level.

i) More relevant research - Before research is started, production problems are identified in the target environment and research site. Research is conducted on immediate problems of the target environment.

j) Better feedback of production problems - Site research usually starts by using the recommended technology from experiment stations. Oftentimes technology is not appropriate so it has to be refined in the site and feedback given to researchers in the experiment station. Other problems identified that limits production are feedback for more in-depth study.

III. Organizational framework for implementing farming systems research

In all developing countries research institutions are strongly discipline and commodity-oriented. Experiments are

generally conducted in experiment stations under controlled environment with on-farm research on component technologies using the mini kit scheme or scattered on-farm component technology research. There are technical committees that evaluate the technologies identified in the stations and recommendation to production programs are developed for the whole country. Production programs and extension activities are also commodity oriented such as Masagana 99 (Philippine Rice Production Program), Maisagana (Philippine Corn Production Program), BIMAS (Indonesian Rice and Upland Crops Production Programs), livestock production programs in the Philippines, Thailand and Sri Lanka and fisheries production programs in Indonesia, Thailand and Philippines. There is a need to develop a more integrated program like the KABSAKA program in the Philippines and cropping systems production program in Nepal.

Research systems are nationally coordinated through agricultural research councils in some countries. Philippines, Malaysia, India, Pakistan, Bangladesh created agriculture councils. The councils are organized based on discipline and commodity research. The Philippines has a farming systems team as one of the commodity teams of the council. Most national programs in Asia have highly centralized research systems. In general, highly trained scientists are assigned at the national level. In the late 70's, more countries decentalized research. Sri Lanka regionalized research in 1977, Philippines 1981, Thailand in 1982 and Indonesia in 1981.

Crop research is in general separate from the institution responsible for livestock and fisheries research although both are under the same Ministry or Agency in most countries. In the Philippines, the Bureaus of Animal Industry, Plant Industry and Fisheries are both under the Ministry of Agriculture. The food crops, animal and fisheries research institutes in Indonesia

are under the Agency for Agricultural Research and Development (AARD). In Nepal, livestock and crop research are under 2 Director Generals but the same Ministry. In Thailand crop research is with the Department of Agriculture and livestock research with the Department of Livestock Development. Sri Lanka is different. Livestock and crop research are under two different Ministries. In general, there is no linkage between crop and livestock, except in countries where forage crop research is with the crop research institution. Likewise, fisheries institutions have no linkage with other institutions. Coordination within and between agencies or institutions is a major problem.

Farming systems is much more complicated than the commodity and cropping systems research. It involves more disciplines and more commodities. We cannot bring together in one organization the crop, animal, fishery and social sciences under one organization and management. This will mean changing the agricultural research systems in all the countries. The best approach is to examine the existing organization and establish a workable organization that will utilize the available manpower, financial resources and political situation. There are many things to do in farming systems research. We can tap all the resources available and assign activities to various institutions. There is a need to establish collaboration between various organizations. A simpler way to accomplish coordination is to establish working groups or committees at a site, regional and national level (Figure 1). If there is a Farming Systems Institute in the country, the institute can take the lead in organizing the different working groups.

Farming systems site

At the site level we need the combined input of crop, animal and social sciences. We need a minimum of 3-4 scientists,

The research team should have an agronomist or social scientist, economist, livestock specialist and crop protection specialist. Since there are very few economists and aquaculturists they can be assigned at the regional level with trained field assistants looking after data collection. The team should live near or in the site. The team members should have: (a) broad spectrum of specialization within the discipline of crop, animal, fishery and social sciences, (b) familiarity with the terminologies and methodology, (c) experience or training in interdisciplinary farming systems research, (d) good communication and working relationships as a team. One of the team member must be assigned as coordinator to coordinate the activities and provide support services to the other members of the team.

The team members should be involved in the selection of the site, description of the site, design of experiments, analysis and interpretation of data and write up of the experiment. Assistance is needed at the regional or national level at the beginning. As the team gets more experience they can effectively plan and implement the research activities in the site.

Regional Working Group

Some countries in Asia have regionalized the research system. In countries where there is regionalized research, an interdisciplinary and interagency group should be created. This can be called Regional Farming Systems Working Group. The group should be composed of senior scientists in the region from the commodity crops, economist, entomologist, plant pathologist, livestock scientists (animal nutrition and animal production) forage crop specialist. aquaculturist and extension specialist. Members can come from various institutions of the Ministries and from Universities in the region.

