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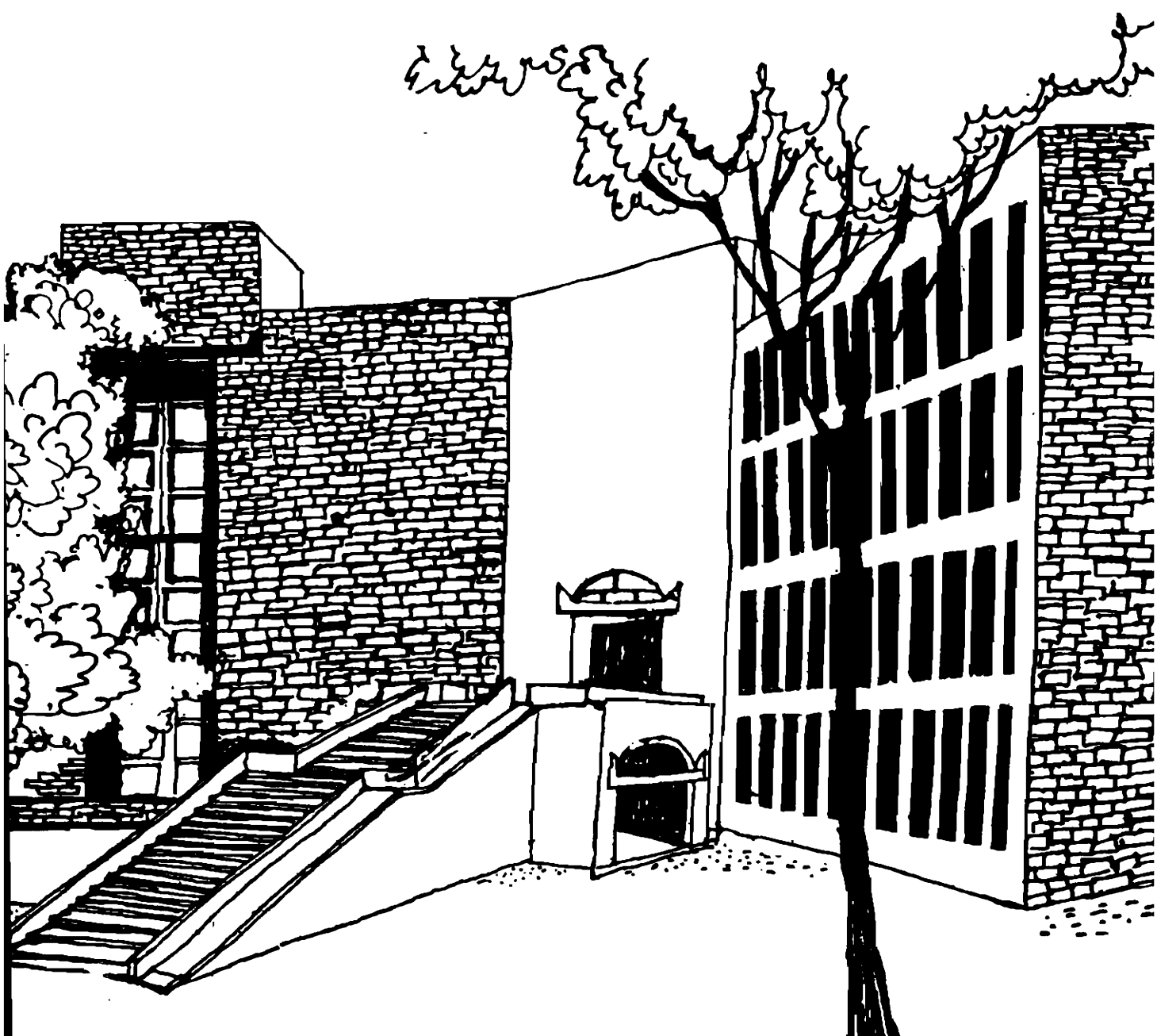

MANAGING RESEARCH NETWORKS:
A STUDY OF INTER-ORGANISATIONAL LINKAGES

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Abstract

Higher the uncertainty in the environment for which technologies have to be developed, greater is the compulsion for inter-disciplinary research. Every discipline necessary for addressing the research problem may not exist in the same institute. Even if it does, the number of scientists may be so few that the peer group for critical scrutiny and growth of the discipline may not emerge. Inter-disciplinary research leading to inter-organizational linkages may become necessary also because the consumer of research may have a diversified resource use strategy. In rainfed, semi-arid and arid environments, most of the disadvantaged households have diversified portfolios. Technologies aimed at improving the performance of these portfolios will have to be evaluated on their effects on different subsystems of household portfolio. Such appraisal may not be feasible within one organization.

Sustainability of technology may thus require three things, (a) client orientation, (b) location specificity, and (c) economic viability with attendant risk minimization together with minimum externalities. To achieve these outcomes, scientists may pool, exchange, segment or authorize use of resources, information, influence and opportunities. In the process, technologies requiring diverse skills, multiple scales of operation and complexity of tasks may be developed through inter-organizational networks. The skills, scale and complexity are independent in nature. Technologies requiring single skill may have to be developed for large scale and complex environments as well as resource management conditions. Similarly, technology at small scale such as micro watershed may require large number of skills and complex interactions. The implications of these interactions for inter-organizational networking remain to be identified.

Many organisations have resources which may not be optimally used within the organisation. Thus the redundancy of some resources and scarcity of others often generate the need for inter-organizational networks. At the same time distribution of power, authority and control over scarce resources and access to key decision makers may be such that some functional networks may not emerge while other dysfunctional networks may get established. Management of networks thus becomes a challenging proposition for the organizational leaders.

In part one of the paper socio-ecological, institutional and public policy contexts of inter-organizational networking are introduced. Literature on evolution and functioning of networks in agricultural research is reviewed in part two. The findings from empirical research based on interviews with the scientists in ICAR and SAUs(State ..) are presented in part three.

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PART I

MANAGING RESEARCH NETWORKS : A STUDY OF INTER-ORGANISATIONAL LINKAGES.

The gains made in Indian agriculture through a mix of public policies, institutional infrastructure, technological back-up and farmers' participation have received global acclaim. There is no doubt about the commendable role played by Indian agricultural scientists in achieving high production targets in irrigated and low risk regions. However, the scientists and planners are not satisfied with the technological alternatives generated in or transferred to dry regions (Venkateshwarlu, 1989; Singh, 1987; Draft Working group report on agricultural research and Education VIII F.Y.P, Planning Commission, 1989).

Higher the uncertainty in the environment for which technologies have to be developed, greater is the compulsion for inter-disciplinary research. Every discipline necessary for addressing the research problem may not exist in the same institute. Even if it does, the number of scientists may be so few that the peer group for critical scrutiny and growth of the discipline may not emerge. Inter-disciplinary research leading to inter-organizational linkages may become necessary also because the consumer of research may have a diversified resource use strategy. In rainfed, semi-arid and arid environments, most of the disadvantaged households have diversified portfolios. Technologies aimed at improving the performance of these portfolios will have to be evaluated on their effects on different sub-systems of household portfolio. Such appraisal may not be feasible within one organization.

Sustainability of technology (see figure 1) may thus require three things, (a) client orientation, (b) location specificity, and (c) economic viability with attendant risk minimization together with minimum externalities. To achieve these outcomes, scientists may pool, exchange, segment or authorize use of resources, information, influence and opportunities. In the process, technologies requiring diverse skills, multiple scales of operation and complexity of tasks may be developed through inter-organizational networks. The skills, scale and complexity are independent in nature. Technologies requiring single skill may have to be developed for large scale and complex environments as well as resource management conditions. Similarly, technology at small scale such as micro watershed may require large number of skills and complex interactions. The implications of these interactions for inter-organizational networking remain to be identified.

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Agricultural research systems have been helped by coordinating arrangements mainly because the planners have been conscious about the need for induced coordination through administered networks. All India Coordinated Research Projects (AICRP), Technology Missions, Research Committees, National Agricultural Research Projects (NARP) Scientific panels and bilateral agreements between ICAR (Indian Council of Agricultural Research) and State Agricultural Universities (SAU's) and International Agricultural Research Centres (IARC's) are some of the ways in which inter-organisational linkages are encouraged.

Given the limited advances in research for rainfed regions, the challenges faced by scientists in terms of socio-ecological, technological, institutional and public policy contexts are varied. In order to strengthen the capacity of the scientists to deliver technological alternatives by working at the research station or/and in the farmer's fields, it is necessary that changes are made in various sub-systems that are interacting at the household and institutional level. In this study we are not analysing the dimensions which influence the demand for technology or its transfer. The thrust is to study the opportunities for networking or coordination that can strengthen the research systems with particular reference to the problems of high risk environments (though examples have been drawn from other contexts also).

Chapter One: Context of Agricultural Research :

a)Socio-Ecological Environment:

Low population density, weak market infrastructure, high ecological heterogeneity even over short distances and very high climatic risks characterise the decision making environment of households in semi-arid, arid, hill and forest regions (Gupta, 1981, 1984, 1987, 1989).

In humid and sub-humid regions prone to floods, the problems are very different: topographical variability coupled with climatic variabilities generates very risky environments for lowland as well as unirrigated uplands. The population density is higher but markets are not strong owing to the preponderance of very small and marginal holdings with hardly any surplus.

In irrigated regions, market as well as public infrastructure is relatively stronger. The clients are very articulated and can create pressure on scientists for resolving various technological problems. Market forces also articulate the interest of surplus farmers and influence the allocation of research resources and forging of linkages. The situation in high risk environments is the reverse. Not only people's articulation weak (Gupta, Patil and Singh, 1992) but the chances of technological inadequacy being complemented by infrastructural robustness is also very low. Technology must be much more robust in high risk environment where back up support is weak.

The case for inter-organizational networking in research is strong even on this score, the assumption being that robust technologies may be difficult to develop without adequate plasticity in-built in it. Plasticity may be a function of different aspects of farming and land use systems. Since any one organization may not have all skills necessary for the purpose, inter-organizational networking may help. If an Institute is well endowed with all facilities in such regions (which is not the case in India with any one institute), networking is redundant and may, in fact, create a drag on the resources of such an institute.

