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Asian Grain Legumes On-farm (AGLO) Research

Report of a Planning Meeting

20-24 Nov 1989

ICRISAT Center
India

ICRISAT

Asian Grain Legumes Network
Legumes Program
International Crops Research Institute for the Semi-Arid Tropics
Patancheru, Andhra Pradesh 502 324
India

1990

AGLO PLANNING MEETING

Purpose:

To plan the strategies for adaptive on-farm research and transfer of technology in Asian countries for ICRISAT's mandate legumes: groundnut, pigeonpea and chickpea.

Objectives:

- Assess each country's needs for increasing legumes production, and review constraints,
- Survey technology available and need for further adaptive research to meet these constraints,
- Review existing strategies for adaptive research, on-farm testing, and transfer of technology,
- Recommend ways in which ICRISAT may be of assistance in supporting these strategies, and
- Propose time-bound plans for country based adaptive research and transfer of technology projects.

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FOREWORD

The report draws together the talks, statements, recommendations, and draft project proposals that were given to the Asian Grain Legumes On-farm (AGLO) Research Planning Meeting held at ICRISAT Center, 20-24 November 1990. The meeting was funded by a Special UNDP grant. The meeting brought together representatives from five Asian countries called the Project Countries (Indonesia, Myanmar, Nepal, Sri Lanka, and Vietnam) to interact on ways to plan for and carry out on-farm adaptive research and to use this background to practice preparing draft project proposals. Guidance was also sought from participants as to the role ICRISAT could play in on-farm adaptive research in their country. Involved in this process were scientists from other Asian countries and organizations who acted as consultants. The results of this meeting will provide guidance to some of these countries who along with ICRISAT will be developing on-farm adaptive research projects with funding from UNDP grant to ICRISAT.

This report has had a minimum of editing resulting in some inconsistancy in style as the intention is to provide participants with a record of the proceedings. It is not intended to be a finalised document that is in any way binding on any party nor is it intended for general distribution.

INAUGURAL SESSION

Welcome and Objectives of Meeting

D. McDonald

Mr Chairman, distinguished visitors, country representatives, consultants, Director General of ICRISAT, and colleagues, on behalf of the ICRISAT management and of the Legumes Program I welcome you to the Asian Grain Legumes On-farm Research Planning Meeting.

The purpose of this meeting is to plan appropriate strategies for adaptive on-farm research and transfer of technology in Asian countries for ICRISAT's three mandate legumes: groundnut, pigeonpea, and chickpea. At ICRISAT we have built up a fairly good picture of the major constraints to production of these three crops on a global scale. We have also learned a great deal through our members of the Asian Grain Legumes Network (AGLN) of the biotic and abiotic stresses and socioeconomic problems limiting production of these three crops in the Asian Region. We have accumulated sufficient information and experience to appreciate that when we move into the area of adaptive on-farm research, it is to the National Agricultural Research Systems (NARS) of the countries of the region that we must turn for advice on what we should be doing and where we should be doing it.

To facilitate this process we have invited representatives from several countries that have indicated, in one meeting or another, their interest in adaptive on-farm research. For convenience we will refer to these as Project Countries. We have also invited scientists from several other countries of the Asian Region whom we know to have experience of on-farm adaptive research and these will be referred to as Consultative Country Representatives. We are also fortunate to have been able to attract to the meeting several consultants from other international and regional organizations.

The objectives of the meeting are to :

- assess each country's needs for increasing legumes production, and review constraints,
- survey technology available and need for further adaptive research to meet these constraints,
- review existing strategies for adaptive research, on-farm testing, and transfer of technology,
- recommend ways in which ICRISAT may be of assistance in supporting these strategies, and
- propose time-bound plans for country based adaptive research and transfer of technology projects.

In essence, we are asking you the country representatives, to indicate what role you can envisage for ICRISAT in relation to adaptive on-farm research in your countries. While doing this, we hope you will be able to develop specific adaptive research project proposals that can be evaluated for funding and early implementation.

The procedures to be followed over the next few days are outlined in your program. Most of the sessions are open to all interested parties but a few as indicated have membership restricted to specified groups.

Thank you very much for coming to this meeting.

Keynote Address

L.D. Swindale

Mr. Chairman, Dr. McDonald, Ladies and Gentlemen,

Let me first extend a cordial welcome to the members of the country delegations and to the members of the UNDP Mission, who are here to participate in this workshop and to listen to what is proposed and agreed upon.

This meeting is one in a series that ICRISAT has been holding to determine what the National Agricultural Research Systems would like ICRISAT to do for and with them. Previous meetings in the series include meetings in 1983, and 1985 that led to the formation of our Asian Grain Legumes Network, the 1987 Chickpea Coordinators' Meeting, and the 1988 meeting of the Regional Legumes Network Coordinators. Next month we will have a worldwide chickpea conference, which should be yet another opportunity for us to explore the same theme.

Pigeonpea and chickpea research started in ICRISAT in about 1974 and groundnut research only in 1976. Although in India there has been a fair amount of research done on the first two crops, and in the world on groundnut, by and large the amount of research activity for these crops is far less than for cereals in general and even for the cereals that ICRISAT includes in its mandate, i.e. sorghum and pearl millet. But over the last 13-15 years, in cooperation with scientists elsewhere, we have made good progress and today we have some important and valuable information about the possibilities of increasing the production of all three of these legumes. This meeting is timed to allow us to bring these improvements to your notice and to learn from you what use you might make of them. You will notice that we had not asked you to prepare papers about legume production and its constraints in your countries. We have tried to take on that burden by reviewing the list of constraints to production available from previous meetings. We will ask you to review what we have prepared.

This meeting has an important characteristic in that most country delegations contain representatives from both research and extension agencies. This underlines the applied and adaptive nature of the meeting. Furthermore, the meeting relates well to the effort that ICRISAT is making in strategic planning in which we emphasize the fact that research and technology development form a continuum. ICRISAT, from time to time, will shift its emphasis along that continuum according to your needs. We also want to involve the National Agricultural Research Systems more closely in helping set ICRISAT's priorities. We want you to help tell us what we should do and I can assure you that we will listen carefully to whatever proposals you make.

ICRISAT Center, at Patancheru, is the global center of an international agricultural research system. ICRISAT has branches in several African countries, in Mexico and in Syria. But, ICRISAT Center is also the regional center for the countries of Asia.

We established the Asian Grain Legumes Network (AGLN) in 1986 to increase our activities in Asia and more recently we have added an applied and adaptive research program known as Legumes On-farm Testing and Nurseries (LEGOFTEN). The AGLN is now well established. We have Memoranda of Understanding with 11 Asian Governments, and we have established work plans with most of these countries. Work plans set out the collaborative research that we have agreed to provide or do together and provide for training to your scientists and technicians. In some cases they also provide for special projects to assist you in undertaking some of your activities.

At the present time the LEGOFTEN program, operating only in India, is supported by a grant from the International Fund for Agricultural Development (IFAD). A similar applied and adaptive research project is being commenced in Sri Lanka shortly with assistance from the Asian Development Bank. The project in India was started in response to a request from the Government to help create awareness of the possibilities for increased production of groundnut that were available in the improved cultivars and improved agronomic practices that had been developed in ICRISAT. The program seems to have been successful, not only with groundnut but with the other two grain legumes, pigeonpea and chickpea, as well. It has several additional benefits. It brings research improvements to the attention of the extension agencies and through them to the farmers as well. It assists in elucidating the reasons for the yield gaps that exist between present farmer practice and what is possible, and it provides invaluable feed-back to improve the focus of future research efforts. From the research end of the continuum, we have provided improved cultivars responsive to better management and to inputs. In the middle of the continuum we have developed improved agronomic practices and now, further along the continuum, we are applying these products and practices firstly at state farms as research managed on-farm trials and, more recently, on farmers' fields as well. The program is proving successful. The reasons include the following:

o The technology that has been made available has been developed for the environmental and farming conditions of this country (India), which we believe apply to some degree in other parts of Asia.

o The national and state Governments wanted the technology so much that they were willing to commit staff to learn and to apply the technology at the field level and to provide funding to make it happen.

- ICRISAT scientists monitored enough of the trials to make sure that the messages were being properly conveyed and the technology was being properly applied. They helped improve the situation where things seemed to be going a little wrong.

- Monitoring the progress of the trials also allowed us to understand better the information that we received from the results and improved the quality of the feedback to research.

- We tried to ensure that there was sufficient seed. Although that was sometimes difficult at the commencement of the project, it improved later on as seed produced by farmers was made available to future experiments.

- The technology worked well enough that farmers who participated felt that they gained in status by participation and there was good radio and press coverage.

We would be obliged if you would share your successes and failures in adaptive research and technology development with these crops to provide guidance for our future endeavours, both here at ICRISAT and throughout the region. Of particular interest would be to understand what resources you consider adaptive on-farm research requires, how to carry out development of technology, how to transfer the technology to farmers, and what help ICRISAT might provide. Can we work together to prepare project proposals for cooperative, adaptive, on-farm research to overcome the constraints to yield increase and to bring about the use of improved cultivars and agronomic practices. We hope that you will draw upon the information that you bring with you and the information that we have provided to come up with innovative ideas for getting appropriate and effective technology adopted by the farmers in the shortest possible time.

There is need to diversify the cropping systems in many parts of Asia and to take advantage of the comparative opportunities available in Asian countries not only to improve their export markets and trade with each other but to improve the supply of both cereals and legume crops in general. Most, if not all, Asian countries have good programs of research, have well organized extension services and can create an awareness of the availability of new techniques and new cultivars to improve production in the farming community. ICRISAT's involvement will depend upon your wishes. We have many other commitments and we are really not a large organization. But please do not hesitate to suggest ICRISAT's input if you feel it appropriate.

I realize that several of you have been to ICRISAT before but some of you are new to our institute. We hope that you will have an opportunity during the few days that you are here not only to participate effectively in this meeting but also to get an overview of the work of the Institute in general. You may see opportunities here to cooperate with us and to utilize our information in ways other than those proposed in this AGLO meeting. We look forward to cooperating with you more effectively in the future for the improvement of the livelihood of farmers and poorer people of all the Asian countries.

Thank you very much.

Farmer-First: A Practical Paradigm for the Third Agriculture

Robert Chambers

This paper uses terms with the following meanings:

CDR: complex, diverse and risk-prone. See also the third agriculture.

FF: farmer-first, referring to the new complementary paradigm of agricultural research and extension which reverses the learning and locations of TOT, with farm families playing a major part in technology development and choice.

Green Revolution (GR) agriculture: the agriculture of fertile and well-watered areas in the South, notably the irrigated plains and deltas of Asia, (Figure 1)

Industrial agriculture: the agriculture of the temperate and rich North, with high inputs and subsidies (Figure 1)

Normal professionalism: the thinking, values, methods and behavior dominant in professions and disciplines and reflecting "core" or "first" biases (Chambers 1986)

The North: the richer, industrialized, countries mainly in the temperate northern hemisphere

Paradigm: a coherent and mutually supporting pattern of concepts, values, methods and action, amenable to wide application

The South: the poorer, agricultural, countries mainly in the tropics

The third agriculture: the variously complex, diverse and risk-prone (CDR) agriculture of the South, mainly rainfed and on undulating land, found in hinterlands, mountains, hills, wetlands, and in the semi-arid, subhumid and humid tropics (Figure 1).

TOT: transfer-of-technology, referring to the normal basic paradigm of agricultural research and extension in which priorities are decided by scientists and funding bodies, and new technology is developed on research stations and in laboratories and then handed over to extension to transfer to farmers.

The Great Challenge of the 1990

In agricultural development, production and poverty, the 1970s and 1980s have witnessed changes in reality and insight. By the mid-1980s, agricultural production had risen sharply in the industrial agriculture of the rich North, and in the green revolution (GR) agriculture of the well-watered fertile plains of the South, but not much elsewhere, in the complex, diverse and risk-prone (CDR) 'third' agriculture of the South. Food surpluses had depressed

	Type of Agriculture	Industrial	Green Revolution	Third 'CDR'
PLACE	Main Locations	Industrialised countries	Irrigated and high rainfall, high potential areas in the South	Rainfed tropics, hinterlands, most of sub-Saharan Africa, etc.
	Climatic zone	Temperate	Mainly tropical	Mainly tropical
STATUS	Condition	Overdeveloped	Developed	Underdeveloped
	Current production as percentage of sustainable production	Far too high	Often near the limit	Low
	Priority for production	Reduce production	Maintain production	Raise production
CHARACTER	Topography usually	Flat or undulating	Flat	Undulating
	Farming system, relatively	Simple		Complex
	Environmental diversity relatively	Uniform		Diverse
	Relative stability	Low risk		High risk
	Use of external inputs	Very high	High	Low
R & D PROBLEMS	Similarity of farmers' and research station conditions	High		Low
	Farmers consulted about research priorities	Richer farmers sometimes		Rarely
	Number of scientists/extensionists per	More		Fewer

1 CDR = Complex, diverse, risk-prone

Figure 1: Three types of agriculture summarised

world prices, with a glut on the market. Excepting Bangladesh, the most populous agricultural countries of Asia - Burma, China, India, Indonesia, Pakistan, Philippines and Thailand - had either achieved food and foodgrain self-sufficiency or had got close to it (FAO 1986). But for much of the third, non-GR agriculture of the South, there had been deepening crisis, with populations rising, land-holdings growing smaller, environments degrading and per capita food production remaining static or declining. According to one estimate, some 1.4 billion people were dependent on CDR agriculture, with roughly 100 million in Latin America, 300 million in Africa, and 1 billion in Asia (Wolf 1986); and short of an AIDS or similar holocaust, these were also the areas and countries where population growth rates would continue to be highest.

The problem now is not one of producing enough food in the world; it is a problem of who grows it, where it is grown, and who has access to it. With population growth and environmental fragility in CDR areas, the problem is also one of generating sustainable livelihoods for the much larger populations of the future, enabling them to live adequately and decently where they are (Conroy and Litvinoff 1988). The alternative is that they have to migrate, often in desperation, to GR and urban areas, where they depress wages and the incomes of other poor people, or to fragile mountain, forest or semi-arid environments where they may contribute to environmental degradation.

The great challenge for the 1990s is, then, to enable the third, CDR, agriculture to transform itself into more sustainable and productive systems, and to support many more people. To be sure, maintaining production and tackling poverty in GR areas is also vital. But the problems and solutions there are better known, although changing (Byerlee 1987), and receive more attention. Moreover, the normal professionalism of agricultural science has served those areas better, but fits badly with the needs and priorities of the third agriculture (Figure 1).

Normal Professionalism, Transfer-of-Technology and the Third Agriculture

Normal professionalism means the thinking, concepts, values, and methods dominant in a profession. It is usually conservative, heavily defended, and reproduced through teaching, training, textbooks, professional rewards, and international professional meetings. Most professional mindsets change only slowly, sometimes long after the realities and priorities have changed. This is true in the social sciences as well as in the physical and biological sciences.

In agricultural research and extension, worldwide, the normal professional paradigm can be described as "transfer-of-technology" or TOT (Chambers and Ghildyal 1985). In this model, agricultural research priorities are determined by scientists and by funding agencies; scientists then experiment in laboratory and on-station to generate new technology; and this is then handed over to extension to transfer to farmers. There have been many modifications and variants, but the TOT model is deeply embedded in normal professional thinking and prescription. It is reflected in teaching, in behavior in the field, and in the rhetoric of development.

The TOT mode has served industrial and GR agriculture rather well. Physical and economic conditions on research stations have been similar to those of resource-rich farms and farm families, which are typical of these two types of agriculture (Figures 2 and 3). The reproductionism of normal agronomic research, in which only a few variables are manipulated, has led to simple packages suitable for uniform controlled environments: E (the environment) has been made to fit high-yielding G (the genotype). Packages have served to standardise farming systems, and have fitted in with economies of scale associated with mechanisation and subsidy. The outcome has been the well-known increases in productivity per unit of land in both industrial and GR agriculture.

However, the TOT model has not done well with the third agriculture. There have been limited successes, but no great production breakthroughs comparable with the green revolutions with wheat, maize, and rice. The explanation lies partly in the contrasts between physical and economic conditions on research stations and those of the resource-poor farms and farm families which are typical of CDR conditions (Figures 2 and 3). It also lies in the disjuncture between the nature of CDR agriculture on the one hand, and the nature of normal professionalism on the other. This can be appreciated by examining CDR agriculture in more detail.

The complexity of any one CDR farming system has many aspects, and these also vary between farming systems. Four deserve mention. First, physically, CDR farm holdings often comprise sloping lands with a variety of conditions of soil, slope, shade, aspect, and water supply, and sometimes include lands in different ecological zones on the same holding, and with energy and nutrient linkages with common property resources. Second, in their internal linkages, CDR farming systems typically involve and rely on complex interactions between crops, livestock, grasses, trees, and sometimes fish and insects. Intercropping and agroforestry in their many forms are typical of this sort of complexity. Third, CDR farming systems are complex temporally, with many different processes and activities at different times of the year. Fourth, CDR farming systems entail several or many enterprises, often off-farm as well as on-farm; many species of useful plants and animals are husbanded, and often these are multi-purpose and multi-product. Finally, compounding all these complexities, CDR farming systems are intimately interlinked with the farm household, its labor power, social structure and economy.

In addition, CDR agriculture often presents diversity of farming systems within short distances, corresponding with differences which are ecological, social and economic, for example in accessibility to markets. It is also often risky, being usually rainfed and subject to the vagaries of climate, without the stabilizing effects of reliable irrigation.

Normal agricultural science does not fit well with these characteristics. The complexity of CDR agriculture presents interactions difficult for scientists to manage and study. Some lie in the gaps between dominant disciplines (concerning agroforestry, tree fodders, crop residues, biological energy use, etc): normal science homes in on its primary concern - crops for agronomists, livestock for animal scientists, trees for foresters - rather than their linkages. Some opportunities lie in complex simultaneous innovation, where several factors must be changed at the same time, as with developing rainfed rice-fish farming, or harvesting soils, nutrients or water, or introducing a cover crop to inhibit weed growth, or much agroforestry where

	Research experiment station	RRF	RPF
Topography	flat or sometimes terraced	flat or sometimes terraced	Often undulating and sloping
Soils	deep, fertile, few constraints	deep, fertile, few constraints	shallow, infertile, Often constraints
Macro and micro-nutrient deficiency	rare, remediable	Occasional	quite common
Plot size and nature	large, square.	large,	small, irregular
Hazards	nil or few	few, usually controllable	more common - floods, droughts, animals grazing crops, etc.
Irrigation	usually available	usually available	often non-existent
Size of management unit	large, contiguous	large or medium, contiguous	small, often scattered and fragmented
Natural vegetation	eliminated	eliminated or highly controlled	used or controlled at microlevel

1 Chambers and Jiggins 1986, adapted from Chambers and Ghildyal 1985

Figure 2. Typical contrasts in physical conditions between research stations, and resource-rich (RRF) and resource-poor farmers (RRP)

	Research experiment station	RRF family	RPF family
Access to seeds, Fertilizers, pesticides and other purchased inputs	unlimited, reliable	high, reliable	low, unreliable
Source of seeds	foundation stocks, and breeders' seed high quality	purchased, high quality	own seeds
Access to credit when needed	unlimited	good access	poor access and seasonal shortages of cash when most needed
Irrigation, where facilities exist	fully controlled by research station	controlled by farmers or by others on whom s/he can rely	controleed by others less reliable
Labor	unlimited, no constraint	hired, few constraints	family, constraining at seasonal peaks
Prices	irrelevant	lower than RPF for inputs. Higher than RPF for outputs.	higher than RPF for RPF for input. Lower than RPF for outputs.
Priority for food production	neutral	low	high
Access to extension services	good but one-sided	good, almost all material designed for this category	poor access; little relevant material

1 Chambers and Jiggins 1986, adapted from Chambers and Ghildyal 1985

Figure 3. Typical contrasts in social and economic conditions among research stations, and resource-rice (RRF), and resource-poor farm (RPF) families

there are tree-crop, tree-livestock or tree-crop-livestock interactions. For scientists tied to respectable statistical methods, these complexities can be an unmanageable nightmare: for if they simplify them until they are measurable, they destroy the complexities which are their strength.

Precisely this bad fit of CDR agriculture with normal professionalism has served to conceal its potential. When the simple packages generated in the TOT mode are not adopted in CDR areas, the conclusion can easily be drawn that the areas themselves lack potential. So they are often referred to as "resource-poor" or "low-resource" areas. But a case can be made out that their sustainable potential as a multiple of present performance, is considerable (Bunch 1987a; Chambers 1987) and far greater than that of GR agriculture, which is already near its limit.

This misfit has been compounded by diversity and by scientists' motivation. There is a problem of cost-effectiveness and rewards using normal R and D methods. Any innovation, such as a new variety or new practice, is likely to fit conditions and needs of far fewer farm families in CDR areas than in GR areas which are or can be made so much more uniform. This makes work harder to justify economically, and also reduces the prestige and incentives of the work for scientists looking for the big breakthroughs. This difficulty is compounded by the presence of far fewer scientists per farming system (Chambers and Jiggins 1986). This reflects the past unpopularity of CDR agriculture, and its low status and low political priority. Irrigated green revolution agriculture has understandably been preferred by scientists and Ph.D students for reasons including accessibility, ease of control, and predictability of experiments, research papers, and PhDs (Gupta 1987).

For the third CDR agriculture, the TOT paradigm is, thus, in crisis. At the extreme, the research priorities and locations are wrong, the messages do not fit, the packages are rejected, and the bad experience is attributed either to farmers' ignorance (prescription - more and better extension), or to farm-level constraints (prescription - ease the farm-level constraints and simplify and control the farm to make it more like the research station).

The crisis is also one of direction. Often, CDR farmers reduce their risks by making their farming systems more complex. In terms of agroecology, this is analogous to the greater resilience in face of insults of complex compared with simple ecosystems. Normal TOT seeks to simplify, thereby increases vulnerability, and emphasizes purchased inputs which for CDR farmers often introduce problems of reliable access. For their part, CDR farm families tend to diversify (both to increase benefits from production and to provide buffering and redundancy to face contingencies) and to rely on factors of production that are under their control.

Farmer-First: The Complementary Paradigm

The crisis has led to questioning the very processes which generate agricultural technology, and to the exploration of new approaches. Increasingly during the 1980s, innovators in the agricultural and social sciences have been working with CDR farmers to find solutions to these problems. By concentrating on what they find to work, they have evolved a new paradigm for agricultural research and extension. The approaches of this paradigm have been given various labels: farmer-back-to-farmer (Rhoades and Booth 1982); farmer-first-and-last (Chambers and Ghildyal 1985); farmer participatory research (Farrington and Martin 1987) and Approach Development (Scheuermeier nd). The name does not much matter, but farmer participation is one key element. For inclusiveness and brevity, I shall try to capture the essence of these approaches with the title farmer-first (FF).

There are now many published sources of FF experience. They include Experimental Agriculture (Farrington 1988) with selected papers from the workshop on Farmers and Agricultural Research: Complementary Methods, held at the Institute of Development Studies, University of Sussex, in July 1987; and Papers of the Agricultural Administration (Research and Extension) Network of the Overseas Development Institute, London. Accessible examples include the work of Jacqueline Ashby and her colleagues at CIAT in Colombia (Ashby et al. 1987), of Roland Bunch and World Neighbors (Bunch 1985), of D M Maurya in India (Maurya et al. 1988), of David Norman and his colleagues in Botswana (Norman et al. 1988), of Robert Rhoades and others at CIP in Peru (Rhoades and Booth 1982), of Sumberg and Okali (1988) on alley farming of Nigeria, and of Baker and others in Brazil (Baker et al. 1988). In Asia, examples of FF and of movements in its direction include SUAN (the Southeast Asia Universities' Agroecosystems Network), agroecosystems analysis (see Conway and McCracken in this volume), the pioneering rapid rural appraisal (RRA) work of the University of Khon Kaen (Khon Kaen University 1987; Lovelace et al. 1988), the Northeast Rainfed Agricultural Development Project (NERAD), also in Thailand, and the Farming Systems Development Project, Eastern Visayas in the Philippines (Lightfoot et al. 1988; Repulda et al. 1987; Tung and Balina 1988).

The essence of FF is reversals of parts of TOT which have tended to go unquestioned (Conroy and Litvinoff 1988). A reversal of explanation looks for reasons why farmers do not adopt new technology not in the ignorance of the farmer but in deficiencies in the technology and the process which generated it. A reversal of learning has researchers and extension workers learning from farmers. Location and roles are also reversed, with farms and farmers central instead of research stations, laboratories, and scientists.