A good example of a regional research set-up is the newly established Regional Integrated Agricultural Research System (RIARS) and Regional Research Office (RRO) in each of the 12 regions of the Philippines. Each region covers 8-12 provinces. RIARS is responsible for farming systems research and the RRO coordinates all the research institutions in the region. The working group is equivalent to the Regional Research Coordinating committee in each region. RIARS has 5 senior scientists with research assistants plus support staff. The team is composed of an agronomist, an economist, a livestock specialist, a social scientist and an extension specialist. The manpower at the regional level is enough for a farming systems research team. As the project progresses more disciplines can be included.

The members of the working group should help in the design of the experiment at the site. It should meet at least once every 3 months to review the progress of activities, identify problems for experiment station research, solve problems in implementation, facilitate research activities in the site and regional station, and coordinate regional meetings and workshop. The region should organize a workshop once a year to review the progress of research and discuss the plan of work for the following cropping pattern year. Other scientists from different disciplines and institutions in the region should be invited in the workshop. Regional farming systems working group should encourage component technology researchers to visit the sites especially if there are problems on some of the components. The meetings and visits will link site researchers with the regional researchers and provide a good flow of information and assistance.

Farming systems research assembles component technologies available from research stations in farmers' field which is further refined by the site team. Component technologies are

conducted in research stations at the national level and regional level. In most cases trained senior scientists are located at the national level. For more effective implementation of farming systems research, there is a need for continued backup by commodity and discipline oriented researchers from national level to resolve bottlenecks to increase production at the farm level. This can be done through regular visits and workshops. Better contact between them would also focus the research at the national or regional level on problems of small farmers.

National Working Group

A National Working Group or equivalent should be created to coordinate the participation of various institutions. This will bring together different institutions directly invovled in farming systems research. The group can plan together research programs, provide guidelines in implementing site and experiment station research with expertise from different institutions, standardize data formats, organize meetings to bring together farming systems researchers, and recommend areas of research. Participating institutions can focus on and assist in developing projects for funding. Members will come from the national farming systems research team, institutions directly involved such as from the livestock, fisheries and crop research centers, extension agency, the head of the regional farming systems teams and other institutions important in implementing farming systems research. The group should meet at least 2 times a year.

A national workshop should be organized by the National Working Group. The objectives of the workshop are: (a) review progress of research in the sites and national and other researcher centers, (b) review research methodologies, (c) develop research plan, (d) exchange research information, and (e) develop recommendations. The working group can meet immediately after the workshop and the second meeting can be

organized 6 months before the start of a cropping season.

IV. Farming Systems Research Methodology

A conceptual framework of cropping systems research and development was formulated after 3 meetings of the Asian Rice Farming Systems Working Group (members are leaders of cropping/farming systems research from national programs). This framework was recently expanded to include animal production system (Fig. 2). It started from selection of target areas and conducting research in selected areas until the production program. It is an interdisciplinary research approach involving biological and social scientists with the participation of the farmers in the research process. A research team is assigned in the site which maybe a village or several villages.

1. Selection of the target areas

This involves the selection of one or more geographical areas representative of large homogenous production zone. The area should have potential for increase produciton and cropping intensity, good marketing system and infrastructure and adequate extension service. In addition, the area should be a priority area for development by the regional and national government. This way when potential has been demonstrated, support for production programs will be given to use the results. A target area may be in the order of 20,000 to 200,000 ha.

Target area is often selected by government planners, administrators and scientists. The area is usually the more depressed or politically hostile areas. Government would like to improve economic development through farming systems research. However, this scheme is difficult because better

trained and experienced scientists and admistrators hesitate to work in and visit this areas. Target areas are often also selected based on projects by different funding institutions. Sometimes duplication of sites with the same environment cannot be avoided.

As soon as target areas are delineated, information is obtained on physical and socio-economic conditions of the target area using secondary data. Check the following: (a) soils map, (b) climate, (c) produciton data on both crops and livestock, (d) regional development plans, (e) marketing information, (f) constraints to production, (g) support services such as input outlets, infrastructure, storage facilities, etc and other items available to understand agriculture in the target area. After getting the information, select a representative area where on-farm research and experiment station research can be conducted. The site can be one or more villages. Extension service and the government agencies should be involved in the selection.