The household adjustments to risk have been studied extensively. (Chaudhary ,Bapat 1975; Jodha, 1978, 1983; Gupta, 1981, 1982, 1987, 1989). The organizational adjustments to risks have also been studied (Gupta, 1986,1988,1990,1992).

The recent thrust on research prioritization on the basis of agro-climatic zones underlines the need for updating and strengthening the mechanisms of eco-specific knowledge generation. It is possible that linkages between different enterprises at household level may generate pressure for the formation of linkages among disciplines / commodities at Research Stations as well.

b)Technological Environment:

Technological alternatives are generated to surpass the `stability' of the indigenously evolved farming systems. They may be spectacularly successful for a short period, but the success is usually

achieved at the expense of ecological degradation - at least in the arid and semi-arid regions. Many sustainable technologies require group action or management of resources on common property basis. At the same time they provide scope for individual oriented technologies. Another important issue is that complex technologies may require inter-organizational linkages.b

Given the diversity of household economy and risk adjustment strategies of farmers and pastoralists, a `cafeteria' or ` portfolio' approach to generation of technology becomes necessary. Location specificity is preferred by some. Scientists involved in the development of hybrid varieties of sorghum and millets feel that new varieties must be continuously screened for wide adaptability.

Crop-livestock-tree and tool interactions are important but institutional linkages among research institutes pursuing research on these enterprises continue to be weak (Gupta, 1988, 1990). Many researches recently have debated over the parameters which have to be taken into account. [1]

> The **Ecological context** in which a crop is grown is also of major consequence and has to be studied carefully. For example, other things being equal, we would notice the predominance of Jowar over slightly better soil and rainfall regions than Bajra in semi arid and arid regions. Therefore, the probability of 100% failure in the year of drought is much more in Bajra, than in Jowar (Gupta, 1983, 1984). This has been disputed by others (Jodha, 1984).

Farm equipments whether operated by hand or by bullocks have not been tested in the field on a scale large enough to be able to estimate their utility. In the absence of such facilities, the feedback farmers to scientists is weak (Gupta, Patel and Shah, 1987). Hence the scientists are looking for opportunities of active collaboration with industries to remove this gap (Gupta and Singh, 1989).

c)**Institutional Environment** :

The technological issues related to the dimensions of research for rainfed regions are also institutional in nature. Bush (1984:218) for example has illustrated three factors influencing the breeding goals of Sorghum research.

(1) Sorghum is utilized in production systems that differ sharply from one another and by producers who have different uses for the crop.

(2) Scientists work in disciplinary groups with narrow agendas which isolates them from other groups of scientists and also their client groups.

(3) Plant varieties are limited in the characters from which they can simultaneously breed and therefore, breeders must make trade-offs. Additionally, plant breeding has at its' centre

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1. Few have argued about the selection of varieties/quality in the early stages of breeding (Onim, 1988: 157). No correlation was found between grain yield and straw quality when 100 varieties of a cereal were screened. (Orskov, 1988: 159). It is now been recognised that despite time and location interactions, maturative value of straw of different rainfed crops differ from variety to variety. ICRISAT has already begin the task of screening the millet varieties for fodder quality.

   The fodder quality varies depending upon soil and water quality and age at which it is harvested. With slightly advanced harvesting (harvesting at physiological maturity or soon after) the quality of straw improves (Rangnekar, 1988). If harvested early but not stacked properly the straw quality may deteriorate. Labour is a constraint at harvest time and hence there is a pressure to harvest early.

the concept of selection, a concept that demands diversity at the same time as it seeks uniformity. These potential conflicts reflect broader problems of science. Issues related to human values permeate the goals and practices of Sorghum researchers.

The way research programmes are organised reflects another dimension of institutional environment. For example ICAR could organize its research programmes on the basis of region (egg. CAZRI for arid zone); disciplines (soil sciences, plant protection, agricultural (all India Maize Research Project, national research centres on Sorghum, millets, oil seeds, rice etc.), problems (salinity, dryland, research project/institution) function (National Academy of Agricultural Research Management, National Centre for Women's Development, etc.) and so on. Linkages between institutions, projects, programmes on same problem or related issues may help in evolving a solution to the complex problems more quickly. These linkages are still involving are extremely slowly. The two major causes for the tardiness are resource crunch and the inadequacy of coordination at top level in ICAR and SAUs. Though planners recognise the need for adopting conservative farming systems (Randhawa & Abrol 1988) integrated pest management, sustainable rainfed systems etc., the research system is biased towards chemical based technologies for crops and breed based technology for non-crop enterprise. Post graduate research programmes also work in parallel to strategic research programmes rather than being linked to them.

The Technology mission on oil seed was launched in May 1986 as to link this commodity with other support system and to monitor the improvement in crop technology, support to farmers to apply the improved technology, improve post-harvest technology and support to industry for applying post-harvest technology. Linkages with agro-processing units and agricultural research groups also became necessary to prioritize allocation of research resources.

d) **Public Policy Environment** :

There have been several reviews of the Indian agricultural research system. The major problems identified in linkage of AICRP's with ICAR and SAUs were (1) dual control of the coordinator and the director of the institute which have AICRP headquarter and (2) Lack of link between research of ICAR institutes and SAU's, (3) Lack of inter-disciplinary work, (4) Many links like those between ICSSR and IIMA have been forged but nothing much has emerged out of it due to lack of activity; (5) Mutual responsibilities in collaborative arrangement with international agricultural research centres were not clearly defined, (6) Many times SAU's felt that they were not given adequate freedom in collaborative work.

Chapter Two : Review of Literature:

WHAT ARE NETWORKS AND WHY DO THEY EVOLVE ?

Networks in agricultural research imply `a cluster of scientists or institutions linked together by a common interest in working dependently or inter-dependently on an identified shared problem or problems' (Plucknet and Smith, 1984). Networks evolve due to a variety of reasons. Political economic factors deal with the distribution of two scares resources, namely, money and authority (Benson, 1975). Organisations as participants in this political economy pursue resources but their interactions are determined by their "market position and power" This affects the flow of resources. Many times these inter-organisational linkages are viewed as existing in a state of equilibrium. The equilibrium in these exchanges are influenced by (1) Respective domains (boundary of influence), (2) Ideologies; (3) Evaluation criteria and (4) Distribution and coordination of work. (Benson, 1975; Lauman and Pappi, 1976).

In agricultural research goals and operating culture of different organisations may overlap or converge or conflict. These conflicts could be solved by authoritative, disruptive, manipulative or cooperative strategies (Benson, 1975). It has been shown that several strategies or combination of these could be used simultaneously in different exchanges among organisations (Gupta, 1987)

In spite of the high coordination costs, the networks help in placing at a regional or global context the new knowledge, technology or common methodology developed by the third world scientists working on the same problems or disciplines. It also makes possible training and experimental programs to be undertaken (Jacques Dupont, 1983; 18-19). Networks also help in stimulation of new perception in people as a result of exchange of ideas. They also help in the development of self-reliance among the participants, (Donald C. Winkelmann, p. 126).

Several factors that may influence inter-organisational networking have been identified by Boje and Whetten (1981) as: (a) Formulation of a joint programme strategy to increase the flow of clients an attributed influence: (b) Placement of administrators from one organisation on the management committee of another: (c) Geographical proximity : (d) Mandatory or imposed relationships among various organisations (Also see, Aldrich, 1977, Pfeffer, 1976); (e) The organisation having a large number of social and work related (probably ethnic, cultural or region based) ties with each other may be able to take a more central position and attributed influence.

Boje and Whetten (1981) concluded that (1) both organisational strategies and environmental constraints influence the evolution of inter-organisational relationships and (2) Externally imposed ties have both costs and benefits. The central organisation is more vulnerable because it is caught between expectation and dependencies. (3) Joint programmes and formal and informal communications are best predictors of referred network centrality.

Networks could be of two types, namely - (1) Formal Networks :- Sanctioned by an official documents approved by the centre. It has a specific budget and occasionally, a full-time coordinator or advisor. (2) Informal Networks :- These do not have an operational budget and the coordinators ro is that of a programme officer. (Karim Oka, P. 1) Besides being formal or informal, networks are o three classes, namely (a) ones with little integration where there is just sharing of ideas, methods, results and germplasm; (b) More integration which includes schedule meetings, richer exchanges c ideas on themes jointly identified and (c) Higher integration where there is joint priority fixing, planning, implementation and monitoring (Winklekman, P. 128)

Provan, (1983) speaks of federation as an inter-organisational linkage network. He says in a "federation affiliated organisations agree to relinquish control over certain activities to the federations management. In return, the federation would minimize the complexity of the linkage network and reduce environmental uncertainty". Federations can be voluntary or imposed. Federations are

of three kinds, namely, participatory where, the affiliates play an active role in federation management: Independent federation - here the FMO functions as a separate organisational entity. Though day to day operations are controlled by the affiliates, they relinquish one or more linkage. The FMO; Mandated Federation where linkage arrangements are forced by law and the consequence of not affiliating are very high (Provan, 1983).

Networks have very dissimilar people researching to achieve a common objective. For networks to work, hierarchy has to be flexible. Since networks deal with matters of actual or potential need, have to keep adapting to new objectives and missions or they would become "relict" systems. They may therefore, look unstable as they change and shift according to changing interest. This short-term instability is really an element that makes for long term, dynamics equilibrium (Sarason and Lorentzleds, 1979).

In India, the key issues is not funds for research except funding for activities that require foreign currencies. The main problems are isolation, lack of contacts and lack of information. By supporting networking the quality of research may improve and production of better results may be possible (Oka, 1987). In Latin America, some of the networks provide access to materials and information essential for national researchers. This access also serves to provide "experience at different locations which can substitute for variation over time at a single site, (Scobie, 1987)

Network links not only among organisations but between farmers and research have provided fruitful results. This has been demonstrated by on-farmers trial conducted as a part of an agriculture campaign undertaken by CNRCIP (Cameroon National Root Crops Improvement Program) in 1982. Balaguru and Rajagopalan (1986) have suggested the advantages of field trials should be an incentive for linkages at field level between scientists and extensions workers. Though they have suggested the need for stronger linkages, they have not stated the factors weakening it (Balaguru, Rajagopalan, 1986) Increase in horizontal accountability between farmers and scientists, should be proceeded by vertical accountability between junior and senior scientists (Gupta, 1987). This may help in forging links between different disciplines and organizations having the expertise.