In this framework, much farming systems research can be seen as an extension of TOT: information has been obtained from farmers by outsiders, and analyzed by them to decide what would be good for the farmers, leading to the design of experiments for testing and adaptation. In contrast, FF reverses roles. Analysis, choice and experimentation are conducted by and with farmers themselves, with outsider professionals in a facilitating and support role.

In the latter 1980s, FF methods are evolving fast. Many forms and variants are being tried. Some of the contrasts with TOT are presented in Figure 4. While not all of these are found all the time, and some can be followed without others, they are mutually reinforcing and cohere as a paradigm contrasting with and complementary to TOT. While farmer participation is a widespread and crucial element, FF goes beyond that to influence decisions and methods which may not involve farmers directly and immediately, for example concerning on-station research.

	TOT	FF
Main objective	Transfer technology	Empower farmers
Analysis of needs and priorities by:	Outsiders	Farmers assisted by outsiders
Transferred by outsiders to farmers	Percepts Messages Package of practices	Principles Methods Basket of choices
The "menu"	Fixed	A la carte
Farmers' behaviour	Hear messages Act on precepts Adopt, adapt or reject package	Use methods Apply principles Choose from basket and experiment
Outsiders' desired outcomes emphasise	Widespread adoption of package	Wider choices for farmers Farmers' enhanced adaptability
Main mode of extension	Agent-to-farmer	Farmer-to-farmer
Roles of extension agent	Teacher Trainer	Facilitator Searcher for and provider of choice

Figure 4. Transfer of Technology (TOT) and Farmer-First (FF) Compared

One sequence which recurs in farmer participatory activities is an interactive process of farmers' analysis, choice, and experiment (FACE) followed by evaluation and extension. The main activities of farmers and roles of outsiders are:

Farmers' activities	New roles for outsiders
analysis	convenor, catalyst, adviser
choice	searcher and supplier
experiment	supporter and consultant

The actors and activities are presented diagrammatically in Figure 5.

Analysis

This exploits farmers' comparative advantage in knowledge. Farmers are experts on their farming systems. Their analysis, if done well, can be expected automatically to screen out impractical irrelevances with a speed and accuracy to which no outsider could aspire, and should home in on their needs. In the process, farmers identify their priorities according to their own criteria. Outsiders can contribute by convening groups, asking key questions, drawing diagrams, and providing information and suggestions. They can take part, but they do not dominate: the main analysts are farmers themselves.

Farmers' analysis can be promoted and supported in many ways:

- Sequence of farmers' group discussions and visits (Baker et al. 1988; Lightfoot et al. 1988; Norman et al. 1988)

- Inspection and discussion - visiting other farmers, research stations, or trial sites (Ashby et al. 1987)

- Innovator workshops, where farmer innovators meet and discuss and compare their new practices (Abedin and Haque 1987; Ashby et al. 1987)

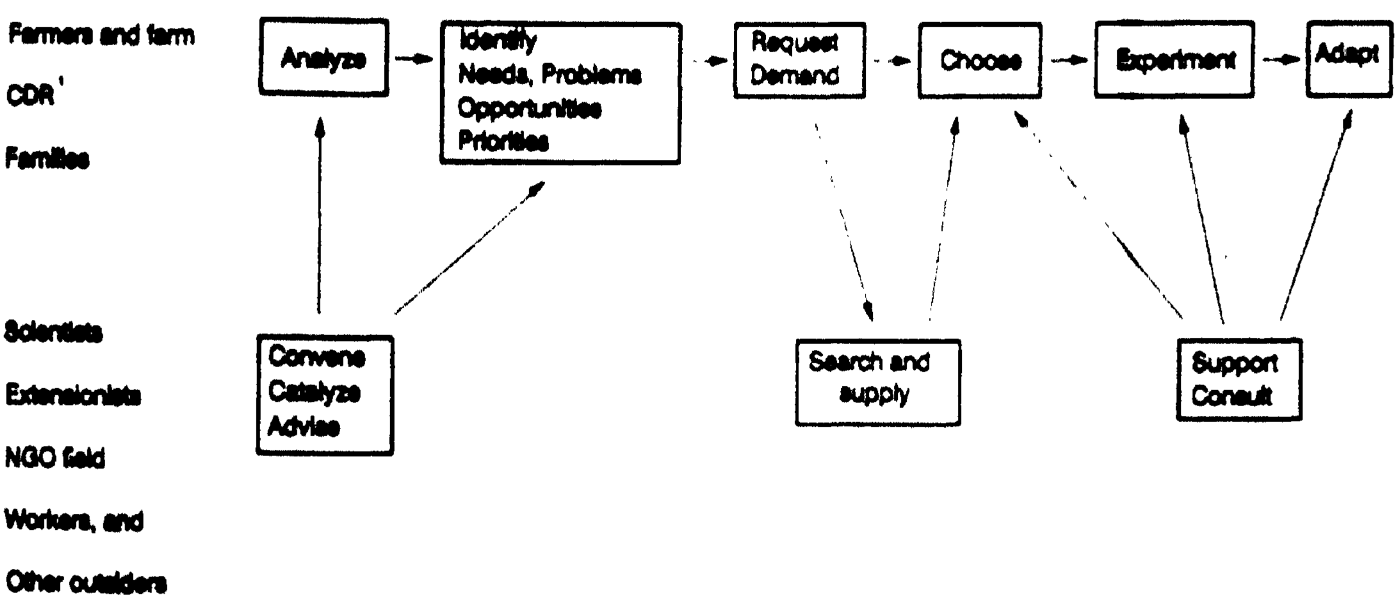
- The use of key priming questions by outsiders, such as "what would an ideal variety look like to you?", "What would you like your landscape to look like in the future?", "What do you farmers talk about when you get together?", "Why do other farmers have different practices to you?", and the unhurried sequence "What was farming like when you were young, how has it changed, what problems have you faced, how have you tried to tackle them, and with what results?"

- Visual aids to analysis such as seasonal diagramming (Conway 1987), aerial photographs and overlays, systems diagramming (Lightfoot et al. 1988), and charts representing farmers' information systematized by outsiders (Kabutha and Ford 1988), drawn on boards or on the ground.

farmer's activities	new roles for outsiders
analysis	convenor, catalyst, adviser
choice	searcher and supplier
experiment	supporter and consultant

The actors and activities are presented diagrammatically below.

Actors **Actions**



[1] CDR - Complex, diverse, risk-prone

(The processes are iterative but for simplicity feedback loops have not been included)

Fig. 5. Activities in the farmers' analysis-choice-experiment (FACE) approach

Methodological questions are many, and much remains to be learnt. Analysis can raise many different sorts of issues. In CDR areas, security of tenure is often a prerequisite for farmers taking a long view. Or relations with Government Departments may turn out to be crucial. It may be necessary to tackle priorities such as these before those which are more directly agricultural. Or analysis may lead straight to experimentation. Often, though, it will lead to search.

Search

Participatory analysis often generates demands for information and material. CDR farmers want and need wide choice and enhanced adaptability. The role of the outsider, whether researcher or extension agent, is to look for and supply a range of information about practices and potentials, and a range of genetic material. An example from the Philippines is a research agenda geared towards meeting farmers' needs which included search for alternative live mulch, alternative leguminous trees, and alternative sources of leguminous cover crops (FARMIIS 1987). The demand is not for the package of practices for normal research and extension, but for a basket of choices.

Methodological questions refer especially to the organisation of extension and research. Extension information systems have to be stood on their head, passing requests up first, before messages down. The difficulty of this reversal can be inferred from experience in the Philippines. Of the seven management information systems for agriculture and natural resources reported (Valmayor and Mamon 1987) six (for research management information, financial management, publications mailing, and administrative support) appear designed to serve central management rather than farmers' needs for information. The seventh - a Research Information Storage and Retrieval System - with potential use to provide information and choices to farmers, was described only in the future tense, with the statement that financial support was needed to extend it to the regions, suggesting that it was not yet in operation. As here, information systems normally serve the managers at the center before farmers at the periphery.

Choice

Presenting choice to farmers can take several forms:

- Minikits (a well-known and well-established approach), containing several varieties of a crop, and several fertilizers, for farmers to test and choose from on their own.

- "Wait-and-see and pick-and-choose" (D. Rocheleau pers. comm). Planting a range of species, varieties or lines and giving farmers an opportunity to observe them and choose from them.

- Releasing small batches of advanced breeders' lines matched to the characteristics of farmers' landraces (Maurya et al. 1988).

- Pre-screening of varietal materials by farmers, as with bush beans and cassava at CIAT in Colombia.

There are methodological questions about how best to elicit and support farmers' criteria and choices. One example, of group discussion, can illustrate. In Colombia, difficulty was experienced with individual farmers making selections from 35 superficially similar varieties of snap beans; but as a group, farmers did better. They walked through rows of beans, examining bean plants and pods of each variety separately. Research staff asked them to indicate which varieties they considered should continue to be tested and which not. Farmers' discussion rapidly focussed on quality characteristics related to market acceptability. In about an hour farmers identified two climbing varieties and two bush varieties which they considered outstanding by their criteria and six bush varieties they would test further (Ashby et al. 1987).

Experimentation

Finally farmers themselves experiment, and adapt technology (Johnson 1972; Rhoades 1987; Richards 1985). Here what is often most important is to transfer to them not packages and precepts, but principles and methods. A famous example of the Transfer of a principle is the International Potato Center's experience with diffused light storage in potatoes. Farmers themselves discovered that sprouting in storage, a problem with new varieties, was inhibited by diffused light storage. Scientists learnt from the farmers, and transferred the principle internationally. But there was no standard store to be build; farm families did not adopt a design but applied a principle, in a myriad of locally adapted different ways. An example of the transfer of a method is provided by World Neighbors, who have a simple procedure of enabling farmers to conduct their own trials more systematically (Bunch 1987 b).

Many methodological questions remain. One persistent problem is allowing and enabling farmers to "own" their experiments, and not to be dominated by outsiders. Enhancing farmers' capacity to experiment remains a major frontier on which much progress is needed and can be expected.

Evaluation and Extension

In the FF mode, evaluation is not by scientists' peers but by farmer adoption. For D.M. Maurya (pers. comm.) whether a line justifies the bulking of seed depends on whether the farmers who try it are asked for seed by other farmers. With farmers' inspections of one anothers' fields and trials, evaluation and extension merge. Extension is not top-down, as often in the T and V mode in practice, but lateral, from farmer to farmer, as with peanuts after rice in Northeast Thailand (Jintrawet et al. 1985), with soil erosion control in the Philippines (S. Fujisaka pers.comm.), and in the approach of World Neighbors (Bunch 1985).

The FF paradigm is still evolving and will never have a final shape, since it is organic rather than a structure. All the same, there are recurring elements which hang together and support each other. One is the resonance between enhancing the adaptability of farmers through widening their choice and knowledge, and enhancing the adaptability of outsiders - scientists, extensionists and NGO staff - through widening theirs. For farmers the choices are of practices and plants; for outsiders, of approaches and methods. For farmers, the adaptability is to uncertain climatic and economic conditions; for outsiders it is to needs, opportunities and insights as they arise. For all, decentralization and reversals of authority to those "below" are entailed: to empower farmers to analyze, choose, experiment and evaluate; and to empower outsiders, however junior, to use their initiative and choose their methods to fit local conditions.

FF thus has its own style, which is decentralized and democratic, in which there is mutual respect and service between outsiders and farmers. Personality is here a key variable. FACE may not be a bad acronym, since the quality of the face-to-face interactions of farmers and outsiders are crucial. A personal impression is that those who have succeeded in pioneering FF approach have been sympathetic people who emphathize with farmers and respect and like them. This cannot be expected of all outsiders, but the fascination and psychic rewards of working closely with farmers and learning from and with them are so high, that more and more outsiders may be attracted to this mode.

Reflections for the future

The argument for the FF paradigm to complement TOT has been developed here in terms of the third CDR, agriculture, but its application is not necessarily so limited. It may increasingly fit the trends in GR agriculture towards complexity and diversity. Some of the new GR complexity comes from the range of inputs (seed, fertilizer, pesticide) and associated practices that have become available and needed. Some also comes from the diversification of crops and crop sequences, for example with non-rice crops increasingly grown in a second season following rice in South and Southeast Asia, and with the rotations such as rice-potato-wheat, cotton-wheat, and sugarcane-wheat. Further, the withdrawal or reduction of input subsides in both GR and industrial agriculture may permit and encourage on-farm diversification towards complexity, as has happened in New Zealand. FF approaches and methods, devised and evolved to meet the special challenges of CDR agriculture, may in the 1990s be found to apply more and more in GR and industrial agriculture, helping the 1990s to become a decade, worldwide, of diversification.

For the present, though, the higher priority appears to lie in CDR agriculture evolving and testing methods, and striving for cost-effectiveness, spread, and sustainability. This raises many questions, including these:

- To what extent, and how, can the FF paradigm be parsimonious, that is, sparing in its demands on outsiders' time so that many more of the diverse farming systems can be served?

- How can FF approaches and methods be assessed and evaluated, to identify what works, and how well it works, and in what conditions?

- How can FF pioneers in national and international agricultural research systems, and in national extension systems, be encouraged, supported and rewarded, in a sustained manner, with freedom to behave in new ways?

- How can practitioners learn efficiently from their experience and pass it on to others?

- How can new syllabi, textbooks, and training courses be evolved to include FF experience and methods?

New paradigms are often rejected by those who have heavy personal investments in the old. In the case of FF, fortunately, conversion is not an all or nothing affair, in which scales fall from eyes. The individual methods can be tried out piecemeal. Their strength, though, lies in their coherence and mutual reinforcement. It is too early to say what the ultimate potential of FF approaches and methods will be. It is not too early to say that finding out that potential is a priority; for on it may depend the sustainable livelihoods of many millions of the poorest in the 1990s and the 21st century.

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ADAPTIVE ON-FARM RESEARCH

IARC Experience

The three papers presented in this session are not available for reproduction in these proceedings. Instead the editors have prepared summaries as these papers provide examples of the range of ways that International Agricultural Research Centers have been involved in on-farm adaptive research.

Transfer of Technology Model in India

P.W. Amin

At ICRISAT the Legumes On-farm Testing and Nurseries (LEGOFTEN) program was established in 1987 in response to a request from the Indian Government to demonstrate to research and extension workers the technology that ICRISAT scientists have been using to obtain high yields in legume crops. This program started with groundnut and eventually expanded to include pigeonpea and chickpea.

This program started by inviting scientists from Universities and State Departments of Agriculture for meetings at ICRISAT where the technology was discussed and plans made with the Indian scientists to establish demonstration trials at their research farms and in farmers' fields. The LEGOFTEN Unit provided help by monitoring the planting, cultivation, and harvest of these trials; and also attempting to arrange necessary inputs if they were not available. The major components of the technology included high yielding and disease resistant elite material, use of raised beds and furrows, application of the appropriate fertilizer formulation, timely application of insecticides when needed, use of gypsum for groundnut, and timely irrigation for dry season crops. This package was compared to that being recommended by State Departments of Agriculture and to the local farmer practices. Farmer field days were held in conjunction with these demonstrations. These contacts stimulated farmers to demand that they be allowed access to the technology, particularly the seed of elite varieties, and they started adopting certain portions of the technology package that they could handle or afford. In some cases the spread of the technology was encouraged by the activities of certain cooperative federations such as those associated with the National Dairy Development Board (NDDB) who were interested in groundnut as an oilseed crop. The federations main contribution was to ensure that seed and inputs were available when the farmers needed them and also arrange for marketing the produce. In one state the farmers formed their own support group to ensure the availability of seed and inputs and like NDDB to hold field days to share the information about the technology with other farmers. The LEGOFTEN Unit has been involved in helping these groups by monitoring the trials and participating in the field days.

This method has proven to be very effective in exposing farmers to new technology so that they can adopt those components that are appropriate to their situations. It has also provided valuable feedback from the farmers to ICRISAT scientists. It has been found that these activities become self sustaining in about two years with no further input required from ICRISAT except to fill requests to start new cooperative groups. Many of these new requests are now being passed on directly to existing groups (such as NDDB) to handle.

Sri Lanka Pigeonpea Production Project Model

K.B. Saxena

The Sri Lanka Pigeonpea Production Project was started as a cooperative effort between the Sri Lanka Department of Agriculture and ICRISAT with financial assistance from the Asian Development Bank (ADB). The objective of this project is to provide dhal from locally grown pigeonpea to replace dependence on imported lentil dhal. This import amounts to about $3 per capita per year. Pigeonpea dhal is known to be accepted in Sri Lanka; the project will determine how well pigeonpea will substitute for lentil dhal.

Earlier attempts to encourage farmers to grow pigeonpea failed because of the farmers' inability to control insect pests and because there was not a dhal making infrastructure to absorb their produce. The project has been able to use pigeonpea lines identified in earlier trials in Sri Lanka as being adapted. These lines are being grown by farmers with cooperative monitoring by research and extension workers. They are also producing seed. The project has also sent an engineer from Sri Lanka to India to determine the most appropriate dhal making technology and equipment to install for handling the various stages in the project starting with farmer scale dhal production moving to village and then to large scale production. These mills will be strategically placed to handle the pigeonpea produced by farmers associated with this project. There is also component in this project to determine the economics of lentil replacement by pigeonpea as related to the cost of production. To backup the outreach adaptive on-farm research component the project includes a component to strengthen pigeonpea on-station research in Sri Lanka including pest control investigations. The project also includes a training component and funds for part time participation of ICRISAT scientists in the project in Sri Lanka.

This project is expected to have quick impact if all the components can be successfully brought together.

ARFSN On-farm Research Methodology

V. Pal Singh

The Asian Rice Farming Systems Network (ARFSN) with coordination from the International Rice Research Institute (IRRI) has been in place for almost two decades. It includes under its umbrella many farming aspects associated with rice including wheat, animals, economics, women, and legumes. The network is based on a systems approach to on-farm research and includes the following steps:

- Site characterization including ecosystems, physical, biological, and socioeconomic. This is done by using existing information such as that provided by maps and available data on climate, soil, etc, by techniques such as rapid rural appraisals, and through direct interaction between researchers and farmers to identify the existing situation.

- System problem analysis includes working with farmers to identify the extent and severity of the problems faced by the farmers and help the farmers select key problems that the researchers will be able to help the farmer to solve.

- Design and implementation of experiments to screen for solutions, and working with farmers to design and carry out the experiments. The physical size and time scale for the experiments also needs to be considered.

- Ecosystem extrapolation to other similar situations. This extrapolation can be at several levels including:

  micro - various components

  meso - selection of alternatives in a region

  macro - key research sites for developing technology

  mega - deals with policy issues

Issues which need to be considered include how to deal with transfering technologies to cover increasing areas. Thus the area for which a technology is appropriate needs to be determined. Another issue is to determine what are the constraints the farmer must deal with. This can only be effectively done if the farmer has confidence in the researcher. Therefore an effort must be made by the researcher to build up this trust. Properly designed and conducted experiments and projects in the end provide satisfaction to all parties involved.

Some Experiences From On-farm Research Program in Indonesia

Charles E. van Santen

Abstract

Six major management issues relevant to conducting on-farm research programs in Indonesia are discussed based on the experiences of the "Maize On-farm Research Program" initiated in 1984 by the Malang Research Institute for Food Crops (MARIF) Malang, East Java and the Soybean Yield Gap Analysis Project (SYGAP) initiated in 1985 by the UN ESCAP CGPRT Centre Bogor, West Java in cooperation with three research institutes of the Indonesian Agency for Agricultural Research and Development.

The paper first describes how cooperation between biological and social scientists in OFR programs increased research efficiency, particularly in the MARIF case study. Secondly it shows how feedback from the on-farm research to on-station research has provided an improved focus of the overall station research program including programs for plant breeding, crop protection,and agronomy/soil fertility. The paper further discusses the importance of farmer involvement in OFR and provides suggestions for further strengthening of this involvement. The importance of a close cooperation with the extension service during the entire OFR process is also highlighted. The paper concludes with suggestions for optimal designs for on-farm trials and surveys.

Introduction

On-farm research (OFR) has already a history of over fifteen years in Indonesia. Budianto (1989) reports that the first program, with an OFR perspective in Indonesia, was initiated in 1973 by the Central Research Institute for Agriculture (CRIA). Since then over fifty OFR projects have been managed by various institutes from the Agency for Agriculture Research and Development (AARD), the agency responsible for coordinating all research within the Indonesian Department of Agriculture.

It goes without saying that it would be far beyond the limited scope of this short paper to present a systematic assessment of the Indonesian experiences with on-farm research. The limited aim of the paper is only to present some experiences from Indonesian OFR case studies in which the author happened to be involved.

The first of these projects is the "Soybean Yield Gap Analysis Project (SYGAP)" initiated in 1985 by the CGPRT Centre in co-operation with the AARD Institutes: the Centre for Agro-Economic Research and the Bogor and Malang Research Institutes for Food Crops (BORIF and MARIF). The author who joined the CGPRT Centre in May 1989 is presently familiarizing himself with this project.

The second of these projects is the "Maize on-farm research program" initiated in 1984 by the Malang Research Institute for Food Crops (MARIF). The author has been closely involved in this program from its inception in January 1984 until April 1989.

The two OFR projects selected for discussion in this paper do not include groundnut, pigeonpea, and chickpea, the grain legumes from the ICRISAT mandate. It is however assumed that the experience gained in these OFR projects has some relevance for these crops as the main focus of the paper is on management and organization of OFR.

The On-farm Research Approach

The purpose of on-farm research is to focus research activities more directly to important crop production problems faced by farmers. The approach, a form of adaptive research, is aimed at adapting new technologies to location specific requirements, enabling farmers to rapidly adopt these recommendations.

This type of adaptive research aims to fill the gap which presently exists between applied research that produces new technologies such as improved crop varieties, and the diffusion phase, in which the extension agent helps the farmer adopt new technologies. It is a research approach developed by CIMMYT (Byerlee et al, 1980 and 1982; Tripp and Woolley, 1989) and recommended by, among others, Simmonds (1985) who has provided a description of the development of the concept, and by Merrill-Sands and McAllister (1988) who propose to call it On-Farm Client Oriented Research (OFCOR).

The OFR approach considers the interactions between a particular farm enterprise and other aspects of the farming system, the possible location specificity of crop production technologies, and recognizes the need for farmer participation in the research process.

The major steps in this approach are diagnosis, planning, experimentation, assessment, and recommendation. All these steps occur in every research cycle and are linked with on-station research. Experimental variables are the result of a process of increased understanding of local farming systems.

The guiding principles of adaptive OFR/FSP procedures are:

- A careful focus on important problems and possible solutions.
- On-farm experimentation under representative farmers' conditions.
- A focus on defined groups of farmers.
- A farming system perspective.
- Use of near-term solutions. To adapt existing technologies or develop alternative technologies.
- Participation by farmers.

- Involvement of the extension service.

- Interdisciplinary cooperation among biological and social scientists.

- Feedback between on-farm and on-station research.

Research activities include on-farm trials, surveys, soil studies, and farmer field days. Research starts with exploratory surveys and trials to tentatively identify problems and possible causes and solutions. Hypotheses about possible solutions are subsequently studied in on-farm trials and surveys. The results of the trials and surveys lead to a reassessment of the problems and the development of recommendations which are subseqûently tested in verification trials and discussed in farmer field days. The close link between surveys and on-farm experimentation allows each successive cycle of trials to be adjusted on the basis of earlier findings, and finally the gradual development of practical recommendations.

The Soybean Yield Gap Analysis Project*

The Soybean Yield Gap Analysis Project (SYGAP) is an OFR project initiated in Indonesia in 1985 as a co-operative undertaking between the CGPRT Centre and the Centre for Agro-Economic Research and the Bogor and Malang Research Institutes for Food Crops of (AARD) with technical support from the Centre de Cooperation Internationale de Recherche Agronomique pour le Developmemt (CIRAD) of France and funded by the European Economic Community.

In Indonesia in 1985 the average soybean yield of farmers was estimated at 0.9 t h^{-1} and in research experiments 2.0 t h^{-1}.

The objective of the project was to study agronomic and socio-economic aspects causing this yield gap.

During the first phase of the Project from 1985 to 1987 the activities were focused on identification of constraints faced by farmers in soybean production. The study included two contrasting soybean production systems: dryland in Garut, West Java and wetland in Pasuruan, East Java.

Farmers, extension workers, and researchers were involved and trials were conducted in farmers' fields to facilitate cooperation between those concerned with direct technological transfer and adoption.

A field survey indicated that increased inputs did not raise soybean yield proportionately, as the recommended technology for soybean was too broad to deal with specific problems. Factors preventing increased yields in Garut included low soil fertility and pest infestation, and in wetland Pasuruan, poor plant establishment, poor drainage, and pests.