2. Site Description

The first activity of the research team is to describe existing farming systems. They have to identify the different production complexes occuring in the site and relate this to difference in environment. For example, the site in Santa Barbara, Pangasinan, Philippines used water availability to classify the environment to rainfed and irrigated. In Iloilo site, soil texture and topographic position were used to classify the environment while in Baturadja, Indonesia, settlement periods were used.

There are several objectives in site description. These are to provide information for planning the on-farm trials to be conducted, develop better understanding of existing farmers' systems, provide benchmark information on farmers' situation

before initiation of the work, collect information useful for extrapolation and help select agronomic and or economic cooperators. The most important is to design the survey to include the first three objectives because the information is needed to implement the on-farm research one month after the survey. The other objectives can be studied during first year or during the testing and evaluation process.

The team would normally get information on the existing crop and animal production systems, constraints to production, present level of technology, crop-livestock interaction, other enterprises in the farm, sources of animal feeds, etc. The team should know the socio-economic conditions in the site such as farm size, family size, tenancy, labor, cash and power availability and cost, marketing, etc. They should also get information on some biotic factors such as diseases and pests distribution over the year, weed distribution, etc.

Site description should not be only conducted by economist or social scientists. Research workers especially who will be assigned in the site should participatc together with extension workers from the area including extension subject matter specialists and researchers from experiment stations designated to backstop the research site.

3. Disign of farming systems

This involves the design of alternative or improve cropping systems, animal systems, crop-animal systems and crop-animal-fishery systems. In the design, we take into consideration the physical, biological, and socio-economic conditions in the site and the farmers' existing systems. Assemble available component technology using the latest recommended practices from regional or national research stations. This technology consists of varieties, tillage practices, planting

methods, crop interactions, intercropping, pest management effects of crop combinations, livestock breeds, quality forages, feeding system, etc. Farming system design and specifications of the component technologies for the system is done by the research team in the site with the help of their supervisors in the regional or national research programs. An example of cropping pattern design is the work in Pimai cropping systems site. The existing system is one rice crop planted in July and August. The cropping system team designed the following cropping patterns for testing: (a) mungbean-rice, (b) peanut-rice, (c) corn-rice, and (d) sesame-rice. The team prescribed the technology for each crop in the system using national or regional recommendations. Most of the cropping systems sites in Asia normally designs 2-4 cropping patterns for testing.

Another example is the crop-livestock research in Santa Barbara, Pangasinan. The designed alternative systems for crops in rainfed lowland site are rice-mungbean, rice-peanut and mungbean-rice and for livestock 1-2 cattle for fattening with Leucaena, mineral supplement and better feeding as the intervention. Farmers have only one rice crop and 0-2 cattle for fattening and draught.

In addition to alternative farming systems, component technology experiments are also identified and designed to conduct research on major problems identified during the site description. An example of component technology research in most sites are varietal trial of crops as it fits the system, fertilizer studies, population studies and insect control. These are conducted to refine the recommendations in the site.

4. Testing

This involves the testing of the designed systems and their management in the respective environments in farmer's

fields. The assumption made in the design of the systems is tested under farmers' management. For each system at least 4 farmers should be involved as replications. For example the cropping patterns to be tested are the following: rice-rice-corn, rice-rice-mungbean, rice-corn-corn and rice-soybean-corn. Get at least 4 farmer cooperators for each pattern Plot size is normally 1,000 sq. meters. Farmers are given the input to test the cropping patterns. Technology are prescribed and discussed for implementation with farmers. Researchers get the data and all the harvest are given to the farmer researchers. For crop-livestock, the procedure for crops is the same but for livestock the project should take advantage of existing livestock. The following procedure can be followed:

a) Crop and livestock production systems - For large animals such as cattle and carabao the best scheme is to study the cropping and livestock separately in the same area. Get the necessary information for the whole farm and introduce innovations on cropping and animal system. Select different cooperators for crops and livestock. Test cropping patterns with at least 4 farmers per pattern and livestock with at least five farmers. Monitor 5-10 agroeconomic cooperators to compare the existing system with the experimental alternative system.

b) Crop-livestock integration - For smaller animals like goats, experiments on crop-livestock in the same plot can be conducted up to 2,000 sq. meters. For example in Masbate site the team is testing corn-corn+mungbean+Leucaena with forage+goat in the system. Crop-livestock integration can be conducted for larger animals but plot size has to be at least 1/2 ha or more. It will be very expensive especially if the project will provide the animals and inputs for the systems. Always select 5-10 cooperators to monitor existing systems and compare the alternative system with existing system.

c) Crop-swine-fish production system - There are several sites in Thailand. However most of the sites are just monitoring whole farm where the rice farmers are following swine-fish integration. This should be compared with farmers not practicing swine-fish or with farmers that do not have small fish pond. Another way of doing the trials is to study cropping systems with 4 farmers per cropping pattern. In the same area study swine-fish separately. However monitor existing system of 5-10 farmer cooperators as control.