Inter-Organizational networking among national and international research organizations:

Baker (1985) stresses on the need of not only linking up IARCs and national programs but also with research laboratories in the developing countries. The link should be forged so as to reflect their research priorities and not that of the developed nations.

Besides setting up research agenda and priorities, agricultural research programs should maintain accountability to the public and must coordinate internally within and between disciplines and between organisations. They must bear relevance to people's needs, be flexible and innovative (Adeyemo, 1984).

Based on the views expressed by different scientists Winkelman has listed the important characteristics of networks. They are :- (1) Clearly defined problems, (2) Problems widely shared, (3) Strong self - interest (i.e. important problem), (4) Participants commitment of resources, (5) External funding, (6) Capacity to contribute, (7) Good coordinator, (8) Sufficient new ideas on materials, (9) Participants contribution to management, (10) Regional scopes, (11) Effective advisory group, (12) Scope for new ideas and free exchange, (13) Linkage upstream, (14) clear theme and strategy, (15) Training and monitoring, (16) Common constants, (17) Capacity to diffuse and to adapt, (18) Access to other networks, (19) Long horizons, (20) Supplemental funding for NARS.

Networks also suffer from a few disadvantages. A major complexity is in managing networks which have participants with varied and uneven experience and with differing level of commitment, coordination and direction. The cost associated with bringing participants together is high (Winkelman). Celebrity researchers are created. They are busy flying from one international location to another

rather than making time for reading and research (Jacques Dupont, 1983). Due to differences in culture and philosophy between different countries, unless proper coordination is done, cohesiveness and efficiency will not be achieved (Dupont).

CGIAR impact Study summary (Kern, 1988-89) noted several contentious issues in the relationship between International centres and the national research systems such as: (a) some national researchers handling international nurseries (implying screening lines developed at international centres even if many of these are of no immediate use to national centres) consider their task to be quite routine while the data goes to international centres, (b) some do not feel as peers in the collaborative work. In fact some feel "slighted in collaborative work--that some national results have been `pirated' without full acknowledgement"(Kern, 1988-89:27), (c) lack of "bottom up" thinking was noticed by some national scientists among the international scientists attached to their centres. These scientists were reported to pursue their own research agenda irrespective of the views of the national scientists, (d) the priorities and program within CGIAR centres were seen by some national centres as having been decided without adequate consideration of their (national centres') needs, (e) the representation of developing countries on the board of international centres was considered inadequate (it was found to be just half though increasing in recent years), (f) many national centres rightly considered that they had achieved eminence which should entitle them to take global responsibilities along with funding by international centres.

A number of national researchers felt that coordinators from different international centres in that country ought too coordinate their efforts. Otherwise, lot of contradictory advice had to be received by the country scientists.

In addition to these factors, one has to recognize that role of international centres could not any more be same as it was in 60s or 70s. The role and responsibility must change and so should the relationships among national and international research organizations.

Obaidullah Khan (1989) reports that, "national perspectives regarding relations and benefits of association with the CGIAR and other international centers are diverse, ranging from appreciation of mutuality and interdependence to concerns about a patron-client relationship to frustration over a sense of unequal competition regarding access to external resources".

In many countries interface between national universities and CGIAR centres is marginal in Africa. Faculty of agriculture at University of Nairobi in Kenya is situated nearby the laboratory of veterinary research of International Laboratory for Animal Diseases (ILRAD). Still the faculty members at the university complain that relationship with ILRAD's staff and facilities is not very beneficial.

Researches in Cameroon, Kenya, Mali and Senegal suggested that they would have liked to play a more direct role in the production of technology. Though they appreciated the supply from international centres of elite genetic material for plant breeding. A Kenya breeder was quoted to say, "A trial should answer a researcher's own problems, or include lines in which he or she has participated in breeding. Otherwise national scientists feel that they have been used as technicians for the implementation of an external agenda". Obaidullah adds,"senior breeders from these countries are concerned that much of the material introduced by the centres is not suitable for local breeding programs because selections are not judiciously made. The range of perspectives vary from very positive to very negative in Zimbabwe. In wheat and cowpea programs, CIMMYT and IITA were seen as very helpful. In maize, much of the material was considered of no use. In soybean, the national scientists felt that international centres had benefited more from trials in the country than the national centre.

Obaidullah summarises the concern of African policy makers,"too many demands by the CGIAR and other international centres without coordination and joint formulation of research program bear the risk of implosion and fragmentation of the evolving national systems.

Regionalization of the research program planning and monitoring is considered a way to ensure *Horizontal cooperation rather than vertical interventions*.

In a study of cooperative arrangements of International Centre for Potato Research (CIP) with other organizations particularly in other countries, it was observed that in areas where research progress was rapid, collaboration worldwide was successful (Dodds, 1987).

Faris (1988, 1990) has been one of the most long standing organizers and analyst of research networks. He observed after a tour of different countries in which ICRISAT had network activities,

> providing funding to national program for their networking activities creates danger of distorting their research priorities and having them become dependent on such assistance. They might even build their research structure on such assistance. There is also the danger that national programs might play off one network against another on the basis of the amount of money they can contribute to the national program.

Faris identifies another very strategic role for national programs. For some of the important global research goals, a particular larger national research program may provide ideal site. For instance, a country may have a `hot spot' suitable for breeding or resistance to a particular stress.

Two particular ways of supporting network financially were identified, (a) bilateral financing by donor of a specific country program, (b) providing funding in the form of trust fund which would be administered by the entire network through a steering committee and the network coordinator.

Faris also identified other factors that had affected the network performance. Cultural norms in different countries affected the way network members were chosen. Also the insistence on harmony affected the forthrightness with which network members gave feedback to each other. The peer competition was often weak because there were few competent scientists in each field in many countries. Incentives for participation in network could be given through joint authorship, tours and participation in special training workshops.

Kirkby (1988:21-22) identifies several issues that deserve attention while evaluating the networks, such as: do these networks have too many meetings, would these network further burden the national capacities for research, will network have an adverse effects by concentrating on stronger members, does the network provide sufficient opportunity to different members to influence the decision making about short and long term goals, administrative aspects etc., and do these networks have their own momentum or would these be sustainable?

A workshop organised by IDRC, CRDI and CIID (1988:86) concluded that among many factors which facilitated forging of links, the links at informal individual and scientific level are faster and more flexible than the ones through governmental channels. Among the negative effects of network participation were, organising steering committees is difficult some times because too many meetings are supposed to be attended, bureaucratic and fiscal constraints at national levels derail the programs, networks should not be too dominated by donors such that national counterpart initiatives are stifled, etc. This workshop also identified four major problems in inter-network coordination: unnecessary duplication of efforts, lack of effort in an important field, too many networks, and sharing technology among networks.

Industry - Research Networking

Leonid (1982) suggested re-examination of the mutual perceptions of their present attitudes by the industry and researchers. The links among them were found to be generally affected by varying importance attached to publications and patent protection for product developed. Cyrt (1985) put it differently. He said, " academics must be willing to get their hand `dirty' and industry people must

be prepared to appreciate abstract reasoning and attempts to generalize." Cyrt (1985) and Doan(1978) also confirm the same two irritants in forging linkages between industry and researchers.

Sounder and Nasser (1990) found 12 out of 21 research consortia successful. Ten attributes were found to be most critical for success, (a) strong commitment, (b) strong decision controls,(c) strong charter, (d) systematic processes, (e) holding matrix structure, (f) stronger technology transfer processes, (g) private benefits, (h) philosophy of governance, (i) technical uniformity and (j) complimentarily. Five common problems were found in the consortia, (a) lack of managerial patience, (b) professional reluctance to partnership, (c) failure to let go, (d) competing with member projects and (d) failure to restrict membership. In a separate study, the same authors supplemented the factors favoring consortia approach. They found following advantages; funding for risky R and D, cost and risk spreading, technological learning, environmental benefits, threat buffering, standardization, avoidance of duplication, pooling of facilities, byproduct utilization etc. Disadvantages were included as, loss of control, flexibility, slowness of response, cultural barriers, equity problems, risk of failure, uncertainty of out put value, staffing problems etc.

In a study in Japanese context, 60 cases of joint research by industry and university scientist were studied. Following factors were looked into: necessity of linkage, benefits, knowledge gained, area of research, timing and duration of linkage, expenses and management of joint research. Three factors were found to be crucial for joint research, (a) assurance of individual benefits, (b) sharing benefits and common objectives, and (c) understanding a partner's technology.

David and Beam (1991) found seven factors particularly responsible for successful interactions between federal research laboratories and industry, (a) person to person contact, (b) flexibility in approach, (c) existence of a transfer champion(i.e. some one for whom successful transfer of technology is a matter of great personal satisfaction), (d) support of a company's as well as federal laboratory's middle management, (e) support from the top management of federal lab and (g) clarification of respective proprietary rights. Among these three factors which were considered most critical were, person to person contact, support of middle management in federal lab and the company, and clarification of proprietary rights. Only about 10-13 per cent reported future pay off from sponsored, contract, or cooperative research involving federal labs.

Mettenry (1990) made a very interesting observation. Cooperative research offered lot of value but this value, was not easy to obtain. Five myths were identified in the industry -university linkages: (a) Industry could get little of value from cooperative arrangements and they were to be tolerated, rather than encouraged,(b) success followed when industrial managers and their counterparts worked out detailed basis of cooperation, (c) there were only few ways in which efforts could be fruitful to all concerned, (d) the culture of both organizations was very different and finished technology was not likely to be obtained through such an arrangement, (e) cooperation was a big industry game and smaller companies were ill advised to get into that. Two additional insights from this study were: (a) fruitful outcomes could come out of such cooperative arrangements if one could get away from boss-to-boss agreement, and (b) if capabilities were equal, life was much easier if the partner was nearer to home. Whether research on super-conductivity, or on drugs between Harvard and Monsanto, mutual trust and respect were vital for productive outcomes. The study noted," it is true that university people cherish freedom to publish their works and (have) a tendency to follow their instincts in new research areas, what appears to industrial people to be cavalier disregard for deadlines for project completion".