Based on these findings tentative recommendations were formulated and tested in the field. The result from the SYGAP I project was that farmers participating in the programs were able to increase their soybean yields by an average of 50% to 60% by applying these recommendations in their own fields.

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* This summary is based on Sumarno et al. (1988) and SYGAP II (1989)

However, it was observed that in spite of this yield increase farmers in the study area did not adapt these recommendations, not even in the vicinity of the on-farm trials.

The SYGAP II project, 1988-1991 aims to focus on farmer adoption of new technologies in particular to identify constraints faced by farmers in adopting these recommendations. The SYGAP II project involves the following three interlinked programs

1. The technical program. To find solutions to problems with which farmers are confronted when they wish to apply research recommendations. Major subjects covered are: crop establishment, crop water supply, fertilizer efficiency, and crop protection.

2. The socio-economic program. This is divided into three programs:

   a. Financial analysis of the recommended farming technologies.

   b. Farming System Analysis. A two year monitoring of selected farm holdings participating in the program to obtain an improved knowledge of the farm economy.

   c. The complementary Study. To identify the interaction between the technical and economical environment of soybean production.

SYGAP-II is being implemented in Thailand and Indonesia by national teams of the Ministries of Agriculture in co-operation with the CGPRT Centre, CIRAD/DSA, CIRAD/IRAT, KIT/AVRDC. The regional perspective of the project hopefully will stimulate an exchange of experiences between scientists from Thailand and Indonesia.

MARIF Adaptive On-farm Research Program

The MARIF adaptive on-farm research (OFR) program with a farming systems perspective (FSP) was initiated in January 1984 in the District of Malang and has now run for ten crops cycles (van Santen and Dahlan 1989).

During the initial four crop cycles from January 1984 to January 1986 the program focused on one study area in which maize as a mono crop is grown under rainfed conditions on young volcanic soils in the Malang district. Since the fifth crop cycle, from January 1986, a second study area in the south of Malang District has been included in the program. This area is characterized by cassava-maize intercrop systems grown under rainfed conditions, mainly on soils overlying limestone.

The main objectives of the program are to:

1. Develop recommendations for mandate crops that farmers can rapidly adopt.

2. Identify research priorities.

Diagnosis of problems in the first study area. During exploratory surveys and initial on-farm trials conducted in the first study area of the young volcanic soils the following major production constraints were identified:

1. ***Atherigona spp.*** **(shootfly).** This is an insect that damages the growing point or shoot of the young plant. Many plants die and others show poor growth.

2. **Overplanting.** Farmers place four to five seeds in one plant hole. This causes interplant competition.

3. **Imbalanced and late fertilizer application.** Farmers apply high doses of nitrogen fertilizer (average 400 kg of urea=166 kg N ha^{-1}) and do not give phosphate or other fertilizers; their first application of urea is only at three weeks after planting.

There is a clear link between these three problems. Traditionally farmers have no means to control shootfly. The only way out is to overplant, hoping that enough seedlings will survive. The possible interplant competition is accepted.

The situation also explains the reluctance of farmers to apply urea at planting. At that time they do not know how many plants will survive and they do not want to waste fertilizer. Three weeks after sowing, when maize plants are not attacked further by shootfly is the time that most farmers in the area apply the first doses of urea.

The immediate effect of nitrogen is very distinct. The visual effect of phosphate is not very clear and the result can really only be measured at harvest time when an increased grain yield is obtained. This may partly explain farmer's reluctance to use phosphate.

In later cycles of OFR experimentation sulphur deficiency, and *Peronosclerospora maydis* (downy mildew) infection were also identified as important production constraints. In two out of ten crop cycles downy mildew was observed affecting up to 80% of the plants and resulting in important yield losses.

Results. Possible solutions for these problems in the first study area were identified, formulated as recommendations, and subsequently tested on fields of cooperating farmers. These recommendations include:

1. Crop protection. Use of carbofuran at planting (5 kg ha^{-1} with 0.15 kg active ingredient ha^{-1}) in planting hole to control shootfly and white grub.

2. Lowering plant density at seeding from the farmer practice of 100,000 - 150,000 plants ha^{-1} to 90,000 plants ha^{-1} and thinning at three weeks after planting to 60,000 plants ha^{-1} plant per ha. This results in a density at harvest of about 50,000 plants ha^{-1} compared with about 40,000 plants ha^{-1} in the present farmer practice.

3. Reducing nitrogen fertilization to 92 kg N ha^{-1} from 168 kg N ha^{-1}.

4. Adding phosphorus fertilization of 45-90 kg P_2O_5 ha^{-1}.

5. Applying all the phosphate and 1/3 of the nitrogen at planting and the balance of the nitrogen at 3-4 weeks after planting.

In later cycles the following was added:

1. Ridomil seed dressing (5g kg^{-1} seed) as a prevention against downy mildew.

2. Sulphur at 25 kg ha^{-1} at planting.

The outcome of these recommendations in the first study area is that farmers cooperating in on-farm trials have been able to double their maize yield from 2.1 to 4.4 ton of dry grain ha^{-1} . Net benefits per ha increased from Rp 209,250 to Rp 460,000. Cost benefits analysis showed that a participating farmer received a return of over four rupiah for each additional rupiah invested.

Implications for maize production. The recommended practices, developed by the OFR team for young volcanic soils require inputs at an increased but modest level and simple changes in crop management. As all aspects of the improved management practices were easily understood by cooperating farmers, it is anticipated that adoption of the recommended practices will be within the scope of the majority of maize producing farmers in the study area.

First indications that this assumption may be correct, are shown by the preliminary findings from a survey conducted during 1988 and carry 1989 to study farmer assessment of MARIF recommendations in the twelve villages cooperating with the MARIF OFR program within the young volcanic soils zone. The findings of this survey show that in 1988 30% of the farmers already use chemical shootfly control, often combined with a lower initial plant stand and use of the improved Arjuna maize variety (37%) or a commercial hybrid maize (25%). During the maize production survey conducted in 1984 in ten out of the same twelve villages not even *one* farmer reported use of carbofuran for control of shootfly. This indicates that a spontaneous adoption of this management practice has taken place during these four years, most likely influenced by the effect of the on-farm trials conducted in the area.

Some Experience Gained

The following remarks describe some experience gained in the two case studies described, with most information obtained from the MARIF OFR program.

Interdisciplinary cooperation among biological and social scientists

During implementation of the OFR activities, a close cooperation was established between the members of the interdisciplinary team responsible for execution of the program. The team consisted of plant breeders, entomologists, plant pathologists, agronomists and economists. The benefit of shared responsibility was found to be large.

The immediate availability of interpretations from the various angles of the participating disciplines increased the efficiency of the research work and avoided misunderstandings inherent in a system where each discipline works in isolation.

Feedback between on-farm and on-station research

The additional information on farmer circumstances which gradually became available during the implementation of the OFR program has helped to establish effective mechanism within MARIF for relating research decisions to farmer's needs and hence has helped to improve the priority setting process for on-station research for all participating disciplines.

The OFR approach has thus helped to rank research priorities and to separate area specific problems from more universal productivity problems. Example of problems from the first study area which have been fed back for on-station research are:

- Shootfly infestation. In the short term the application of carbofuran is adequate. In the medium term other chemical control measures may be required and in the longer term maize varieties which are resistant to shootfly infestation are needed. Entomologists and plant breeders have initiated research focused on achieving these aims.

- Downy mildew infection. In the long term development of downy mildew resistant varieties are required and research by pathologists and plant breeders is underway.

- Soil fertility. In the short term it appears that suitable fertilizer recommendations for the first study area have been developed. However, due to the intensive farming being used it is expected that in the medium and long term improved recommendations may be required to sustain soil fertility. The situation thus requires continuous monitoring by the soil fertility section of MARIF.

- Maize varieties. Presently both the OFR team and MARIF maize breeders have improved understanding of the characteristics of maize varieties, required by farmers growing the crop in the young volcanic soils. These include:

o Improved husk cover (to allow better on-farm storage).

o Specific consumer requirements. flint type of grain, easy to grind (hard) with a yellow grain color.

o Increased lodging resistance.

o A full season maturity of 90 days and over.

o Downy mildew resistance.

o Shootfly resistance.

o Drought tolerance.

Farmer involvement

The main contact the projects had with farmers was during the on-farm trials and in surveys. The farmer carried out all the management practices in on-farm trials with the exception of treatments which were carried out by the researcher or the field assistant. It was found useful to take time to discuss with farmers the details of the field where the on-farm trial was conducted, in particular possible causes for the differences in crop performance between the trial plot and the rest of the field. These discussions were found particularly helpful during two phases of the OFR process. Firstly during the beginning of the OFR process when exploratory trials are conducted, especially if these are "superimposed" trials where only one or two treatments differed from the farmers' management. Secondly during the assessment phase when the validity of new technologies is tested through verification trials in the study area.

The result from these discussions was an improved researcher's understanding of field conditions and how the farmer perceed these fields. On many occasion farmers made researchers aware of issues which the researchers had overlooked.

Cooperation with the extension service

The field extension agent is responsible for diffusion of new technologies. He is often stationed in the village and has a first hand knowledge of farm conditions in his area.

The importance of good cooperation between on-farm research teams and extension workers been stressed many times. In practice, however, it may be difficult to establish good contacts between the researchers and the field extension agents. In Indonesia for example researchers and extension agents belong to different agencies. Extension staff have many duties and limited resources to execute these duties. In the SYGAP program it has been possible to have good contacts from the first season onwards, the MARIF OFR program only succeeded after several years to establish good cooperation.

It is essential that extension is involved in the OFR team work at an early stage. This gives the OFR team better access to farmers and knowledge of local farm conditions and allows the extension agent to be familiar with new technologies at an early stage.

Trial designs

It was found useful to keep on-farm trial designs as simple as possible, with the minimum number of treatments feasible. It was observed that trials with complicated designs, with "satellite" trials, require much attention to manage, are difficult to analyze and, often provide little new information. In case several hypotheses are to be tested within the same season it is advisable to design separate trials.

In exploratory trials "plus one/superimposed trials" appear useful. This involves the farmers' management practices with only one treatment replaced by an alternative as suggested by the researchers. This type of trial is easier to understand and to analyse as the often used "minus one" type of trials in which one treatment is omitted from a package of recommendations and replaced by the farmer's practice.

Survey designs

In addition to the informal exploratory survey conducted as a first step in the OFR process there will be a need for several other surveys. In particular in the case of the MARIF OFR program it has been found very useful to conduct "single subject" surveys, focusing on only one or a group of narrowly related subjects. Results of this type of survey can be obtained rapidly and have given very accurate and focused information needed for further steps such as the design of trials for the next crop cycle.

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Status of Grain Legume On-Farm Trials in the Philippines

Danilo C. Cardenas

Introduction

Traditionally, agricultural research has concentrated its efforts on the generation of new technologies from trials on experimental stations. This tradition is based on the assumption that the best technology in the experiment station would also be the best in farmers' fields. Only recently has this assumption been challenged. After about a decade, the national agricultural science community has finally accepted the need for a systematic verification scheme in farmer's field before any technology can be recommended for general use by farmers. This realization came about due to the common observation that despite several research breakthroughs scored by the international and national research systems, the output of the small farmers had remained low compared to yields obtained from experiment stations (Gomez and Gomez 1988).

To date, the Philippines has been conducting an increasing number of on-farm trials at several sites throughout the country. These trials are essentially designed to assess the performance of newly developed technologies under actual field conditions. This procedure exposed the new production technology to a much wider range of growing conditions than that usually available at research stations. Consequently, results of the on-farm trials are felt to be more realistic and more appropriate to the requirements, environment, and resource limitations of farmers.

Current Activities

In the Philippines, the task of evaluating the feasibility, viability,and appropriateness of new technologies under actual field conditions is divided into three phases namely: technology adaptation (TA); technology verification (TV); and technology piloting (TP). These activities comprise the last three stages of the technology development process adapted by the National Agriculture and Resources Research and Development System (NARRDS) and the

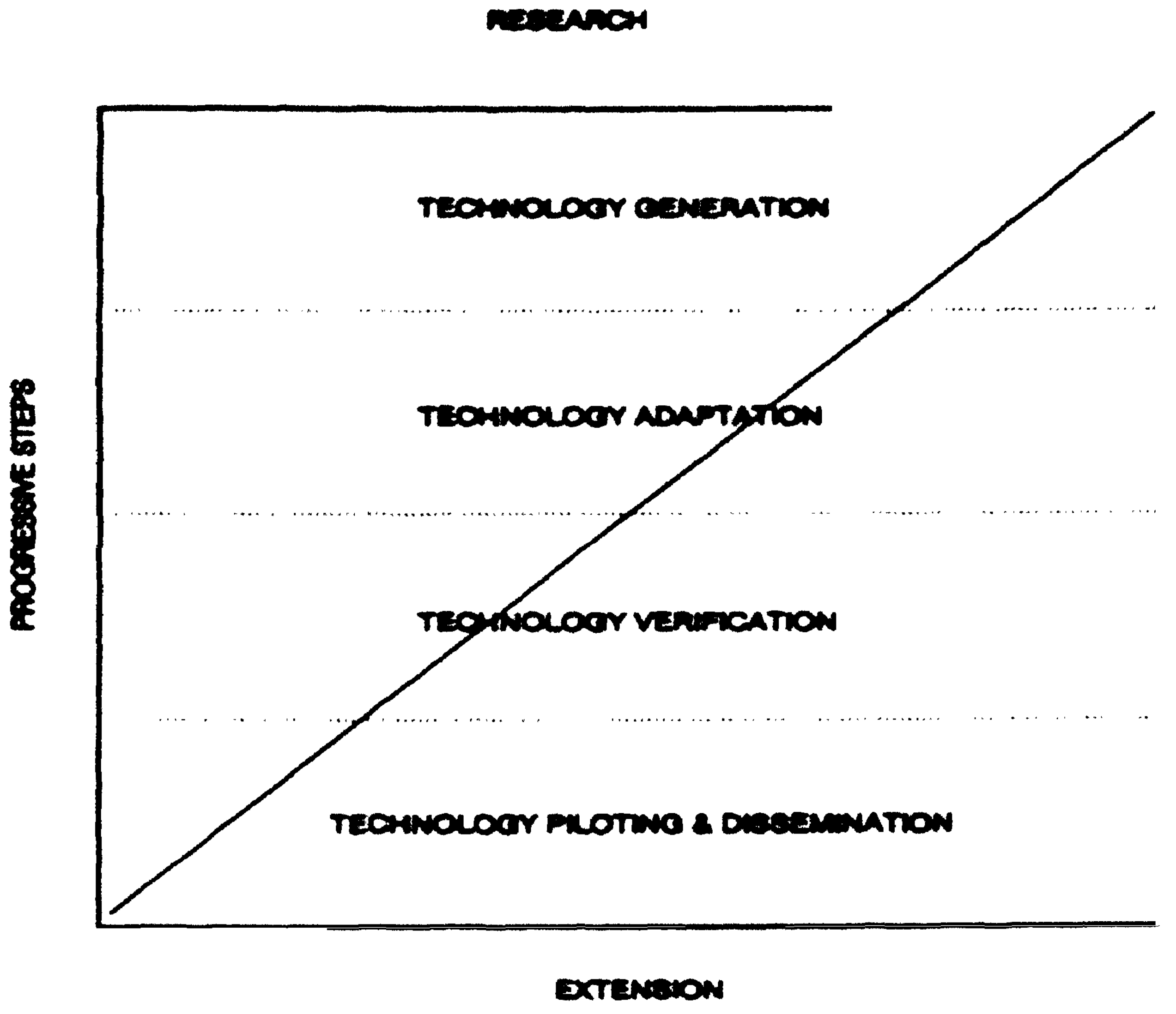

Fig. 1. Degree of involvement of research and extension from technology generation to dissemination (DA-BAR, 1989)

Department of Agriculture (DA) which forge the critical link between research and extension (Figure 1).

The salient features of these three different types of on-farm trials as practiced in the Philippines are presented in Table 1. Last year, the DA conducted a total of 36 TA trials on variety and fertilization covering 6 legumes crops and 28 TV cropping pattern trials. On the other hand, other members of the NARRDS also conducted three pilot projects on field legumes covering an aggregate area of 907 hectares with 1309 farmer cooperators (Table 2).

Table 1. Salient features of the different types of on-farm trials conducted in the Philippines

Particulars	Technology Adaptation	Technology Verification	Technology Piloting
Purpose	o Evaluate the stability and replicability of the performance of technologies over space and time	o Compare the performance of improved technologies to that of the farmer's practice	o Confirm and demonstrate the value and operational feasibility of improved technologies
Location of Trial	o May be on-station or on-farm	o Mainly on-farm	o Mainly on-farm
Number of Treatments	o Less than 10 treatments	o Usually two-treaments	o Usually best treatments
Methodology	o Several locations (farm-based)	o More locations (farm-based)	o Community-based
	o Replicated	o Unreplicated	o Unreplicated
	o Sites selected at ramdom in the target area (environmental conditions)	o Sites selected at ramdom in the target area (environmental conditions)	o Sites purposely selected to represent environmental conditions
	o Coverage of target area need not be	o Coverage of a target area need not be contiguous	o Coverage preferably contiguous
	o Works with small plots	o Works with larger plots	o Whole farm or community

Particulars	Technology Adaptation	Technology Verification	Technology Piloting
	o Researcher-managed	o Farmer managed with extension supervision	o Farmer managed with extension extension assistance
Focus	o Regional (different agro-climatic Zones)	o Provincial/ Municipal (within target zones/recommendation domain)	o Similar development zone/Recom-mendation
Common Data Collection Method Employed	o Complete enumeration	o Complete enumeration	o Random sampling
Financial Arrangements With Cooperators	o Project provides all inputs of the trials	o Project provides all inputs of the trials	o Project loan only for inputs required for technology utilization

Table 2. Scope of PCARRD-MARRDS development action projects, 1989.

Project title	Duration	Implementing Agencies	Total Area Planted To Date Hectares	No. of Cooperators
1. Soybean Pilot Production Program	1983-89	CLSU/DA-R II	192.26	285
2. Mungbean Development Action Project	1985-90	MMSU/DA-R IX, DMMMSU/DA-R II, CLSU/TCA	643.17	925
3. Peanut Development Action Project	1987-91	DA-R II/DMMMSU, CLSU	71.77	99

Highlights of Accomplishments

In June 1989, the Philippine Seed Board approved the release of 6 new legume varieties for commercial planting. All of these recently approved cultivars have wide agro-ecological adaptation and yield as much as, if not more than, the present recommended varieties. Most came from different genetic backgrounds, thus, contributing to a diversity of planting materials now available to Filipino farmers. These new cultivars were the results of breeding and varietal testing work including on-farm trials conducted by government research institutions.

In the Soybean Pilot Production Program, the average yield of farmer-cooperators ranged from 850-1207 kg ha^{-1}, where 45% of them obtained higher yields than the national average (0.94 t ha^{-1}). The return on investment (ROI) of roughly 76-107% is comparable to that of rainfed rice and double that of upland corn. The rate of loan repayment was high (80-90%) and the rate of technology utilization was 60%. The project produced 3 types of audio-visual training materials and 2 types of extension pamphlets. It also established linkage with the private sector who now adopted our former pilot sites as regular raw material suppliers.

In the Peanut Development Action Project, the recommended component technology (variety + inoculation) consistently outyielded the traditional farmer's practice by 27-46%. Technology utilization was estimated to be more than 80% within two years of introduction.

In the Mungbean Development Action Project, the same trends were observed. In addition, the average, net income of mungbean farmers were almost doubled. As a result of our trials, Taiwan Green (BPI-Mg 9) was recently recognized by the Philippine Seed Board as a new cultivar to be recommended for commercial planting. Other unexpected impactsof the project include: increased labor employment opportunities in the rural areas particularly during the harvesting season, creation of a new agribusiness venture in Isabela, and increased awareness by farmers of the availability of new technologies.

The project was also awarded second place on technology commercialization at the 1988 National Science and Technology Week Celebration and the Best Paper on Development during the 1987 Regional Research Review (Labios 1989).

Conclusion

The methodology on on-farm trials being adopted by the NARRDS is still on its formative stage. Certainly, a log more improvements will have to be made based on experiences and lessons learned. So far, the following are our observations regarding the conduct of on-farm trials:

- Choosing the right people/institutions to carry out on-farm trial activities is just as important as selecting sites and farmer cooperators o the availability of a ready market to absorb whatever additional produce is obtained by farmers greatly influences their decision on what crops to plant.

o providing technical assistance alone does not always ensure complete adoption of recommended technologies.

o The bane of most on-farm trials is the non-availability of production inputs at the right time, place, quantity, and quality.

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PULSES PRODUCTION PROGRAM IN PAKISTAN

Abdul Majeed Haqqani

Agriculture accounts for over 23% of Pakistan'sgross domestic products, employing about 50% of the labor force, and 70% of export earnings.Hence, it is the main stay of Pakistan's economy catching the attention of the Government to formulate a comprehensive policy for growth and development of the agriculture sector. Highest priority should be given to bridging the gap between actual and farm yields by removing the production constraints responsible for this gap. The grain legume production bench mark and targets for the Seventh Plan are given in Table 1.

Table 1. Actual and projected targets for pulses production in Pakistan (in '000 tonnes)

Crops	1982-83 Actual	1987-88 Estimates	Bench 7th Plan 1987-88	Targets 1982-83	Actual 6th Plan	Growth rates 7th plan*
Pulses	694	608	740	900	-2.6	4.0
Chickpea	491	367	550	650	-5.7	3.4
Others	203	241	190	250	3.5	5.6

* = Over Benchmark

Technology generated by Agricultural Research Institutes would not be fruitful if the technology is not disseminated efficiently tofarmers. The following agencies are actively involved in the generation and dissemination of Agricultural Recommendations formulated by the research institutes.

- Agricultural Research:
  - Federal Research Institutes
  - Provincial Research Institutes
- Agricultural Extension
- Adaptive Agricultural Research Stations
- Crop Maximization Program
- Farming System Research Program
- Agency for Barani (Rainfed) Area Development
- The Punjab Agency for Barani Area Development
- The Sind Arid Zone Development Authority
- Agriculture Department
- Private Sectors

Agricultural Research

Federal and Provincial Research Institutes, plays an important role in the development of agriculture particularly in developing of high yielding varieties and production of modern package of technology. Priority research programs for different crops were started in a coordinated manner in the Sixth Five Year Plan. A substantial improvement of varieties was made during the Sixth Plan. During the Seventh Five Year Plan (1988 to 1993) (Pakistan Planning Commission 1988), research activities will be organized in the following manner:

- Basic research will be carried on in National Institutes such as NARC. Applied research involving development and testing of new varieties will be at the provincial research institutes.
- High yielding and disease resistant varieties of pulses will be evolved.
- Agronomic research will be undertaken to develop a package of management practices for pulse crops in order to exploit the maximum yield potential of improved varieties.
- Research programs will be undertaken to evolve improved production technology and systems for less favored environments such as semi-arid and arid regions.

Agriculture Extension

Agriculture extension service is in close contact with the farmer. Extension workers educate the farmers about the latest agricultural techniques through the following standardized procedures:

- Mass meetings
- Individual contacts
- Agricultural fairs
- Demonstration plots
- Radio and TV
- Newspapers, posters and leaflets
- Training and visits

The efficiency of agricultural extension services is constrained by poor service conditions, inadequate provision of extension aids and other equipment, and lack of transport. In order to overcome these deficiencies the Trainings and Visits (T&V) systems of agriculture extension has been introduced and implemented in the Punjab, Sind, and Baluchistan provinces after testing satisfactorily in five districts each in the Punjab and Sind during the Sixth Five Year Plan. The following specific measures will be taken into account to improve the extension services during the current Seventh Five Year Plan:

- Removal of current deficiencies in the T&V agricultural extension systems.
- Transfer of latest production technology to the farmers supplemented by more extensive use of mass media.
- Reorganisation and specialization of extension services in different agro-ecological conditions.
- Provision of incentives to extension workers.
- Introduction of farmers training programs.

Adaptive Agricultural Research Stations

These institutes undertake the testing and appraisal of promising cultivars and production technology in various agro-ecological regions and provide specific information to the Extension Department for dissemination to farmers.

Crop Maximization Program (CMP)

Although CMP is not dealing with any pulse crop at present, it presents a model to augment pulses production.

In 1981-82, the Rice Maximization Program (Muhammed 1987) was implemented by the Pakistan Agricultural Research Council (PARC) in collaboration with the Provincial Agricultural Departments in Gujranwala and Larkana Districts. This project received widespread appreciation in the area as the adopter farmers obtained considerably higher yields than did the traditional farmers. Encouraged by this experience, CMP was launched in 1985 by PARC with financial assistance from the Italian Govt. The salient features of CMP are as follows:

- Demonstrate the proven package of technology on farmers fields.
- Demonstrate and test the Italian technology for wheat, rice, and maize, and adoption of proven results.
- Exchange of information and results between the project and non-project area farmers and motivate them for the adoption of technology.
- Provide a regular follow-up whereby the strategy developed will be monitored, evaluated and updated as required to meet the changing situation.
- Train the farmers and extension agents to carry out the CMP successfully.