Component technology research should be conducted to further refine the recommended technology used in the cropping and animal systems. An example of component technology research are: (a) varietal trial of crops in the pattern, (b) fertilizer rates, (c) weed control, (d) insect control, (e) plant population studies, and (f) others. Experiments should focus on technology that can increase production and income of the pattern and cut the cost of production.

In some countries, the research site is 5-20 kilometers away from the experiment station. On-farm testing is conducted in farmers' fields and component technology may be conducted in the experiment station using the conventional research design with several treatments and 3-4 replications. Simple experiments with 2-4 treatments can also be conducted in farmers' fields. These scheme is true in Thailand and Bangladesh. In most countries there is no research station in the target area. Farming systems testing and component technology research should be conducted in farmers' fields. There are 2 kinds of research: research managed and superimposed trials. Research managed trials are the same as experiment station trials but conducted in farmers' fields. Analyses and interpretation are the same as in experiment stations. Normally the trials are replicated within the same farm and treatments can be more than 5. The super-imposed

trials are used to evaluate the performance of component technology assigned to the experimental cropping pattern. Usually trial is conducted in cropping pattern field. Number of treatments should be less than 5. Replications are also across farm like the cropping pattern.

5. Multilocation testing and pilot production programs (Preproduction)

a. Multilocation testing

Multilocation testing is a procedure for evaluating the improved farming system that are found promising in the research sit. Test should be conducted in many locations that represents the environment of the research site. The number of test locations will vary depending on extent where data can be extrapolated and manpower and financial resources of the home country.

After 3 years of testing farming systems in the research site, the team is expected to identify a technology that is biologically and economically superior than the present farmer's farming system. In previous working group meetings the conditions discussed for the improved cropping patterns to be superior are: (a) net return per hectare should be at least 30% higher than farmer's system, and (b) net return above cash costs must be at least twice the cash cost.

Extension workers play an important role in multilocation testing. they should conduct the multilocation trials in cooperation with researchers. The research team design the farming systems to be tested and define the domain of adaption of the system. The team then prepares detailed recommended practices for growing the crops and animals. See to it that materials are available for testing. A Preproduction Management Committee composed of at least a representative from the research team, regional or provincial

subject matter specialist and soil scientist and extension workers should identify the locations using secondary data and visit the locations together with the extension worker of the area to select the locations. An experienced researcher (preferably one who works in the site and may be the researcher representing research in the multilocation testing committee) should be assigned to follow-up and back-stop the extension worker conducting the multilocation trials. He may be designated as Preproduction Research Coordinator. He should work full time in linking extension with research. His coverage may be based on geographical, political or regional demarcations depending on the number of test locations.

The committee should identify the municipalities or districts within the extrapolation area and concentrate the multilocation test in one or 2 villages in each selected municipalities or district instead of scattering the test in many villages or municipalities. The advantages of clustering the plots are: (a) less research or extension personnel are needed, (b) precision at a specific area is increased, (c) supervision of plots is easier and less expensive, and (d) more locations can be handled within the extrapolation area. To spread the technology in wider area the multilocation trials can be followed by demonstration plots by regular extension workers in other villages within the target area.

A 1-2 weeks training should be conducted for the extension workers who will implement the multilocation trials. It should cover principles of farming systems research, procedures in conducting multilocation testing, component technology for the farming systems to be tested, methods of measuring and importance of physical and socio-economic environments, data gathering, analysis and their interpretation, how to work farmers and others.

b. Pilot production program

Another step before large scale production program is the pilot production program. This phase involves conducting a production program covering few to hundreds of hectares. Generally the multilocation testing involves testing the technology in 1,000 sq. meter plots and in several locations. If the technology is promising it can be expanded to 10-200 hectares the following year. Pilot production can also be started in the research site after 3-4 years of research. The pilot production program is used to determine the support structure needed in large scale production program. It should be designed to determine the following: (a) intervention needed to provide credit, purchased inputs, markets; (b) management structure needed to insure timely delivery of the inputs; (c) organizational structure needed to implement a systems program; (d) extent of farmers' adoption of the farming systems technology; (e) manpower and financial requirements for implementation of the production program. Pilot production program is usually implemented by extension workers with researchers providing the technical backstop. A Pre-production Management Committee involving various institution involved in food production should be organized. It should involve representative from credit institution, extension service, research institution, agricultural inputs, distribution-marketing agency, and political leaders in the community. All extension workers involved in the program must be trained on the new farming systems technology.