Various myths were refuted and following important lessons were outlined by Mettenrg,(a) " success comes when scientists and engineers who will be actually doing the cooperative work are convinced of its value, (b) there are many ways that successful cooperation can be structured. If what you know about does not suit you, look around and you will find something that will, (c) size of the firm was not a barrier to success".

Inter-institutional Coordination among research organizations with in country

In an interesting study about the patterns of communication among scientists from different disciplines and backgrounds, Wolf(1984) suggested that for maximum effectiveness, a scientist should, (a) " be able to understand the technical disciplines involved so that he or she can talk the jargon of each side, interpret their requirement, clarify what is being requested by them; (b) be responsible and able to negotiate with other sides about priorities and other similar touchy matters, and (c) have had a diversified job history so that his advice will be based on broad experience. This is definitely not the first job experience..."

Oliver (1990) reviewed literature on inter-organizational interactions and identified six determinants: necessity, asymmetry, reciprocity, efficiency, stability and legitimacy. He regretted that available theoretical frameworks on inter-organizational networking provided only partial understanding of the reasons for networking.

In a study aimed at Reorganization of ICAR Headquarters, (The Report hereafter) Gupta et al., (1991) focussed special attention on networking function of ICAR headquarters. It was stressed that ICAR could not have the same function as it had in sixties by when the state universities had not come into their own. Thus the need for networking. The networking was "considered a time consuming task and the result show up only with a lag. It can also become an important means of problem solving by pooling resources and skills across institutions when providing all types of resources under single roof becomes impossible due to budgetary and other constraints".

The Report also suggested for a stronger linkage with financial institutions like venture capital organizations like Technological Development Information corporation of India (TDICI- a subsidiary of ICICI) for encouraging commercial exploitation of biotechnology breakthroughs.

One of the suggestions in The Report for empowering Directors of different institutes was need for discretion for them to commission stripe reviews or external reviews by outsiders. Some of these reviewers could even be potential collaborators. Having been recognised for their excellence and appreciated for their critical assessment of an institutes's program , such colleagues are likely be found acceptable for networking.

Another suggestion was to strengthen the networking function was to have regional directors who would coordinate with various research institutions, NGOs, universities and industries to make research more client responsive and efficient.

Two national workshops were organised at IIM-A on Management of Research for Rainfed Regions for Chief Scientists (Gupta, 1988) and Vice Chancellors and Directors of ICAR institutes(Gupta, 1990) to discuss various ways of strengthening research linkages among disciplines, on-farm and on -station , basic sciences and applied dry farming research, and with postgraduate education. It was noted that unless the coordination at the apex level in ICAR improved among various Deputy Director Generals incharge of various disciplines, the field level coordination among different subject matter institutions was unlikely to improve a great deal (Gupta, 1988:2). This is an important constraint which applies much more to countries in which public investments are high and often routed through an apex organizations like ICAR.

Scientists-NGO linkage

Osborne(1990) identifies several factors that may influence the quality of linkage between NGOs and the scientists. Do they speak the same technical language, do they view the farmers' knowledge same way, does each party have the time to develop links, while NGO may benefit from such an association, do the scientist also see these benefits, does the top management appreciate the links between the scientists and the NGOs, do the local level scientists need authorization to enter into contacts with NGOs etc.

Rangenkar (1989) describes experience of BAIF in the field of collaborative research with plant an livestock scientists. Apart from the fact that BAIF is represented on many official bodies, committees, this is one of those rare examples where an NGO has comparable excellence in the field of research compared to public or private sector.

Chapter Three: Insights from Interactions

Networking as a system of research first began in the 1920's in the U.S. It concentrated on regional maize network in the Mid-West. At the same time regional networks were created for wheat breeders in the north great plains and north central region to share their results and improve production. The internationalization of networks came about in the 1950's with the outbreak of strong rust epidemic in the U.S. The effort proved to be successful and soon more than 100 countries were participating the network. It was around this period that networks were being started in India as well. These became the AICRP (All India Co-ordinated Research Projects). At first the AICRP concentrated on maize, millet and Sorghum. This soon extended to rice and wheat (and many other crops as well as disciplines or problem areas) (Winkelmann, Pp 125-126).

Over the decades, networking and coordinated research have slowly gained popularity. Though networking has thrown up some challenges, inter-organisational research programmes among ICAR institutes, state government departments and international organisations like ICRISAT have helped in sharing data, resources and results.

We first present the insights from the data derived from primarily questionnaire survey followed by the insights gained from personal interviews.

Findings of Survey:

A: Nature of professional interactions (Table 5)

Almost half the scientists respondents in our survey had explored collaboration within ICAR institutes as well as outside(though these were not completely overlapping sets). Majority of the scientists had participated in national conferences though less than one fifth of those who reported had attended international conferences. Response from international centres was as positive as from national centres. One could not say that we did not have culture of cooperation. It is just that not more have tried. Or many who did, burned their fingers and learned to be perhaps helpless. This could not be explored properly.

Table 6 -- Pattern of Publications

Organistions of the respondents	Individual or collaboration within the department	In Collaboration with other organisations	
CAZRI (5)	117		
CRIDA (3)	57	49	(one has no collaborative work).
CRRI (1)	159	6	
DRR (1)	8	3	
IGFRI (3)	179	4	
NAARM (1)	33	1	
NRCS (9)	48(One respondent-both together about 100)	9	
APAU (2)	51	12	
GAU (8)	212	4	(Some have no publication)
GKVK (2)	55	5	(One respondent no collaborative work)
HPUHF (1)	35	10	
KAU (3)	60	28	(2 of respondents have no collaboration work)
MPAU (2)	25	15	(one has no collaboration and one has only collaborative work)
TNAU (8)	443	3	(many collaborative works-nos. not listed by individual)
ICRISAT (2)	2	1	
Total	1484	150	

B: Pattern of Publications (Table 6)

We wanted to study the extent to which research papers get written through inter-organizational and inter-disciplinary research. The idea was to check whether there existed any trend in this regard. As was expected, there were far fewer collaborative publications with persons outside one's own organization. Barring CRIDA, all other ICAR institutions had far fewer inter-organizational publications than agricultural universities. This only confirms well known problem of authoritarian culture prevailing in most ICAR institutions with even greater restrictions imposed by the headquarters. One could speculate that there was no objective difference in the opportunities for such collaboration. The actual difference thus could be attributed to either individual temperament and preferences or organizational environment permitting greater flexibility.

Table 7

Research Thrust: Who decides it?

Sr. No	Source of thrust	Frequency
1.	Scientist on their own keeping in view institute mandate	27
2.	Director	1
3.	Programme Leader	9
4.	Scientist along with Director	2
5.	Scientist with Programme Leader	2
6.	Mutual consultation among scientists	4
7.	Research Council of the Institute/ University	2
8.	Annual workshops	2
9.	No response	2
Total		51

Table 8

Client Orientations: Farmers constraints as identified by the scientists

Sr.No	Constraints of farmers	Frequency
1.	Poor Economy of the farmer	3
2.	Lack of technical/knowledge/guidance	2
3.	Lack of skilled labour	1
4.	Poor availability of hybrid seeds	3
5.	Dehulling	1
6.	Insufficient availability of fertilisers *- tillage equipments	1
7.	Productivity stagnation	2
8.	New market demands not matching with available quality	1
9.	Scarcity of timber, fuel and fodder	1
10.	Irrigation supply	1
11.	Excessive/inadequate ground water exploitation	4
12.	Low productivity livestock affecting income generation	1
13.	Lack of concentrate feed to livestock	1
14.	Establishing pastures	1
15.	Poor infrastructure	1
16.	Could not identify the constraints	1
17.	No response	25
Total		50

Table 9

Need for New Direction for Research or Management change in Rainfed Regions

Sr.No	Suggestion	Frequency
1.	Enhanced participation of farmers	4
2.	Participation of NGO/Voluntary organisation	1
3.	Better Inter Organisational linkages	8
4.	Generating programmes for farmers in lean periodicals (Feb-June)	1
5.	Reorganising existing programme and redesigning priorities	9
6.	Thrust on interdisciplinary research	2
7.	Better planning of resources for employment generation	2
8.	Encouragement to mixed farming system	3
9.	Conservation of water and drainage system	3
10.	Intercropping and agroforestry	3
11.	Application of pesticide/herbicides	1
12.	Prices of dryland crops should be stabilised	1
13.	Need to develop database on nutritional deprivation in different locations and seasons	1
14.	No response or no specific response	22
Total		61

In the case of CRIDA, the presence of ICRISAT close by makes a big difference compared to other institutions. TNAU had maximum publications per scientist though within organization. Either resource affluence or sufficiency may have caused this or it is just a sample attribute without any larger significance.

C: Decision about Research Thrusts (Table 7)

The majority of the scientists have reported autonomy in deciding the research programme on their own. If more collaborations have not emerged, in these cases one could not blame the hierarchical order. On the other hand, lack of reference to inter-disciplinary fora may imply some weakness of the system.

D: Client orientation of the scientists (Table 8)

The hypothesis here is that inter-disciplinary or inter-organizational linkages may be forged in response to the needs of farmers. Half of the number of scientists could not identify any particular constraint of farmer which had a bearing on their research. Those who did identify constraints, generally articulated them in very general terms.

Perhaps this is one area where much more work needs to be done to understand how scientists can become more responsive to the constraints or opportunities of various classes of farmers. Interestingly in no case have the scientists noted any inadequacy in their technology as a basis of perceived constraint of the farmers.

E: Need for new direction for research or management for rain-fed regions (Table 9)

About 1/3 of the responses referred to strengthening of inter-organizational linkages together with reorganization of existing programme priorities. Apart from a suggestion on a nutritional database, all other suggestions were general and related to on-going research activities.