The Approaches used for implementation of CMP are:

- Make contacts between the farmers and scientists of allied agencies.
- Formulation of package of production technology.
- Lay-out demonstration plots with financial assistance of CMP.
- Lay-out demonstration blocks with financial involvement of farmers.
- Make available necessary technical know-how and inputs to the farmers both for demonstration plots and blocks.
- Train related personnel.
- Organize field days.
- Prepare printed material to disseminate the CMP concept.

Farming System Research Program

In Pakistan, farming system research (FSR) has been considered a supplement rather than replacement of conventional agricultural research extension, designed to assist and augment existing research approaches (Majid et al.

1989). It makes farmers and scientists intimate partners in problem analysis, diagnosis, and resolution using technology, and has been described as farmer-based, problem-solving, holistic, multi-disciplinary, and complementary.

Farming system approach (FSA) emphasizes a two way information flow (Fig.1). New research activities on the farm and at the experiment stations will emerge as FSR methods and perspectives are adopted. FSA is a systematic way for researchers to identify farmers' problems. It studies the farmers existing system and identifies, problems and opportunities as a basis for carefully planning on-farm experiments for selected technologies which are deemed to be compatible with farmers' environment (Fig.2).

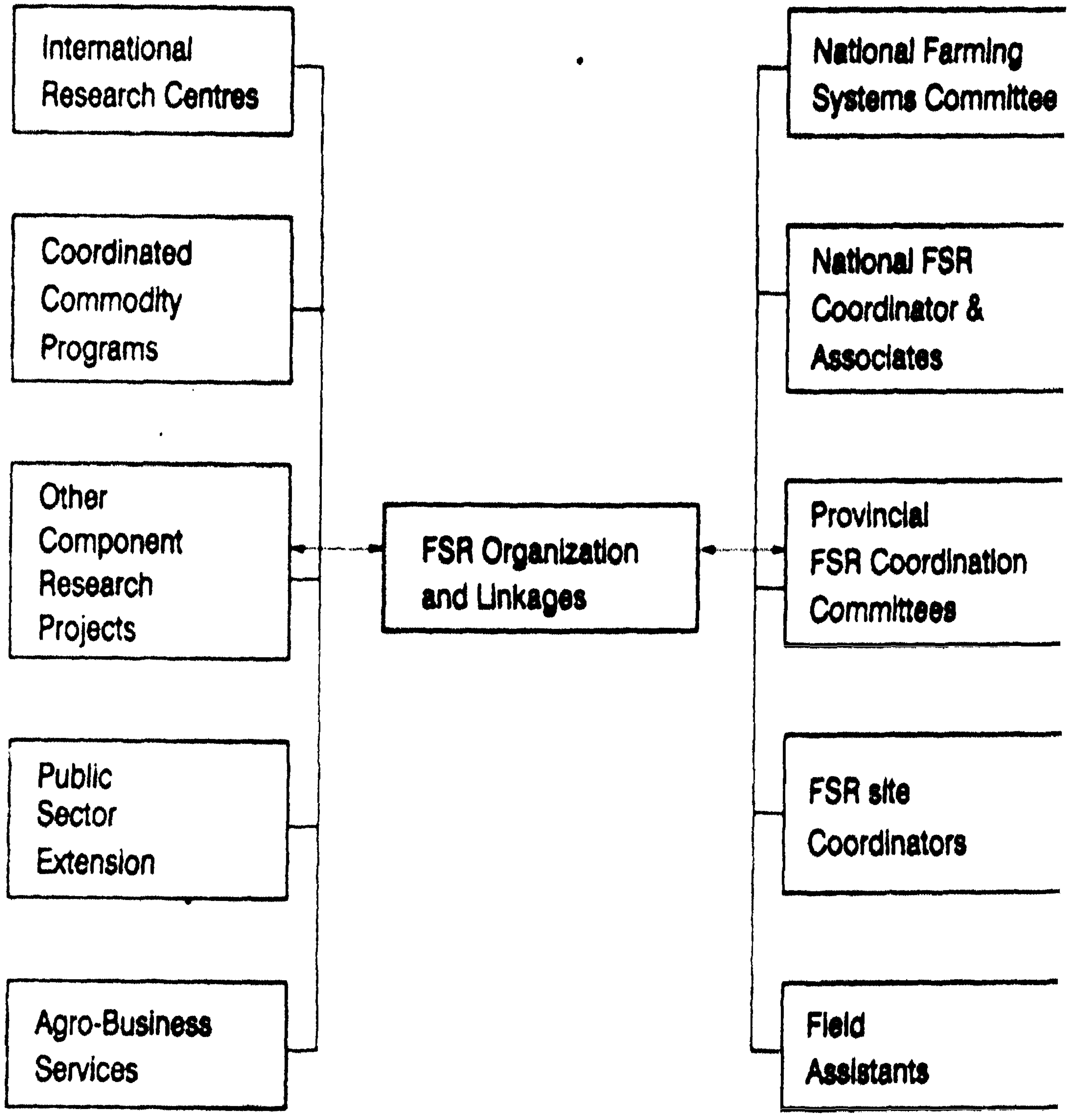
The Pulses Program at the National Agricultural Research Centre (NARC), Islamabad is actively involved in a FSR Program. Every year chickpea, lentil,and mungbean experiments based on research findings and farmers oriented problems are being conducted on farmers fields'. The results presented in Table 2 clearly differentiate modern production technology and farmers' practice in terms of net returns. The net return obtained by using latest techniques should motivate the farmers to grow more pulses.

Table 2. Net profit (in Rupees) per hectare in Farming System Research Experiments of Chickpea (Variety: CM 72) on farmers' fields

Treatment	Yield kg/ha	Gross benefit	Cost of production	Net benefit
Improved practice	1124	7590	2434	5156
Farmers' practice	507	3420	1580	1840
Improved practice (No weeding)	620	4189	2059	2130
Improved practice (No fertilizer)	817	5513	2062	3451
Improved practice (No pesticide)	976	6585	1947	4638

Agency for Barani Areas Development

The approach of the Agency for Barani Area Development in the Punjab, the Sind Arid Zone Development Authority in Sind and, the Agricultural Departments in the NWFP and Baluchistan for dissemination of promoted technology is collaboration with agricultural extension services. Their function is to introduce high yielding, disease and drought resistant varieties developed by Research Institutes in the Barani areas (Rainfed).



[1]FSR - Farming systems research

Fig. 1. Organization linkages and information flow of FSR[1] in Pakistan

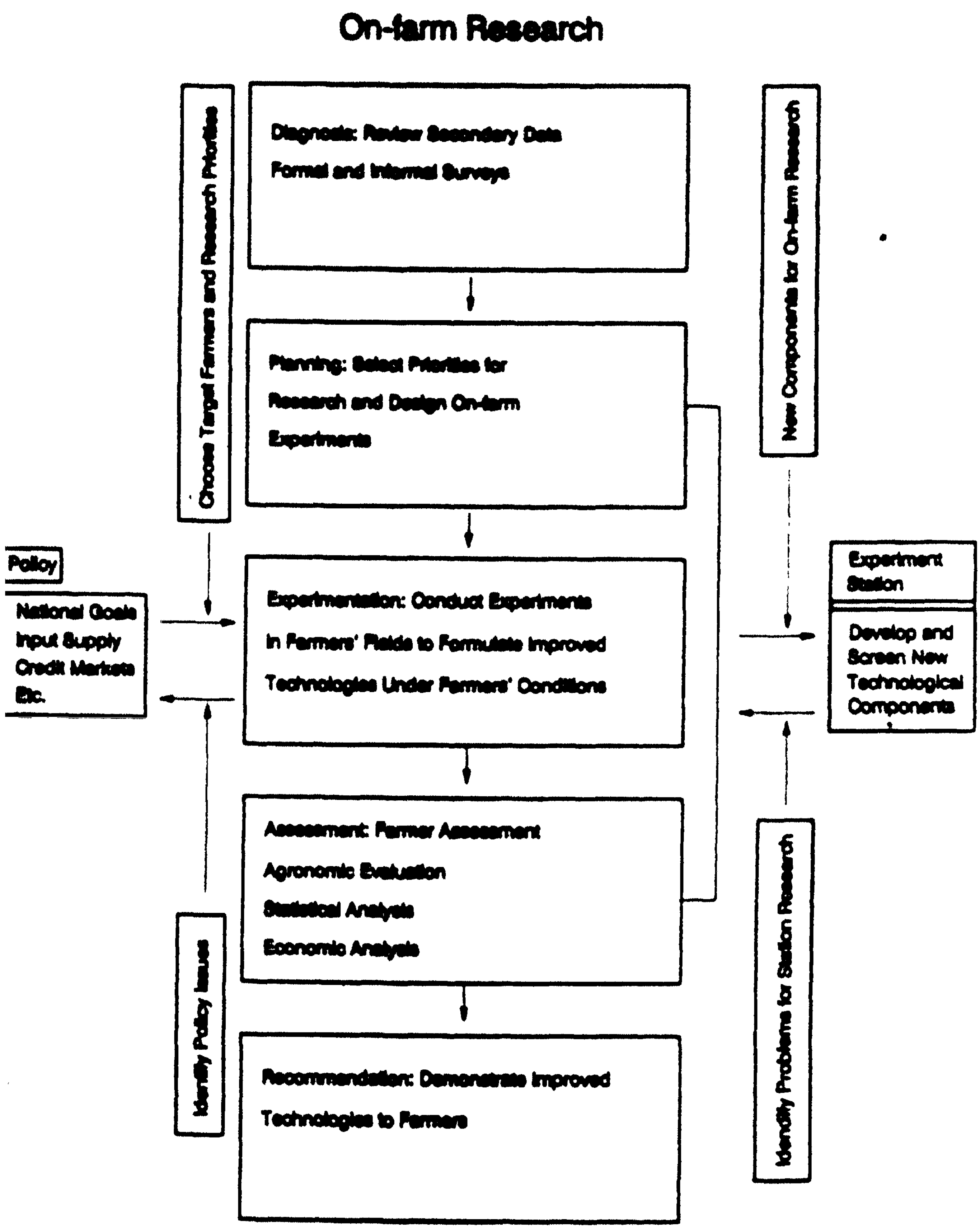


Fig. 2. Stages of a Farming Systems Approach to Research

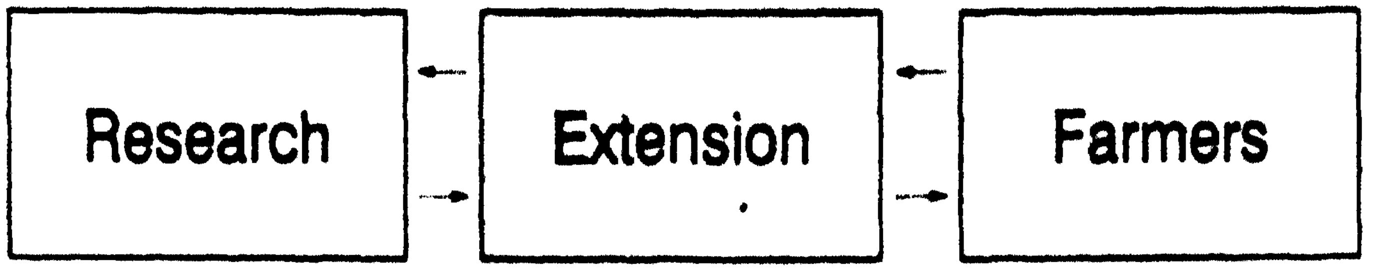
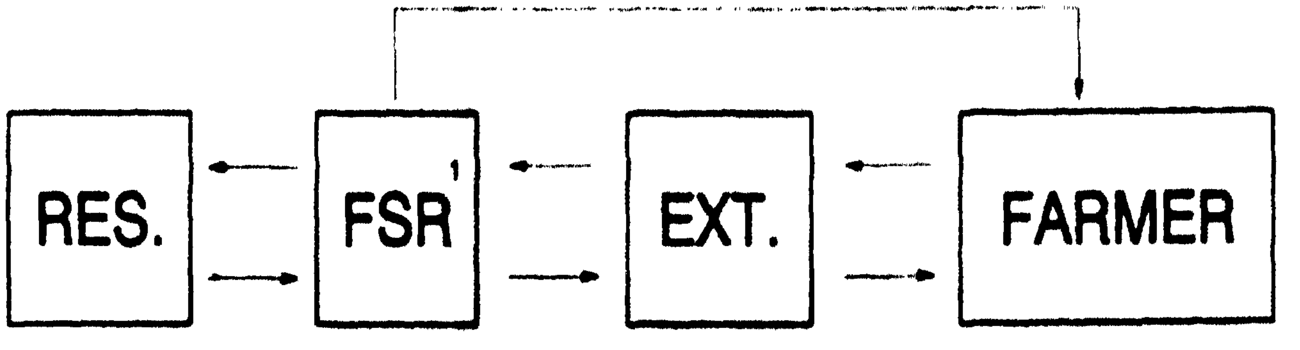


Fig. 3. The "feedback" technology transfer systems (Stoop, 1988)



1. FSR - Farming systems research

Fig. 4. The modified "feedback" technology transfer systems (Stoop, 1988)

Private Sectors:

The private sector, which is involved directly or indirectly in educating farmers about recent advanced developments in modern package of technology, also serves as a backbone of agricultural development in the country. A few important groups in the private sector in Pakistan are as follows:

- Fertilizer Companies
  - National Fertilizer Corporation
  - Daud Corporation
  - Exon Chemicals
- Pesticide Companies
  - Cieba Giegy
  - Sandoz
  - Hoechst
- Banks providing credit facilities
  - Agricultural Development Bank of Pakistan (ADBP)
  - Habib Bank Ltd.
  - National Bank of Pakistan
  - Cooperative Societies

These private sector groups employ Agricultural Graduates as Credit Officers, who as part of their duties teach farmers about the use of agricultural inputs.

Feedback Mechanisms

The feedback mechanisms in Pakistan are contingent upon the response of farmers to the production technology presented to them. The feedback model developed by Stoop (1988) was earlier used for generation and dissemination of production technology (Fig.3). More recently the FSR component has been included in the feedback model by Stoop (1988) (Fig.4). Stoop considers FSR as an extension component while in Pakistan research activities on the farm and at experiment station are considered as part of the FSR method. In the modified feedback model it is assumed that research begins and ends with the farmer. But both farmers and extension workers play significant roles in the FSR process. On the basis of their experience, knowledge, and farming skills, both offer their perception of problems, appraise the potential, and test the latest package of technology generated by Research Institutes.

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On-farm Research and Field Testing of Production Technology of Legumes in Farmers' Fields

S. Lal

India has experienced impressive successes in food production in recent years. Starting with only 51 million tonnes in 1950-51, it has reached more than 170 million tonnes in 1988-89. Although this success is commendable it is without including the full potential of the improved varieties and technologies which have been dififcult to demonstrate on a large scale. The high yields obtained at research stations have not impressed farmers who prefer to see instead the performance of the new variety or technology on their own farms. At the same time, the scientists are looking for feedback from the fields which can ultimately help them further refine their technology.

The demands for transfer of technology for accelerating agricultural production are enormous. This transfer is a complex task being interdisciplinary and multi-institutional in approach and content. In India the following four organizations are devoted to extension for agricultural and allied production.

- Indian Council of Agricultural Research (ICAR)
- Department of Agriculture, Government of India/State Government
- Department of Rural Development, Government of India/State Government
- Non-Government Organizations (NGOs)

Realizing the value of the transfer of technology in agriculture the ICAR launched five front line extension projects (Table 1). These projects are implemented through ICAR Research Institutes, State Agricultural Universities, State Departments of Agriculture, and some selected voluntary organizations.

Table 1. Details of Extension Projects launched by ICAR

Project	Year of start	No. of centres/ districts
National Demonstration Project (NDP)	1965	48
Operational Research Project (ORP)	1974	152
Krishi Vigyan Kendra (KVK)	1974	97
Lab to Land Programme (LLP)	1979	116
All-India Coordinated Project for the development of scheduled castes and tribes	1979	35

National Demonstration Project

This project was started in 1965 with the realization that unless the scientists could demonstrate what they advocated, their advice would not be accepted by farmers. The main objects of the project were:

- To demonstrate the genetic potential of new varieties.
- To train farmers and extension workers in the new technology.
- To enable researchers to collect information problems on adopting the technology.
- To determine the income and employment generation potential of the crops and technology.
- To determine the yield gaps and operational constraints.

The following types of demonstrations are organized under NDP.

- Single crop demonstrations
- Multiple cropping demonstrations
- Rainfed cultivation demonstrations
- Special problem soil demonstrations
- Entire farming system demonstrations

Steps in conducting National Demonstrations

The various steps involved in the NDP can be broadly categorised into following three stages:

Planning Stage

Number of demonstrations for different crops: The state level coordination committee decides on the number and types of demonstrations for each crop. Only major crops are included in the demonstration program with emphasis on oilseeds and pulses.

Distribution of responsibilities: Each of the four specialists (Agronomy, Soil Science, Plant Protection, Agriculture Engineering, Animal Husbandry) take the full responsibility of conducting 5-6 demonstrations, out of 25 demonstrations conducted in each district.

Selection of sites and farmers: A large number of sites are selected initially. Willing and cooperative cultivators with small holdings are selected. The detailed information on the site is collected and the selection of the site is done with the help of local extension staff. A good demonstration site has assured irrigation facilities, good and productive soil, and nearness to the village approach road.

Size of the plot: In general, the plot size for demonstration is 0.4 ha. However, where farmers have small farms, the plot size could be less.

Farmer-Scientist interaction: The scientists develop close linkage with the farmers. They explain the purpose of the demonstration, crop sequences and package of practices to be followed.

Package of practices and inputs: The subject matter specialists (SMS) to have finalize package of practices for each demonstration, on the basis of which the requirement of seed, fertilizers, and plant protection chemicals is worked out.

Calendar of operations: The written plan of activities and the dates on which different operations have to be carried out are prepared by the SMS.

Assessing yields: A committee is constituted which arranges harvesting and processing of the crop in the presence of the farmer for assessing yield.

Execution stage

Laying out of demonstrations: The subject matter specialist (SMS) layout the demonstrations and erect a publicity board. All operations are performed under the SMS's personal supervision of the specialists.

Field operations: All field operations are performed by the farmers in the presence of SMS-in-Charge. Scientists visit the demonstration regularly.

Field days: The field days are organized by the SMSs at different stages of crop growth and at harvest where discussion and question-answer sessions are held.
Record keeping: Information on various operations and performance of the crop is recorded in the diary provided by ICAR.

Harvesting and threshing: These operations are done under the supervision of the committee.

Residual fertility status: The soil scientist collects the soil samples after harvest to assess residual fertility.

Submission of report: The data are submitted in duplicate to the State Coordinator for onward transmission to ICAR.

Cost-Benefit ratio: The cost-benefit ratio for each crop and cropping sequence followed is calculated and economic returns are worked out.

Follow up stage:

Publishing results: The results of successful demonstrations are published through the mass media.

Follow up with technical guidance: The farmers are pursued to adopt the practices demonstrated to them.

Coordination Committee

The state level coordination committee consists of top level experts of the University headed by the Director of Extension. When demonstrations are conducted by the Deptartment of Agriculture, the Committee is headed by the Director of Agriculture of that State. Similarly the Director of ICAR Institutes is the Head of the Coordination Committee when the Institute assumes the responsibility of conducting demonstrations. The Committee prepares the guidelines for conducting demonstrations.

The sub-committee of this Committee is at the district level and consists of Subject Matter Specialists of the Project, Deputy Director of Agriculture/District Agriculture Officer and Training Officer. The senior most member of the sub-committee becomes the Chairman. The sub-committee guides the conduct of demonstrations and arranges training.

Results

Various types of demonstrations conducted so far (>25000) have successfully shown the yield gaps as they exist between the farmers' yields under normal conditions and the yields obtained by the scientists on farmers' fields under the same conditions (Table 2).

Such an information has proved to be very useful for the scientists in perfecting the package of practices for different crops.

Table 2. Productivity of different crops under national demonstrations and national average (kg ha^{-1}), 1984-85

Crop	National average	Average of National Demonstrations
Rice	1417	3224
Wheat	1870	3554
Maize	1456	3496
Sorghum	715	4036
Pearl Millet	569	2388
Mungbean	403	682
Chickpea	661	1516
Groundnut	898	2177

Operational Research Projects (OPR)

This project aims at disseminating the proven technology in a discipline or area among the farmers on a watershed basis. Watershed cover the whole village or cluster of villages and is concurrently studying the technological, extension or administrative constraints as barriers to the rapid spread of improved technical know-how. The project attempts to involve allied agencies and institutions to show the need for an inter-institutional and inter-disciplinary approach. The principle of 'Social Audit' was introduced together with scientific and financial audits. The thrust is on influencing the farming families with a low yearly income.

The ORPs have been undertaken on two kinds of problems: , the common agricultural problems affecting the farming community requiring group or common action, such as plant protection, rodent control, etc.; and total resource development of the watershed area.

Objectives. The Objectives of ORPS are to:

- Test, adopt and demonstrate agricultural technology on farmers' fields in a whole village or a cluster of villages making up a watershed.
- Determine the profitability of new technology and its pace of spread.
- Identify the constraints.
- Demonstrate group action as a method of popularizing technology.

Organization. The ORPs are implemented through the State Agricultural Universities, ICAR Institutes and State Department of Agriculture.

A Scientific consortium and a Project implementation consortium are constituted to review and guide the project activities through action groups.

Progress. In ORPs there has been remarkable success in improving the productivity of crops and overall income of farmers. In the ORP for increasing pulse production in Mohindergarh district of Haryana, the scientists of Haryana Agricultural University, Hisar demonstrated about a 60% higher yield of chickpea varieties H 208 and H 355 over local varieties. Similarly, weed control, use of Rhizobium culture, and zinc application in chickpea increased the yield substantially. Similar results were obtained with improved varieties of pigeonpea in large scale demonstrations.

Krishi Vigyan Kendra. These Kendras impart vocational training in agriculture through work experience to extension workers who are already employed. Each Kendra has its own syllabus. The main objective of the Kendra is to provide training to help bring about a breakthrough in agricultural production.

In all, there are eight specialized training courses in KVKs, where the training on pulses production is provided only under the 'Dryland Agriculture' course.

There are Teachers Training Centres also which provide in-service training of the trainers.

The project is sponsored by ICAR and implemented by ICAR Institutes, State Agricultural Universities, State Departments of Agriculture, and voluntary organizations.

Lab to Land Programme:

This programme assists selected farm families in developing and implementing individual farm plans for improving their entire farming system to generate more employment and income. The basic idea is to bring scientists and farmers into close contact and introduce low cost technology. The main objectives of the project are to:

- study the background and resources of the selected farmers and landless laborers
- introduce low cost agricultural technology
- assist farmers develop feasible farm plans
- help farmers adopt improved technologies
- organise training program and extension activities
- make farmers aware of opportunities and agencies
- develop linkages with scientists and institutions for future guidance
- provide a feed back mechanism for agricultural scientists and extension workers.

Organization For effective implementation and monitoring of the program, India was divided into 8 zones on the basis of population, soil, climate, agro-ecosystem, and administrative infrastructure. Each zone is headed by a Zonal Coordinator who is assisted by the two program officers. There is a Zonal Advisory Committee consisting of representatives of participating institutions. This Committee meets 2-3 times a year to guide and apprise the program.

Progress Five thousand farm families were adopted in Phase I, and 75000 in Phase II. These families were diverse including landless laborers, small and marginal farmers, scheduled castes and scheduled tribes. Various programs for increasing the income of the farm families were launched. Among them, the impact of improved varieties substantially raised productivity and production. For example, in Haryana the average yield of cereals, millets, pulses and oilseeds increased when the lab to land programwas introduced (Table 3). This program also generated more income and employment.

Table 3. Yield levels of different crops under lab to land program (LLP) in Haryana

Crop	Yield (kg ha^{-1}) Before LLP	After LLP
Wheat	1500	2250
Bajra	650	850
Mustard	800	1250
Groundnut	650	1050
Pigeonpea	600	1450
Chickpea	600	1020
Summer mungbean	200	500

Popularization of Pulses Production Technology for increasing production

To increase pulses production through adoption of improved production technology the Govternment of India launched the following schemes which continued to the end of the VI Plan, and thereafter were combined into the National Pulses Development Programme (NPDP).