6. Production Program

As soon as the most promising system are identified through multilocation testing and pilot production programs, a large scale production program can be implemented.

The extension organization takes the responsibility of implementing the program with the help of other supporting services. The experience in the pilot production will define the institutions and mangement needed in the program. Target coverage should be established and extension areas are identified. Production program can be implemented in target coverage and multilocation and demonstration trials are conducted in extension areas which later can be expanded to large scale production program. All extension workers involved in the program should have training on the technology.

V. Asian Rice Farming Systems Network

The network of research sites was established in Asia in collaboration with national programs. It is a scheme for IRRI and national programs to work together to jointly increase food production in Asia through the identification of a more productive rice-based farming systems that are acceptable to small scale farmers. The research methodology followed in the Network was discussed earlier. This was extended also not only on rice-based but also to some upland crops based systems.

National programs have expanded their activities in the last 10 years. There were 6 cropping systems sites in 1975 in 3 countries and in 1984 there were 194 cropping systems/farming systems sites in 13 countries in Asia. Thailand, Philippines, Nepal, Sri Lanka and Bangladesh are implementing the preproduction phase. Philippines and Nepal are also implementing production programs. India plans to conduct cropping systems research in 20 sites and rice-fish farming in 6 sites.

There are several collaborative research activities in the Network. The major one is cropping pattern testing where we are jointly monitoring cropping pattern agronomic and economic performances in 44 sites representing rainfed lowland, irrigated,

partially irrigated and deepwater rice. Shown in Table 1 is the promising cropping patterns in 12 countries. The latest collaboration is on crop-livestock research in 5 farming systems sites (one each from Thailand, Philippines, Indonesia, Nepal and Sri Lanka). The other collaborative research which are mostly conducted in experiment stations and some in farmers' fields are varietal testing of upland crops before and after rice, farm implement for intensive cropping, rice-wheat cropping systems, long-term cropping pattern and fertilizer studies and insect management.

Table 1. Number of crops in farmer's predominant patterns, number of crops in the experimental pattern and the promising cropping pattern.