Table 10

Constraints Impeding Research Network

Sr.No.	Type of factors	Frequency
1.	Lack of support from top leader	5
2.	Conflicting claims for credit by scientists result	9
3.	Professional Rivalry	5
4.	Lack of interdisciplinary approach	7
5.	Lack of direction of thrust area research	2
6.	Lack of technical staff/specialist	13
7.	Lack of provision for involvement with private organisation	3

8.	Research credit sharing in industry sponsored research	4
9.	Patent right problem in network research	2
10.	Red tapism	13
11.	Lack of cooperative effort/working environment	3
12.	Research farm/labs	3
13.	Equipment/farm implement	14
14.	Land/above inputs	5
15.	Raw material	2
16.	Transport facilities	2
17.	Financial constraints	17
18.	No constraints/no response	15
Total		124

F: Constraints impeding research networking (Table 10)

Finance, equipment, red tapism, lack of technical staff and conflicting claims for credit by the scientist were the five most important constraints impeding research networking. Although some of these constraints could well be the reason for forging linkages, some of the other factors such as involvement with private sectors and NGOs, norms for patenting and norms of sharing credit while dealing with industry require policy changes. Factors such as conflicting claims for credit by the scientists, professional rivalry, lack of inter-disciplinary research, etc., require action at the level of scientists themselves. Using existing channels like research council for presentation of research projects and following existing norms would reduce adhocism in research.

Certain features of organizational working would affect research whether one collaborate with some other organizations or not. It is important therefore not to get bogged down with removal of all constraints before embarking upon any effort for networking.

Table 11

Factors which facilitate Network

Sr.No	Type of factors	Frequency
1.	Individual's initiative and commitment	5
2.	Personal rapport	2
3.	Exchange of views among scientists	11
4.	Formal & informal exchange of newsletters and information	10
5.	Inter-disciplinary approach	8
6.	Sharing of specialised lab facilities	3
7.	Complimentary different expertise informally	4
8.	Common interest	41
9.	Linkages with Indian and Foreign institutions of higher learning	9
10.	Expert group meetings	5
11.	Participation in seminar/workshop/ conferences	20
12.	Articulation of role & responsibilities	9
13.	Clear norms for sharing research credit	12
14.	Linkages with higher education of administration & seminar scientists	4
15.	No specific comment	4
	Total	110

G. Factors facilitating networking: (Table 11)

The most important dimension which seem to have fostered networking dealt with exchange of information (point 3, 4, and 11). Almost 40 per cent of the responses related to exchange of views, formal and informal exchange of newsletters and participation in conferences and seminars, etc.

Clear norms for sharing credit, articulation of roles and responsibilities were the second most important factors responsible for facilitating networking.

In addition, the individual initiative, personal rapport, linkage with Indian and foreign institutions and scientists were other supporting factors.

It is important to appreciate that many of the successful collaborations began informally on one to one basis. Perhaps that is the way most relationships emerge. At the same time, we met many scientists who underlined the fact that the collaboration was informal, on personal basis and not necessarily inter-institutional. Apparently there was a fear that any claim otherwise, would unnecessarily put them in conflict with managers of the system. This fear should not have arisen so eloquently. The leaders of the research organizations have to recognize that the best relationships among disciplines, departments and institutions begin informally. The institutional rules and procedures must not only tolerate these but even encourage the same. However, whether or not this will happen would depend upon the extent to which research environment will be liberalized and debureaucratized.

The importance of clear articulation cannot be over emphasized. In general, Indian culture does not encourage precision in such matters. We seem to prefer ambiguity even if it puts us in trouble many times. This is a feature of our professional life which will not change overnight. Sensitivity to this weakness of our culture can be helpful in structuring relationships. It is all the more important when collaborating individuals have not known each other for many years.

Table 12

Resources and Organisations for future linkages

Sr.No	Centres for linkage	Frequency
1.	Government department/organisations:	
	State	8
	Central	13
2.	Institutes:	
	Management	1
	Technical	3
	University	1
3.	Industries	
	Small Scale and agro industries	3
	Public Sector	2
	Private	3
4.	NGO/Voluntary organisations	4
5.	Direct linkages with farmers	1
6.	Inter-scientists/disciplinary links	3

7.	Inter-state linkages for specific crop research	8
8.	International institutes	6
9.	Collaboration desired but without specification	3
10.	Not required/no response	11
Total		70*

* Frequency is more than the questionnaire code frequency as more than one response of each scientist has been listed separately under different headings.

There are many other factors which have come up in the case study though they have not articulated in the questionnaire response as clearly. For instance, the role of the coordinator was found to be an important factor influencing success or failure of networks. If coordinator was competent and commanded respect, many collaborating scientists did not mind minor lapses in his or her administration of network. On the other hand, if such was not the case, the style of governance became more important than the substance of networking.

H. Resources and organizations for future linkages (Table 12)

It was encouraging to note that at least a small section of the respondent scientists recognized the role of private sector, small scale and agro industries, NGOs and in one case, the farmers. The role of central organizations in strengthening future linkages comes out so predominantly apparently because most scientists realize that without their support nothing much was going to happen anyway.

Process of Networking :

The process of networking could lead to successful or failed outcomes. Various factors that could facilitate or impede the networking were seen so far from the data obtained through questionnaire responses. However, very rich insights were obtained when detailed discussions were held with different scientists. Some of them preferred to discuss their ideas rather than fill up the questionnaire.

We have summarised various lessons under seven headings:

A: Factors impeding inter-organizational networking:
B: Informal collaboration as a basis of networking
C: Unsuccessful collaboration with State Departments and other Institutions
D: Fruitful collaboration with Industry
E: Successful collaboration between different research institutions
F: Successful cooperation with state departments
G: Collegial perception of AICRP

A: Factors Impeding inter-organizational networking:

a. Pooling of resources in periods of scarcity.

Several organizations faced scarcity or resources either temporarily or regularly. The interactions could or could not be fruitful. Three examples of the not-so-fruitful interactions are illustrated here. There are large number of other examples of similar kind not mentioned here. In fact, it was very difficult to find many successful and inspiring examples of inter-institutional collaboration.

1. If the top does not care...

A senior scientist at Indian Grassland and Forage Research Institute narrated an experience of a collaborative project on crop livestock systems research. It was mooted in a meeting of the directors of IGFRI, Central Soil and Water Research Institute (CSWRI) and Central Arid Zone Research Institute (CAZRI) in 1977. It was revived in 1985 and an invitation was sent to all ICAR animal science institutes as well as other institutes with potential interest. A workshop was held in 1988 involving various interested colleagues. A scientist at veterinary college, Nagpur also got involved. Even though the idea initiating collaborative projects was welcome at ICAR, nothing positive was done to encourage the initiative. Those institutes which wrote to IGFRI expressing their wish to join the project also were not encouraged. Gradually, IVRI, GBP University, Pant Nagar and Nagpur College also dropped out. An extremely important area of collaborative research thus fizzled out for want of proper organizational support from top.

2. Who will take the credit...

Director-Research of Kerala Agricultural University (KAU) took the initiative to study the root wilt disease of coconut through a collaborative study with Central Plantation Crop Research Institute (CPCRI), Kasargod. CPCRI had an electron microscope which was necessary for the purpose, though KAU was supposed to do the analysis. CPCRI was to help in isolating the mycoloplasm. The Plant Pathology Department of KAU and the State Agriculture Department were also collaborating in this study. KAU scientists felt that CPCRI scientists were skeptical in the beginning. There was ambiguity about how the credit would be shared if discovery was actually made. There was a feeling that all the relevant points were not being addressed in the coordination meetings and much of the work had to be done by KAU scientists. CPCRI scientists were perceived as secretive and not very forthcoming about their findings. They also claimed that solution to the problem of root wilt had been found - a claim which was refuted by KAU scientists. Soon after these claims, and counter claims, even the limited sharing of data also stopped and nothing much came out of the collaboration.

It is possible that CPCRI views this episode from a different angle and justifiably so. Regardless of who should be blamed how much, the situation is not unique. Costly facilities like electron microscope cannot be provided and maintained in every institution which may need it. At the same time, why would a research institution act like a service institution (as was expected from CPCRI in this case) unless it has some technical gains. It would have been desirable if the norms regarding resource requirement, respective roles and credits had been clarified right in the beginning.

3. Being a good follower is a part of leadership

There was a collaboration between KAU and Rubber Research Institute (RRI), Kottayam for adaptive research to introduce rubber plantation in the higher ranges, that is in non-conventional areas. There was a feeling in KAU that their respective roles were not clearly defined. In the beginning RRI wanted a lead in the field work but when KAU took the lead in research, RRI reportedly did not show much interest. The joint meetings continued to take place but the activity did not move much.

Here again, the actual reasons for the breakdown may be many but what is important is the perception among the key actors. If these examples are typical, one has to obviously look for some mechanisms which facilitate collaboration and pooling of resources.

International centres may have had similar experience in dealing with ICAR institutions or SAUs. Some of the international centres have expressed their exasperation in dealing with Indian agricultural research system. Some of it may be genuine grievance while some may be a reflection of the resilience of research system. Many times when aid agencies cannot have their way, they may interpret close scrutiny as stone walling. On the other hand, bureaucracy may indeed create hurdles sometimes either because the scientists concerned involved in the research are not in the good books or the research managers or the bureaucracy does not find anything in it for itself. The fact that some of the international institutions started inviting administrative officers in ICAR to international research meetings shows how bureaucratic barriers have been overcome.

Many shortcuts tried by national or international centres of research to facilitate collaboration in the short run may prove counter productive in the long run.

B: Informal collaborations as a basis of networking

a. It all begins with a Hullo!

We found several examples of functional collaboration which had evolved entirely from informal contacts. Dr.Raj Reddy, Dean of College of Veterinary Sciences, Andhra Pradesh Agricultural University (APAU), Hyderabad was one of those few scientists who had a flair for seeking external cooperation and getting results. He narrated many examples of successful cooperation, notable being the collaboration with National Research Centre for Sorghum (NRCS) and ICRISAT. Dr.Reddy wanted to screen advanced sorghum lines for their suitability for livestock. The varieties were to be screened for dry matter digestibility as an indicator of their suitability for livestock. Being purely informal, the cooperation generated tremendously rich insights. A similar collaboration had been developed by an NGO, Bharatiya Agro Industrial Foundation (BAIF) for screening sorghum and millet varieties.

Dr.Murthy and Dr.Rana of NRCS narrated another example of informal collaboration. They have been continuing with the breeding research for sorghum using A1 and A2 types of cytoplasmic donors from Texas for more than ten years. Dr.Murthy got this material from Dr.Fred Niller who was his colleague when they were both in Texas. Several improved varieties of sorghum using local germplasm and these parents have since been developed.