Centrally sponsored scheme. This scheme had the following components:

o **Demonstration** The demonstration on package, fertilizer, and plant protection were conducted. The rate of financial assistance was Rs. 375 ha^{-1}.

- **Seed multiplication and distribution** There was provision for a subsidy for breeder seed production to ICAR Institutes and State Agriculture Universities; for foundation seed production to National Seeds Corporation (NSC) and State Farms Corporation of India(SFCI), and for certified seed production to State Seed Corporations on the basis of quantity of seed produced.

- **Plant Protection** Under this scheme financial assistance was provided to farmers for plant protection chemicals, plant protection equipment, and operational charges for raising pulses.

- **Rhizobium culture** Assistance was provided to equip microbiological laboratories and subsidized distribution of inoculum packets.

Centrally sponsored scheme on summer mung production

This scheme started in 1982-83 provided the following assistance from the Central Government:

- Demonstration - Rs.375 ha^{-1}
- Certified seed - Rs.200 q^{-1}
- Irrigation - Rs.100 ha^{-1}
- Publicity - Rs.100 ha^{-1}

The impact of this scheme has increased as the area under summer mung from 0.77 million ha in 1981 to 1.34 million ha in 1985.

Central Sector Scheme for Distribution of Minikits

This scheme was started in 1981-82 to popularize promising pre-released and newly released varieties of pulses through farmers' participation. The details of this scheme are given below:

Size of minikit: Area 0.1 ha. On the basis of seed supply the size of kit was as follows:

Chickpea, peas = 6 kg

Lentil = 4 kg

Pigeonpea, mungbean
urdbean, mothbean,
cowpea = 2 kg

Each kit contains treated seed, rhizobium culture, and literature on the package of practices.

Programme formulation: This Committee was headed by the Director of Agriculture of that State with representatives of NSC, SFCI, ICAR Institutes, and Directorate of Pulses Development. They discussedand decided the no. of minikits, selection of varieties, availability of seed arrangement of seed multiplication for next year, and problems encountered in running the program.

Priorities: Under this scheme small and marginal farmers, specifically belonging to scheduled castes and tribes were selected. Replacement of local varieties by new ones, intercropping, and increasing intensity of cropping received the used to be main consideration.

Preparation of minikits: The seed producing agencies like NSC, SFCI, State Seed Corporations supplied the minikits and Government of India reimbursed the costs.

Implementation: The State Department of Agriculture implementedand supervised this program. The Director of Pulses Development madesurprise visits to see the distribution of minikits.

Monitoring: There were close links between the State Department of Agriculture and the Directorate of Pulses Development for monitoring the program. Each month the consolidated report on the progress of the program was submitted to the Ministry of Agriculture, Govternment of India.

Evaluation: The program committee evaluated the performance of the program.

The National Pulses Development Programme (NPDP)

In the VII Plan all the above schemes were merged into one which is known as NPDP. It has the following 16 components:

- Minikits distribution
- Block demonstrations
- Breeder seed production
- Foundation seed production
- Certified seed production
- Rhizobium culture
- Plant protection chemicals
- Plant protection equipment
- Adaptive trials
- Operational area
- Biological control
- Training
- Strengthening of Rhizobium culture labs
- Organization of seed village
- Stocking of seed

o **Agricultural implements**

The progress achieved on some of the above components such as minikit distribution, block demonstration, and adaptive trials can be seen in Table 4.

Table 4. Achievements under NPDP 1986/87-1988/89

	1986-87		1987-88		1988-89	
Programmes	T[1]	A[2]	T	A	T	A
Minikits (No.)	132960	133138	197076	218318	77017	67935
Block Demonstrations (ha)	48350	44186	48878	47057	39523	36131
Adaptive trials (ha)	1725	775	1386	1175	1199	1101

[1] T = Target
[2] A = Achieved

Research minikits

This program only covers varietal popularization. Two categories of varieties are included: the newly released and notified varieties introduced for phasing out the old ones and varieties which identified by the workshop but yet to be released and notified for getting the farmer reaction. Varieties to be included in the kits are identified in a meeting of the Director of Pulses Development, Project Director (Pulses), Joint Directors of Pulses from different states, and producing agencies. Certified seeds of released and notified varieties, and test stock seed of the newly identified varietiesis made available by the State Farms Corporation of India (SFCI). The cost of the minikits is reimbursed by the Governmet of India. The nucleus seed for production of test stock seed is supplied to SFCI by the breeders as soon as the variety is identified by the workshop.

Constraints in conducting research minikits

There are several constraints in conducting research on minikits and in general minikits resulting in poor quality of demonstrations so that the results are not convincing. For this reason, the Central Variety Release Committee has waived off the requirement of research minikit data for release and notification of the variety. However, it recommends conduct of the minikit for popularizing the varieties.

The constraints faced in conducting such minikits can be grouped into following categories:

Technological constraints

- Non-availability of high yielding varieties comparable to cereals.
- Non-availability of quality seed.
- Non-availability of low cost locally suited agricultural implements.
- Non-availability of disease and pest resistant varieties.
- Losses due to weeds.
- Unsuitable soils which prevent realization of genetic potential of varieties.

Administrative constraints

- Inadequate manpower support. The Village Level Worker is the contact person. They are already heavily burdened with several other programs.
- At the State level, the non-filling of posts and the, frequent transfers of persons under the NPDP.
- Inadequate transport.
- Inadequate storing facilities for inputs.
- Centralization of powers.

Extension constraints

- Lack of training facilities.
- Poor publicity media.
- Lack of incentives for extension workers

Social constraints

- The adoption behavior of the farmers is very poor.
- Marketing problem of the produce.
- Social values, customs, religious taboos and caste system influence the adoption.
- Illiteracy and self-centered attitude of the farmers.

Suggestions for improvement of Research Minikit Programme

- Ambitious seed production should be arranged.
- Only those varieties which possess substantial superiority in terms of yield and resistance should be included.
- Separate staff should be assigned for this program.
- Planning should be made at least 3 months in advance.
- The farmers should be compensated in case the trials fail or give poor yield.
- Adequate facilities for mobility should be made.
- Adequate arrangement for storing and transporting of the inputs be made.
- The farmers should be educated well before conduct of the trials.
- Field days should be organized.
- facilities for harvesting, threshing, and storing should be arranged.
- Mass media should be used for popularization of the varieties, in addition to conducting the trials.
- Adequate financial powers should be provided to the officer executing the program.
- Incentives provided to the extension workers.
- Awarding prizes to the farmers recording the highest yield.
- Incentives to the farmers in terms of support price for pulses.

PRODUCTION CONSTRAINTS AND TECHNOLOGY IDENTIFICATION

Each country group met separately to review the production, constraints, and technology in their country for groundnut, pigeonpea, and chickpea. This background information was used to help develop their research project proposals. This review allowed each group to identify their high priority problems. It does not provide an exhaustive or detailed review.

The following star system used gives an indication of the relative importance of each factor or problem:

**** extremely important

*** very important

** important

* little importance

- not present or not considered. May need special consideration at a later date.

INDONESIA

Production constraints and technology available for groundnut and pigeonpea production in Indonesia

Factor	Groundnut	Pigeonpea
Area (000 ha)	595	< 0.5
Production (000 t)	493	< 1
Av Yield (kg ha^{-1})	998	300
Local cultivars	Subang Sukabumi Jepara Tuban	Late
Improved new cultivars	Gajah Macan Banting Kidan Tupai Tapir Kelinci	Mega (Hunt)
Potential Yield (kg ha^{-1})	3000	2500
Maturity required		
Early	90 days	Experimental
Long		Present
Crop Season		
Rainy	60%	Main
Post-rainy	25%	
Post rice	15%	
Pattern	Sole	After maize or rice
Rainfed	90%	100
Irrigated	10%	
Soil type	Latosol, andosal, regosal, aluvial, Vertisol, red yellow podzolic	
deficiency	Mg, K,P,	Mo, S
toxity	Al, acidity, alkalinity	acidity
nodulation	Poor	Yes

Factor	Groundnut	Pigeonpea
Waterlogging	Occasionally	-
Water		
drought	± 20%	*
irrigation problem	On dry season crop	
Nutrition Management		
manures	sometimes	no
fertilizers	sometimes	no
soil amendments	no	no
Agronomic		
land preparation	simple, shallow	*
seed viability	± 80%	*
plant population	often too high (400,000 ha^{-1}	**
weed management	late or incomplete	**
Disease		
bacterial wilt	***	resistant
late leaf spot	****	-
early leaf spot	*	-
rust	***	-
Aspergillus flavus	***	-
Witches broom	**	*
Leaf spot	-	*
Sterility mosaic	-	?
nematodes	-	-
Pests		
thrips	***	-
jassids	**	-
white grub	*	-
aphids	**	*
leaf miner	**	-
spodoptera	**	-
rat	***	-
wild boar	**	-
Helicoverpa	-	***
podfly	-	**
Maruca	-	***
pod bugs	-	**

Factor	Groundnut	Pigeonpea
Variety weaknesses		
low yield potential	**	
seed availability	***	***
disease susceptibility	***	-
pest susceptibility	***	**
Harvest/Post harvest		
Harvest	**	**
Threshing	**	**
Drying	**	**
Storage	**	**
Utilization	-	** substitute for soybean
Infrastructure		
Research	-	-
Extension	-	-
Training	-	**
Seed Production	**	**
Input availability	*	-

MYANMAR

Production constraints and technology available for groundnut pigeonpea and chickpea

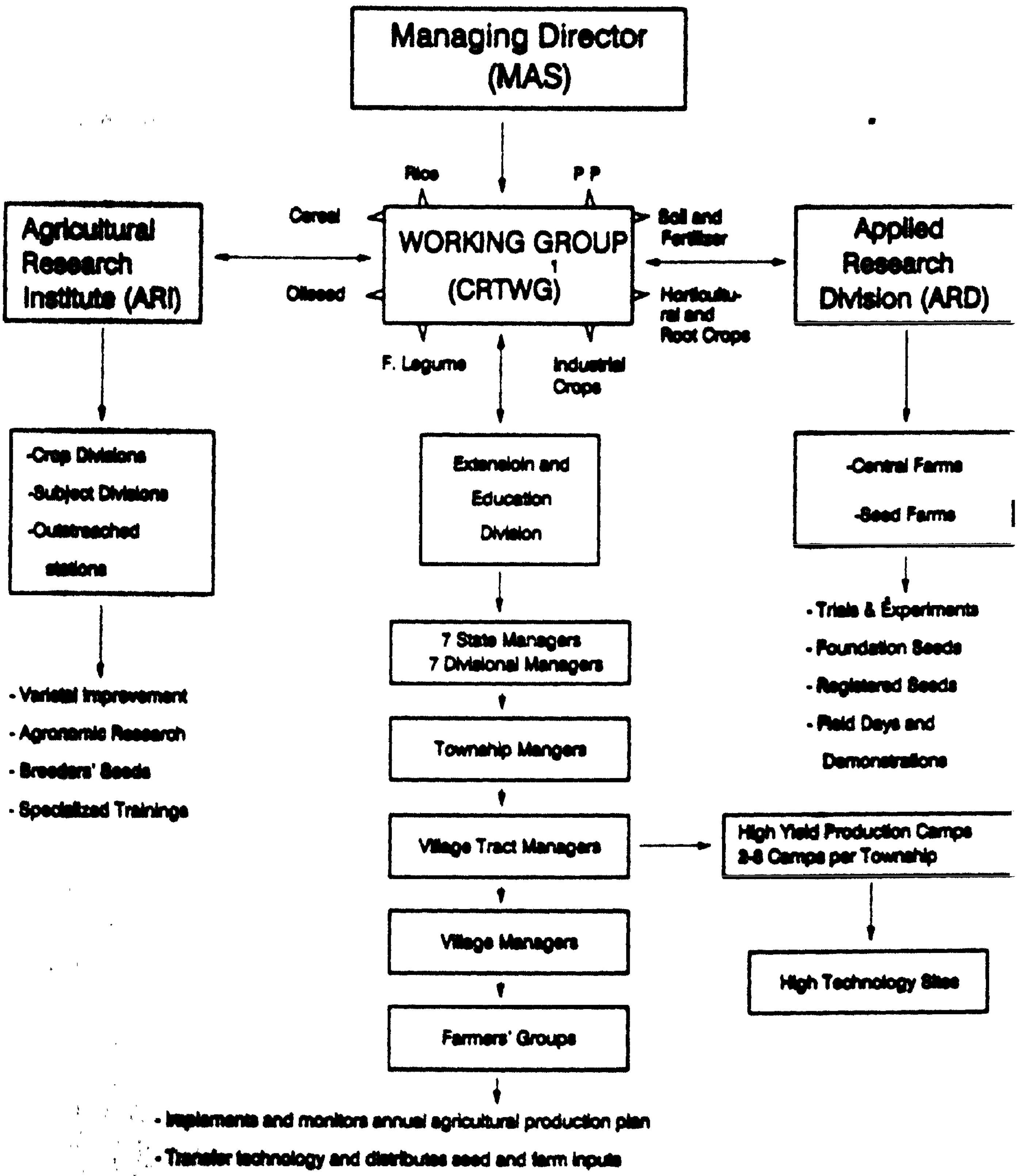
Factor	Groundnut	Pigeonpea	Chickpea
Area (000 ha)	560	67	203
Production (000 t)	550	41	160
Av Yield (kg ha^{-1})	Wet 1040 Dry 790	700	900
Local cultivars	S Jap S poll 21 Kyaung	Shwedingor	Karachi-gram
Improved new cultivars	Simpadetha (1), (2), (3) M-10,-11,-12	Yezin 1 Yezin 2	Shwe Kyamon Yezin 1 ICCV 2 ICCC 37
Potential Yield (kg ha^{-1})	Wet 2250 Dry 1500	2000	2000
Importance of maturity (rank)			
Short	1	2	1
Medium	2	1	2
Long	3	3	
Crop Season (rank)			
Rainy	2	1	-
Post-rainy	1	2	1
Post rice	3	-	1
Pattern	Sole	mixed	Relay/ sequential
Rainfed	100%	100%	100%
Soil type	Light	Light	Heavy,
deficiency	** P, Ca	**	**
toxity	-	-	-
nodulation	*	-	**
Waterlogging	-	-	**
Salinity	-	-	***
Acidity	-	-	-

Factor	Groundnut	Pigeonpea	Chickpea
Water			
Drought	***	**	***
Nutrient management used			
Manure	✓	-	✓
Fertilizers	✓	-	✓
Amendments	✓ rainy	-	-
Agronomic problems			
Land preparation	**	-	-
Seed viability	***	-	-
Sowing	**	-	-
Plant population	**	**	*
Weed management	** rainy incomplete	***	**
Sprouting	***	-	-
Diseases			
Fusarium wilt	*	*	***
Late leaf spot	****	-	-
Early leaf spot	**	-	-
Rust	*	-	-
Seedling rot	**	-	-
Aspergillus flavus	***	-	-
A. niger	**	-	-
Leaf spot	-	*	
Phytophthora blight	-	*	-
Sterility mosaic	-	*	-
Collor rot	-	*	-
Dry root rot	-	-	**
Leaf spot	-	*	-
Stem canker	-	*	-
Stunt	-	-	*
Pests			
White grub	**	-	-
Termite	**	-	-
Spodoptera	**	-	-
Hairy Caterpillar	**	-	-
Rodent	**	-	-
Helicoverpa	-	**	***
Podfly	-	*	-
Maruca	-	**	-
Aphids	-	*	-
Jassids/thrips	-	*	-
Variety weaknesses			
low yield potential	**	**	**
seed availability	***	**	**
disease susceptibility	**	-	**

Factor	Groundnut	Pigeonpea	
pest susceptibility	**	**	**
waterlogging ensitivity	-	-	*
Harvest/Post harvest			
Harvest	-	-	-
Threshing	-	-	-
Drying	**	-	-
Storage	**	-	*
Utilization	-	-	*
Prices	-	*	*
local markets	-	-	*
International markets	**	-	*
Infrastructure			
Research	*	-	*
Extension	-	-	-
Training	***	***	***
Seed Production	***	**	**
Input availability	**	*	**

ORGANIZATION OF MYANMAR AGRICULTURE SERVICE (MAS)

The following organizational chart is presented here to help in planning on-farm adaptive research projects for Myanmar



[1]CRTWG - Crop Research and Technical Working Group

There is one for each major crop. Each CRTWG consists of a subject matter (or) crops specialist as Chairman and technicians from ARI, ARD, and the Extension Division

Main functions of Extension Division

- Implementation & monitoring of annual Agricultural Production Plan.

- Transfer of technology & distribution of quality seeds & farm inputs

In every township, there are 2 to 8 production camps where farmer's meetings are organized. Demonstration, trial and field days are also conducted at the high technology site of the camp area during the cropping season.

The coordination committees comprising of a Senior Extension staff member, crop technicians, and subject matter specialists are organised in each state and division to identify the problems and farmers' needs after identification the problems and the farmers' needs are conveyed to the Crop Research & Technical Working Group (CRTWG).

NEPAL

Production constraints and technology available for groundnut pigeonpea and chickpea

Factor	Groundnut	Pigeonpea	Chickpea
Area (000 ha)	4	18	29
Production (000 t)	6	12	17
Av yield (kg ha^{-1})	1500	760	900
Local cultivars	Trishuli Trishuli	Nepalgunj Rampur Local	Dhanush Trishul
New cultivars	B4 ICGS 36 AC 343	ICPL 366 ICP 8398 ICPL 161	Rhadha Sita ICCL 821032
Potential Yield (kg ha^{-1})	3000	3600	5000
Duration required	100 day	130-150 day	140-150 day
Crop Season			
Rainy	√	√	-
Post-rainy	-	-	√
Pattern	mixed with maize	On bunds	Intercrop
Rainfed	√	√	√
Soil			
type	light	heavy	heavy
deficiency N P Zn Mg Ca	*	*	*
nodulation	*	** after rice	-
waterlogging	-	*	*
salinity	-	-	*
Water			
drought	*	*	**
Nutrient management problem			
Manure	*	*	*
Fertilizers	**	**	**
Soil amendments (limes)	**	-	-

Factor	Groundnut	Pigeonpea	Chickpea
Agronomic problems			
Land preparation	*	*	**
Seed viability	-	-	**
Sowing	-	-	*
Plant population	*	**	**
Weeds	****	***	***
Diseases			
Rust	*	-	-
Dry root rot	**	**	**
Fusarium wilt	-	**	**
Phytophthora blight	-	*	-
Sterility mosaic	-	***	-
Botrytis	-	-	***
Nematodes	**	*	*
Pests			
Jassids/thrips	-	*	-
White grub	*	-	-
Leaf miner	*	-	-
Termites	*	-	-
Helicoverpa	-	**	**
Podfly	-	***	-
Maruca	-	*	-
Other pod borers	-	*	-
Pod bugs	-	*	-
Variety weaknesses			
low yield potential	**	**	**
seed availability	****	****	****
disease susceptibility	****	****	***
pest susceptibility	*	***	**
frost sensitivity	-	*	-
Harvest/Post harvest			
Harvest	**	-	-
Threshing	**	-	-
Drying	-	-	-
Storage	*	**	**
Utilization	-	-	-
Prices	*	**	**

Factor	Groundnut	Pigeonpea	Chickpea
Infrastructure			
Research	*	-	*
Extension	-	-	-
Training	***	***	***
Seed Production	***	**	**
Input availability	**	*	**
Research manpower	***	***	***
Extension manpower	-	-	-
Extension worker communication	***	***	***

SRI LANKA

Production constraints and technology available for groundnut pigeonpea and chickpea

Factor	Groundnut	Pigeonpea
Area (000 ha)	8	Nil
Production (000 t)	9	
Av Yield (kg ha^{-1})	780	
Local cultivars	No.45 M 11 X 14 Red Spanish Uganda Erect	
New cultivars	-	MI10 ICP 7035 ICPL 2 ICPL 87 ICPL 151 ICPL 161 ICPL 312 ICPL 8324
Potential Yield (kg ha^{-1})	?	4000
Duration		90-120
Cropping		
Rainy	***	Oct-Jan
Post-rainy	*	Mar-May
Post rice	3	-
Pattern		Sole/mixed
Rainfed		95%
Irrigated		5%
Soil		
types	Alfisols Non-calic Brown soils Red and yellow latisols	Light
Waterlogging	-	*
Salinity	*	-

Factor	Groundnut	Pigeonpea
Water		
Drought	****	*
floods	****	*
Agronomic problems		
Weed management	-	***
Diseases		
Early leaf spot	**	-
Late leaf spot	****	-
Rust	***	-
Pod rot	?	-
Bud necrosis	***	-
PMV	?	-
Bacterial wilt	*	-
Stem rot	*	-
Aflatoxin	**	-
Sterility mosaic	-	**
Pests		
Thrips	***	-
Jassids	***	*
Aphids	***	-
White grub	*	-
Helicoverpa	-	***
Podfly	-	***
Maruca	-	****
Bruchid	-	***
Variety weaknesses		
seed availability	-	****
disease susceptibility	-	**
pest susceptibility	-	****
waterlogging sensitivity	-	**
Harvest/Post harvest problems		
Harvest		*
Threshing		***
Storage (bruchid)		***
Processing		****
delivery system		**

VIETNAM

Production constraints and technology available for groundnut

Factor	Groundnut
Area (ha)	275
Production (t)	275
Avr. yield (kg ha^{-1})	1000
Local cultivars	Mo Ket Giay Sèn Do Bac Giang Tran Xuyen
New cultivars	Sen Lai (Sen x White Moe Chau)
Potential yield (Kg ha^{-1})	3000
Crop duration	110 days in southern Vietnam 135-140 days in northern Vietnam

Crop Season

	Area (000 ha) 1985	1995	Crop Season DG	DH
1. Northern midland area and Red River delta	50.6	85	July/Aug-Oct/Dec Jan/Feb-May/Jun	
2. Northern part of central coast line	47.6	80	Jan/Feb-May/Jun	
3. Central coast line	18.8	45	Apr/May-Jul/Aug Nov-Mar/Apr	
4. Central Highland	29	50	Aug-Dec Apr/May-Jul/Aug	
5. East of South	45.6	105	Aug/Dec-Jan/Feb Apr/May-Jul/Aug	
6. Mekong Delta	20.3	25	Apr/May-Jul/Aug	

- Sole/mixed

Northern Vietnam (NV) 90% sole; 10% mixed with corn

South Vietnam (SV) 60% sole; 40% mixed 1 row of maize + 4 rows of groundnut

Factor	[illegible]
Soil	
Rainfed	Degraded sandy soils
Irrigated	Light aluvial soils
- Deficiency (List)	P, Ca, Mo,B, low in org. carbon
- Toxicity	Al, Fe chlorosis
- Nodulation	30% area shows poor nodulation
- Waterlogging	Sometimes at maturity
- Salinity	None
Water	
- Drought	Mid season and terminal
- Irrigation problems	Furrow method. Fe chlorosis following irrigation is a problem in southern Vietnam
Nutrition management	
manures	FYM (@ 6 t ha^{-1}) and coconut ash only in south (100-300 kg ha^{-1})
fertilizers	N, P (300 kg SSP), Ca as lime (0.5-1 t ha^{-1}) (no gypsum), no micronutrients
Agronomic	
Land preparation	2 ploughings with country plough (15-20 cm deep), 2 harrowings, hand breaking clods raised beds 1-1.2 m wide
Seed viability	A major problem because of high humidity during storage
Sowing	30 x 10 cm
Plant population	35 plants sq m^{-1}
Weed management	2-3 hand weedings
Diseases	
Early leafspot	****
Late leaf spot	***
Rust	*** (in S Vietnam)
Budnecrosis (TSWV)	-
PStV	Present, but not important *
Bacterial Wilt	Important in certain years **
Seed and Seedlings rots	** Sometimes
Stem rot	**
A. flavus	**
Nematodes	?