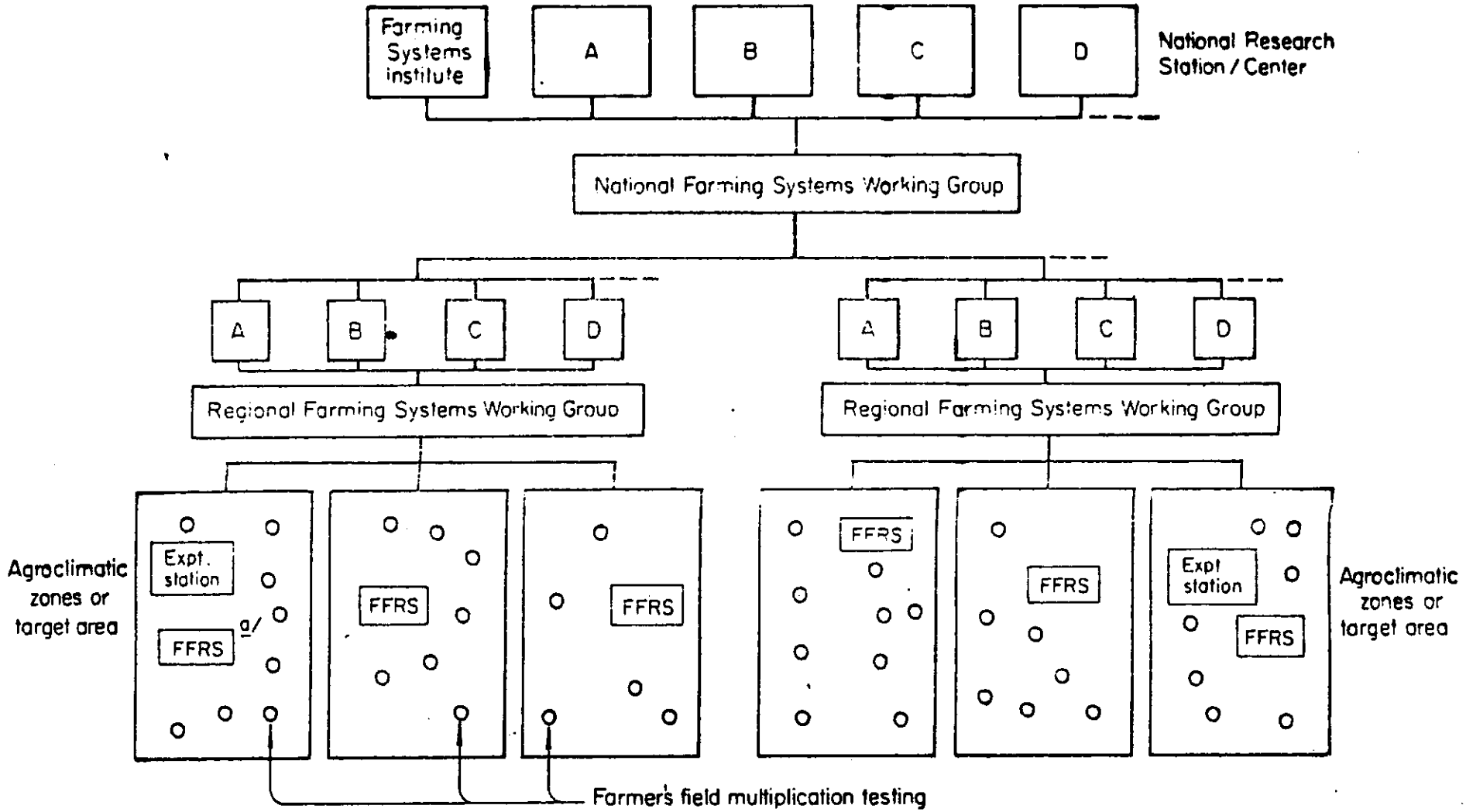
Site	No.of crops in pattern		Promising cropping pattern
	Farmers'	Tested	
Rainfed lowland			
Carmen, Philippines	2	3	rice-rice-mungbean
Abuyog, Philippines	2	2-3	rice-rice-water-melon
Wakema, Burma	1-2	2	jute-rice
			rice-tobacco
Kota Bharu	1-2	2	rice-peanut
Vigan, Philippines	2-3	3	rice-rice-onions
Bantoa, Indonesia	1	2	rice-rice*
Katapotha,Sri Lanka	1-2	2	rice-peanut
			rice-bush sitao
Bireun Acch	1	2	rice-soybean
Ratna Nagar, Nepal	1-2	2-3	rice-maize
Guimbal, Iloilo	1-2	2-3	rice(DSR)-green corn
			rice(DSR)-mungbean
Khon Kaen, Thailand	1	2	peanut-rice
			cowpea-rice
Nakonsri Thammarat	1-2	2-3	mungbean-rice-mungbean
Rainfed lowland (with cooler temperature)			
Pumdi Bhumdi, Nepal	2-3	2-3	rice-wheat maize
			rice-maize
Sukchaina, Nepal	2	2	rice-chickpea
			rice-wheat
Hathazari, Bangladesh	2-3	3	rice-rice
			rice-rice-cowpea

Table 1. (Cont'd)

Site	No.of crops in pattern Farmers'	Tested	Promising cropping pattern
Partially irrigated			
North Nawin, Burma	1	2	rice-sunflower
Bandarawela, Sri Lanka	2	2-3	rice-potato-bean
Patheingyi, Burma	1	2	cotton-rice
Yezin, Burma	1-2	2-3	rice(DSR)-peanut
Phrae, Thailand	1-2	2-3	mungbean-rice-soybean
Hathazani, Bangladesh	2-3	3	rice-rice-wheat
			rice-rice-peanut
Rainfed dryland			
Antique, Philippines	2	2-3	rice-corn+peanut
Bukidnon, Philippines	2	2-4	rice+corn-corn+peanut
Batumarta, Indonesia	2-3	4	rice+corn/cassava/
			peanut or soybean
Manito Albay, Philippines	2	2-3	rice-sweet potato-
			mungbean
Irrigated			
Beijing, china	1-2	2	wheat-rice(DSR)
Mahaweli H, Sri Lanka	2	2-3	rice-onion/chillies
			rice-peanut
Changsha, China	2-3	2-3	rape-rice-rice
Parsa, Nepal	2-3	3	rice-maize-maize
			rice-wheat-rice
Shoaxing, China	2-3	2-3	barley-rice-corn
			barley-rice-rice
Ratna Nagar	2	3	rice-wheat-mungbean
			rice-wheat-maize
Kyeongbuk, South Korea	2	2	rice-vegetables (pea,
			garlic) Wheat-rice
Candelaria, Zambales	2	2-3	(new)
Kaoshiung, China	2-3	2-3	rice-soybean-corn