Having known each other earlier meant extending prior trust to the area of collaborative work. Strategies which encourage people to first know each other may have better chances than the ones which expect relationships to be forged after the fact.

b: Building upon the redundancies in state departments

Dr.Saxena, a maize entomologist collaborated with District Rural Development Agency through his personal contacts. His aim was to try out on-farm research for biological control of water hyacinths. He wanted a feedback from people to understand their problems in developing appropriate technologies.

Similarly, Dr.R.K.Singh, Director Research, at NDUAT, Faizabad, along with his colleague Dr.I.S.Singh approached DRDA as well as Forestry Department for on-farm research to reclaim alkaline wastelands. The funds available under National Rural Employment Programme were used to lay out various experiments on land reclamation using different species of trees.

The redundant resources were used for productive end by pooling skills in research and development system with resources and materials of DRDAs and Forestry department. It has been argued that there always are some or the other redundant resources in every organization; the trick is to identify such a resource and add value to it for mutual advantage.

C: Unsuccessful collaboration with State Departments and other Institutions

There are many examples of failure but only a few have been picked up to illustrate the dimensions of dysfunctional linkages.

a) Role ambiguity as inhibitor of cooperation

Prof.Udaikumar at UAS, Bangalore worked on a project to control Yellow Leaf Syndrome in arecanut in collaboration with the State Department of Horticulture. The venture did not succeed. It was probably because the responsibilities of different actors were not spelt out clearly. The department personnel did not take the initiative as per the expectation of the scientists. In many such cases the absence of client orientation is a major reason for lack of responsibility. The staff in the department may have considered this research as a problem of scientists rather than one of farmers.

b) Financial delays: Whose problem it is?

Prof.Shantha Malliah, Head of Department of Forestry in UAS had a similar experience in a project on agro-forestry supported by National Wasteland Development Board (NWDB) and ICAR. The long delays in disbursing funds made the entire project suffer.

The scientists of CRIDA were involved in an ICAR sponsored project on integral pests management in Andhra Pradesh. The Directorate of Rice Research (DRR), ICAR, Andhra Pradesh Government Department of Agriculture and CRIDA were jointly responsible for it. For want of adequate response from the department personnel, the technological trials did make any progress. On the other hand, the Regional Coordinator of ICAR Extension Programme tried several experiments on the same subject with the collaboration of NGOs and the Department of Agriculture. His experience was more positive. Perhaps, the extent of follow up which ICAR Regional Coordinator could effect not have been possible for CRIDA scientists, but what little was possible also suffered.

c) Lack of supra-organizational coordination at apex level

The scientists of Central Institute of Agricultural Engineering (CIAE) were involved in an operational research project on improved agricultural implements and machinery in a watershed development project supported by World Bank. The idea of collaboration with them came at up one of the workshops of ICAR. Assistant Director General (ADG)-Soils took the initiative. A collaborative project involving Central Research Institute of Dryland Agriculture (CRIDA), CIAE, CSWRI and State Department of Agriculture was conceived. After a while, the scientists in ICAR reportedly lost interest and the proposals dropped. The CIAE, however, started work on it through its own funds in view of the importance of the project but the original idea of involving different organizations could no longer be pursued.

d) Distorted incentives for incorporating inter-organizational inputs in government programmes

The animal ecology division of CAZRI has developed several cost effective technologies for rodent control in desert areas. They could not take up trials in the farmers field on large scale because the officials from Drought Prone Area Programme (DPAP) and Desert Development Programme (DDP)

did not cooperate. The scientists concerned suspected that the hesitation on the part of these agencies might be result of certain other inefficient but more advantageous (to the officers, and not the farmers) practices continuing in the system. A similar reluctance was experienced when the concerned scientists approached a state university.

The coordinator of All India Coordinated Research Project (AICRP) on Agricultural Meteorology tried to develop collaboration with the Meteorological Department of Government of India at Pune. Though a joint research proposal was developed, the response from Meteorology Department was not very positive. Since the representative from the department did not attend the workshops of AICRP, the matter could not be resolved even there. A centre has been set up by ICAR in Pune with the hope of close collaborative arrangements but apparently this also did not work.

e) Contractual ambiguities preventing continued collaboration

Professor of Microbiology at the UAS, Bangalore had worked on a project on biological nitrogen fixation. It was a collaborative project in which Indian portion was funded by ICAR and the US funded its own research. There was exchange of scientists and information. However, when the issue of patenting the discovery arose, the disputes could not be resolved. Perhaps this was avoidable through better clarification of the issues in the initial research contract.

f) Successful innovation but unsuccessful diffusion

This is a case where collaboration with international organization was successful but similar cooperation could not be achieved with the local industry for diffusion of the technology. Two scientists with background in engineering and biochemistry at CIAE were involved in a project on pearling and milling of sorghum. They were trying to design a machine for pearling. They started their work in 1983 and entered into collaboration with Tropical Development Research Institute (TDRI), U.K. in 1985. CIAE was strong on pearling and TDRI on milling. A prototype of mill was worked out and further modifications were made during 1987-88 to 1990-91. Despite developing three prototypes, however, the logical extension of technology to the industry could not take place. Perhaps if the industry had been involved in the first place in defining the problem and generating the solution, such a situation might not have arisen.

g) International collaborations for generating national data

Many times international organizations collaborate not so much to generate collaborative learning as to gain access to national data. The unfortunate part is that Indian scientists fall prey to such attempts because of the incentives for international travel or consultancies. A leading social science institute was involved in such a study with World Bank in which detailed data on household resource use, functioning of credit, product and labour markets etc., was collected from different states. As per the understanding, the data was to be provided on computer tapes to the sponsors. The Indian scientists never co-authored any of the publications arising out of the study. In some cases it was struggle for them to get the right to process this data on their own.

Similarly under Indo-US bilateral agreement, a project on agro meteorology was submitted. Indian scientists were supposed to be trained and American scientists were provided consultancy for the purpose. In return Indian scientists had to share their data. This helped the American scientists involved in this study to gain expertise on Third World conditions and thereby generate the demands for their consultancy in other countries. If Indian scientists had insisted on similar data from US for analysis, perhaps the research could have generated reciprocal expertise. Alternatively a condition that all publications based on Indian data will have to be collective property of the institutions involved could have been imposed. This is a sensitive area where we need much closer scrutiny of

bilateral and multilateral agreements. The first author had made a suggestion in this regard to National Academy of Agricultural Research Management (NAARM) and ICAR though nothing unfortunately has happened so far.

Since we have not been able to pursue these narratives with each of the actors involved, we would not like the specific instances of field collaboration to be given any importance. Our intention here is to only illustrate the kind of bottlenecks or facilitative factors that impinge on the interactions between different research and administrative organizations.

D:Fruitful collaboration with Industry

There are several projects sponsored by public or private sector industry in agricultural research systems. A detailed review of corporate investment in agricultural research is available elsewhere (Gupta and Singh, 1990). Some illustrative examples are given here.

a) Corporate sponsored public sector R&D

Hindustan Zinc Limited supported a project in Agricultural University in Bangalore to look at pesticide residues as well as mining of rock phosphates. The study involved farmers, scientists and other department people. Apparently because of clear responsibility, allocation of funds from outside agency and emphasis on results rather than inputs, the collaboration was considered quite successful. Similarly, the Forest Corporation and other private or joint sector industries supported projects in the Forestry Department at the same university with positive results.

b) Industry initiated collaborative research with public institutions

During a Farmers' Fair organized by CIAE, a representative of the manufacturing association in Madhya Pradesh approached the scientists to produce a soya bean harvester. As a result of the collaboration following this decision, a tractor drawn soya bean harvester was produced through close interactions with the manufacturers association.

In KAU a private sector multinational company sponsored research on the development and release of hybrid cocoa during 1977. The MOU provided clearly that all the scientific information would be the property of the university and published by them. The funds were provided by the company very quickly so that necessary staff could be appointed. Similarly, in another project sponsored by Department of Biotechnology on tissue culture of cocoa, funds provided by the company were used with their permission for related research activities.

c) Industry induced international collaborations

ITC on its own sought collaboration with Pacific Seed in Australia, Department of Industry in Queensland, Australia, Iowa State University, Cereal Research Institute, Hungary, and Palm Oil Research Institute, Malaysia. What is remarkable about this is the ease with which multinational collaborative arrangements could be forged with clear eye on commercialization. Similar initiatives must be taken up in pubic sector for locating partners in other Third World countries as well as in the private sector. It is obvious that necessary safeguards to protect national interests would be required. But one should never assume, as the experience has clearly shown, that public interest is necessarily served by public sector.

Only one unsuccessful collaboration with industry was narrated by a scientist in CIAE, Bhopal. The Project Coordinator of Power Tiller Scheme had collaborated with an industry for the manufacture of a castor oil processing machine. The entrepreneur concerned slightly modified the design and marketed the same without acknowledging the contribution of the university or the scientist. In this case, the positive side is that the technology provided was so good that industry commercialized it on its own with its own modifications. This should be a matter of satisfaction. On the negative side about the lack of acknowledgement could certainly be a barrier for such interactions in future. We do not know what attempts were made to correct the situation.

This problem is likely to arise more and more often in future when collaborations with industry will become necessary owing to resource squeeze and need for getting closer to the client. Lest opportunities for fruitful cooperation are lost through the dysfunctional dynamics, flexible but prototype MOUs or contracts should be circulated among research organizations.

E: Successful collaborations between different research institutions

Several factors emerge with regard to successful cases. We p;resent here examples illustrating each factor.

a. Competent leadership

The Chief Scientist at a Research Station in Bijapur coordinated a project sponsored by CRIDA and ICRISAT to UAS, Dharwad. The chief investigator of this project was chosen on the basis of his proven competence in the field of phosphorous management - the subject of the project. The entire research team and the collaborators acknowledged the leadership. The coordination posed no problem.

b. Individual Competence as basis for collaboration

Dr. Srivastava, Director, CIAE, Bhopal has been involved in a project on Efficient Utilization of Animal Power - an ad hoc scheme of ICAR. The collaboration is with seven different institutions in UP, Rajasthan, Haryana and Madhya Pradesh. Subsequently, he found that Dr. Nirmalam had done extensive research on elephants in KAU. He was invited for a workshop in Dharwad. An ad hoc project was proposed with him and the Forest Department. The resulting collaboration was quite fruitful.