Factor	Groundnut
Insect Pests	
Thrips	*** - severe in dry weather
Jassids	*** - severe in dry weather
White grub	* Some in riverian areas
Termites	-
Aphids	*
Leaf miner	-
Spodoptera	**
Hairy Caterpillar	*
Harvest/Post harvest	
- Harvest	Pre-harvest irrigation wherever possible ploughing followed by hand lifting
- Threshing	By hand, coincides with rice transplanting, labour problem
- Drying	Due to frequent rains and cloudy days drying becomes a problem
- Storage	Bamboo baskets absorption of air moisture causes loss by seed viability
- Utilization	Roasted nuts confectionery; oil, export
Variety weaknesses	
Low yield potential	**
Seed availability	****
Disease susceptibility	***
Pest susceptibility	**

Sensitive to:

a) Sprouting in the field due to lack of fresh seed dormancy.
b) Cold temperatures affecting germination in northern Vietnam.
c) Acidity (acid soils)

Infrastructure problems	
Research	***
Extension	***
Training	****
Seed production	****
Input availability	**

Utilization problems

Storage	****
Delivery systems	-
Prices	-
Local markets	-
International markets	-

Status Paper on Constraints to Production and for Transfer of Technology in Chickpea

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Introduction

Chickpea is one of the most important grain legumes in Bangladesh, Myanmar, Nepal, and Pakistan. It is grown on receding and residual soil moisture as a postrainy season (winter) crop in the Indian sub-continent. It forms an important part of the diet of the rural poor in these countries because of its high quality protein and relatively low price. Chickpeas are consumed mainly as 'dhal' but also in a variety of forms, including 'besan' (flour made out of 'dhal'), whole grain, green seeds and leaves as vegetable, roasted grains, sweets, and several other confectionary products. The husk and broken grains are also occasionally used as animal feed.

Area and production

The area, production, average yield and potential yield of chickpea in these four countries are given in Table 1. The productivity is reported to be highest in Myanmar (836 kg ha^{-1}) followed by Bangladesh, Nepal and Pakistan. The potential yield also varies from 2000 kg to 5000 kg ha^{-1} depending upon the length of the growing season.

Chickpea is grown on lands that remain fallow in the rainy season or after a cereal crop (mainly rice) in the rainy season. In Bangladesh and Nepal, the area under these two patterns is almost equally distributed. In Myanmar, it is mostly grown after rice, while in Pakistan it is mainly grown after fallowing in the rainy season. Most areas are under desi type chickpea except small pockets in Pakistan, where kabuli types are also grown. It is mostly a rainfed crop and area under irrigation is very small.

Table 1. The area, production, average yield, and potential yield of chickpea in South and South-East Asia.

Country	Area ('000 ha)	Production ('000 t)	Average yield (kg ha^{-1})	Potential yield (kg ha^{-1})
Bangladesh	50	37.5	750	5000
Myanmar	225	236	925	NA
Nepal	30	16	526	5000
Pakistan	844	583	540	NA

NA = not avaialble

Available cultivars and released varieties - their potential and weaknesses

Bangladesh

Two local landraces, Sabur 4 and Pabna local, are under cultivation. Both have small seeds and are late and susceptible to wilt and other diseases. Another cultivar Hyprosola released in early 80's also has very small seed and is susceptible to diseases. A recent release is cultivar Nabin, selected from an ICRISAT chickpea line, which has relatively larger seed and high yield potential but is susceptible to wilt and collar rot. However, several high yielding and wilt resistant lines are currently under advanced stage of testing and will soon be available to the farmers.

Myanmar

The oldest and widely grown cultivar in Myanmar is Karachi local. It has smaller seeds and is susceptible to wilt. Two cultivars, Yezin 1 (P 436) and Schwe Keymon (K 850 x F 378), selected from materials supplied by ICRISAT, have been recently released in Myanmar. Yezin 1, though potentially high yielder, is susceptible to wilt. Schwe Keymon, however, combines high yield and large seeds and is resistant to wilt. Two ICRISAT desi chickpea cultivars, ICCC 4 and ICCC 42, have also given excellent performance in on-farm trials in Myanmar. An interest in growing kabuli chickpeas for domestic as well as export purposes is on an increase in the country and an ICRISAT extra-short duration wilt resistant kabuli cultivar, ICCV 2, is already in pre-release multiplication and may prove as a boon for drought-prone areas. ICCC 32 is another medium-duration wilt resistant kabuli cultivar which has shown a good promise.

Nepal

Two cultivars, Dhanush and Trishul, which are selections from the local landraces, were released in early 80's. Potentially they are not very high yielding, have smaller seeds, and are susceptible to wilt. However, they are tolerant to botrytis gray mold and produce well in *Botrytis* endemic areas in central and eastern 'tarai'. Recently released cultivars, Radha and Sita, with relatively larger seed and high yield potential have done very well in western and mid-western 'tarai'. But they are susceptible to gray mold. Some of the new cultivars currently under on-farm testing, such as ICCL 82108, combine high yield, resistance to wilt, and tolerance to botrytis gray mold. The kabuli cultivar ICCC 32 is also doing well in on-farm trials.

Pakistan

After the ascochyta blight epidemics in early 80's, the old chickpea cultivars, that were susceptible to the disease were discontinued to be grown in the country. Only three cultivars, C 235, C 44 and CM 72, showing some tolerance to ascochyta blight, were taken up for multiplication and distribution to the farmers. Cultivar CM 72, which initially showed a good tolerance to the disease has become susceptible. The wilt resistant kabuli cultivar ICCC 32 which has done so well in the central India is expected to do well in blight-free areas, such as Sind.

Available technology (if any), bottlenecks for transfer of technology

Several chickpea cultivars have been recently released in these countries. Some are direct introductions from ICRISAT or the neighbouring countries and some have been developed by the national crop improvement programs. These cultivars have high yield potential but lack the necessary resistances to biotic and abiotic stress factors. For example, cultivar CM 72 released in Pakistan is now susceptible to ascochyta blight. Similarly, Radha and Sita in Nepal, and Nabin in Bangladesh are susceptible to botrytis gray mold which is the most serious disease in these countries. However, a number of chickpea lines combining required tolerance to important stresses and high yield potential are in advanced stage of testing and likely to be released very soon. ICCL 83228 in Bangladesh; ICCV 2, ICCC 32 and ICCC 42 in Myanmar; and ICCL 82108 in Nepal are a few examples of such promising cultivars. ICCV 2 and the newly developed extra-short duration lines ICCV 88201 and -88202 in particular hold a great promise for these countries as they can make fullest use of the short season and therefore are particularly suited to rice-fallows and drought-prone areas. ICRISAT kabuli cultivar ICCC 32 is another genotype which has a great potential for Myanmar, Nepal and Pakistan.

So far as the crop management is concerned, the research efforts have not been very consistent and the information available is very little. The experiments conducted in Nepal have shown that late sowing, wider row spacing, and intercropping with linseed, mustard or wheat helps in reducing the incidence and spread of botrytis gray mold and provide higher returns. This technology may be equally appliable in Bangladesh and in parts of Myanmar. The research on various aspects of crop management conducted at ICRISAT and by Indian national programs can be expected to be of great applicable value in similar environments existing in these countries. A massive response of chickpea to irrigation in lower latitudes observed at ICRISAT and elsewhere is well known and this can help in boosting the chickpea production in irrigated areas in these countries. Chickpea genotypes resistant to drought have been identified at ICRISAT which produce 30-40% higher yield in low-productivity environments. Cold tolerant lines developed by ICRISAT, that are capable of setting pods in cool winter in northern India and escaping the damage likely to be caused by pod borer and foliar diseases, can benefit the farmers in northern Pakistan. Similarly, cultivars identified as adapted to early and late sowing by ICRISAT and Indian national programs are expected to do well in similar situations in the neighbouring countries. Genotypes resistant to wilt and tolerant to root rots, stunt, and He icoverna pod borer are available. Information on chemical control measures of pod borer and foliar diseases such as gray mold and ascochyta blight is also available and can be made use of, if needed.

As fairly good infra-structure for a proper conduct of trials exists at experimental stations in all the four countries. The extension network for on-farm testing is also good. However, there is a lack of scientific and technical manpower and therefore the research set up is weak. But awareness to have more skilled and trained personnel is growing among these countries and staff are being encouraged for higher degrees and for training at international research organisations to learn about the advancement in technologies. The flow of scientist in and out of the country is also increasing.

The basic inputs like fertiliser, insecticides, fungicides etc. are not easily available or else the prices are too high to be within the reach of a common farmer. Subsidy on these inputs are rare and low. Also, there are hardly any incentives for higher production by way of support price etc. One of the major bottlenecks in transfer of technology is the absence of well organized seed industry in these countries. Most seed producing agencies are under public sector and lack commercial zeal. The new and identified varieties cannot spread fast due to paucity of quality seed. Also the funds allotted to research organizations are meagre.

Constraints to chickpea production

The constraints to chickpea production in Bangladesh, Myanmar, Nepal, and Pakistan are listed in Table 2. As evident from the table, the nonavailability of good quality seed, drought, temperature, soil acidity, agronomic management, diseases and pod borer are the major constraints to the production across the four countries. Chickpea is traditionally grown as a rainfed crop in marginal and submarginal lands on receding soil moisture. Therefore, plant establishment and management of land, water, and weeds is generally poor. These problems are further complicated by erratic rainfall and temperature regime. Whatever technology is available, seldom reaches to farmers and adopted. The inputs such as fertilizers, insecticides and fungicides are not easily available and their cost is generally too high for a common farmer to afford.

Among the biotic constraints, Helicoverpa pod borer, wilt, botrytis gray mold, collar rot and root rots are the major problems in all the four countries. Ascochyta blight is the most feared biotic constraint in Pakistan. The level of resistance to gray mold and ascochyta blight in the available cultivars is very low. No control measures other than resistant varieties is recommended for the diseases. The availability of common pesticides and appliances is generally poor and the cost is also high. The integrated pest management (IPM) is almost nonexistent in these countries but there is an increased awareness about its importance among the scientists. An intensive training for scientists and the extension workers in the ecology of Helicoverpa pod borer, its activity, and different control measures is essential to acquire the IPM technology and its transfer.

Cultivars adapted to early or late-sowing and to rice-based cropping system are lacking, preventing the diversification in the cultivation of the crop. Among the abiotic stresses, drought is the major constraint in Myanmar, Nepal and Pakistan, and to certain extent in Bangladesh. Soil acidity is another constraint in several parts of Nepal, Myanmar, and Bangladesh while soil salinity adversely affects the crop in Pakistan. Low winter temperatures in northern Pakistan and high temperature in the other three countries prevent the optimum pod set in chickpea. The management of land, water, and weeds is generally poor resulting in low crop productivity.

The socio-economic constraints are also very important in all the four countries. Marketing is not very much organized and largely remains under the control of private traders. Prices usually crash at the time of harvest benefitting the traders and not the growers and consumers. In Myanmar, however, prices are mostly determined by the government but generally these are not supportive enough to give any incentive to the farmers. All the four countries are almost self-sufficient in meeting the domestic demands. However, there is a growing realization of the potential of export to the neighbouring countries. Consumer preference is for desi chickpeas but awareness for kabulis for export trade is catching up.

Table 2. Constraints to chickpea production.

Constraints	Bangla-desh	Myanmar	Nepal	Pakistan
Seed availability	***	****	****	***
Soil factors				
Physical (drainage)	**	*	*	*
Chemical				
Deficiency				
Zn	**	?	?	?
Ca			**	?
Mg		?	**	?
Mo		?		?
Fe		?	?	**
Toxicity	?	?	?	?
Acidity	**	****	***	?
Salinity	?	?	*	***
BNF	**	**	**	**
Nutrients Management				
Manures	*	*	*	?
Fertilizers	**	*	***	?
Soil amendments	*	?	***	?
Soil moisture				
Drought	*	****	***	****
Waterlogging	**	*	*	?
Temperature	**	**	**	**
Agronomic constraints				
Land management	***	*	**	**
Water management	**	****	***	***
Weed management	****	*	***	**

Constraints	Bangla-desh	Myanmar	Nepal	Pakistan
Diseases				
Wilt	**	****	*	**
Ascochyta blight	-	-	-	***
Botrytis gray mold	***	-	***	?
Root rots	**	****	*	**
Stunt	*	*	*	**
Insect pests	**	**	*	?
<u>Helicoverpa</u>	*	****	***	**
Nematodes	?	?	**	?
Utilization				
Human	***	****	***	***
Animal	?	?	?	?
Post-harvest problems				
Drying	**	*	**	-
Storage	***	*	***	*
Marketing	*	*	*	*

**** = great importance BNF = Biological Nitrogen Fixation
* = little importance
- = not relevant
? = unknown

Discussion and Conclusion

A fairly good setup of extension network already exists in all the four countries. The newly identified cultivars possess a high yield potential and have produced upto 5 t ha^{-1}. Several of these are also resistant to wilt and tolerant to root rots but they have yet to reach the farmers. The extra-short duration desi (ICCV 88201 and -88202) and kabuli (ICCV 2) cultivars developed by ICRISAT have a vast scope since they can make use of limited soil moisture and the short season. Similarly, materials specifically adapted to early and late-sowing, cooler temperature, and drought environment, that have been identified at ICRISAT can be expected to do well in the similar environments existing in these countries. Information on crop management generated in these countries, at ICRISAT, and elsewhere, which include land and water management, cultural and chemical control of diseases and insect pests, and sowing dates, intercropping etc. need to be put together for the benefit of the farmers.

All the four countries need help in research and seed production for an effective transfer of technology. Although a good setup of extension network does exist, a LEGOFTEN-type catalytic activity will help a great deal and ensure the effective transfer of whatever technology is available at present. Since many outside agencies such as FAO, UNDP, IRRI, IITA, USAID, Winrock International, IDRC, ICIMOD, FCDP etc. are active in these countries, there is need of a better coordination among these to make the transfer of technology a success.

RECOMMENDATIONS TO ICRISAT

The delelegates were asked to provide guidance to ICRISAT as to how it could help them best in adaptive research and training.

ICRI le in Adaptive Research Asian Countries

The following are reports prepared by the (country) delegates meeting as individual countries without outsiders. They were asked to consider what role they felt ICRISAT could play in adaptive research in their country. Each group was provided with the following list of suggestions should they wish to consider them:

Supplying germplasm
Supplying breeding material
Providing technology
Providing scientists - short term
- long term
Helping to organize surveys
Holding meetings
Holding monitoring tours
Helping in planning
Participating in - adaptive research
- demonstrations
- extension to farmers
Others: Suggest ways ICRISAT and your programs should interact

INDONESIA

Adaptive and On-farm Research

- Help in formulating surveys of constraints to groundnut production, through a rapid rural appraisal.
- Help in formulating a plan for on-farm research, including design, organizational set-up, and technology to be tested.
- Train agricultural officers on methodology, technique, and socio-economic analysis associated with OFR.
- Supply publications, hand books, and manuals, related to on-farm research.
- Hold monitoring tours and workshops concerning on-farm research.
- Provide scientists on a short term basis.

On the ICRISAT Mandate Crop Research

- Supply germplasm resistant to pest and diseases (groundnut: resistant to jassid, aphids, thrips, leaf miner, late leaf spot, rust, yellow mosaic virus; pigeonpea: resistant to pod borers).

- Supply groundnut breeding material with high yield and, early maturity, and resistance to aflatoxin and leaf spots.
- Provide information on the new technology generated from research.
- Organise workshops on specific topics, such as pest management, nutrient management, and post harvest techniques.
- Review the national research plan related to ICRISAT's mandate crops.
- Supply publications, such as monographs on specific topics and commodities.
- Provide information on nutrient management on groundnut and pigeonpea.
- Train research workers on research methodology and research management.

MYANMAR

In addition to the list of suggestions provided by the organisers, ICRISAT can play a role in adaptive research in Myanmar in the following ways:

- Supply publications and information about ICRISAT's mandate crops.
- Help strengthen local training for both farmers and agricultural staff, and also provide training material.

NEPAL

ICRISAT can help Nepal's adaptive research program in the following ways:

- Conduct socio-economic surveys in the major legume growing areas of Nepal to understand the farmers' methods of legume cultivation, constraints to production, storage, marketing, etc.

  Major areas are:

  - Western Tarai for chickpea and pigeonpea
  - Central Tarai for groundnut.

- Help in planning adaptive and on-farm research programs in specific areas of Nepal.
- Supply germplasm of mandate legumes.
- Supply bulk quantity of specific outstanding varieties to rapidly disseminate these varieties in the country.
- Supply breeding materials.
- Make specific crosses as requested by the national program and send the early generation lines for selection and testing in Nepal.
- Provide useful equipment and instruments needed by the country program.
- Support the training program and in-country monitoring tours for national program research and extension workers.

- o Train country scientist for specific subjects as needed by the country program. This should include short term and degree training for national legume scientists.
- o Help set up and maintain laboratories in the country e.g. production of Rhizobium culture and a quality testing laboratory.
- o Evaluate country programs by employing ICRISAT and other AGLN country scientists.
- o Provide short term scientists for handling specific problems on the country's request.
- o Annual monitoring of the crop program by ICRISAT scientists during the crop season.
- o Conduct monitoring tours in various AGLN countries to observe research and on-farm testing programs for the mutual benefit of all AGLN countries.
- o Supply ICRISAT's publications to the national research program and other legume research centers in Nepal.
- o Provide material such as slides, video cassettes, and equipment for the training program in the country.
- o Invite ministers, high level planners, and administrators to visit ICRISAT to observe the research program, facilities, and activities of ICRISAT.

SRI LANKA

The need for a viable adaptive research program has been a major constraint in the transfer of technology from national research centers to farmers throughout Asia. ICRISAT can play a significant role in the formulation and strengthening of these adaptive research programs in Asia. ICRISAT should play a supporting role in the formulation of national adaptive research programs and their execution. The proposed ICRISAT role in Sri Lanka is summarized below.

- o Planning: Assist in planning national on-farm research and transfer of technology. ICRISAT will assist in the organization of surveys and the conduct of planning meetings.
- o Germplasm: Provide germplasm, improved crop varieties, and technology.
- o Equipment: Assist in the procurement of equipment and training material required in the conduct of adaptive research trials and demonstrations in farmers' fields.
- o Training: Assist in the training of adaptive research personnel and extension staff in on-farm research and technology transfer. Training in the use of computer packages for the analysis of multilocational trials should be emphasized. The training program should be tailored to meet national needs. The type and the duration of training will be determined by Sri Lanka.

- Scientists: Scientists from ICRISAT are required on a short-term basis to assist in planning and evaluation of on-farm research and transfer of technology.

- Monitoring tours: ICRISAT should help organise tours to monitor and evaluate national on-farm research and technology transfer programs. ICRISAT should organise visits to on-farm research programs in other member countries.

- Literature: Provide national programs with relevant literature and assist in the documentation of on-farm research findings and proceedings of meetings.

- Communication: ICRISAT should communicate with the Director of Agriculture, in respect of provision of ICRISAT scientists, training opportunities, and funding of adaptive research and technology transfer programs. Communication on technical matters between ICRISAT's scientists and staff of the Sri Lanka national program may be direct.

VIETNAM

Suggestions for ICRISAT's role in adaptive and on-farm research and technology transfer in Vietnam are as following:

- Supply germplasm of groundnut and pigeonpea.

- Supply breeding materials and varieties of groundnut with high yield combined with resistance to pests and diseases.

- Provide long-term scientists and establish a research station in collaboration with Vietnam. (Problem will be discussed and decided in detail during the next visit of ICRISAT scientists to Vietnam in the near future).

- Hold meetings (one tentative meeting will be held in March 1990 in Hanoi).

- Hold monitoring tour with Vietnam and ICRISAT's scientists in 1991.

- Help in planning.

- Participate in adaptive research.

- Supply funds for conducting the above mentioned activities.

INDIA

India as one of the consultant countries provided the following suggestions:

- o Germplasm supply: This is one of ICRISAT's objectives. The Indian National Program works on all ICRISAT's mandate crops and requests germplasm as and when needed. This assistance should continue.

- o Supply of breeding material: The Indian National Program gets breeding material two ways through:

  - special meetings/visits to ICRISAT, and

  - annual workshops of the All India Coordinated Projects.

  This should continue.

- o Provide technology:

  - Applied technology - that which can go directly to the field or to extension workers for its application, can be looked after by the Indian National Program and does not need the support of ICRISAT. However, ICRISAT may develop the methods to be used to transfer the technology for which the national scientists may be trained.

  - Basic technology such as, special breeding methods, biotechnology, technology for screening of breeding material,

  - Laboratory technology - may be shared between ICRISAT and the Indian National Program.

- o Provide scientists: The Indian Program is quite strong with reference to manpower.

- o Train scientists: However, ICRISAT can provide special training to the national scientists in field and laboratory research, seed production, and biological insect control.

- o Organize surveys: ICRISAT can assist in germplasm collection and in special surveys on diseases and pests.

- o Hold meetings: ICRISAT should organise meetings on special issues such as:

  - Hybrid pigeonpea
  - Dwarf pigeonpea
  - Ascochyta and botrytis disease problems of chickpea
  - Breeding for drought resistance
  - Late pigeonpea
  - Seed production

- o Monitoring tours: ICRISAT should organize production tours both within and outside the country.

- Planning: Help not required.
- Participation: Adaptive research - Methodology
- ICRISAT may be involved in methodology issues
- ICRISAT's input not required in demonstrations or extension to farmers.
- Information service: Through literature, films, and cassettes.
- Build up of institutions for developing regional research capabilities. ICRISAT should consider assisting in strengthening institutions for the following disciplines: soils, and agricultural engineering.
- ICRISAT can have a role in helping in the use of biotechnological tools for improving grain legumes.

Training topics

The following are some training topics recommended by the country groups for consideration by ICRISAT:

Research methodology and management
Recent advances on varietal improvement including genetic engineering and cell biology
Computer training for statistical analysis
Instrument and equipment maintenance
Methodologies for non-rice based cropping systems
Methodologies for adaptive on-farm research
Crop modeling and yield projections
Integrated pest and disease management for legume crops
Entomology of pigeonpea
Crop loss assessment
Seed production and technology
Crop post-harvest handling, storage, transport, and utilization
Aspects of legume product processing
Management of library
Project impact assessment

PLENARY SESSION

The Country Working Group (CWG) Chairman presented their project proposals. The session Chairman asked for any points of clarification after each presentation. After all the presentations were made, discussion was then country-wise followed by a general discussion.

Myanmar

The diagnostic trials proposed are meant to identify constraints to production; for example large differences in yield between locations.

Nepal

The target of raising the present 0.6-0.7 t ha^{-1} yield of chickpea to 3.0 t ha^{-1} in the short period of the project was considered too ambitious and unrealistic, particularly considering to the few staff identified for the project. Failure may discourage funding agencies to support such projects. However, it seems the objective is to demonstrate the potential yield of 3 t ha^{-1} on farmers' fields and not to raise the average productivity to that level. In spite of demonstration of successes it seems doubtful if the government will come forward to sustain the efforts at the end of the 3 year project. Questions of approaches such as socioeconomic surveys for prioritization of constraints to production vs straight forward potential yield demonstrations, using the information currently available, were discussed at length. No consensus emerged. Each approach had its merits and demerits and a two pronged approach accommodating both was suggested. Assessment of adoption and impact of technology demonstrated was considered necessary at the end of project period. It was felt that farmers do not adopt the technology as a whole but those components of a technology which they consider useful.

Vietnam

The request for establishing a groundnut research center in Vietnam was elaborated. Funding is not requested for building and staff but for improving the functional aspects by way of equipment and help in conducting on-farm trials. Such activities are not currently carried out in Vietnam. At present on-farm trials are contemplated only on groundnuts and exploratory trials on chickpea and pigeonpea. The latter two crops are not only important as human food but can be considered for animal feed as well.

Sri Lanka

In view of an already on going project on pigeonpea the suggestion was made that the new funding could be used for increasing emphasis on groundnut and chickpea. The demand for groundnut and chickpea seems limited in the country. Groundnut is used for confectionery purpose and cannot compete with coconut for oil. Chickpea will need to compete with high value crops including vegetables. However, the scope for promoting these crops will be explored.

Adoption of pigeonpea is catching on as seen by major headway achieved in production, and the attractive prices of the produce. Additional funds are required to pursue and support these efforts.

Indonesia

Two project proposals were made, one on groundnut and another on pigeonpea. Straight forward adoption trials on farmers' fields were proposed based on the knowledge and experience already gained. Such trials have not been done in the past. In pigeonpea, the groundwork done by the ACIAR project is to be utilized. Pigeonpea should find its place in the open market rather than being supported by the government. Demand from soya sauce industry and as a vegetable already exists. The objective of these trials is to first demonstrate high yield and later to develop an economic package. These trials could serve the purpose of demonstrations of prospective technology as well as diagnostic trials. Packages of practices were considered dynamic rather than static. For example, the increased use of weedicides instead of hand weeding with change in circumstances.

General Discussion

Current efforts on the project by the countries concerned was included in the background information on the project. Plans on the continuity of the project initiated and ways and means of evaluating the impact when the project is terminated after three years were also considered. Questions were asked on the basis of how a country chooses from many projects offered by different donors and it appeared that at least Nepal could absorb almost all proposals in their ongoing Programs. Support for project research vs strengthening the existing research, extension and outreach linkages were considered. It may differ with crop, for example, strengthening of existing structure was considered applicable to rice but not to groundnut and pigeonpea in Indonesia. Close monitoring of trials and demonstrations was recommended.