Table 1. (Cont'd)

Site	No.of crops in pattern		Promising cropping Pattern
	Farmers'	Tested	
Deepwater and tidal swamp			
Daudkandi, Bangladesh	2	2-3	DW rice-fallow-potato DW rice-potato-sesame
Barambi, Indomesia	1-3	4-6	rice-rice in paddy and corn+peanut/cassava+ sorghum in bunds



a/ Farmers field research site

Fig. 1. Organizational structure of Farming Systems Research in a national research system.

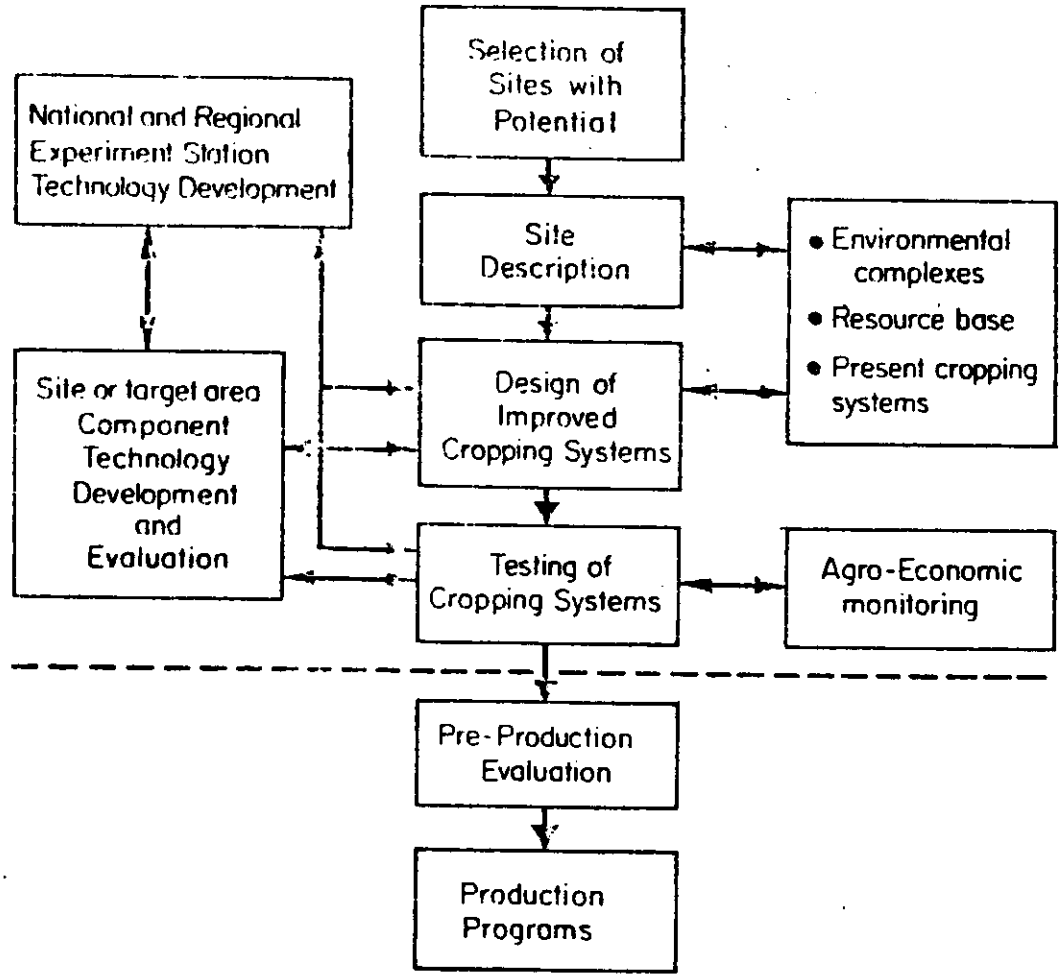


Fig. 2. Farming Systems Research and Development.