Another example of collaboration triggered by appreciation of mutual competence is provided by CIAE and Regional Research Laboratory (RRL), Bhopal. The RRL had started this collaboration with the purpose of applying in `bell metal technique' for use in design of farm implements. Since RRL did not have field testing capabilities and CIAE did not have basic metallurgical skills it was a perfect case of recognizing each other strengths. The prototype was to be developed by CIAE with the help of private manufacturers while RRL was to help in job work and design. Part of the credit for cooperation should go to the scientists involved who did not let their organizational and professional egos to come in the way.

As noted earlier, Dr. Raja Reddy of APAU had a collaborative project initiated informally with National Research Centre for Sorghum. Later, Principal, Sorghum Breeder of ICRISAT also initiated a project with him to test sorghum residues and grains for food value. Undoubtedly the competence demonstrated by Dr. Reddy through his earlier work with NRCS might have been a major reason for his being approached by ICRISAT.

The three examples offer important lessons (a) scientists who crib about resource constraints have obviously not realised that resources follow performance in general; (b) small but substantial gains through informal cooperation often pave the way for large and sustained collaboration; and (c) acknowledgement of mutual competence goes a long way in generating respect and accommodation for each others' sensitivities.

c. Resources as incentives

Collaboration with any international organization may be triggered by several inducements. Access to (a) large multi-location facility of trials, (b) expertise, (c) germ plasm, and (d) information support, may induce collaboration. The finance , equipment and other resources could also lead to collaboration even in cases where expertise need not be hired in from international organizations.

There are several collaborative projects between CRIDA and ICRISAT though not with the same degree of collegiality or functionality. In a project on water harvesting, ICRISAT mainly provided instruments for data recording. It remains to be seen whether the outcome of such a collaboration would lead to any definite capacity building.

d. Inter-disciplinary research constraints as spur for inter-organizational cooperation.

The National Institute of Nutrition (NIN, Hyderabad) started a study with ICAR to study the nutritional aspects of sorghum in 1967. The Indian Council of Medical Research also joined hands with ICAR and NIN in this study. The All India Coordinated Research Project on Sorghum invited inputs from NIN regularly. For several years the collaboration continued very smoothly with frequent meetings because the top officials of NIN and ICAR were committed to this research. In 1971 Ramaiah Committee looked into the collaboration on various other crops and suggested that NIN could concentrate on sorghum whereas IARI could concentrate on wheat. Dr. Devasthale was the key scientist in NIN coordinating the research. Subsequently, the interest waned at lower top levels and the collaboration did not continue formally. This is the case where a very important research programme could not continue for want of periodic renewal of formal mechanisms.

A question, however, remains as to why the model developed by Dr. Raja Reddy of informal cooperation followed by formal association could not be developed? It would be perhaps inappropriate to blame the apex level entirely for the lack of support for follow up. It is a case where formal collaboration did not lead perhaps sufficiently to a strong informal bonding among colleagues.

e) Networking skills of the coordinator

There is no doubt that many collaborative arrangements work despite all the intra and inter organizational irritants only because the coordinator is extremely skillful. We did come across a few examples of this kind in both national and international systems.

Dr. Siddique at National Research Centre on Rice achieved a significant breakthrough in Basmati rice through collaborative work over more than a decade. Our visit to rice research directorate was one of the most pleasant experiences so far as team spirit was concerned. While most of the other scientists in different ICAR institutions complained about some or the other factor, we did not hear much about problems in collaborative programmes on rice. Perhaps the skills of the coordinator not just in the subject matter but also in team building may have been responsible for the results. Sharing of credit, we were told, was very fair in this collaborative research about Basmati.
Dr. Alagar Swamy at ICRISAT was responsible for Cooperative Cereal Research Network encouraged by ICRISAT. He was trying to develop Asian sorghum network. While the ICRISAT had been tried to test its material in different parts of world, the response was not so good. It was discov-

ered that among other reasons, the poor quality of material sent, inadequate monitoring, lower quarantine period etc., were responsible for poor results. Once the first two bottlenecks were removed, the data reporting from collaborators shot up to 82 per cent in 1990. The coordinator tried to help different collaborators in developing region specific models. He was trying to move from crop modeling technique to region based or network location based models. The earlier efforts of Dr.Faris in this regard were of considerable advantage when Dr. Swamy took over.

In a review of Environmental Characterization Programme at the International Rice Research Institute (IRRI), Manila, the first author as a member of the review team raised the issue of accountability of research coordinators to the member countries. Many times either the data of different centres pooled at international centres was not fed back to each counterpart or the papers written from the pooled data were always authored by the scientists of international centres. Further, even in activities in which the best expertise might be available in one of the member countries, the coordinator was located at the international centre. Obviously, the coordinated research programmes are unlikely to succeed if the research eminence of the coordinator is not acknowledged by all the members of the team. This problem is equally evident in national systems.

f) Collaboration among national institutions triggered by international agencies

There are several examples where an international agency identified the opportunity for collaboration, funded the meetings and workshops and in some cases also supported the individual research by the network members. The positive side is that such opportunities help in emergence of a critical peer group within the country so that quality of research improved. The Negative side is that the funding agency may try to impose either an inadequate conceptual framework or bring in consultants who may not be the most knowledgeable on the subject. The East Indian Farming System Research Programme supported by Ford Foundation is an example of weak collaboration in which there was very little science. Also most of the consultants were not competent enough to generate proper respects for rigour. With an incompetent consultant, it is inevitable that he or she would not like to highlight the incompetence or inadequacy of collaborators. The funding agency may try to legitimize its own models of research even though there may have been no empirical or conceptual validation.

A collaboration between ICAR, CFTRI and ICMR on improvement of rain-fed mustard crop supported by Swedish University of Agricultural Sciences was one of the rare cases of a very important networking process. Such a network should have emerged on its own and continued even when external support was not available. After the termination of the project, NIN continued its collaboration with the University in Sweden.

The coordinated research projects with different international centres have been going on for long time. Many of these collaborations were facilitated by the existence of All India Coordinated Research Project (AICRP).

g. Evolution of a network triggered by international organizations: The case of mycorrhiza network:

Dr. Karim Oka reviewed the networks triggered by International Development Research Centre (IDRC), Canada. The following case of mycorrhiza research is best appreciated through a detailed quotation from his review of the subject.

> - In 1985 the Centre had in its forestry pipeline three project proposals related to root symbiosis: one on **Ectomycorrhiza** with Delhi University, one on **Endomycorrhiza** with University of Agricultural Sciences (UAS), Bangalore and the last one on **Frankia** with the Indian Agricultural Research Institute (IARI), Delhi. At one time, there were plans to merge those three proposals into one large project with a project coordinator. The proposal was abandoned primarily because of the difficulty in obtaining official request approval for a project

involving three different institutions not from the same Government body. Moreover, the three proposals did not have enough in common scientifically to justify their merging into one. It was decided therefore to consider the proposals independently.

- In the process of reviewing the proposals, the PO wanted to ensure that a) they were scientifically sound; b) they were of practical benefit to the people of the country; c) they were not a duplication of work being (or already) done elsewhere; and d) the institution and the scientists had the competence to undertake the research. It was found that research on Mycorrhiza and on Nitrogen Fixing organisms was taking place simultaneously in a large number of institutions and that BNF research was already coordinated through an "All India Coordinated Project". Mycorrhiza research, however, was being carried out without any coordination mechanisms. Part of the Mycorrhiza research was purely academic and focussed on fundamental research while other researchers were focussing on field application. Scientists were working in isolation and only very few knew each other. Several cases of duplication and of obsolete research were found.

- Two meetings sponsored by IDRC were initiated in November '86 in Bangalore and Delhi aiming at bringing together "known" scientists from Southern and Northern India respectively with the intention of preparing a State of the art of Mycorrhiza research. During this meeting each participant was asked to produce a list of scientists and institutions he/she was aware of involved in mycorrhizal research. The total number obtained was so high that the Centre decided to sponsor the first **National Mycorrhiza Round Table**.

- The Round Table was held in March '87 in Delhi and was attended by 76 Indian scientists from all over the country. Two scientists from Nepal sponsored by UNESCO joined the group. The ceremony was opened by Dr. Randhawa, Director General of ICAR, Ministry of Agriculture and the closing ceremony by Dr. Maheshwar Dayal, Director of the Department of Non-conventional Energy Sources (DNES), Ministry of Energy. Both strongly stressed the importance of mycorrhizal research for the country and the economic impact it would likely have. Each participant had 10 minutes to present briefly his/her research programme an results followed by a period of questions and comments. Attendance and participation in the discussions were very high as this was the first opportunity for people to meet and learn about each other. Most were working in isolation and had no idea about colleagues 'research and even colleagues' existence. Asked whether linkages and cooperation between them would be beneficial, all participants responded positively. Everybody expressed great satisfaction and although due to budget constraints they all had to come by train, share modest accommodation at the University guest houses and eat food prepared and served in the open air, they all were very pleased to have come and were hoping that such opportunity will occur again.

- The total budget for the Round Table was 7000 CAD of which IDRC provided 5000 CAD, a very reasonable cost for such number of participants and 3 days of meetings.

The Choice between Network funding and Project funding

- The total number of scientists in India working on Mycorrhiza is not known with precision but based on information received in March 1987, it is likely to be over one hundred working in more than 35 institutions.

- With the limited resources available in the Centre, it is unlikely that we (IDRC) can fund more than two projects a year on mycorrhizal research in the SARO region. Even the figure of two is already high. With the number of existing non-IDRC mycorrhiza projects in India, funding for one additional project is unlikely to have a significant impact. The exact budget spent presently on mycorrhizal research in India is not known but it is probably important when considering the volume of research being done.

- It is our belief that IDRC funds can benefit better if they could be used to strengthen the existing research projects rather than funding few more. Money does not seem to be always the key issue for Indian research except may be to fund items or activities that require foreign currencies. The main problem scientists are facing is isolation, lack of contacts and lack of information. By providing support to networking activities IDRC can improve manifolds the quality o the research work being presently done and produce higher results. This implies providing scientists with services they badly need for the advancement of their research and that they cannot obtain otherwise.