Summarizing the information on soil, climate, diseases, and pests available with other organizations operating in the country for use in these new projects was suggested.

Seed multiplication, storage, and distribution could become a bottleneck, particularly in groundnut, if appropriate action in not initiated well before time. Mention was made of seed production village schemes where a few farmers could be trained in seed production technology and who could then produce seed and distribute it to the farmers in the neighbourhood. This could reduce overhead cost of seed production and distribution of improved varieties.

In his closing remarks, Dr. J.L. Monteith, Director, Resource Management Program (RMP), ICRISAT described the close and effective collaboration between AGLN and RMP. He cautioned that involvement in too many site specific problems by this group could dilute their efforts. He said RMP keeps in close touch with NARS to appraise themselves of the constraints and pass on the solutions and suggestions to those problems for adapting them to site specific and local issues.

Mr. A.N. Bhattarai, Nepal, thanked Dr. L.D. Swindale, ICRISAT Management, and organizers of the workshop on behalf of the participants from outside for this opportunity for useful and fruitful discussions.

PROJECT PROPOSALS

The project country representatives - Indonesia, Myanmar, Nepal, Sri Lanka, and Vietnam - were each asked to develop adaptive on-farm research project draft proposals for their own country. These country representatives were joined by members of the Consultant group of participants and ICRISAT staff as shown below:

Country Working Groups

Indonesia	Myanmar	Nepal	Sri Lanka	Vietnam
Project country representatives (Country Group)				
DM Arsyad	Khin Maung Aye	AN Bhattarai	HP Ariyaratne	Pham Van Bien
S Soebroto	Myat Htwe	RK Neupane	SJBA Jayasekera	Ngo The Dan
Sumarno	Aung Thwin	ML Pradhan	WM Jayasena	Pham Huy Trung
Consultant group				
CE van Santen	DC Cardenas	MI Khan	Pal Singh	Hgu Hai Nam
F Taylan		S Lal		
ICRISAT Staff				
CLL Gowda	KC Jain	O Singh	M Pimbert	LJ Reddy
PW Amin	YS Chauhan	MV Reddy	KB Saxena	JVDK Kumar Rao
NP Saxena	SL Dwivedi	CS Pawar		P Subrahmanyam
J Kumar				

The participants were provided with a general outline to help them develop their draft project proposals. This outline was intended as a prompt to stimulate discussion and not as a hard and fast layout. This activity was intended primarily as a practice exercise to learn the procedure necessary in writing a proposal. However, they can be considered as a starting point to indicate the form the on-farm adaptive research on ICRISAT legume crops might take in each country.

General outline provided to project country working groups to help develop proposals

In developing the project proposal each group should consider the following points.

Problem

Crops or systems to be involved (Chickpea, pigeonpea, groundnut, other)

Why was choice made? (Give supporting background)
Will a survey or other method be required to determine which crops or systems to include in project?

Most important constraints to be overcome

Biotic and abiotic stresses (pick from list already developed)
Farmer input
Markets
Utilization

Technology to overcome these constraints

Can existing technology be used directly?
Will technology need adaptation to local or farmer conditions?
Will new technology need to be developed?

Objective statement

- In simple terms - what is to be outcome and how is it to be done?
- Very short and concise.
- To be developed based on problem statement.

Methods

Identify methods to be used. Some suggestions:

Planning meetings

Surveys
Controlled experiments on-station
Adaptive research
On-farm research
Training
Research-extension-farmer interfaces.

Materials (needed vs. available)

Staff - research, extension, administration
Facilities - offices, fields
Equipment - transport, field equipment
Outside involvement - ICRISAT, other institutes
Budget requirement - internal and external
Administrative support required

Expected outcome

Time frame
Evaluation procedure

INDONESIA

DRAFT PROPOSALS FOR GROUNDNUT AND PIGEONPEA

The revised proposal which only covers groundnut is reproduced here. This is followed by the pigeonpea proposal which was developed at the meeting at ICRISAT.

This proposal was revised after the participants returned to Indonesia in consultation with Dr. Ibrahim Manwan, Director of the Central Research Institute for Food Crops, Bogor.

GROUNDNUT

Title	Groundnut on-farm Research and Demonstration Project - Indonesia
Objective	To increase farmer groundnut production through adaptive on-farm research and demonstrations in two major groundnut production areas in Java.
Funds required	US$ 160,000
Funding agency	UNDP/FAO/ICRISAT
Duration	Three years, starting March 1990
Implementing agencies	The Agency for Agricultural Research and Development* (AARD) The Indonesian Extension Services**
Cooperating agency:	ICRISAT Hyderabad, India

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* The AARD will be represented by:
- The Central Research Institute for Food Crops (CRIFC), Bogor
- The Malang Research Institute for Food Crops (MARIF), Malang
- The Bogor Research Institute for Food Crops (BORIF), Bogor

** The Indonesian Extension Services will be represented by:
- Directorate of Food Crop Extension of the Directorate General for Food Crops of the Department of Agriculture
- Agency for Agricultural Extension, Training and Education (AAETE)
- Provincial Services for West Java and East Java:
  - o Provincial Agricultural Services - DIPERTA
  - o Secretariat of the Mass Guidance Organisation Office (BIMAS)
  - o Agricultural Information Service (BIP)

Background

Groundnut is the second most important food legume crop in Indonesia with an average annual harvested area of over 500,000 ha. Demand in Indonesia exceeds national production and annually some 50,000 tons of groundnut are imported. Increased groundnut productivity would therefore increase both farmer income and save foreign currency through increased aggregate national off-production.

The average farmer groundnut yield is 1.1 t ha^{-1} of dry pods. With improved technology yield levels have been obtained of 3 t ha^{-1} dry pods on-station and of 2 t ha^{-1} on farmers' fields.

Farmers grow groundnuts using traditional management practices with low levels of inputs. Groundnuts are grown in several agroclimatic zones both under rainfed conditions and in wetlands.

About two thirds of groundnuts is planted under rainfed conditions, with planting between November and March and harvesting between February and July. Cropping systems include mono-cropping and mixtures with maize, cassava, and other food crops.

One third of groundnut is planted as a second or third crop after irrigated rice. Farmers grow groundnut as a cash crop. Cropping systems including groundnut provide favorable net returns per hectare when compared with other cropping systems. The farm gate price is attractive and may rise to US$ 1 per kg dry seeds in the off-season.

Major constraints

Major constraints to groundnut production occurring in Indonesia are the following:

- Use of plant material with low yield potential
- Soil compaction and poor drainage
- Leaf spot and rust
- Nutrient deficiencies
- Weed competition
- Bacterial Wilt
- Peanut Stripe Virus

Major opportunities

Major opportunities for increased yields include the following practices:

- Use of improved plant material, free from seed-borne diseases, with high genetic yield potential, such as Kelinci, Tapir, and Gajah varieties.
- Improved land preparation practices, including use of raised bed.

- o Increased use of organic matter to improve the soil's water-holding capacity.
- o Use of a balanced chemical fertilizer package.
- o Proper plant density 250,000 seeds ha^{-1} with optimal spacing
- o Control of diseases and pests.
- o Weed control measures.

Improved technology is available on-station and can be directly applied on farmers' fields. Due to the great variability in field conditions, technology components should be tested on-farm.

Objectives of the Project

- o To develop models for technology development for groundnut based on a careful diagnosis of constraints faced by farmers producing this crop.
- o To test on-farm alternative technologies for increased groundnut productivity.
- o To arrange transfer of improved groundnut production technology to farmers through demonstration plots and farmer days.

The Study Areas

The project will include two study areas, each representing major groundnut production areas. These are:

- o Tuban, East Java

In Tuban Kabupaten (District), East Java, groundnut production is under rainfed conditions. Area planted under groundnut in this Kabupaten covers about 24,000 ha per annum. Average rainfall is 1200 mm per annum. Major soil types include black alluvial soils. The main planting period is in November and harvest is in February-March. Current production level is 1 t ha^{-1} of dry pods.

- o Subang, West Java, represents a major groundnut production area in which this crop is grown on wetlands as second or third crop after irrigated rice. Average rainfall is 1600 mm per annum. Major soil types are latosols and andosols. The main planting period is from March to May and harvesting takes place three to four months later. Current production level is 1.2 t ha^{-1} of dry pods.

Methodology

The project will initially cover three years and include the following types of activities:

- Planning Meetings[1]
  - With inter-agency[2] and interdisciplinary [3] participation
  - Timing: at the beginning of the project and at the beginning of each crop season.

- Collection and analysis of secondary data
  - Physical aspects (climate, soils)
  - Production, marketing, and end use of groundnuts.

- Surveys (exploratory/informal/RRA type of surveys and formal surveys)
  - Farmer groundnut production practices including constraints to production
  - Marketing and processing, including constraints to these activities.

- On-farm experimentation
  - Testing of hypotheses and verification of tentative recommendations developed.

- Assessment and formulation of recommendation
  - Through planning meetings of research, subject matter and extension staff.
  - Through field days with farmers and field level extension staff.

- Demonstrations of recommendations on large scale
  - Through on-farm demonstration plots and farmer days.

Training

Most of the training will be "on the job" training involving village level extension workers and selected farmers participating in the implementation of the program. In addition at the beginning of the project and possibly at the beginning of each subsequent crop year short training courses will be organized for field staff involved. Field days for farmers will be organized at the end of each cropping season.

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1 Detailed work plans are presented in Annex 1
2 Interagency includes representatives from research, extension, farmers, and local government.
3 Interdisciplinary includes both biological and sociological specialists.

Cooperation between research, extension, and farmers

Researchers, extension staff and farmers will closely cooperate in the implementation of all aspects of the program.

Cooperation with ICRISAT

It is proposed that one ICRISAT agronomist and one plant pathologist attend the yearly planning meetings. As the need may arise, the Indonesian project manager may request ICRISAT for the above two specialists and/or other ICRISAT specialists to be available for short consultancies to advise the Indonesian team on specific subjects.

Expected output

- Increased researcher's understanding of farmer's groundnut production system.
- Development of practical recommendations for increased groundnut production for both study areas (groundnut after irrigated rice and groundnut under rainfed conditions).
- Strengthened cooperation between research and extension services to assist the farmer in increasing groundnut production and hence farmer income.

Proposed organization

- From research
  - One project manager
  - One part time administrative officer
  - Five researchers (groundnut breeder, agronomist, entomologist, virologist/pathologist, agro-economist)
  - Four field assistants (two per study area)
- From extension
  - Two subject matter specialists (one per study area)
  - Six village level extension agents (PPL) - Three PPL per study area.

In each study area two research field assistants will be stationed during the growth season who will work together with three village level extension workers (PPL) under the supervision of an extension subject matter specialist (PPS) for daily management of the on-farm experimentation.

Project headquarters

The headquarters for the project is proposed to be located in the Malang Research Institute for Food Crops.

Funds requested from international sources

(in '000 US$)

		1 year	2 years	3 years	Total
1.	Operational research costs including - farm inputs - travel - training - planning meetings - field days	30	45	50	125
2.	Equipment[2]	30	-	-	30
3.	Publications			5	5
	Total	60	45	55	160

1 Salaries of national research and extension staff are paid from the national budget. A workshop with international attendance may be planned in the third year with financing obtained from outside sources.

2 See Annex 2

ANNEX 1

Detailed Workplans - Groundnut, Indonesia

Activities Proposed for First Year

o Initial Planning Meeting

Objective: To discuss and approve the work plan for the first year

Participants:

- Researchers (CRIFC, BORIF, MARIF, ICRISAT)
- Extension agents (DIPERTA, BIMAS, BIP)
- Directorate of food crops - staff
- Representatives of local government
- Farmer representatives

Period: at the start of the program - March 1990.

Expected outputs of the Planning Meeting: a detailed work plan for all activities planned and assignment of tasks to staff concerned.

- o Exploratory survey

(Using RRA and other informal types of survey techniques)

Objective: To describe farmer groundnut practices and constraints faced in groundnut production.

Implementation: Interdisciplinary and inter-agency team, including agronomists, plant breeders, crop protection specialists and agro-economists and extension subject matter specialists.

Period: During the growth season. The optimal time for the survey would be 60-70 days after planting. For Subang this would be approximately during May (1990) and for Tuban approximately during January/February (1990 or 1991).

- o Compilation and analysis of secondary data

Objective: compiling and analysis of secondary data including information on:

- Climate and soils
- Areas under production
- Input levels
- Enumeration of available agricultural services

Implementation: Economics department of participating institutes together with extension staff resident in the study area.

Period: Starting March 1990, continuing as required.

- o Regular Planning Meetings

Objective: To design on-farm experimentation program based on findings of surveys, analysis of secondary data, and on-farm trials.

Implementation: Research staff and extension subject matter specialists (PPS).

Period: After completion of each cycle of on-farm trials and surveys.

Initially for Subang: November 1990 and in following years, November.

Initially for Tuban: February 1990 or 1991 and following years February.

- o On-farm experimentation program

In general detailed trial designs for on-farm experimentation can only b formulated after the following has been completed:

- the initial-planning meeting
- initial data collection
- exploratory survey by an interdisciplinary and interagency team.

Tentatively the following on-farm experimentation is envisaged:

Joint farmer/extension/research managed exploratory trial

Objective: To compare farmer management practices with alternative management practices.

Implementation:

Design	:	Jointly by researchers, farmers, and extension specialists
Daily management	:	Farmers
Daily supervision and record keeping	:	Extension agents
General supervision and analysis	:	Researchers

Period: Season 1990/1990 Tuban: November
Subang: January

Researchers managed trials

Objectives:

Variety:

- to compare performance of improvced grondnut varieties with farmer varieties.

Land Preparation:

To compare the effect on yield of

- different methods of tillage
- different types of raised plant beds.

Pest control:

- to identify major pests
- to assess for each major pest the crop loss involved
- to compare various control measures for each major pest identified.

Disease control:

- to identify major diseases
- to assess crop losses caused by each major disease
- compare various control masures for each major disease identified.

Fertilizer management

- to study the response of groundnut to different levels of K, P, N and minor elements.

Implementation:

Location	:	Experimental Farm of DIPERTA (WKBPP'S), Selected farmer fields
Design	:	Researchers
Daily management	:	Farmers, field assistants, and village extension agents (PPL)
Daily supervision and record keeping	:	Field assistants and extension subject matter specialists (PPS)
Analysis	:	Researchers

Period: Season 1990/91 : Tuban - November
Subang - February

Field days

Objective: To discuss results from the program with farmers, local authorities , researchers, and extension staff at the end of each crop season.

Implementation: Field visit to trials
Discussion in village headquarters.

Period: At the end of each crop season, two to three weeks before harvesting

Tuban: January
Subang: April

Activities Second and Third Years

In the adaptive research approach, activities for each research cycle are based on an assessment of the findings of the previous research cycles. In view of this it is not possible at this stage to make a work plan for the second and third year.

However, it is assumed that the results of the first year already will allow formulation of tentative recommendations for groundnut production for each of the two study areas.

Assuming that this is the case, the activities of the second and third year will give major emphasis to verification types of trials in which many farmers should participate (e.g. forty farmers per study area).

For other issues requiring further clarification additional researcher managed trials and/or single subject surveys may still have to be carried out.

ANNEX 2

Specification of equipment required

	(million Rupiah)
- One four wheel vehicle	Rp 25
- Four motor cycles (two for each study site)	Rp 15
- Four knapsack sprayers	Rp 1
- Four improved ploughs (reversible blades)	Rp 2
- 10 units of weather stations	Rp 10
Total	Rp 53 million*

* This is approximately equivalent to US$2900

PIGEONPEA

Developing Pigeonpea Production in Indonesia

Background

Pigeonpea is among the five most important grain legumes grown in Indonesia. It is grown in Java, South Sulawesi, Bali, Lambok,and in the islands to the east of Lambok up to Timor. Pigeonpea tolerates drought well and shows promise in the eastern part of Indonesia where other grain legumes can not be cultivated profitably. The use of pigeonpea as a food component is quite common in these growing areas, and also it can be used as a supplement to soybean in making tempe. Tempe made of 30% pigeonpea + 70% soybean tastes as good as that made of 100% soybean. Since Indonesia still imports around 500,000 tons soybean annually, developing and increasing pigeonpea production could help reduce the amount of soybean imported.

Although this crop had been commonly grown, large production has never been attained. There is a need to introduce this crop to areas where pigeonpea has never been grown, as well as to intensify its production in the regions where the crop is traditionally grown.

Objectives

- o To facilitate the transfer of suitable technology for developing and increasing pigeonpea production in Indonesia.
- o To increase the farmers' income in Indonesia.

Methodology

- o Locations :
  - o Subang, on irrigated land during the dry season
  - o Lambok, dry land, rainfed, during the tail end of the rainy season

- o Experimentation :

First year : 20 units

- Agronomic trials including fertilizers trial, water management, pest management and, plant population study.
- Varietal trials
- Cropping systems (monocrop, mixcrop) trials

Second year : 45 units

- Package of technology testing at farmers' fields, involving 20 farmers in each location.
- Seed increase

Third year

- Pre-production trial, applying the most suitable technology, involving 50 farmers in each location.
- Demonstration blocks and economic analysis.

- o Executing Agencies:

Central Research Institute for Food Crops cooperating with the Directorate of Food Crop Extension.

- o Organization

- National steering committee	=	2 persons
- Project coordinator	=	1 person
- Research scientist	=	6 persons
- Extension specialist	=	4 persons
- Field assistant	=	4 persons
- Extension agents	=	4 persons

o **Equipment Needed**

1 Vehicle
4 motor cycles
6 sprayers

o Proposed Budget

- From the national program = in kind
- From ICRISAT: US$175,000 for three years

Budget heading	Year I $	Year II $	Year III $	Total $
1. Operational cost/trials	10,000	15,000	20,000	45,000
2. Equipments	20,000	5,000	5,000	30,000
3. Local travel	15,000	15,000	20,000	50,000
4. Supplies	5,000	5,000	10,000	20,000
5. Training and Workshop	-	10,000	20,000	30,000
	50,000	50,000	75,000	175,000

Expected Outcome

o Technology of production will be used by farmers.

o Production of pigeonpea will be increased.

o Increase in farmers' income.

MYANMAR
DRAFT PROPOSAL

Title

Grain legume on-farm adaptive research in Myanmar

Objective

- o To increase and stabilize yield per unit area of groundnut, chickpea, and pigeonpea.
- o To upgrade living standard of farmers in dry-zone area by way of increased production though applying improved technology.

Present status of crop

The present average yield and the targeted average yield per unit area of groundnut, chickpea, and pigeonpea is as follows:

Crops	Area ,000 ha	Production ,000 t	Average yield (kg ha^{-1})	Targeted average yield (kg ha^{-1})
Groundnut (total)	536	519	968	1739
winter season	289	345	1193	2200
Rainy season	247	175	700	1500
Chickpea	195	164	841	2000
Pigeonpea	47	41	612	1600

Crop priorities

Groundnut - First priority because of its large area and production, and domestic use as an oil crop.

Chickpea - Also first priority because of larger area, greater production, and wider export market potential than pigeonpea.

Pigeonpea - Second priority because of its limited use.

Project duration: - 3 years (1990-92).

Production constraint

o Biotic/Abiotic

Stresses	Crops		
	Groundnut	Chickpea	Pigeonpea
Biotic	Late leafspot Rust Leaf miner Spodoptera	Fusarium Dry root rot Pod borer	Pod borer Maruca
Abiotic	Drought Dormancy Phosphorus deficiency	Drought	Drought

o Other constraints

- Non availability of seed of improved varieties
- Poor weed management
- Difficulty in land preparation
- Lack of improved implements
- Shortage of fertilizer, pesticide, herbicide, fungicide, etc.
- Loss of seed viability
- Non-availability of farm labor.

Technology, Resources and Knowledge available to overcome these production constraints

o Planning meeting

- organize annual work plan meeting, preferably in April each year.

o Cultivation practices

- Local cultivation packages - (Available)

- Improved cultivation package - (To be developed)

. Improved variety
. Fertilizer
. Plant population
. Herbicide, pesticide, fungicide, etc.
. Seed dressing
. Weed management
. Soil amendment
. Proper land management (Broad/narrow bed and furrow vs. flat)

- o Trials
  - Multilocation diagnostic trials
  - Adaptive on-station as well as on-farm trials.
- o Monitoring tour.
- o Organize field day to demonstrate improved technology among farmers, extension workers, etc.

Organizations

- o Myanmar Agriculture Services - ARI, ARD 4, and Extensive Division.
- o ICRISAT

Training and consultancy needs

- o Organize training to local staff in Myanmar.
- o Specific training of local staff at ICRISAT Center if required.
- o Need based consultancy by ICRISAT or any other organization.

Infrastructure required

- o Facilities available
  - Local staff
  - Office space
  - Field plots
- o Facilities required
  - Land preparation equipment
  - Spraying equipment
  - Thresher, shellers, diggers in case of groundnut
  - Balances
  - Transport - to be specified later on
  - Storage - Storage facility to be developed

Budget

Cash estimate for 3 years of project period, including foreign currency cost and local contributions are given in the following table.

Components	External funding ($,000)	Local funding ($,000)	Total ($,000)
Seeds	20	-	20
Fertilizer	20	20	40
Agro-chemical	20	20	40
Equipment	30	-	30
Training and consultancy	30	10	40
Transport facility	20	-	20
Demonstration and Trial	-	20	20
Administration	-	20	20
Other contingency	10	10	20
Total	150	100	250

Expected outcome

- Identification of improved technology packages to increase production of grain legumes.
- Popularize improved production technology.
- Crop diversification in non-traditional areas.
- Strengthened research-extension linkages.
- Organize large scale seed production of improved varieties and make seed available to farmers.

NEPAL
DRAFT PROPOSAL

Project 1 Chickpea and Pigeonpea

Project Title

On-farm Research and Technology Demonstration for Chickpea and Pigeonpea in Nepal

Problems

Productivity of chickpea 600 kg ha^{-1} and pigeonpea 700 kg ha^{-1} is very low in Nepal. Improved varieties with improved technology could produce yields of 3 t ha^{-1} in both crops.

Main constraints

Chickpea

- Botrytis and Fusarium wilt diseases
- Pod borers
- Farmers do not apply fertilizers
- Field preparation and sowing practices do not give good stands
- Weed control and cultural practices are sub-optimal
- Farmers do not take control measures for insects and diseases
- Seed of improved varieties is not available

Pigeonpea

- Sterility mosaic disease is serious
- Pod borers damage causes losses in yield of up to 30%
- No fertilizers applied
- Field preparation and sowing practices do not produce good plant stand
- Weed control and other cultural practices are nominal
- Farmers do not take control measures for insects and diseases
- Seed availability of promising variety is not sufficient

Technology to overcome these constraints

Chickpea

- Recommended varieties for chickpea are Sita and Radha which have been already tested in Farmers' Field Trials (FFT) and could be tested directly in farmers' fields.
- Many chickpea lines like ICCL 82108 and ICCC 32 are promising but have to be tested in farmers' fields. Production demonstration also has to be conducted in farmers' fields to demonstrate that yields of up to 3 t ha^{-1} is feasible with adaption of improved technology.
- New technology, such as disease and insect resistant varieties, and improved cultural practices have to be developed along with rhizobium inoculation.

Pigeonpea

- o Bahar, PR 5147, ICPL 8398, and many other lines have shown good promise in FFT and these lines could be demonstrated on large scale in farmers' field.

- o Insect and disease resistant varieties, and new improved cultural practices have to be developed.

Objectives

- o To demonstrate and transfer improved technology of legume crops to give stable higher production.

- o To further understand the constraints and limitations to higher productivity of legume crops.

- o To modify and refine the technology to give still better productivity.

- o To strengthen the capability of NGLIP to conduct on-farm testing by providing necessary mobility and other facilities.

- o To understand the socioeconomic constraints to higher production of chickpea and pigeonpea.

Background

Average yield of chickpea and pigeonpea are low in Nepal, at 600 and 700 kg ha^{-1} respectively. It has been already proved that recently released varieties of chickpea and promising varieties of pigeonpea are capable of producing a commercial yield of 3 t ha^{-1} with improved packages. NGLIP have tested promising varieties of chickpea at 30 locations and pigeonpea at 40 locations, and 400 chickpea and 200 pigeonpea minikit packets were distributed during 1988/89. However, dynamic production demonstration programs have not been conducted to produce quick impact on production in farmers' fields. The capability of outreach teams on Regional Research Stations specially at Nepalganj is not very satisfactory, and so has to be strengthened to make it dynamic and effective.

The Project

- o Production demonstrations with improved technology should be conducted to demonstrate that 3 t ha^{-1} yields are possible in farmers' fields.