- Scientists working in isolation do not benefit from others' experience and don't learn from others' successes and failures; they spend unnecessary time and money in duplication. Some of the research tasks become impossible for them as they need to deal with too many parameters that they cannot handle alone. Because some research requires particular equipment not entirely available in their institution, their research is sometimes abandoned even when this equipment is available in other institutions nearby. Often complementary work could have taken place if scientists knew about each other and if mechanisms for cooperation existed. Certain services are too expensive to be produced at the level of each institution independently. In the case of endomycorrhiza the production of large quantities of inocula for field experiments requires facilities individual institutions cannot afford. To become economically feasible, the production has to be taken up in one location and then supplied to all institutions.

- Hence, the development of the idea of supporting a network which does not necessarily include IDRC projects. This does not mean that the Centre should not consider funding of research projects within the network but that IDRC funding should not be a "sine qua non" condition for the support of the network.

Main Features of Mycorrhiza Network

- In the first stage the Network will link more than 34 on-going research projects within India, none of them funded by IDRC. The Network will then expand to cover the other South Asian countries and eventually the rest of Asia. However, in each country, national coordination and networking should precede the integration to the regional network.

The **General Objective** of the Network will be:

-to strengthen research, encourage cooperation, promote exchange of information and germplasm material and facilitate transfer of technology to the field through the establishment of a research network.

The **specific objectives** of the Network will be:

a) to produce and maintain a directory of mycorrhizasts;
b) to make an inventory-catalogue of mycorhiza research projects
c) to produce computerized bibliographic data bases with first emphasis on Indian mycorrhiza literature;
d) to provide Database Search Services;

Unlike other networks in which research supported by IDRC or other international organizations, may have been the focus of inclusion, the mycorrhiza network is an exception. It deals with projects which are not funded by IDRC. In this sense the value addition in entire research projects is primarily through networking. The provision of a peer group and other objectives of the network undoubtedly suggest this as very potent model for emulation. It is obvious that about one lakh

rupees spent on the workshop could have been easily mobilised within ICAR or Department of Science and Technology. Why is it that such networks do not emerge and become a dominant way of peer research scrutiny and achievement of quality results. One hypothesis is that researchers cooperated because they anticipated eventual support from IDRC in this case. Although subsequent discussions with some of the key actors revealed that many hopes were not fulfilled because of the bureaucratic intransigence in the national research system, the organic process through which the cooperation emerged shows that cooperation could not have been restricted to the scientists working in agricultural universities or ICAR institutions. Further, many of the basic scientists, though interested in academic aspects, would not have minded interacting with those busy in application. Assuming that the duplication found in research could also have been discovered through desk review, the more difficult task of persuading scientists engaged in such duplication to introspect requires peer pressure. A more detailed study is called for to look into how some of the assumptions in this model are actually worked out. The dilemma of IDRC about limited funds and therefore not supporting many projects in the region is very forthrightly faced in the case study. The fact that one additional project was unlikely to make a significant impact led to a very appropriate decision of investing scarce resources in networking. This lesson, we hope, will be learnt by many apex research funding and administering organizations in the Third World. It is a very precise and insightful recognition that the major problem of scientists is isolation.

H:Successful cooperation with state departments

While there are far too many examples of unsuccessful collaborations, the ones which are successful often remain obscure.

1. Watershed as an arena of inter-disciplinary cooperation

Watershed projects have been initiated all over the country. It is expected that in some cases, various research and action institutes would collaborate not just for the development of watershed but also for doing on-farm research. This is a goal which has remained largely unmet. The University of Agricultural Sciences, Bangalore, Dry Land Development Board (DLDB) and Soil Conservation Research Training Institutes at Bellari and Dehra Dun, CRIDA and ICRISAT were involved in operation research in dry land development. In addition, the state forest development corporation, and the department of agriculture were also involved. The lessons from the pilot collaborative project were used for replicating and modifying the watershed development model in different parts of Karnataka.

A separate action research project supported by Swiss Development Cooperation was taken up by Indian Institute of Management, Ahmedabad, in collaboration with DLDB, UAS, Bangalore, Syndicate Bank, Canara Bank, Cooperative Bank and Syndicate Agricultural Foundation. The idea was to explore the scope that exists for tying credit with technology in high risk environments. With the help of volunteer bankers and DLDB officials, a collaborative understanding of problems in this process was achieved.

2. Community boards as sponsor of research

There are a large number of community corporations, boards and cooperative federations. In a study on cooperative investments in agricultural research (Gupta and Singh, 1989) had found a very weak tendency on the part of such bodies to invest in agricultural research. However, there are exceptions. The Spices Board sponsored a study on solving some problems of cardamom cultivation at Department of Microbiology, UAS, Bangalore. The financial support was given by the Board and research responsibility was with UAS. Apparently a monthly reporting system ensured that collaboration between scientists and sponsors worked smoothly.

3. Inter-organizational projects as spur for inter-disciplinary research

It has been seen in many research organizations that scientists from different disciplines do not come together on their own or through their mutual discovery of common interest. However, the barriers to collaboration shaken when there is an outside sponsor. There could be several reasons ranging from resources, monetary incentives, the glamour of working with collaborators etc. In an operations research project on an integrated energy and nutrient supply system, the scientists of Central Institute of Agricultural Engineering took the initiative. A team of scientists was formed.

Scientists from different disciplinary backgrounds in renewable energy, nutrient supply, soil science, etc., came together to collaborate with Madhya Pradesh State Urja Vikas Nigam, CAZRI, Jodhpur; IGFRI, Jhansi, M.P. Agro Industries Corporation, Environmental Pollution Control Board, State Forestry Departments, National Land Use Planning and Bureau of Soil Science, Nagpur etc. were involved. The technical input was provided mainly by CIAE. The Agro Industries Corporation provide the bio-gas plant. CIAE leased 40 acres of panchayat land for the purpose. The project merged research goals with technology transfer and demonstration purposes.

E: Collegial Perception of AICRP

The coordinated research projects have been an important organizational innovation for generating communality of objectives among agricultural scientists located in different parts of the country. While much is said about location specific research and for good reasons, one should not forget the advantages offered by wide screening and testing. For instance, a castor variety developed in Gujarat ostensibly for agro climatic conditions of Gujarat was found far better suited to conditions in Andhra Pradesh. Similarly, a groundnut variety bred for Andhra Pradesh found its niche in Gujarat. There are many such examples which prove that basic philosophy of coordinated research projects was sound. It is true that not in every crop can one aim at wider adaptability or selection by serendipity. Also, over time, the organizational arrangements for coordination have come under strain. We pursued this issue not only in individual discussions but also in research management workshops referred earlier.

The limited possibility of developing technologies with wide diffusion potential in rain-fed regions further underscores the need for rethinking strategies of coordination.

1. The technical programme is often discussed and finalized in workshops but owing to ineffective control over the financial and administrative resources, the coordinators were not able to ensure desirable results in all the cases. Many scientists responsible for a coordinating research centre have to shoulder other responsibilities and thus tend to neglect the duties under the coordinated project. Coordinating scientists could be transferred without reference to the coordinator.

2. The confidential report (CR) of coordinating scientists in ICAR institutions was written by the Director of the Institute. The project coordinator did not have any say in the matter. This, in the view of many scientists, was a bone of contention. The project coordinators felt that the concerned scientists of a coordinated research project justifiably give more importance to the instructions of the Director rather than that of the research programme advised by the coordinator. In the normal course, such a problem should not have arisen. The coordinator could command respect more out of competence than authority. But in real life, the situation has been different. Most institutes have had bureaucratic culture. There is a need to re-examine at this arrangement. In some of the programmes the coordinating centres have been upgraded into national research centres without an autonomous structure. The irony is that some of the coordinators end up creating the same complications as the Director they complaint about.

3. There is a growing impression that most experiments pursued under coordinated project are of routine nature. Same kind of experiments are repeated at different centres for the sake of comparison even if such a comparison was not of much substantive importance. Several colleagues at CRIDA felt that collaborative research based on voluntary initiatives might be more effective than an administratively coordinated research.

4. A suggestion was made that there should a cross linkage between commodity programme and the dryland research programme. During the Research Management Workshops, it was mentioned that research link between crops, livestock, trees and tools was crucial. It is also recognized that by merely hiring a few livestock scientists, CRIDA was unlikely to make any impact on the subject. Also, these scientists would not grow because of being isolated from their peer group. The ideal arrangement would have been if the livestock research institutes established as an outreach centre at CRIDA through which collaborator will be pursued. Unfortunately, since 1988 when this workshop was organized, nothing much has changed in this regard. The inter-disciplinary research continues to be a confused patch work approach of having a few scientists perform a few disjointed experiments.

5. The leadership qualities of the coordinator were crucial for the success of the network. Some scientists even suggested that rather than continuing a coordinated project with a less competent leader, it might be desirable to close the project. Even otherwise, the project should have some time limit beyond which, unless maintenance research had to be done as in plant breeding, the project should be discontinued. This might also have help in controlling the routinization of the research.

6. A clear articulation of the farmers' problems was supposed to improve the effectiveness of coordinated research projects. But in most cases formal diagnostic exercises are rarely carried out.

7. The coordinators of various related research projects should periodically meet under the guidance of Dy.Director General of concerned ICAR. An example was given by the coordinator of AICRP (Soil Test Crop Response) that since 1982 there had been no meeting of the coordinators. Obviously, the possibility of overlap and duplication becomes unavoidable under such circumstances.

8. A suggestion was made that while coordinated research projects could address larger and generalized problems, a kind of `satellite' research programme might be much more useful for addressing location specific problems in collaboration with the state department officials. Dr.Krishnaiah of Directorate of Rice Research gave example of a problem of gaull midae in rice in Srikakulam district. The screening of rice varieties was done on the farm itself to identify the resistant lines. He also suggested that each coordinated research programme should have a strong link with post graduate research so that problems not amenable to solutions to available technology could be pursued further in a more rigorous manner.

9. Some scientists felt that credit for releasing an improved variety was almost always taken by the breeder concerned and the contribution of plant pathologists, entomologists and agronomists were not adeq