- o Strengthen the capability of outreach research team and extension services of the project district of Nepalganj Regional Research Station by providing staff, mobility, and other facilities.

- o Conduct socioeconomic surveys with the help of ICRISAT and Socioeconomic Research and Extension Division (SERED) of NARC to understand the constraints and legume cultivation practices of farmers.

- o Improve the seed availability of improved varieties by purchasing seed from the production demonstration plots.

- o One block production program of at least 50 ha would be developed in each district and all new technologies would be tested and demonstrated these in the future.

Project area

Western Tarai districts (Kailali, Kanchanpur, Banke, Bardia, Dang, and Kapilbastu districts)

Methodology

- o The Regional Research Station at Nepalganj would develop a strong linkage with the extension agencies of its command area. NGLIP would play an important role to organise a planning meeting with concerned agencies.

- o The benefits of this program would be discussed in detail and agreement would be reached by defining role and responsibilities of all the concerned agencies.

- o Outreach research officer and extension officers would be trained at ICRISAT for production technology of these crops.

- o NGLIP and Regional Research Station, Nepalganj would organize a training program on legume production technology to concerned extension workers with the help of ICRISAT.

- o Survey for selecting sites and discussion with farmers would be done at least two months before the planting season.

- o All the necessary inputs would be provided by the project and the farmer would use his land and labor for these demonstrations. Improved seeds from production demonstrations would be purchased by the project for further dissemination.

- o Rewards would be given to the best performing farmers, extension workers, and to research outreach officers after evaluation of demonstration in each season.

- o A permanent Block Production Program of at least 50 ha would be established in each district in the 3rd year, and in future all improved technology would be tested there. These blocks would serve as a seed multiplication unit for each district.

Materials needed

	Total requirement	Presently available	Additional requirement
Staff			
Outreach research Officer	3	3	-
Junior technicians	3	3	-
Extension officers	3	3	-
Motor bikes	7	-	7
Balances	20	2	18
Sprayers/dusters	20	5	15
Measuring tapes	20	5	15
Moisture testers	20	2	18
Seeds			
Fertilizers			
Insecticides			
Fungicides			
Others			
Funds for socioeconomic survey			

Distribution of target

Target for 3 years	Year-I	Year-II	Year-III
Production demonstrations demonstrations	10 (2 dis-tricts)	20 (6 dis-tricts)	40 (6 dis-tricts)

Outside Involvement:

ICRISAT Survey

Training of extension and outreach officers
In-country training for extension workers
Monitoring and evaluation of demonstrations
Seed and visual aid supply

Annual budget requirement (NRs)

		Internal	External
Salary	Outreach officers	90,000	-
	Junior technicians	60,000	-
	Extension officers	180,000	-
D.A. @ Rs. 100/day		-	100,000
Fuel		-	200,000
Inputs		-	400,000
Stationery		-	50,000
Repair		-	50,000
Training		-	100,000
Contingencies		-	100,000
Total		330,000	1,000,000
Non-expendable			
Motor bikes (7)		-	350,000
Sprayers & dusters (22 each)		-	100,000
Total expenditure (NRs)		330,000	1,450,000

(1 US $ is equivalent to 30 NRS)

Budget for various years from the project

	1st year	2nd year	3rd year	Total
Expendable	1,000,000	1,200,000	1,400,000	3,600,000
Non-recurrent	450,000	-	-	450,000
Total	1,450,000	1,200,000	1,400,000	4,050,000

Benefits

(1) Farmers would acquire improved technology capable of producing 3 t ha^{-1} in the project area.

(2) Improved varieties along with improved technology of chickpea and pigeonpea would be made available to farmers through demonstrations.

(3) Use of rhizobium culture would be popularized.

(4) Production of chickpea and pigeonpea would increase substantially in the project area.

(5) Various socioeconomic and biological constraints of farmers for better production of these pulses would be known to researchers and extension workers who would be able to direct their efforts to solving them.

Evaluation procedure

The project would be evaluated by a team of ICRISAT scientist, a consultant of the donor agency (consultancy expenses not included) and representatives of NGLIP, SERED, and Extension services after the results of two years are available.

The evaluation team would visit production demonstrations, interview the farmers, extension workers, and the Nepalganj outreach team.

Project 2 - Groundnut

Project Title

On-farm Research and Technology Demonstration for Groundnut Crop in Nepal

Problem

Productivity of groundnut is 1000 kg ha^{-1} though a yield of 2500 kg ha^{-1} is achievable with improved technology.

Main constraints

- Due to late maturity of the presently recommended variety B 4 farmers cannot take a winter crop, so groundnut area is not expanding at a fast rate.
- Leaf spot disease is a serious problem.
- Loss as due to weeds is very pronounced.
- No fertilizer is applied.
- Plant protection measures are absent or nominal.
- Quality seed is in short supply.

Technology to overcome these constraints

- ICGS 32 is an early variety which allows farmers to grow a winter crop. NC AC 343 is a better yielding variety than B 4.
- Lasso gives effective weed control at crop establishment.
- 20 kg N and 60 kg P_2O_5 ha^{-1} have produced beneficial effects on yield.
- Lime application produces better yield.
- Plant protection measures would substantially increase groundnut yield.

Objectives

- To demonstrate and transfer improved technology of groundnut for stable higher productivity.

- To continuously test in farmers' fields improved technology generated by the National Oilseed Development Program (NODP).

- To strengthen the capability of NODP to conduct on-farm testing by providing necessary mobility, and other facilities.

- To understand farmer's constraints to higher productivity of the crop and expansion of the crop area.

Background

Until very recently groundnut was only grown in small pockets in the hills and for home use in the Tarai. Recently a Vegetable Ghee Factory was established at Hetauda with the capacity of utilizing (50,000 of oilseeds $year^{-1}$). This factory is attempting to expand the groundnut area with the help of NODP in adjacent districts of Central Tarai. Groundnut prices have gone up and many Indian traders across the border are buying groundnut in competition with the Ghee Factory. This has helped to develop a competitive market, and in 1988 the groundnut area almost doubled Limited numbers of FFT and minikits are now conducted in the 6 Central Tarai districts. However, production demonstrations with the total improved package for higher production has yet to be done.

The Project

The project will do the following:

- Provide production demonstrations with improved technology are to be conducted to demonstrate that 2500 kg ha^{-1} yield is possible in farmers' fields.

- Strengthen the capability of the outreach research team of NODP by providing mobility and other facilities.

- Improve the seed availability of improved varieties by purchasing seed from the production demonstrations.

- Develop One Block Production Program of at least 50 ha in each district where all new improved technologies will be tested and demonstrated in the future. This will make each Block the groundnut technology and seed resource center in each district.

- Conduct socioeconomic surveys with the help of ICRISAT and SERED of NARC to fully understand the constraints of groundnut cultivation in farmers' fields and find ways to expand the crop area so that Vegetable Ghee Factories in Nepal would be able to get raw materials.

Project area

Central Tarai districts (Makwanpur, Parsa, Bara, Ranthat, Sarlahi, Mahottari, and Dhanusha)

Methodology

- NODP at Sarlahi would develop strong links with the Regional Director,and District Extension Agencies of the area and the Vegetable Ghee Factory management.
- Agreements would be reached by defining the roles and responsibilities of all the concerned agencies.
- NODP would organize a training program with the help of ICRISAT to familiarize the extension workers with improved technology and extension officers would be trained at ICRISAT.
- Survey to select sites would be done jointly at least two months before the planting season.
- All the necessary inputs would be provided by the project and farmers would use their own land and labor for these demonstrations, FFTs, and minikits. Improved seeds from production demonstrations would be purchased by NODP or the Agriculture Input Corporation (AIC).
- Rewards would be given to best performing farmers, extension workers, and even to research outreach officers after evaluation of demonstrations in each season.
- Field days would be organized in each season for the farmers, administrators, politicians etc., to demonstrate the impact of the improved technology.

Needs

	Total need	Presently available	Additional need
Staff			
Outreach research Officer	1	1	-
Junior technicians	3	3	-
Extension officers	6	6	-
Equipment			
Transport			
Motor bikes	7	-	7

Field equipment			
Balances	22	2	20
Sprayers	22	5	17
Dusters	22	1	21
Measuring Tapes	22	2	20
Groundnut digger	2	-	2

Outside Involvement

ICRISAT

Survey
Training to extension and outreach officers
In-country training for extension workers as helpers
Monitoring and evaluation
Seed and visual aid supply

Annual budget requirement (NRs)

	Internal	External	Total
Salary			
Outreach officers (2)	90,000		90,000
Junior technicians (3)	60,000		60,000
Extension officers (6)	180,000		180,000
Sub-total			330,000
Fuel	-	100,000	100,000
Repairs	-	50,000	50,000
Input (seed, fertilizers, pesticide bags, etc., tapes)	-	300,000	300,000
Stationary	-	30,000	30,000
In-country training	-	100,000	100,000
Rewards and incentives	-	50,000	50,000
TA DA	-	50,000	50,000
Input storage rent	-	50,000	50,000
Contingent recurrent	-	50,000	50,000
Total		800,000	1,060,000
Non-expendable			
Motor bikes (7)		350,000	350,000
Sprayer & dusters (22 each)		100,000	100,000
Groundnut digger (2)		10,000	10,000
Socioeconomic survey evaluation		200,000	200,000
Total recurring expenditure for 3 years		-	2,400,000
Non-recurring expenditure		-	660,000

Benefits

- o Average groundnut yield per ha in the project area would increase.
- o Groundnut area would increase along with production.
- o Vegetable Ghee Factory would be self-sufficient in raw material.
- o New technology would be readily adopted by the farmers in other crops also.
- o Farmers would receive substantial benefit and their economic condition would be bettered.

Time frame 1990 - 1993 or 1995

Evaluation procedure

Project-2 would be evaluated by a team of ICRISAT scientist, a consultant of the donor agency and representatives of NODP,SERED, and Extension Services after two years of results are available.

SRI LANKA

DRAFT PROPOSAL

Title

On-farm Research and Extension Project on Pigeonpea and Groundnut

Background

Grain legumes constitute an important component of the human diet in Sri Lanka. They are particularly important where the level of protein nutrition among pre-school children, pregnant and nursing mothers, in rural areas is very low. According to the reports of the Medical Research Institute, Sri Lanka, per capita consumption of 48 gm of pulses per day (1440 gm per month) is required to maintain good health and vigor among adults.

Table 1. Average per capita consumption of pulses per month by income groups (g)

Income groups (Rs)	Dhal	Gram	Green gram	Black gram	Cowpea	Soya x soya products	Others	Total
0-100	129.9	-	-	-	6.0	-	-	135.9
101-200	136.3	-	4.1	-	29.0	-	-	169.4
201-400	65.2	2.4	23.6	0.6	39.0	1.9	9.1	141.8
401-600	54.9	1.8	16.5	1.4	59.2	1.6	10.6	146.0
601-800	58.2	1.6	18.0	1.9	59.4	4.1	7.2	141.4
801-1000	72.0	4.5	25.9	0.8	55.0	3.5	7.4	169.1
1001-1500	87.8	3.4	30.3	2.0	65.5	3.0	8.0	200.0
1501-2000	114.1	5.1	32.4	4.5	51.5	1.7	12.7	222.0
2001-3000	169.9	3.2	43.6	3.3	56.4	10.6	9.9	289.9
3001-5000	201.5	8.3	46.8	6.5	50.3	10.2	5.8	329.2
5001-10,000	279.3	5.3	36.5	4.1	34.0	7.8	1.2	317.2
Over 10,000	246.8	3.9	41.6	6.4	31.1	6.8	13.2	349.8
Overall Average	106.8	3.9	30.3	2.6	55.8	4.5	8.6	

Source: Consumer Finance Survey, Central Bank of Ceylon, 1982

Food surveys conducted by the Central Bank of Sri Lanka have shown a progressive reduction in the consumption of animal foods in the lower income groups in recent times, obviously due to escalaotic stresses

- Early and late leaf spot, rust, bud necrosis.

- Important insect pests include aphids, thrips, jassids, and white grubs

o Varieties

- Lack of suitable early maturity, and confectionery types particularly for the Yala season.

Introduction of improved medium duration varieties of groundnut for the rainfed highlands during the Maha season and short-duration high yielding types for the irrigable low lands during Yala season will help to increase national production. There is a great need to introduce to farmers varieties of groundnut with resistance to early and late leaf spot, rust, and bud necrosis. High yield should be combined with consumer acceptability.

Objectives

o To meet the local demand for high protein food and animal feed.

o To provide a substitute (pigeonpea) for imported pulses.

- To increase the stability and sustainability of existing annual and perennial cropping systems.
- To incorporate a cash crop (groundnut) into rainfed small scale farming systems.
- To increase farm incomes.
- To generate opportunities for employment.

Methodology

- Hold planning meetings to determine the nature of on-farm trials and mechanisms of technology transfer. Research and extension staff will participate in these meetings.
- Conduct base-line surveys and rapid rural appraisal surveys.
- Conduct controlled experiments on station for the development of component technology (insect pest control, disease control, seed storage, etc.).
- Conduct adaptive research on farmers' fields with researcher and farmer participation. These will help identify suitable genotypes for specific locations and farming systems.
- Undertake on-farm research to verify improved technology with the participation of research and extension personnel, and farmers.
- Conduct field days and demonstrations in farmers' fields.
- Use on-farm research activities and field days as research-extension-farmer interfaces.
- Introduce viable seed dehulling (dhal making) methods for pigeonpea to farmers.
- Establish an efficient seed distribution scheme for farmers.
- Train research and extension staff and farmers (formal, informal, and lateral training).

Implementation

Funds provided by the donor agency will be channeled through ICRISAT. The project will be coordinated by a senior officer from the Department of Agriculture as nominated by the Director of Agriculture. Adaptive and on-farm research activities in respect of pigeonpea will be centered at Maha Illuppallama, while activities related to groundnut will be centered at Angunakolapelessa. Activities at each of these research stations will be carried out under the guidance of the respective Deputy Directors (Research).

Adaptive and on-farm research and transfer of technology in respect of pigeonpea will be carried out in the districts of Anuradhapura, Puttalam, Moneragala, Kurunegala, and System B of Polonnaruwa. Similar activities in respect of groundnut will be carried out in Puttalam, Moneragala, Kurunegala, and System B of Polonnaruwa district. Adaptive and on-farm research activities will be carried out by research staff attached to the two Regional Research Stations in collaboration with the Assistant Directors (Agriculture) and extension staff in each of the identified districts.

Project period and sources of funding

The project will operate over a period of 3 years with possible extension into a second phase for an additional period of 3 years. Funding required for smooth implementation of the project will be met jointly by the donor agency and the Government of Sri Lanka.

Services, facilities, and equipment from Sri Lanka

Counterpart staff, facilities and equipment maintenance, office space, seed storage, crop work areas, farm land, and machinery at field stations, laboratory and office supplies, secretarial assistance, and technical support staff will be provided by the Government of Sri Lanka.

Donor funds

(US$)

	Year 1	Year 2	Year 3	Total
Salaries & Wages				
- Labor	13000	14000	16000	43000
Equipment Supplies and Machinery				
- Jeep (1 No.)	-	15000	-	15000
- Motor bikes (5 Nos)	5000	-	-	5000
- Office equipment	1000	1000		
- Field supplies	1000	1200	1500	3700
- Lab equipment	1500	2000	2500	6000
- Agro: chemicals	2000	4000	6000	12000
- Fuel	3500	4000	5000	12500
- Training equipments	4000	5000	2000	11000
- Stationery	1000	2500	3000	6500
Total	19000	34700	21000	74700
Training				
- Training at ICRISAT	6000	6000	6000	18000
- Local training (field staff)	1000	1000	1000	3000
- Local training	1000	1000	1000	3000
Total	8000	8000	8000	24000
Travelling and subsistence	2400	2500	2600	7500
Total	2400	2500	2600	7500
Visits				
ICRISAT specialists	5000	5000	6000	16000
- Local staff to ICRISAT	2500	2500	3000	8000
Total	7500	7500	9000	24000
Contingency	2500	3000	3500	9000
Total	2500	3000	3500	9000
Grand Total	52400	69700	60100	182200

Counterpart Funds

	Year 1	Year 2	Year 3	Total
		(US$)		
Salaries and wages				
Research Staff	1750	1950	2150	5850
Extension Staff	2500	2700	2900	8100
Labor	1000	4500	5000	10500
	5250	9150	10050	24450
Equipment, supplies & maintenance				
Office Equipment	500	500	500	1500
Field Supplies	500	500	500	1500
Lab Equipment	750	750	750	2250
Agro Chemicals	500	600	700	1800
Fuel	2000	2200	2500	6700
Training Equipment	750	750	750	2250
Stationery	200	250	300	750
Maintenance of Vehicles, Farm machinery and equipment	5000	5000	5000	15000
	10200	10550	11000	31750
Training (Local)	500	500	500	1500
Travel and subsistence	1000	1000	1000	3000
	1500	1500	1500	4500
Grand Total	16950	21200	22550	60700

Summary Budget (US$)

	Year 1	Year 2	Year 3	Total
Counterpart funds	16950	21200	22550	60700
Donor funds	52400	69700	60100	182200
		Grand Total		242900

VIETNAM
DRAFT PROPOSAL

Title

Development and transfer of technology for increasing groundnut and pigeonpea production in Vietnam.

Background

In Vietnam there are many legume crops including groundnut, soybean, mungbean, and pigeonpea. Among the legume crops groundnut is dominant. The area under groundnut is about 275,000 ha and the average pod yield is about 900 kg ha^{-1}. The economic benefits of groundnut production are recognized by the peasants and the government. At present there is we have an ambitious plan to extend groundnut cultivation to about 360,000 ha with an average pod yield about 1.2 t ha^{-1}. The national legume program was established to help implement this plan and international cooperation with the ICRISAT was approved by the Government.

Production constraints

Groundnut yield remains very low because of the following constraints:

- Resources allocated to groundnut research are very meagre. There is little input from international organizations to strengthen groundnut research. As a result the genetic resource of groundnut in the country is very poor and research work is limited.

- o All the groundnut cultivars presently grown in Vietnam belong to the Spanish group. These are characterized by low yield potential because of their short duration and lack of fresh seed dormancy. They lose their seed viability quickly and their seed size is very small.

- o The groundnut crop is predominantly grown in degraded soils.

- o Seed and seedling disease damage is very high.

- o Lack of cultural practices such as seed treatment, control of diseases and pests, timely fertilizer application, and management.

- o There is not a good seed multiplication program to produce high quality seed with good germinability.

Research Priorities

For groundnut

In order to increase productivity and stability of production in Vietnam, high priority should be given to develop varieties and management practices as follows:

- o Identify improved varieties for production from international groundnut varietal trials from ICRISAT and, implement selection and multiplication of promising varieties.

- o Improve farming practices for groundnut production by:

  - studying cropping system based on groundnut production

  - studying intercrops of groundnut with maize, cassava, and other plantation crops (tea, rubber, coffee, pineapple)

  - evaluating pest and diseases damage to groundnut production and applying IPM system

  - studying nutrition requirement of groundnut in the main growing areas, for example, micronutrient deficiency, nitrogen balance, and application of Rhizobium inoculant.

- o Improve seed and seed technology by:

  - establishing local seed production units in the main groundnut growing areas.

  - developing storage techniques for improving seed viability (germinability).

- o On-farm testing and transfer of technology to the farmers by:

  - establishing demonstrations of new varieties and new technology on farmers' fields in three main groundnut growing areas

- organizing field days and training courses for farmers on the following aspects:

  use of improved varieties
  application of the IPM system for pest and disease control
  storage technique of groundnut seeds at farmers' family level

- publishing and communicating new technology to farmers.

For Pigeonpea, we are:

o testing adaptation of ICRISAT varieties in different cropping systems

o multiplying suitable varieties for middle land and central highland

o placing demonstrations in some areas.

For Chickpea, we are:

o Starting to test ICRISAT varieties as a winter crop in north Vietnam.

National Adaptive On-farm Research Network Vietnam

We plan to establish a National Network for adaptive on-farm research in Vietnam under the two leading research institutes in the country.

- in the north - INSA, Hanoi
- in the south - IAT, Ho Chi Minh City
- With participating institutions consisting of 8 research institutes and research centers, and 4 agricultural universities located in different zones.

Projects

Groundnut

Groundnut is the most important grain legume and is currently grown on about 275,000 ha in Vietnam. The national yield level of groundnut remaines static at around 900 kg ha^{-1}. The most important constraints to groundnut production in Vietnam is lack of high yielding varieties with resistances to major biotic (foliar diseases and pests, seedling diseases) and abiotic (drought, poor seed quality, inadequate nutrient supply) factors. However, there is little information on the extent of crop losses due to these factors. Since groundnut is one of the main foreign exchange earning crops in Vietnam, the government is trying to expand the area under the crop to about 360,000 ha by the year 1995 and also to increase the productivity to 1200 kg ha^{-1}. The following proposal is being made to achieve this goal.

Objectives

- To identify, develop, and transfer technology for higher production.
- To increase groundnut productivity by about 300 kg ha^{-1}.
- To assess the economic importance of various biotic and abiotic stresses in groundnut production.
- To train local research personnel in various aspects of groundnut research and production.

Methods

- Planning meetings (Priority): To be held annually before the planting season - alternatively in Southern and Northern Vietnam. (Vietnam and ICRISAT Staff).
- Survey: Diseases (including aflatoxin contamination) and pest surveys. Germplasm collection. (Vietnam and ICRISAT Staff).
- Controlled experiments on-station
    - Diagnostic trials (Priority).

      To assess the economic losses caused by various foliar and seedling diseases, insect pests, and nutrients (both macro and micro).
    - Yield evaluation of elite varieties from ICRISAT and other sources.
- Adaptive research (on State Farms) (Priority): In order to identify technology transferable to the farmer for quick gains, this activity should receive high priority.
    - Yield potential: Study yield potential to provide a benchmark of the yield that can be expected if all constraints are removed. This benchmark can be used to measure the effectiveness of various treatments in reaching the potential yield level.
    - Initial treatments:
        - Improved variety + improved package of practices.
        - Local variety + improved package of practices.
        - Improved variety + Local package of practices.
        - Local variety + local package of practices.

The details of the improved package of practices and the local package of practices will be worked out at the planning meeting.

- On-farm research (priority): The results obtained from the adaptive research would be confirmed in larger on-farm research trials. If the technology is found useful it would be extended to farmers' fields. From the experience gained in the farmers' fields the technology will be suitably modified and tested again.

- o Training: The extension staff will be trained in the improved groundnut production technology at the time of conducting adaptive and on-farm trials. In addition, training is required for technicians and research scientists in the following areas:

  - Breeding methods, practical skill development in laboratory and field techniques with special emphasis on pathology, entomology, seed production, breeding nursery management, and research management with a systems approach.

  - An in-country training program is essential where the local research and extension persons can serve as resource persons in addition to ICRISAT staff.

- o Research - extension - farmer interfaces: The work indicated under the items adaptive research and on-farm research provides opportunity for a better interaction among researchers, extension staff, and farmers.

Inputs (needed vs. available)

- Staff available: Research (5+4), extension (4+4)
  Experimental stations (4+2)
  Administration Total = 23

- Facilities available: 5 Experimental stations, and farmers fields will be made available when required.

- Facilities needed: One car (micro bus)
  2 Photocopying machines
  2 Cameras
  Weighing balance

- Budget required : Internal : 20 million dong Vietnam (= US$ 7,000),
  External : (from ICRISAT) US$ 60,000/year.

- Administrative support required: Secretary/typist - One

- Outside involvement : only ICRISAT.

Note: To initiate a long term groundnut improvement program for sustained growth in groundnut production in the country, we need a groundnut research center. ICRISAT may assist us in identifying an external donor agency for establishing such a center.

Expected outcome

A technology suited to farmers' requirements that provides a higher productivity of groundnut than the present level (after least least years 3 years).

Evaluation procedure

Annual meeting of scientists including extension officers to discuss the results and evaluate the progress and impact (at later stages).

Pigeonpea and chickpea

At present pigeonpea and chickpea are not important crops in Vietnam. However we explore the possibility of introducing and adopting these crops into Vietnam. In this direction we shall try to.do the following things:

Pigeonpea

- Determine appropriate uses for pigeonpea in Vietnam including seed, vegetable, fodder, erosion control, wind break, fuel, and green manure.
- Determine areas in Vietnam where pigeonpea can be or should be grown.
- Determine what pigeonpea cultivars can fit into existing or new cropping patterns.
- Determine what constraints exist (pests, diseases, agroclimate) and develop a research strategy and program to overcome these constraints.

Chickpea

- Determine agroclimatic areas where chickpea can grow (North Vietnam).
- Determine yield contraints, etc. for chickpea cultivations.

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